GEOTECHNICAL INVESTIGATION
PROPOSED RANCHO SAN JACINTO
RESIDENTIAL DEVELOPMENT
SEC ESPLANADE AVENUE & HEWITT STREET
SAN JACINTO, CALIFORNIA

-Prepared By-

Sladden Engineering

800 East Florida Avenue
Hemet, California 92543
(951) 766-8777

Sladden Engineering

45090 Golf Center Parkway, Suite F, Indio, CA 92201 (760) 863-0713 Fax (760) 863-0847
6782 Stanton Avenue, Suite C, Buena Park, CA 90621 (714) 523-0952 Fax (714) 523-1369
450 Egan Avenue, Beaumont, CA 92223 (951) 845-7743 Fax (951) 845-8863
800 E. Florida Avenue, Hemet, CA 92543 (951) 766-8777 Fax (951) 766-8778

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WMR Residential Investments, Inc.
27127 Calle Arroyo, Suite 1910
San Juan Capistrano, California 92675

Subject: Geotechnical Investigation

Project: Proposed Rancho San Jacinto Residential Development
SEC Esplanade Avenue and Hewitt Street
San Jacinto, California

Sladden Engineering is pleased to present the results of our geotechnical investigation for the proposed residential development to be constructed on the subject site located on the southeast corner of Esplanade Avenue and Hewitt Street in the City of San Jacinto, California. Our services were completed in accordance with our proposal for geotechnical engineering services dated September 28, 2016 and your authorization to proceed with the work. The purpose of our investigation was to explore the subsurface conditions at the site in order to provide recommendations for foundation design and site preparation. Evaluation of environmental issues and hazardous wastes was not included within the scope of services provided.

The opinions, recommendations and design criteria presented in this report are based on our field exploration program, laboratory testing and engineering analyses. Based on the results of our investigation, it is our professional opinion that the proposed project should be feasible from a geotechnical perspective provided that the recommendations presented in this report are implemented into project design and carried out during construction.

We appreciate the opportunity to provide service to you on this project. If you have any questions regarding this report, please contact the undersigned.

Respectfully submitted,
SLADDEN ENGINEERING

Matthew J. Cohrt
Principal Geologist

PROFESSIONAL GEOLOGIST
Matthew J. Cohrt
No. 2634
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Brett L. Anderson
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
BRETT L. ANDERSON
No. C45389
Exp. 9/30/18
CIVIL ENGINEERING
STATE OF CALIFORNIA

James W. Minor III
Staff Geologist

SER/jm

Copies: 4Addressee

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INTRODUCTION

This report presents the results of the geotechnical investigation performed by Sladden Engineering (Sladden) for the proposed residential development to be constructed on the subject site located on the southeast corner of Esplanade Avenue and Hewitt Street in the City of San Jacinto, California. The site is situated at approximately 33.7706 degrees North latitude and 116.9500 degrees West longitude. The approximate location of the site is indicated on the Site Location Map (Figure 1).

Our investigation was conducted in order to evaluate the engineering properties of the subsurface materials, to evaluate their *in-situ* characteristics, and to provide engineering recommendations and design criteria for site preparation, foundation design and the design of various site improvements. This study also includes a review of published and unpublished geotechnical and geological literature regarding seismicity at and near the subject site.

PROJECT DESCRIPTION

Based on our preliminary discussions, it is our understanding that the proposed project will consist of constructing a residential development on the site. Sladden anticipates that the new project will also include new paved roadways, landscape areas, an onsite infiltration basin and various other site improvements. For our analyses we expect that the proposed new residential structures will consist of relatively lightweight one (1) or two (2)-story wood-frame structures supported on conventional shallow spread footings and concrete slabs-on-grade.

Sladden anticipates that grading will consist of minor cuts and fills in order to accomplish the desired pad elevation and to provide adequate gradients for site drainage. This does not include the removal and re-compaction of the primary foundation bearing soil within the building envelopes. Upon completion of the project grading plans, Sladden should be retained to ensure that the recommendations presented within in this report are incorporated into the design of the proposed project.

Structural foundation loads were not available at the time of this report. Based on our experience with relatively lightweight wood-frame structures, we expect that isolated column loads will be less than 20 kips and continuous wall loads will be less than 2.0 kips per linear foot. If these assumed loads vary significantly from the actual loads, we should be consulted to verify the applicability of the recommendations provided.

SCOPE OF SERVICES

The purpose of our investigation was to determine specific engineering characteristics of the surface and near surface soil in order to develop foundation design criteria and recommendations for site preparation. Exploration of the site was achieved by drilling four (4) exploratory boreholes to depths of between approximately 21 and 51 feet below the existing ground surface (bgs). Specifically, our site characterization consisted of the following tasks:

- Site reconnaissance to assess the existing surface conditions on and adjacent to the site.
- Advancing four (4) exploratory boreholes to depths between approximately 21 and 51 feet bgs in order to characterize the subsurface soil conditions. Representative samples of the soil were classified in the field and retained for laboratory testing and engineering analyses.
- The performance of laboratory testing on selected samples to evaluate their engineering characteristics.
- The review of available geologic literature and discuss potential geologic hazards.
- The performance of engineering analyses to develop recommendations for foundation design and site preparation.
- The preparation of this report summarizing our work at the site.

SITE CONDITIONS

The site occupies approximately 14.58 acres and is identified as APN 439-180-015. The site is located on the southeast corner of Esplanade Avenue and Hewitt Street in the City of San Jacinto, California. The site is vacant and bounded by Esplanade Avenue to the north, existing residences to the east, East Commonwealth Avenue to the south and Hewitt Street to the west.

In general the site is relatively level with no discernable trends in surface gradients. According to the USGS 7.5' San Jacinto Quadrangle map (USGS, 2016), the site is situated at an elevation of approximately 1,585 feet above mean sea level (MSL).

No natural ponding water or surface seepage was observed at or near the site during our field investigation conducted on October 13, 2016. Site drainage appears to be controlled via sheet flow and surface infiltration.

GEOLOGIC SETTING

The project site is located in the Peninsular Ranges Physiographic Province of California. The Peninsular Ranges are mountainous areas that extend from the western edge of the continental borderland to the Salton Trough and from the Transverse Ranges Physiographic Province in the north to the tip of Baja California in the south. The Peninsular Ranges Physiographic Province is characterized by northwest-trending topographic and structural features that locally include the San Jacinto Structural Block. The San Jacinto Structural Block is a northwest-southeast trending elongated structural block bounded on the southwest by the San Jacinto Fault and by the San Andreas Fault Zone to the northeast. The province is characterized by elongated, northwest-southeast trending mountain ranges and valleys and is truncated at its northern margin by the east-west grain of the Transverse Ranges. Mountainous areas of the Peninsular Ranges Physiographic Province generally consist of Igneous, metasedimentary and metavolcanic rocks. However, plutonic rocks of the Southern California Batholith are the dominant basement rock exposed (Jahns, 1954).

The site has been mapped by Dibblee (2003) to be immediately underlain by Quaternary-age alluvium. The geologic setting for the site and site vicinity is illustrated on the Regional Geologic Map, Figure 2.

SUBSURFACE CONDITIONS

The subsurface conditions at the site were investigated by drilling four (4) exploratory boreholes. The approximate locations of the boreholes are illustrated on the Borehole Location Photograph (Figure 3). The boreholes were advanced using a truck-mounted Mobile B-61 drill rig equipped with 8-inch outside diameter (O.D.) hollow stem augers. A representative of Sladden was present to log the materials encountered and retrieve samples for laboratory testing and engineering analysis.

During our field investigation a mantle of fill/disturbed soil was encountered to a depth of approximately three (3) feet below existing grade. Underlying the fill soil and extending to the maximum depth explored, native alluvium was encountered. The site soil consists of interbedded silty sand (SM), sand (SP) and sandy silt (ML) that was encountered to the maximum depths explored. Generally the native earth materials appeared generally below optimum moisture content with in-situ densities generally increasing with depth.

The final logs represent our interpretation of the contents of the field logs along with the results of the laboratory observations and tests of the field samples. The final logs are included in Appendix A of this report. The stratification lines represent the approximate boundaries between soil types although the transitions may be gradual and variable across the site.

Groundwater was not encountered during our field investigation on October 13, 2016. Based on our exploratory bores and our review of groundwater level data (CDWR, 2016) groundwater levels in the site vicinity have been recorded in excess of 100 feet bgs. Accordingly, groundwater should not be a factor during construction of the proposed project.

SEISMICITY AND FAULTING

The southwestern United States is a tectonically active and structurally complex region, dominated by northwest trending dextral faults. Faults in the region are often part of complex fault systems composed of numerous subparallel faults that splay or step from main fault traces. Strong seismic shaking could be produced by any of these faults during the design life of the proposed project.

Sladden considers the most significant geologic hazard to the project to be the potential for moderate to severe seismic shaking that is likely to occur during the design life of the project. The proposed project is located in the highly seismic Southern California region within the influence of several fault systems that are considered to be active or potentially active. An active fault is defined by the State of California as a "sufficiently active and well defined fault" that has exhibited surface displacement within the Holocene epoch (about the last 11,000 years). A potentially active fault is defined by the State as a fault with a history of movement within Pleistocene time (between 11,000 and 1.6 million years ago).

Based on our research, the site is not currently located within any State of California or County of Riverside designated fault zone (CDMG, 1980; RCPR, 2016). Table 1 lists the closest known potentially active faults that was generated in part using the EQFAULT computer program (Blake, 2000), as modified using the fault parameters from The Revised 2002 California Probabilistic Seismic Hazard Maps (Cao et al, 2003). This table does not identify the probability of reactivation or the on-site effects from earthquakes occurring on any other faults in the region.

TABLE 1
CLOSEST KNOWN ACTIVE FAULTS

Fault Name	Distance (Km)	Maximum Event
San Jacinto-San Jacinto Valley	<2.0	6.9
San Jacinto-Anza	4.8	7.2
San Andreas-Southern	26.8	7.2*
San Andreas-San Bernardino	26.8	7.5*
Elsinore-Temecula	35.9	6.8
San Jacinto-San Bernardino	38.0	6.7
Elsinore Glen Ivy	38.0	6.8
Elsinore-Julian	39.6	7.1
San Andreas – Coachella	44.4	7.2

*8.2 for multiple segment rupture

2013 CBC DESIGN PARAMETERS

Sladden has reviewed the 2013 California Building Code (CBC) and summarized the current seismic design parameters for the proposed structure. The seismic design category for a structure may be determined in accordance with Section 1613 of the 2013 CBC or ASCE7. According to the 2013 CBC, Site Class D may be used to estimate design seismic loading for the proposed structure. The 2013 CBC Seismic Design Parameters are summarized below. The project Design Map Reports are included within Appendix C.

Risk Category (Table 1.5-1): I/II/III
Site Class (Table 1613.3.2): D
S_S (Figure 1613.3.1): 2.597g
S_1 (Figure 1613.3.1): 1.191g
F_a (Table 1613.3.3(1)): 1.0
F_v (Table 1613.5.3(2)): 1.5
S_{MS} (Equation 16-37 {F_a X S_S}): 2.597g
S_{M1} (Equation 16-38 {F_v X S_1}): 1.786g
S_{DS} (Equation 16-39 {2/3 X S_{MS}}): 1.731g
S_{D1} (Equation 16-40 {2/3 X S_{M1}}): 1.191g
Seismic Design Category: E

GEOLOGIC HAZARDS

The subject site is located in an active seismic zone and will likely experience strong seismic shaking during the design life of the proposed project. In general, the intensity of ground shaking will depend on several factors including: the distance to the earthquake focus, the earthquake magnitude, the response characteristics of the underlying materials, and the quality and type of construction. Geologic hazards and their relationship to the site are discussed below.

I. Surface Rupture. Surface rupture is expected to occur along preexisting, known active fault traces. However, surface rupture could potentially splay or step from known active faults or rupture along unidentified traces. Based on our review of Jennings (1994), CDMG (1980), Dibblee (2003) and RCPR (2016) known faults are not mapped on or projecting towards the site. In addition, no signs of active surface faulting were observed during our review of non-stereo digitized photographs of the site and site vicinity (Google, 2016; Terra Server 2002). Finally, no signs of active surface fault rupture or secondary seismic effects (lateral spreading, lurching etc.) were identified on-site during our field investigation. Therefore, it is our opinion that risks associated with primary surface ground rupture should be considered "low".

II. Ground Shaking. The site has been subjected to past ground shaking by faults that traverse through the region. Strong seismic shaking from nearby active faults is expected to produce strong seismic shaking during the design life of the proposed project. A probabilistic approach was employed to the estimate the peak ground acceleration (a_{max}) that could be experienced at the site. Based on the USGS Interactive Deaggregation (USGS, 2008) and shear wave velocity (Vs30) of 360 m/s (USGS, 2016a), the site could be subjected to ground motions on the order of 0.67g. The peak ground acceleration at the site is judged to have a 475 year return period and a 10 percent chance of exceedence in 50 years.

III. Liquefaction. Liquefaction is the process in which loose, saturated granular soil loses strength as a result of cyclic loading. The strength loss is a result of a decrease in granular sand volume and a positive increase in pore pressures. Generally, liquefaction can occur if all of the following conditions apply: liquefaction-susceptible soil, groundwater within a depth of 50 feet or less, and strong seismic shaking.

Groundwater data available at CDWR (2016) indicates groundwater depths greater than 100 feet bgs in the vicinity of the site. Based on the depth to groundwater it is Sladden's professional opinion that risks associated with liquefaction should be considered "low".

IV. Tsunamis and Seiches. Because the site is situated at an elevated inland location, and is not immediately adjacent to any impounded bodies of water, risk associated with tsunamis and seiches is considered negligible.

V. Slope Failure, Landsliding, Rock Falls. The site is located on relatively flat ground and not immediately adjacent to any slopes or hillsides. Therefore, it is our professional opinion that risks associated with slope instability should be considered "negligible".

VI. Expansive Soil. Expansion Index testing of select samples was performed in order to evaluate expansive potential of the materials underlying the site. Based the results of our laboratory testing (EI=13), the materials underlying the site are considered to have a "very low" expansive potential. Accordingly, risk of structural damage associated with volumetric changes in the underlying earth materials should be "low".

VII. Settlement. Settlement resulting from the anticipated foundation loads should be minimal provided that the recommendations included in this report are considered in foundation design and construction. The ultimate settlement is estimated to be less than one inch when using the recommended bearing pressures. As a practical matter, differential settlement between footings can be assumed as one-half of the total settlement.

VIII. Subsidence. Land subsidence can occur in valleys where aquifer systems have been subjected to extensive groundwater pumping, such that groundwater pumping exceeds groundwater recharge. Generally, pore water reduction can result in a rearrangement of skeletal grains and could result in elastic (recoverable) or inelastic (unrecoverable) deformation of an aquifer system.

Locally, no fissures or other surficial evidence of subsidence were observed at or near the subject site. However, site specific effects resulting from long term regional subsidence is beyond the scope of our investigation.

IX. Flooding and Erosion. No signs of flooding or erosion were observed during our field investigation conducted on October 13, 2016. Risks associated with flooding and erosion should be evaluated and mitigated by the project design Civil Engineer.

X. Debris Flows. Debris flows are viscous flows consisting of poorly sorted mixtures of sediment and water and are generally initiated on slopes steeper than approximately six horizontal to one vertical (6H:1V)(Boggs, 2001). Based on the flat nature of the site and the composition of the surface soil, we judge that risks associated with debris flows should be considered remote.

CONCLUSIONS

Based on the results of our investigation, it is our professional opinion that the project should be feasible from a geotechnical perspective provided that the recommendations included in this report are incorporated into foundation design and carried out through construction. The main geotechnical concern in the design and construction of the proposed project is the loose condition of the near surface soil.

Because of the presence of artificial fill soil and the loose conditions of the near surface soil, remedial grading including over-excavation and re-compaction is recommended for the proposed building areas. We recommend that remedial grading within the proposed building areas include the removal and re-compaction of loose surface soil. Specific recommendations for site preparation are presented in the Earthwork and Grading section of this report.

Groundwater was not encountered within our bores and groundwater is expected to be in excess of 50 feet below the existing ground surface in the vicinity of the site.

Caving did occur to varying degrees within each of our exploratory bores and the surface soil may be susceptible to caving within deeper excavations. All excavations should be constructed in accordance with the normal CalOSHA excavation criteria. On the basis of our observations of the materials encountered, we anticipate that the subsoil will conform to that described by CalOSHA as Type B or C. Soil conditions should be verified in the field by a "Competent person" employed by the Contractor.

The following preliminary design recommendations present more detailed design criteria that have been developed on the basis of our field and laboratory investigation.

EARTHWORK AND GRADING

All earthwork including excavation, backfill and preparation of the subgrade soil, should be performed in accordance with the geotechnical recommendations presented in this report and portions of the local regulatory requirements, as applicable. All earthwork should be performed under the observation and testing of a qualified soil engineer. The following geotechnical engineering recommendations for the proposed project are based on observations from the field investigation program, laboratory testing and geotechnical engineering analyses.

a. Stripping. Areas to be graded should be cleared of the vegetation, associated root systems and debris. All areas scheduled to receive fill should be cleared of old fills and any irreducible matter. The strippings should be removed off-site, or stockpiled for later use in landscape areas. Existing fill soil should be removed in its entirety and replaced as engineered fill. Voids left by obstructions should be properly backfilled in accordance with the compaction recommendations of this report.

b. Preparation of the Building Areas. In order to achieve firm and uniform bearing conditions, we recommend over-excavation and recompaction throughout the building areas. All artificial fill and low density native soil should be removed to a depth of approximately 4 feet below existing grade or 3 feet below the bottom of the footings, whichever is deeper. Remedial grading should extend laterally, a minimum of 5 feet beyond the building limits. The exposed surface should then be scarified, moisture conditioned to near optimum moisture content and compacted to at least 90 percent relative compaction. The previously removed soil may then be replaced as engineered fill.

c. Compaction. Soil to be used as engineered fill should be free of organic material, debris, and other deleterious substances, and should not contain irreducible matter greater than six (6) inches in maximum dimension. All fill materials should be placed in thin lifts not exceeding six inches in a loose condition. If import fill is required, the material should be of a non-expansive nature and should meet the following criteria:

Plastic Index	Less than 12
Liquid Limit	Less than 35
Percent Soil Passing #200 Sieve	Between 15% and 35%
Maximum Aggregate Size	3 inches

The subgrade and all fill material should be compacted with acceptable compaction equipment, to at least 90 percent relative compaction. The bottom of the exposed subgrade should be observed by a representative of Sladden Engineering prior to fill placement. Compaction testing should be performed on all lifts in order to verify proper placement of the fill materials. Table 2 provides a summary of the excavation and compaction recommendations.

TABLE 2
SUMMARY OF RECOMMENDATIONS

*Remedial Grading	Excavation and/or recompaction within the building envelopes and extending laterally for 5 feet beyond the building limits and to a minimum depth of 4 feet below existing grade or 3 feet below the bottom of the footings, whichever is deeper.
Native / Import Engineered Fill	Place in thin lifts not exceeding 6 inches in a loose condition, compact to a minimum of 90 percent relative compaction.
Asphalt Concrete Sections	Compact the top 12 inches to at least 95 percent compaction within 2 percent of optimum moisture content.

*Actual depth may vary and should be determined by a representative of Sladden Engineering in the field during construction.

d. Shrinkage and Subsidence. Volumetric shrinkage of the material that is excavated and replaced as controlled compacted fill should be anticipated. We estimate that this shrinkage could vary from 20 to 25 percent. Subsidence of the surfaces that are scarified and compacted should be between 1 and 2 tenths of a foot. This will vary depending upon the type of equipment used, the moisture content of the soil at the time of grading and the actual degree of compaction attained.

FOUNDATIONS: CONVENTIONAL SHALLOW SPREAD FOOTINGS

Conventional shallow spread footings may be used for building support. Load bearing walls may be supported on continuous spread footings and interior columns may be supported on isolated pad footings. All footings should be founded upon properly engineered fill and should have a minimum embedment depth of 12 inches below lowest adjacent grade for single-story structures and 18 inches below lowest adjacent finished grade for two-story structures. Continuous and isolated footings should have minimum widths of 18 inches and 24 inches, respectively. Continuous and isolated footings placed on compact engineered fill soil may be designed using allowable (net) bearing pressures of 1800 and 2000 pounds per square foot (psf), respectively. Allowable increases of 250 psf for each additional 1 foot in width and 250 psf for each additional 6 inches in depth may be utilized, if desired. The maximum allowable bearing pressure should be 3,000 psf. The allowable bearing pressures apply to combined dead and sustained live loads.

The allowable bearing pressure may be increased by one-third when considering transient live loads, including seismic and wind forces. All footings should be reinforced in accordance with the project structural engineer's recommendations.

Based on the allowable bearing pressures recommended above, total static settlement of the shallow footings is anticipated to be less than one-inch provided that foundation area preparation conforms to the recommendations described in this report. Differential static settlement is anticipated to be approximately one-half of the total settlement for similarly loaded footings spaced up to approximately 50 feet apart.

Lateral load resistance for the spread footings will be developed by passive soil pressure against the sides of the footings below grade and by friction acting at the base of the concrete footings bearing on compacted fill. An allowable passive pressure of 250 psf per foot of depth may be used for design purposes. An allowable coefficient of friction 0.40 may be used for dead and sustained live loads to compute the frictional resistance of the footing placed directly on compacted fill. Under seismic and wind loading conditions, the passive pressure or the frictional resistance may be increased by one-third.

All footing excavations should be observed by a representative of the project geotechnical consultant to verify adequate embedment depths prior to placement of forms, steel reinforcement or concrete. The excavations should be trimmed neat, level and square. All loose, disturbed, sloughed or moisture-softened soils and/or any construction debris should be removed prior to concrete placement. Excavated soil generated from footing and/or utility trenches should not be stockpiled within the building envelope or in areas of exterior concrete flatwork.

SLABS-ON-GRADE

In order to reduce the risk of heave, cracking and settlement, concrete slabs-on-grade should be placed on properly compacted soil as outlined in the previous sections of this report. The slab subgrades should remain near optimum moisture content and should not be permitted to dry prior to concrete placement. All slab subgrades should be firm and unyielding. Disturbed soil should be removed and then replaced and compacted to a minimum of 90 percent relative compaction.

Slab thickness and reinforcement should be determined by the structural engineer. All slab reinforcement should be supported on concrete chairs to ensure that reinforcement is placed at slab mid-height. Final slab-on-grade designs should be in accordance with the structural engineer's recommendations.

Slabs with moisture sensitive surfaces should be underlain with a moisture vapor retarder consisting of a polyvinyl chloride (pvc) membrane such as 10-mil Visqueen, or equivalent. All laps within the membrane should be sealed and at least 2 inches of clean sand should be placed over the membrane to promote uniform curing of the concrete. To reduce the potential for punctures, the membrane should be placed on a pad surface that has been graded smooth without any sharp protrusions. If a smooth surface can not be achieved by grading, consideration should be given to placing a 1-inch thick leveling course of sand across the pad surface prior to placement of the membrane.

PRELIMINARY PAVEMENT DESIGN

Asphalt concrete pavements should be designed in accordance with Topic 608 of the Caltrans Highway Design Manual based on R-Value and Traffic Index. An R-Value of 50 was assumed to develop the following preliminary pavement sections. On-site and any imported soils should be tested for R-Value after grading. Actual R-Value of subgrade soil should be consistent with the pavement design. For Pavement design, a Traffic Index (TI) of 6.0 was used for the light duty pavements. We assumed Asphalt Concrete (AC) over Class II Aggregate Base (AB). The preliminary flexible pavement design is as follows:

RECOMMENDED ASPHALT PAVEMENT SECTION LAYER THICKNESS	
Pavement Material	**Recommended Thickness**
	TI = 5.5
Asphalt Concrete Surface Course	3.0 inches
Class II Aggregate Base Course	4.0 inches
Compacted Subgrade Soil	12.0 inches

Asphalt concrete should conform to Sections 203 and 302 of the latest edition of the Standard Specifications for Public Works Construction ("Greenbook"). Class II aggregate base should conform to Section 26 of the Caltrans Standard Specifications, latest edition. The aggregate base course should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Method D 1557.

CORROSION SERIES

The soluble sulfate concentrations of the surface soil were determined to be 100 parts per million (ppm). The soil is considered to have a "negligible" corrosion potential with respect to concrete. The use of Type V cement and special sulfate resistant concrete mixes should not be necessary. Soluble sulfate content of the surface soil should be reevaluated after grading and appropriate concrete mix designs should be established based upon post-grading test results.

The pH levels of the surface soil was determined to be 8.2. Based on soluble chloride concentration testing (150 ppm), the soil is considered to have a "low" corrosion potential with respect to normal grade steel. The minimum resistivity of the surface soil was found to be 2,400 ohm-cm, that indicates the site soil is considered to have a "moderate" corrosion potential with respect to ferrous metal installations. A corrosion expert should be retained to provide appropriate corrosion protection measures for corrosion susceptible installations.

UTILITY TRENCH BACKFILL

All utility trench backfill should be compacted to a minimum of 90 percent relative compaction. Trench backfill materials should be placed in lifts no greater than six inches in a loose condition, moisture conditioned (or air-dried) as necessary to achieve near optimum moisture conditions, and then mechanically compacted in place to a minimum relative compaction of 90 percent. A representative of the project geotechnical consultant should test the backfill to verify adequate compaction.

EXTERIOR CONCRETE FLATWORK

To minimize settlement related cracking of concrete flatwork, the subgrade soil below concrete flatwork areas should first be compacted to a minimum relative compaction of 90 percent. A representative of the project geotechnical consultant should observe and verify the density and moisture content of the soil prior to pouring concrete.

DRAINAGE

All final grades should be provided with positive gradients away from foundations to provide rapid removal of surface water runoff to an adequate discharge point. No water should be allowed to be pond on or immediately adjacent to foundation elements. In order to reduce water infiltration into the subgrade soil, surface water should be directed away from building foundations to an adequate discharge point. Subgrade drainage should be evaluated upon completion of the precise grading plans and in the field during grading.

LIMITATIONS

The findings and recommendations presented in this report are based upon an interpolation of the soil conditions between the exploratory bore locations and extrapolation of these conditions throughout the proposed building areas. Should conditions encountered during grading appear different than those indicated in this report, this office should be notified.

The use of this report by other parties or for other projects is not authorized. The recommendations of this report are contingent upon monitoring of the grading operation by a representative of Sladden Engineering. All recommendations are considered to be tentative pending our review of the grading operation and additional testing, if indicated. If others are employed to perform any soil testing, this office should be notified prior to such testing in order to coordinate any required site visits by our representative and to assure indemnification of Sladden Engineering.

We recommend that a pre-job conference be held on the site prior to the initiation of site grading. The purpose of this meeting will be to assure a complete understanding of the recommendations presented in this report as they apply to the actual grading performed.

ADDITIONAL SERVICES

Once completed, final project plans and specifications should be reviewed by us prior to construction to confirm that the full intent of the recommendations presented herein have been applied to design and construction. Following the review of plans and specifications, observation should be performed by the Soil Engineer during construction to document that foundation elements are founded on/or penetrate into the recommended soil, and that suitable backfill soil is placed upon competent materials and properly compacted at the recommended moisture content.

Tests and observations should be performed during grading by the Soil Engineer or his representative in order to verify that the grading is being performed in accordance with the project specifications. Field density testing shall be performed in accordance with acceptable ASTM test methods. The minimum acceptable degree of compaction should be 90 percent for subgrade soil and 95 percent for Class II aggregate base as obtained by the ASTM Test Method D1557. Where testing indicates insufficient density, additional compactive effort shall be applied until retesting indicates satisfactory compaction.

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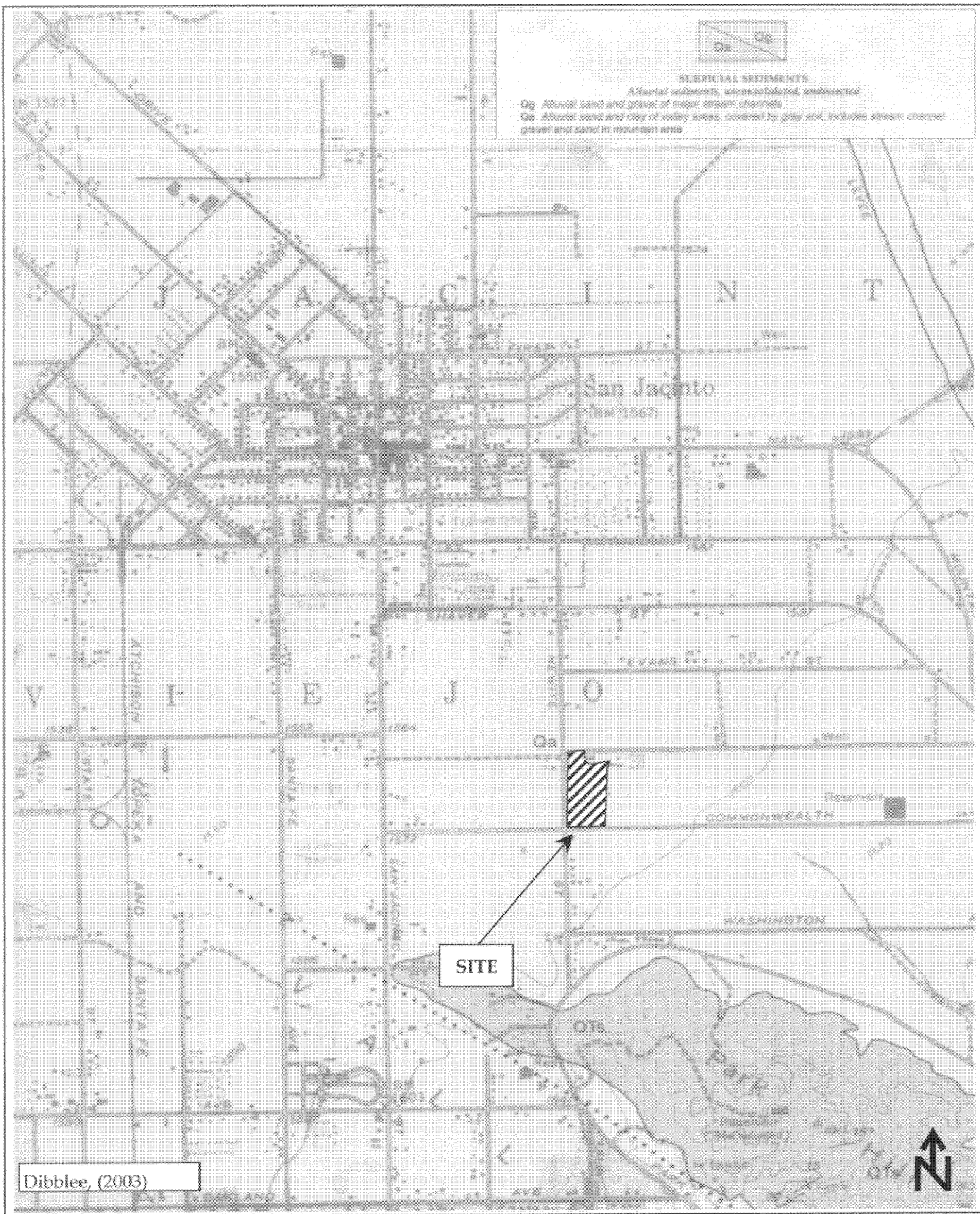
FIGURES

SITE LOCATION MAP
REGIONAL GEOLOGIC MAP
BOREHOLE LOCATION PHOTOGRAPH

Sladden Engineering	SITE LOCATION MAP	FIGURE 1
	Project Number: 644-16051-1	
	Report Number: 16-11-146	
	Date: November 22, 2016	



Sladden Engineering	REGIONAL GEOLOGIC MAP	FIGURE 2
	Project Number: 644-16051-1	
	Report Number: 16-11-146	
	Date: November 22, 2016	

Sladden Engineering	BOREHOLE LOCATION PHOTOGRAPH	FIGURE
	Project Number: 644-16051-1	3
	Report Number: 16-11-146	
	Date: November 22, 2016	

APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

For our field investigation four (4) exploratory bores were excavated on October 13, 2016 utilizing a truck mounted rig (Mobile B-61) equipped with 8-inch outside diameter (O.D.) augers. Continuous logs of the materials encountered were made by a representative of Sladden Engineering. Materials encountered in the boreholes were classified in accordance with the Unified Soil Classification System which is presented in this appendix.

Representative undisturbed samples were obtained within our borings by driving a thin-walled steel penetration sampler (California split spoon sampler) or a Standard Penetration Test (SPT) sampler with a 140 pound automatic-trip hammer dropping approximately 30 inches (ASTM D1586). The number of blows required to drive the samplers 18 inches was recorded in 6-inch increments and blowcounts are indicated on the boring logs.

The California samplers are 3.0 inches in diameter, carrying brass sample rings having inner diameters of 2.5 inches. The standard penetration samplers are 2.0 inches in diameter with an inner diameter of 1.5 inches. Undisturbed samples were removed from the sampler and placed in moisture sealed containers in order to preserve the natural soil moisture content. Bulk samples were obtained from the excavation spoils and samples were then transported to our laboratory for further observations and testing.

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			TYPICAL NAMES	
COARSE GRAINED SOILS MORE THAN HALF IS LARGER THAN No.200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN No.4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY-GRADED GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN No.4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN HALF IS SMALLER THAN No.200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS & 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, CLEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS: LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

EXPLANATION OF BORE LOG SYMBOLS

California Split-spoon Sample

Unrecovered Sample

Standard Penetration Test Sample

Groundwater depth

Note: The stratification lines on the borelogs represent the approximate boundaries between the soil types; the transitions may be gradual.

SLADDEN ENGINEERING

BORE LOG

Drill Rig:	Mobil B-61	Date Drilled:	10/13/2016
Elevation:	1585 Feet (MSL)	Boring No:	BH-1

Sample	Blow Counts	Bulk Sample	Expansion Index	% Minus #200	% Moisture	Density, pcf	Depth (Feet)	Graphic Lithology	Description
	11/12/13	1	13	33.2	1.9	102.3	2		Silty Sand (SM); grayish brown, slightly moist, fine- to coarse-grained (Fill).
	5/8/9			70.2	4.7	87.8	4		Sandy Silt (ML); grayish brown, slightly moist, very stiff, low plasticity (Qa).
	2/4/5			51.3	9.4		6		
	9/10/11			45.9	9.2	109.9	8		Sandy Silt (ML); grayish brown, slightly moist, stiff, low plasticity (Qa).
	5/10/16			21.7	5.3		10		
	8/9/13			62.3	14.7	102.2	12		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
	3/4/8			59.7	21.0		14		
	8/21/23			21.6	11.0	115.8	16		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
	8/13/16			4.5	2.6		18		
	16/23/30			2.8	1.5	110.9	20		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
	8/16/21			4.3	2.7		22		
							24		
							26		Sandy Silt (ML); grayish brown, moist, stiff, low plasticity (Qa).
							28		
							30		Sandy Silt (ML); grayish brown, moist, stiff, low plasticity (Qa).
							32		
							34		
							36		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
							38		
							40		Gravelly Sand (SP); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
							42		
							44		Gravelly Sand (SP); grayish brown, slightly moist, dense, fine- to coarse-grained (Qa).
							46		
							48		Gravelly Sand (SP); grayish brown, slightly moist, dense, fine- to coarse-grained (Qa).
							50		

Completion Notes:
Terminated at ~51.5 Feet bgs.
No Bedrock Encountered.
No Groundwater or Seepage Encountered.

PROPOSED RANCHO SAN JACINTO DEVELOPMENT
SEC ESPLANADE AVENUE & HEWITT STREET, SAN JACINTO

Project No: 644-16051
Report No: 16-11-146

SLADDEN ENGINEERING

BORE LOG

Drill Rig:	Mobil B-61	Date Drilled:	10/13/2016
Elevation:	1585 Feet (MSL)	Boring No:	BH-2

Sample	Blow Counts	Bulk Sample	Expansion Index	% Minus #200	% Moisture	Density, pcf	Depth (Feet)	Graphic Lithology	Description
							2		Silty Sand (SM); grayish brown, dry to slightly moist, fine- to coarse-grained (Fill).
	3/5/6			26.2	3.6		6		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
	5/6/10			41.6	5.9	102.0	10		Silty Sand (SM); grayish brown, slightly moist, loose, fine- to coarse-grained (Qa).
	5/6/5			12.8	3.4		16		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
	6/11/16			25.9	6.2	105.2	20		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
							22		Terminated at ~21.5 Feet bgs. No Bedrock Encountered. No Groundwater or Seepage Encountered.

Completion Notes:

PROPOSED RANCHO SAN JACINTO DEVELOPMENT
SEC ESPLANADE AVENUE & HEWITT STREET, SAN JACINTO

Project No: 644-16051
Report No: 16-11-146

SLADDEN ENGINEERING

BORE LOG

Drill Rig:	Mobil B-61	Date Drilled:	10/13/2016
Elevation:	1585 Feet (MSL)	Boring No:	BH-3

Sample	Blow Counts	Bulk Sample	Expansion Index	% Minus #200	% Moisture	Density, pcf	Depth (Feet)	Graphic Lithology	Description
							0		Silty Sand (SM); grayish brown, slightly moist, fine- to coarse-grained (Fill).
	4/4/6			35.9	2.7		5		Silty Sand (SM); grayish brown, slightly moist, loose, fine- to coarse-grained (Qa).
	4/6/7			54.3	8.6	97.4	10		Sandy Silt (ML); grayish brown, slightly moist, medium stiff, low plasticity with trace gravel and clay (Qa).
	4/5/8			30.0	7.6		15		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
	9/14/18			10.0	2.8	105.5	20		Gravelly Sand (SP); light gray, slightly moist, medium dense, fine- to coarse-grained (Qa).
	7/12/12			25.3	6.2		25		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
	16/23/40			25.3	4.1	107.3	30		Silty Sand (SM); grayish brown, slightly moist, dense, fine- to coarse-grained (Qa).
	5/6/12			37.6	13.2		35		Silty Sand (SM); grayish brown, moist, medium dense, fine- to coarse-grained (Qa).
	13/22/27			11.0	4.1	111.4	40		Gravelly Sand (SP); light gray, slightly moist, dense, fine- to coarse-grained (Qa).
	11/17/18			13.6	5.8		45		Silty Sand (SM); grayish brown, moist, dense, fine- to coarse-grained (Qa).
	17/27/42			3.0	1.4	108.9	50		Gravelly Sand (SP); light gray, slightly moist, dense, fine- to coarse-grained (Qa).

Completion Notes:
Terminated at ~51.5 Feet bgs.
No Bedrock Encountered.
No Groundwater or Seepage Encountered.

PROPOSED RANCHO SAN JACINTO DEVELOPMENT
SEC ESPLANADE AVENUE & HEWITT STREET, SAN JACINTO

Project No: 644-16051
Report No: 16-11-146

SLADDEN ENGINEERING

BORE LOG

Drill Rig:	Mobil B-61	Date Drilled:	10/13/2016
Elevation:	1585 Feet (MSL)	Boring No:	BH-4

Sample	Blow Counts	Bulk Sample	Expansion Index	% Minus #200	% Moisture	Density, pcf	Depth (Feet)	Graphic Lithology	Description
							2		Silty Sand (SM); grayish brown, dry to moist, fine- to coarse-grained (Fill).
	5/6/11			58.1	3.4	96.7	6		Sandy Silt (ML); grayish brown, moist, stiff, low plasticity with trace gravel and clay (Qa).
	3/3/5			77.0	19.5		10		Sandy Silt (ML); grayish brown, moist, medium stiff, low plasticity with trace gravel and clay (Qa).
	7/11/11			9.0	2.3	113.2	16		Gravelly Sand (SP); light gray, slightly moist, medium dense, fine- to coarse-grained (Qa).
	7/9/15			23.4	6.0		20		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
							22		Terminated at ~21.5 Feet bgs. No Bedrock Encountered. No Groundwater or Seepage Encountered.

Completion Notes:

PROPOSED RANCHO SAN JACINTO DEVELOPMENT
SEC ESPLANADE AVENUE & HEWITT STREET, SAN JACINTO

Project No: 644-16051
Report No: 16-11-146

APPENDIX B

LABORATORY TESTING

APPENDIX B

LABORATORY TESTING

Representative bulk and relatively undisturbed soil samples were obtained in the field and returned to our laboratory for additional observations and testing. Laboratory testing was generally performed in two phases. The first phase consisted of testing in order to determine the compaction of the existing natural soil and the general engineering classifications of the soil underlying the site. This testing was performed in order to estimate the engineering characteristics of the soil and to serve as a basis for selecting samples for the second phase of testing. The second phase consisted of soil mechanics testing. This testing including consolidation, shear strength and expansion testing was performed in order to provide a means of developing specific design recommendations based on the mechanical properties of the soil.

CLASSIFICATION AND COMPACTION TESTING

Unit Weight and Moisture Content Determinations: Each undisturbed sample was weighed and measured in order to determine its unit weight. A small portion of each sample was then subjected to testing in order to determine its moisture content. This was used in order to determine the dry density of the soil in its natural condition. The results of this testing are shown on the Boring Logs.

Maximum Density-Optimum Moisture Determinations: Representative soil types were selected for maximum density determinations. This testing was performed in accordance with the ASTM Standard D1557-91, Test Method A. The results of this testing are presented graphically in this appendix. The maximum densities are compared to the field densities of the soil in order to determine the existing relative compaction to the soil.

Classification Testing: Soil samples were selected for classification testing. This testing consists of mechanical grain size analyses. This provides information for developing classifications for the soil in accordance with the Unified Soil Classification System which is presented in the preceding appendix. This classification system categorizes the soil into groups having similar engineering characteristics. The results of this testing is very useful in detecting variations in the soil and in selecting samples for further testing.

SOIL MECHANIC'S TESTING

Expansion Testing: One (1) bulk sample was selected for Expansion testing. Expansion testing was performed in accordance with the UBC Standard 18-2. This testing consists of remolding 4-inch diameter by 1-inch thick test specimens to a moisture content and dry density corresponding to approximately 50 percent saturation. The samples are subjected to a surcharge of 144 pounds per square foot and allowed to reach equilibrium. At that point the specimens are inundated with distilled water. The linear expansion is then measured until complete.

Direct Shear Tests: One (1) bulk sample was selected for Direct Shear testing. This test measures the shear strength of the soil under various normal pressures and is used to develop parameters for foundation design and lateral design. Tests were performed using a recompacted test specimen that was saturated prior to tests. Tests were performed using a strain controlled test apparatus with normal pressures ranging from 800 to 2300 pounds per square foot.

Consolidation Test: Two (2) relatively undisturbed samples were selected for consolidation testing. For this test, a one-inch thick test specimen was subjected to vertical loads varying from 575 psf to 11520 psf applied progressively. The consolidation at each load increment was recorded prior to placement of each subsequent load. The specimens were saturated at 575 psf or 720 psf load increment.

Corrosion Series Testing: The soluble sulfate concentrations of the surface soil were determined in accordance with California Test Method Number (CA) 417. The pH and Minimum Resistivity were determined in accordance with CA 643. The soluble chloride concentrations were determined in accordance with CA 422.

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Maximum Density/Optimum Moisture

ASTM D698/D1557

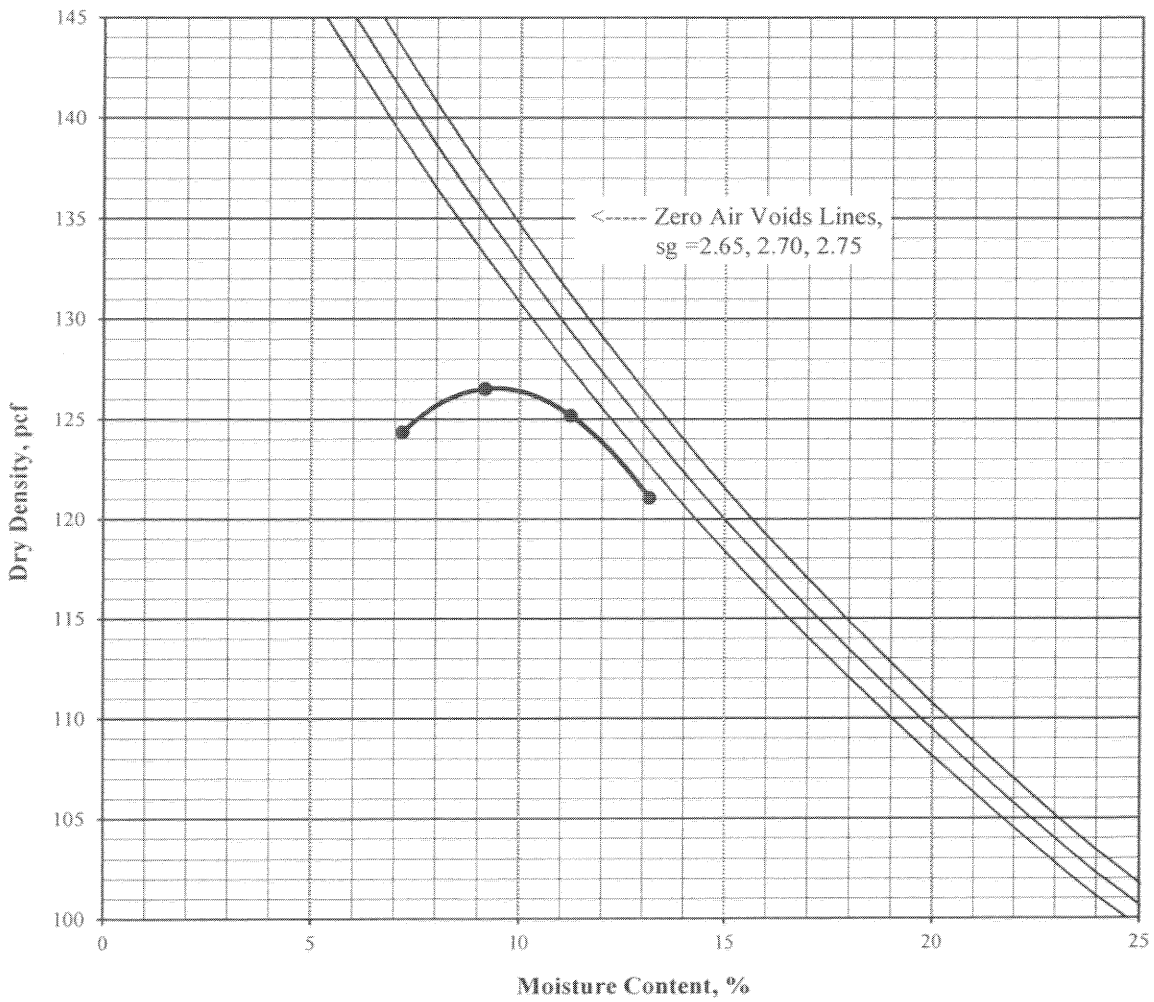
Project Number: 644-16051-1
Project Name: Rancho San Jacinto Development
Lab ID Number: LN6-16418
Sample Location: BH-1 Bulk 1 @ 0-5'
Description: Dark Brown Silty Sand (SM)

November 9, 2016

ASTM D-1557 A
Rammer Type: Machine

Maximum Density: 127 pcf
Optimum Moisture: 10%

Sieve Size	% Retained
3/4"	
3/8"	
#4	0.8



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Expansion Index

ASTM D 4829

Job Number:	644-16051-1	November 9, 2016
Job Name:	Rancho San Jacinto Development	
Lab ID Number:	LN6-16418	
Sample ID:	BH-1 Bulk 1 @ 0-5'	
Soil Description:	Dark Brown Silty Sand (SM)	

Wt of Soil + Ring:	576.6
Weight of Ring:	192.0
Wt of Wet Soil:	384.6
Percent Moisture:	8.8%
Sample Height, in	0.95
Wet Density, pcf:	122.7
Dry Denstiy, pcf:	112.8

% Saturation:	48.1

Expansion **Rack # 1**

Date/Time	11/3/2016	11:30 AM
Initial Reading	0.0000	
Final Reading	0.0130	

Expansion Index **13**

(Final - Initial) x 1000

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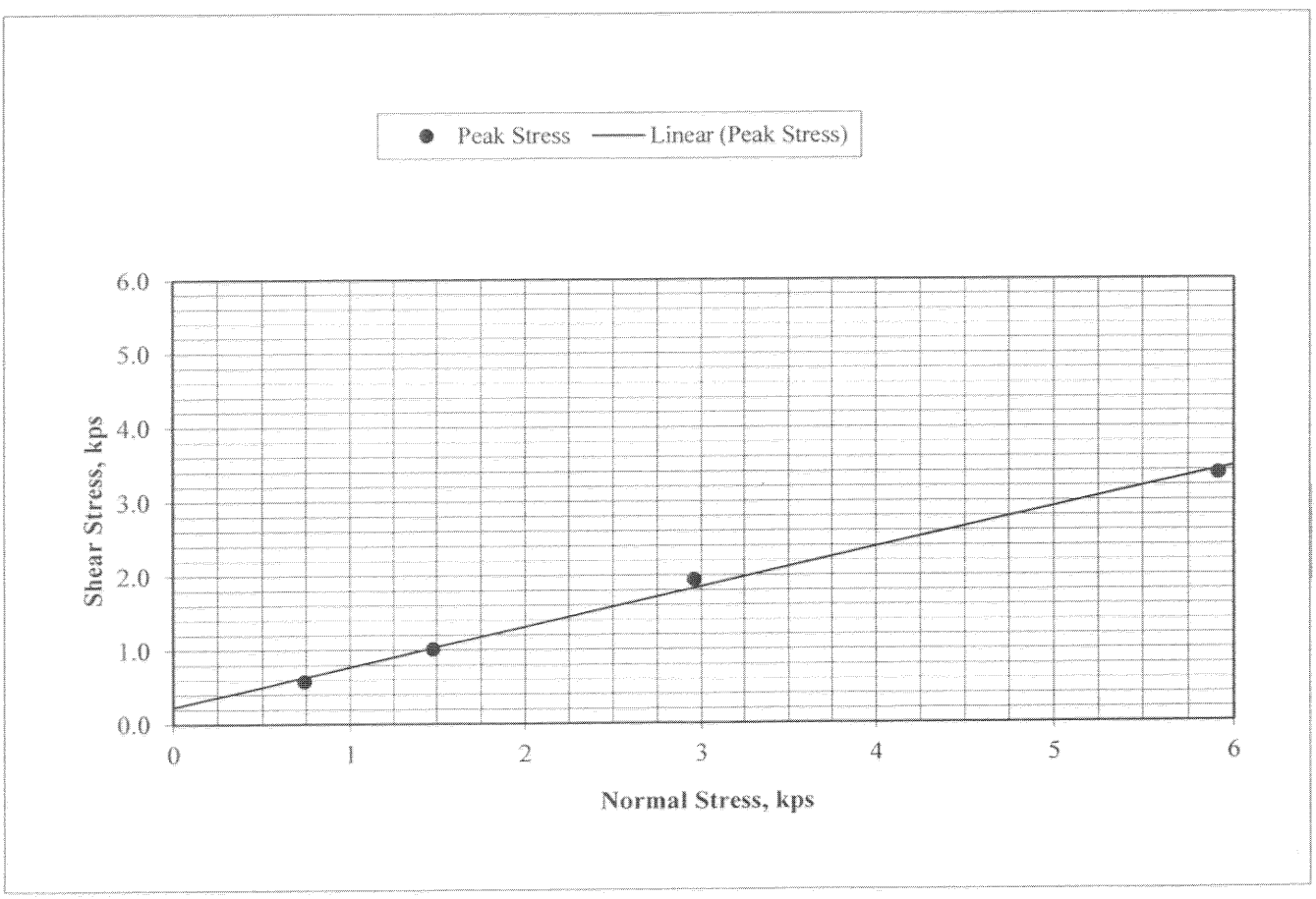
Direct Shear ASTM D 3080-04
(modified for unconsolidated condition)

Job Number:	644-16051-1		November 9, 2016
Job Name	Rancho San Jacinto Development		Initial Dry Density: 114.4 pcf
Lab ID No.	LN6-16418		Initial Mosture Content: 9.8 %
Sample ID	BH-1 Bulk 1 @ 0-5'		Peak Friction Angle (Ø): 28°
Classification	Dark Brown Silty Sand (SM)		Cohesion (c): 230 psf
Sample Type	Remolded @ 90% of Maximum Density		

Test Results	1	2	3	4	Average
Moisture Content, %	16.8	16.8	16.8	16.8	16.8
Saturation, %	95.8	95.8	95.8	95.8	95.8
Normal Stress, kps	0.739	1.479	2.958	5.916	
Peak Stress, kps	0.576	1.012	1.942	3.360	



Job Number: 644-16051-1
Job Name: Rancho San Jacinto Development
Date: 11/9/2016

Moisture Adjustment	
Wt of Soil:	1,000
Moist As Is:	3.2
Moist Wanted:	10.0
ml of Water to Add:	65.9

Remolded Shear Weight	
Max Dry Density:	127.0
Optimum Moisture:	10.0
Wt Soil per Ring, g:	151.2

UBC

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Gradation

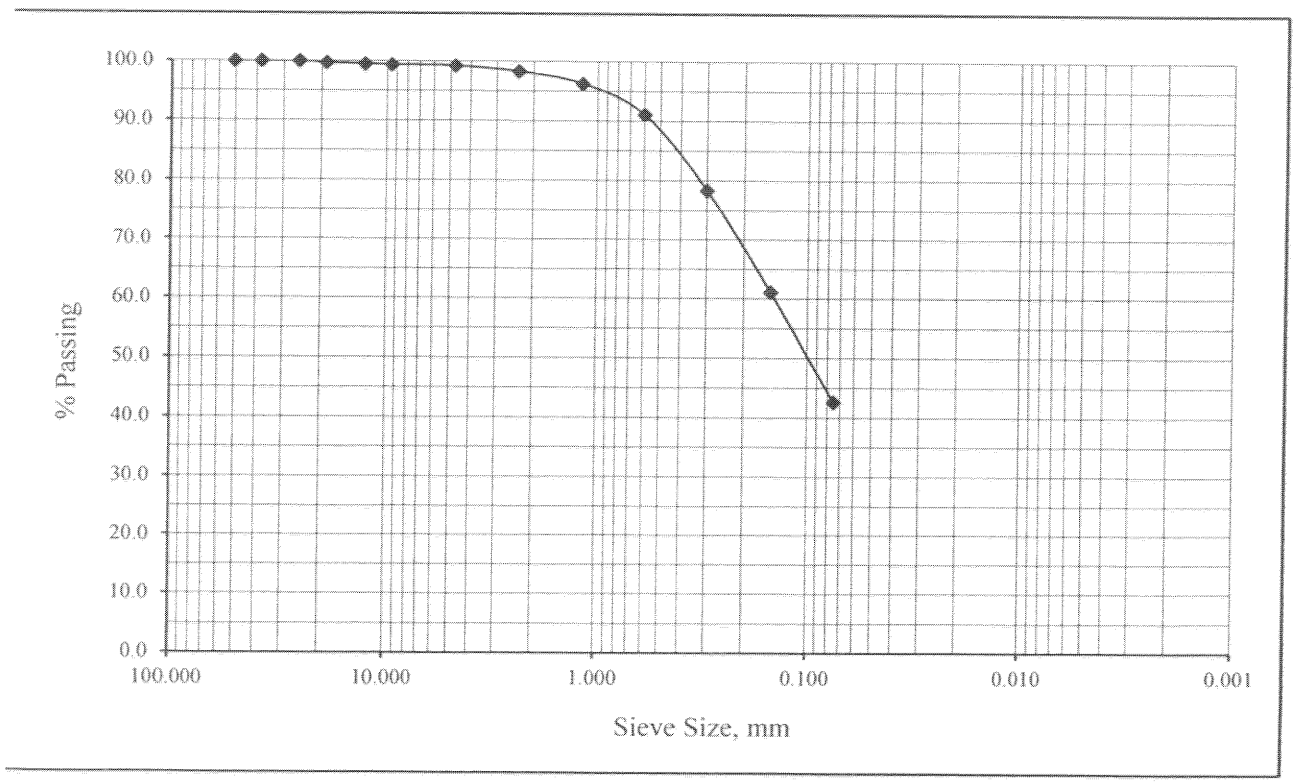
ASTM C117 & C136

Project Number: 644-16051-1
Project Name: Rancho San Jacinto Development
Lab ID Number: LN6-16418
Sample ID: BH-1 Bulk 1 @ 0-5'

November 9, 2016

Soil Classification: SM

Sieve Size, in	Sieve Size, mm	Percent Passing
2"	50.8	100.0
1 1/2"	38.1	100.0
1"	25.4	100.0
3/4"	19.1	99.7
1/2"	12.7	99.5
3/8"	9.53	99.4
#4	4.75	99.2
#8	2.36	98.3
#16	1.18	96.3
#30	0.60	91.1
#50	0.30	78.4
#100	0.15	61.1
#200	0.075	42.6



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Gradation

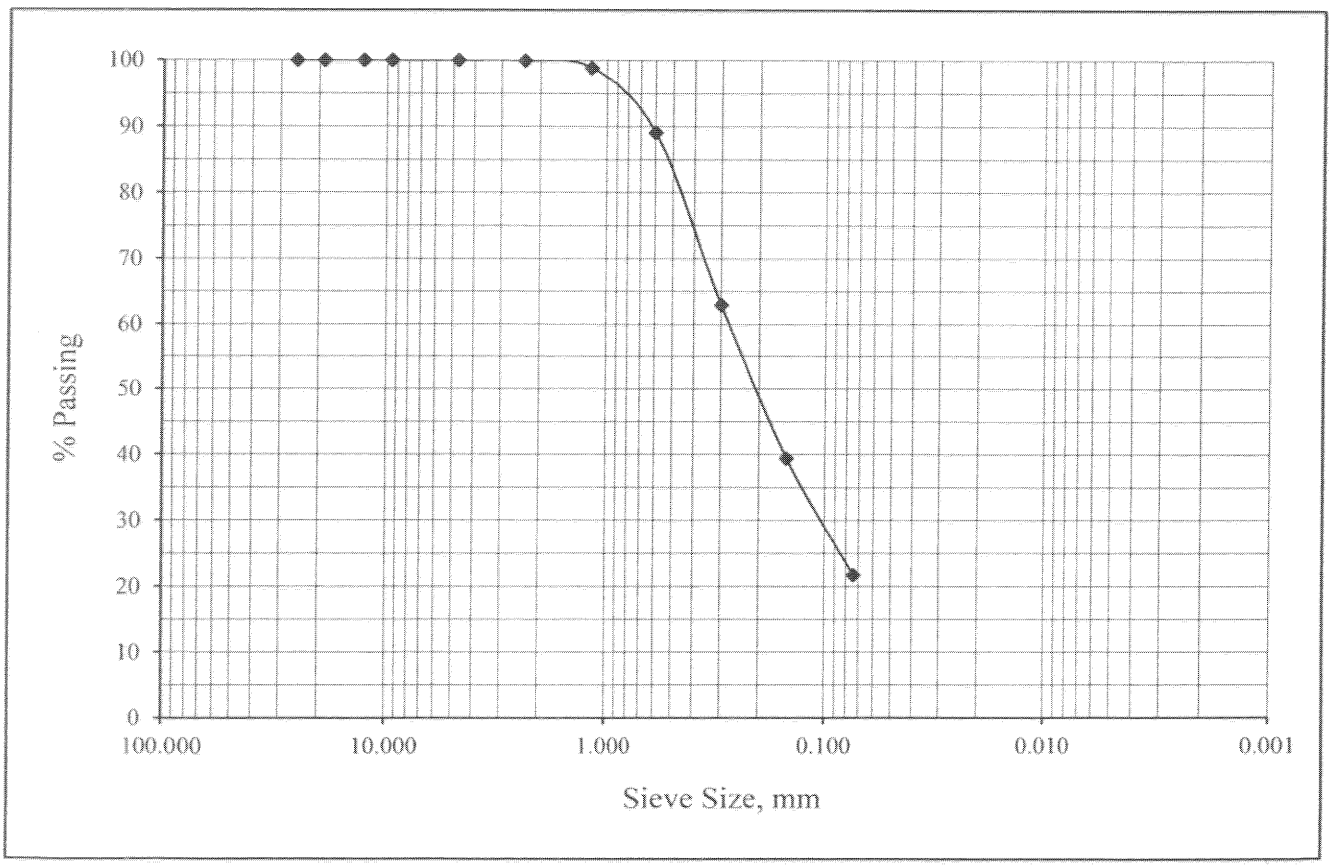
ASTM C117 & C136

Project Number: 644-16051-1
Project Name: Rancho San Jacinto Development
Lab ID Number: LN6-16418
Sample ID: BH-1 S-5 @ 20'

November 9, 2016

Soil Classification: SM

Sieve Size, in	Sieve Size, mm	Percent Passing
1"	25.4	100.0
3/4"	19.1	100.0
1/2"	12.7	100.0
3/8"	9.53	100.0
#4	4.75	100.0
#8	2.36	99.9
#16	1.18	98.9
#30	0.60	89.1
#50	0.30	63.0
#100	0.15	39.4
#200	0.074	21.7



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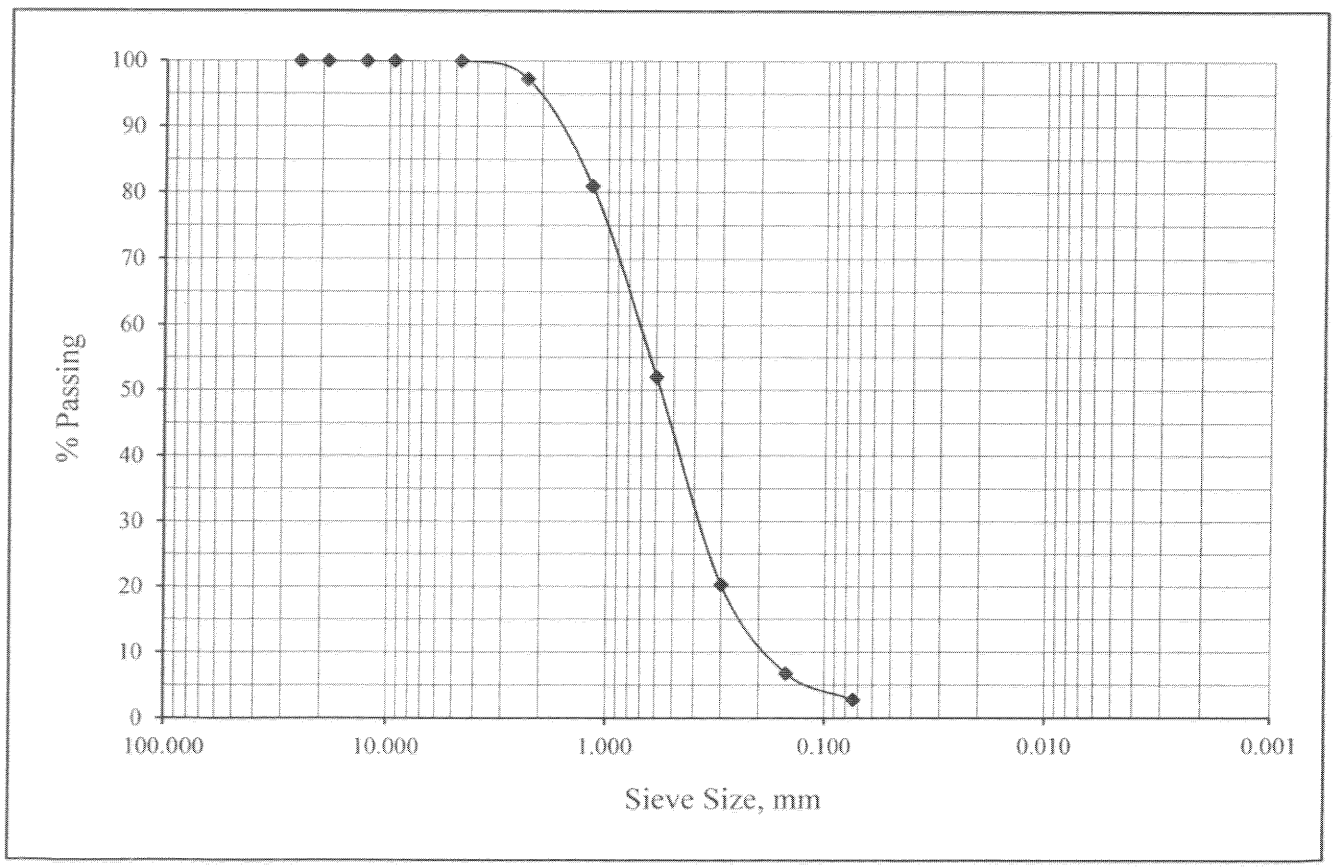
ASTM C117 & C136

Project Number: 644-16051-1
Project Name: Rancho San Jacinto Development
Lab ID Number: LN6-16418
Sample ID: BH-1 R-10 @ 45'

November 9, 2016

Soil Classification: SP

Sieve Size, in	Sieve Size, mm	Percent Passing
1"	25.4	100.0
3/4"	19.1	100.0
1/2"	12.7	100.0
3/8"	9.53	100.0
#4	4.75	100.0
#8	2.36	97.3
#16	1.18	81.0
#30	0.60	52.0
#50	0.30	20.3
#100	0.15	6.8
#200	0.074	2.8



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Gradation

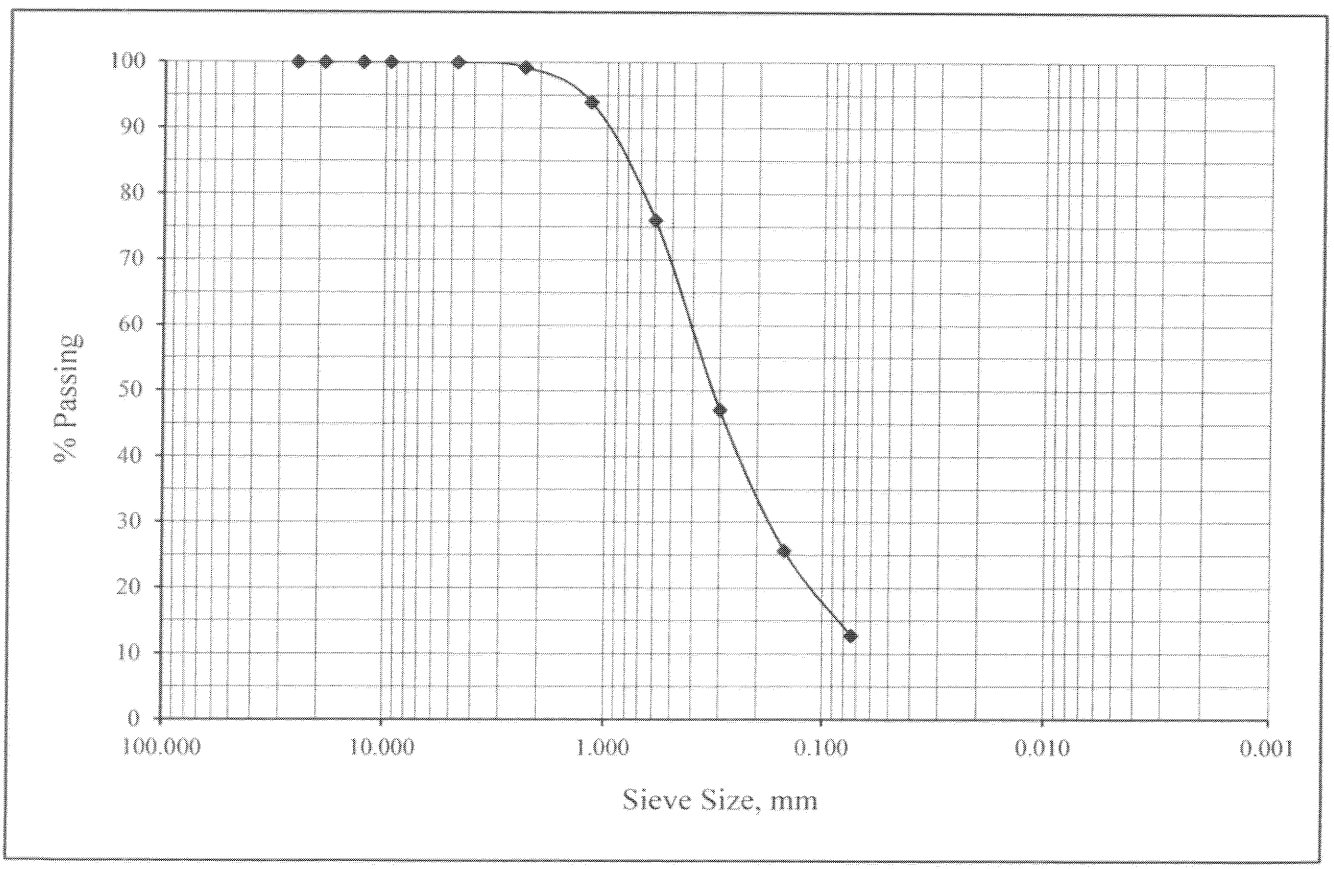
ASTM C117 & C136

Project Number: 644-16051-1
Project Name: Rancho San Jacinto Development
Lab ID Number: LN6-16418
Sample ID: BH-2 S-3 @ 15'

November 9, 2016

Soil Classification: SM

Sieve Size, in	Sieve Size, mm	Percent Passing
1"	25.4	100.0
3/4"	19.1	100.0
1/2"	12.7	100.0
3/8"	9.53	100.0
#4	4.75	100.0
#8	2.36	99.2
#16	1.18	93.9
#30	0.60	76.0
#50	0.30	47.1
#100	0.15	25.7
#200	0.074	12.8



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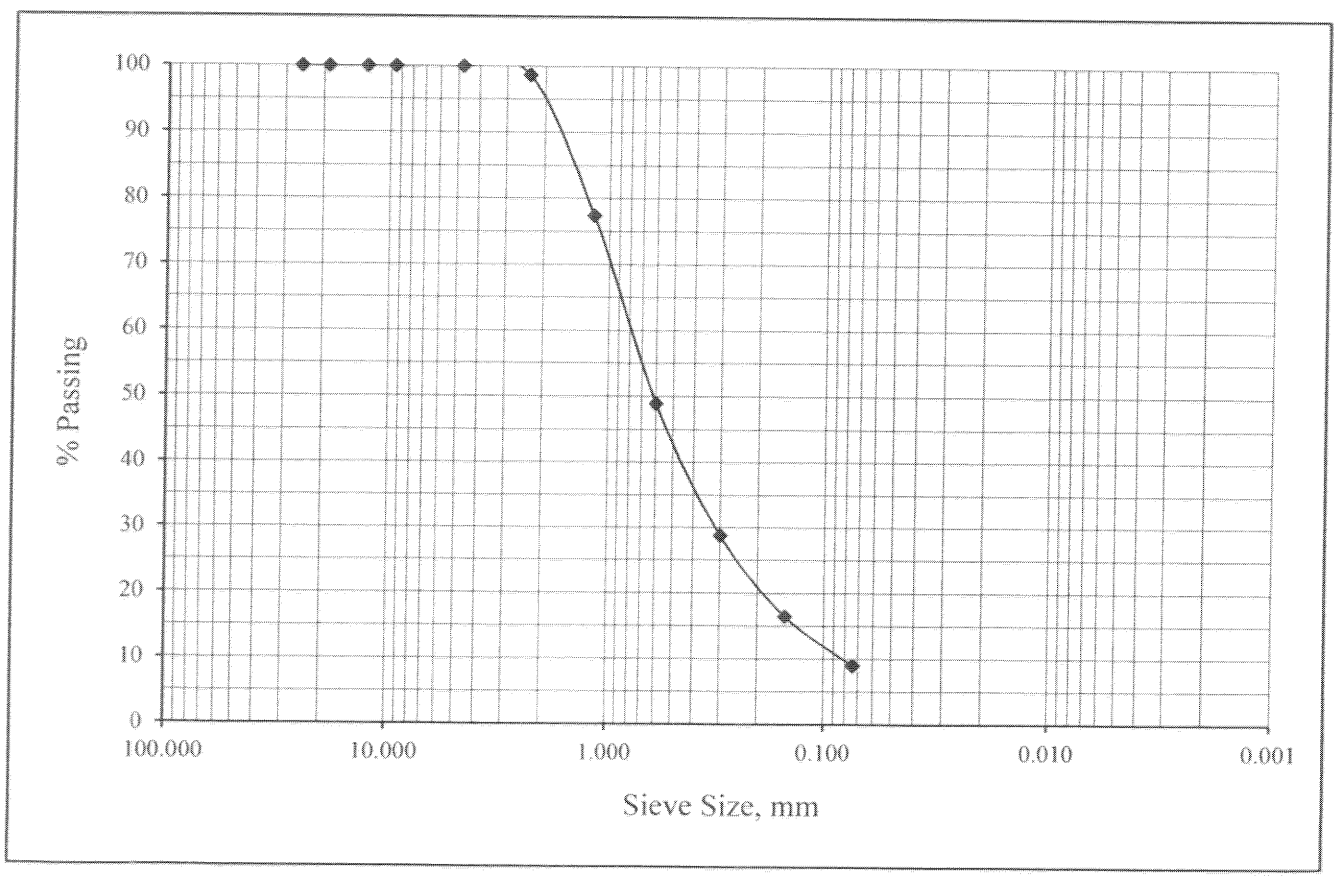
ASTM C117 & C136

Project Number: 644-16051-1
Project Name: Rancho San Jacinto Development
Lab ID Number: LN6-16418
Sample ID: BH-4 R-3 @ 15'

November 9, 2016

Soil Classification: SW-SM

Sieve Size, in	Sieve Size, mm	Percent Passing
1"	25.4	100.0
3/4"	19.1	100.0
1/2"	12.7	100.0
3/8"	9.53	100.0
#4	4.75	100.0
#8	2.36	98.7
#16	1.18	77.5
#30	0.60	48.9
#50	0.30	28.8
#100	0.15	16.5
#200	0.074	9.0



Sladden Engineering

450 Egan Avenue, Beaumont, CA 92223 (951) 845-7743 Fax (951) 845-8863

One Dimensional Consolidation

ASTM D2435 & D5333

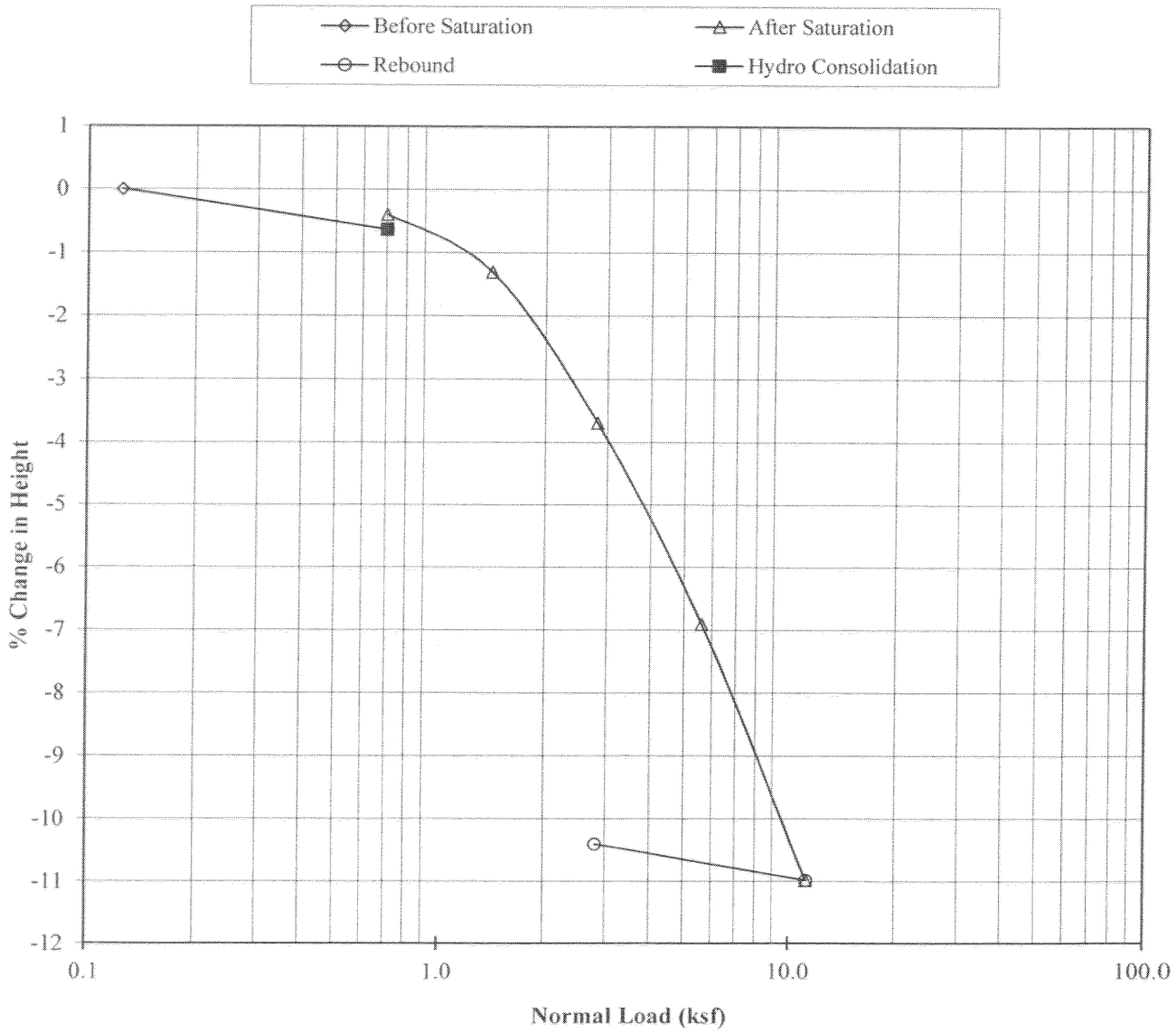
Job Number: 644-16051-1
Job Name: Rancho San Jacinto Development

November 9, 2016

Lab ID Number: LN6-16418
Sample ID: BH-1 R-2 @ 5'
Soil Description: Brown Silt w/Sand (ML)

Initial Dry Density, pcf:	82.6
Initial Moisture, %:	4.7
Initial Void Ratio:	1.018
Specific Gravity:	2.67

% Change in Height vs Normal Presssure Diagram



Sladden Engineering

450 Egan Avenue, Beaumont, CA 92223 (951) 845-7743 Fax (951) 845-8863

One Dimensional Consolidation

ASTM D2435 & D5333

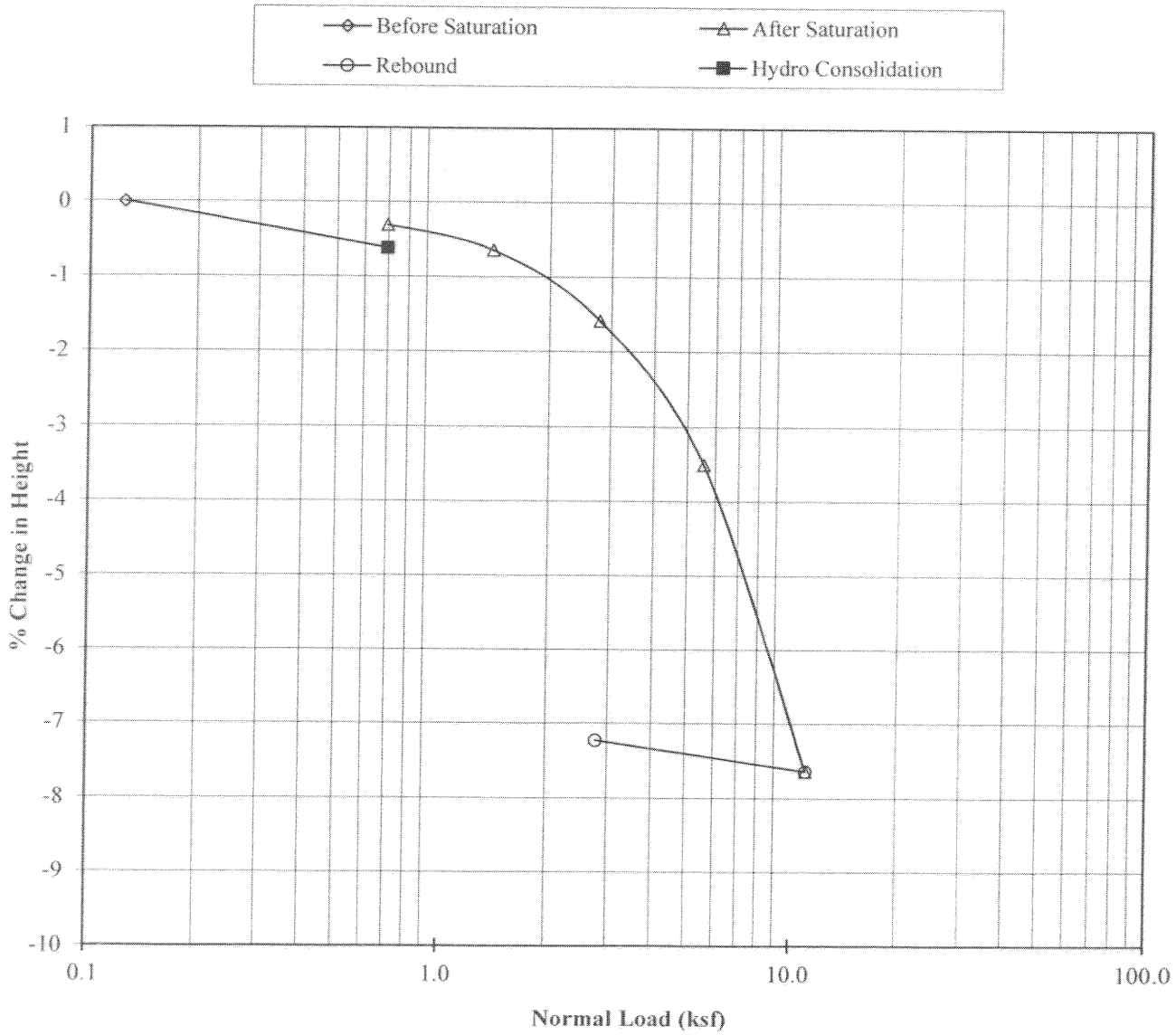
Job Number: 644-16051-1
Job Name: Rancho San Jacinto Development

November 9, 2016

Lab ID Number: LN6-16418
Sample ID: BH-3 R-2 @ 10'
Soil Description: Dark Brown Sandy Silt (ML)

Initial Dry Density, pcf:	96.6
Initial Moisture, %:	8.6
Initial Void Ratio:	0.726
Specific Gravity:	2.67

% Change in Height vs Normal Presssure Diagram



Sladden Engineering

6782 Stanton Ave., Suite A, Buena Park, CA 90621 (714) 523-0952 Fax (714) 523-1369
45090 Golf Center Pkwy., Suite F, Indio, CA 92201 (760) 863-0713 Fax (760) 863-0847
450 Egan Avenue, Beaumont, CA 92223 (951) 845-7743 Fax (951) 845-8863

Date: November 9, 2016

Account No.: 644-16051-1

Customer: Bill Lo Consultant c/o Blaine Wormer

Location: APN 439-180-015, TTM 37229, San Jacinto

Analytical Report

Corrosion Series

	pH per CA 643	Soluble Sulfates per CA 417 ppm	Soluble Chloride per CA 422 ppm	Min. Resistivity per CA 643 ohm-cm
BH-1 @ 0-5'	8.2	100	150	2400

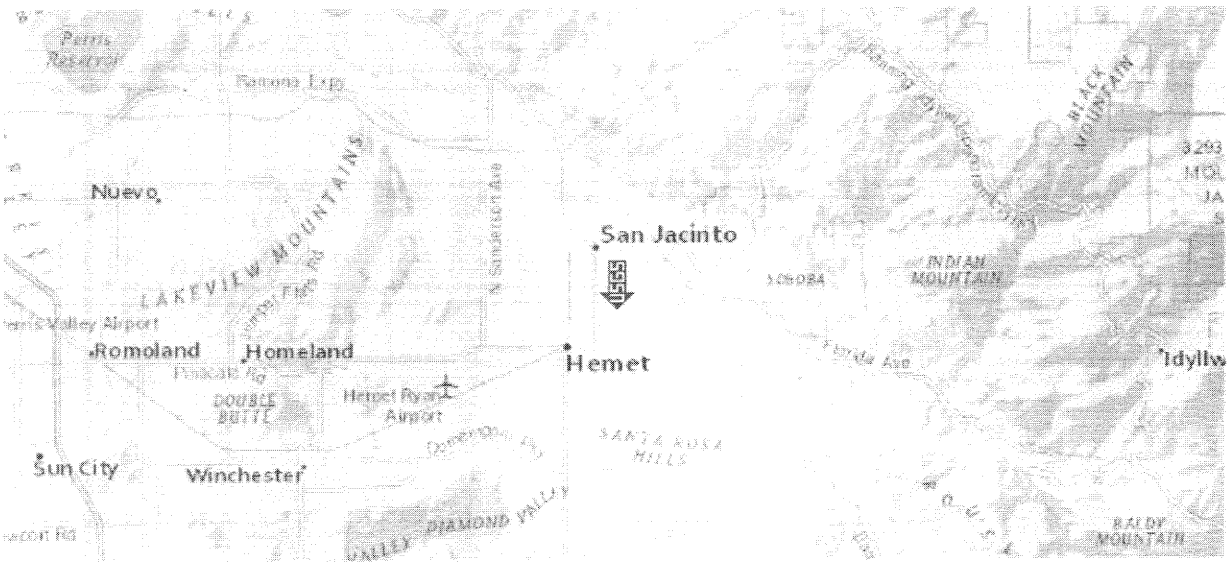
APPENDIX C

2013 SEISMIC DESIGN MAP AND REPORT
VS30 GRADIENT MAP
PSH DEAGGREGATION OUTPUT

USGS Design Maps Summary Report

User-Specified Input

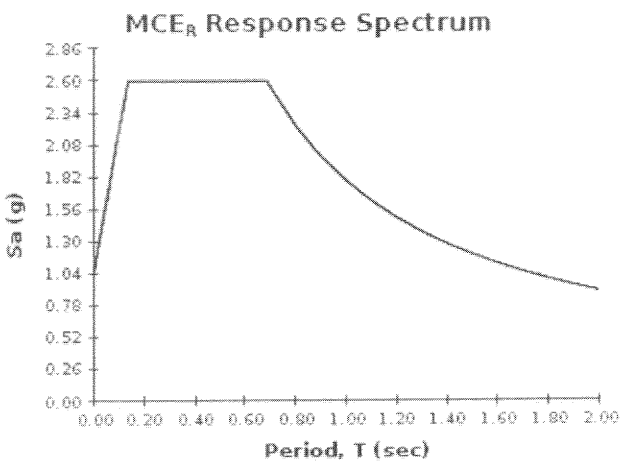
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	33.77062°N, 116.95°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	I/II/III

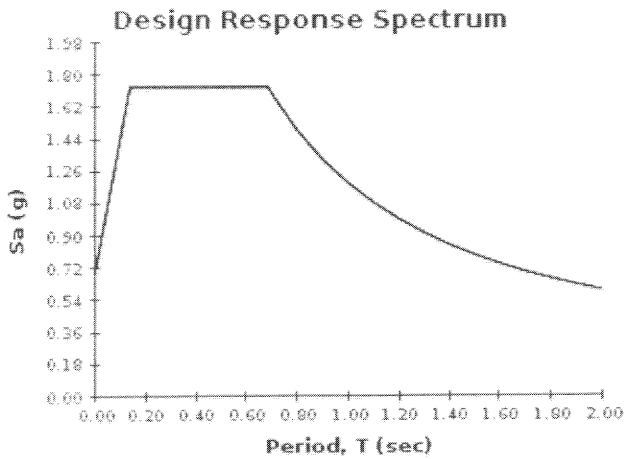


USGS-Provided Output

S_S =	2.597 g	S_{MS} =	2.597 g	S_{DS} =	1.731 g
S_1 =	1.191 g	S_{M1} =	1.786 g	S_{D1} =	1.191 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.





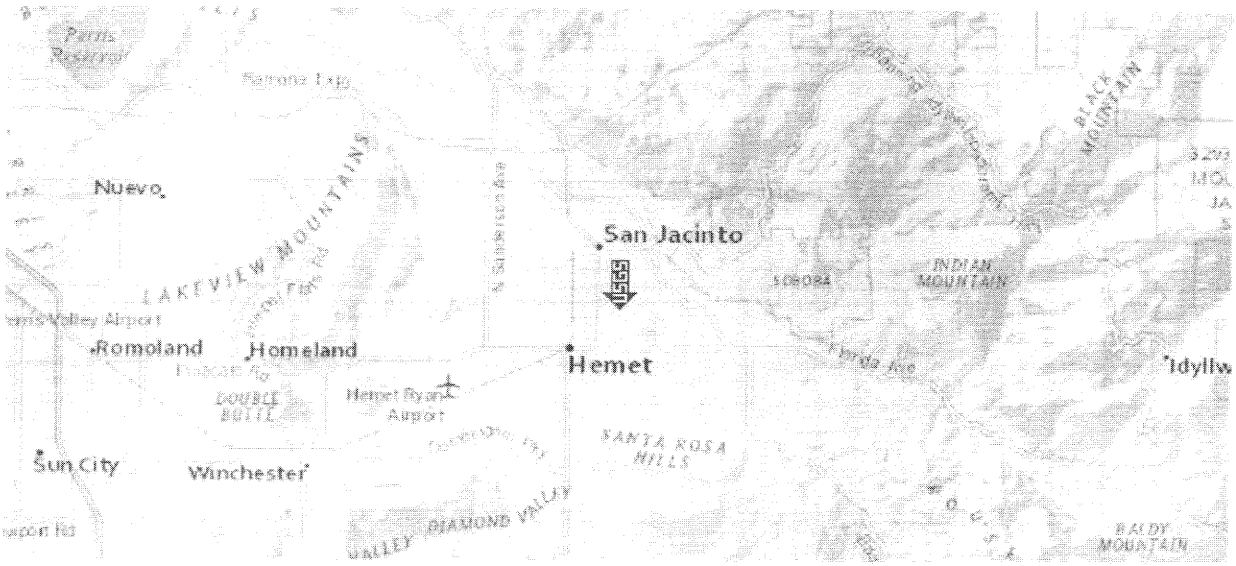
For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

Although this information is a product of the U.S. Geological Survey, we provide no warranty, expressed or implied, as to the accuracy of the data contained therein. This tool is not a substitute for technical subject-matter knowledge.

USGS Design Maps Summary Report

User–Specified Input

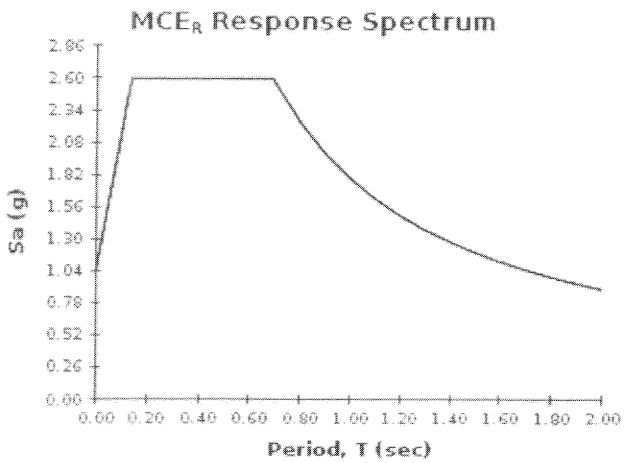
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	33.77062°N, 116.95°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	I/II/III

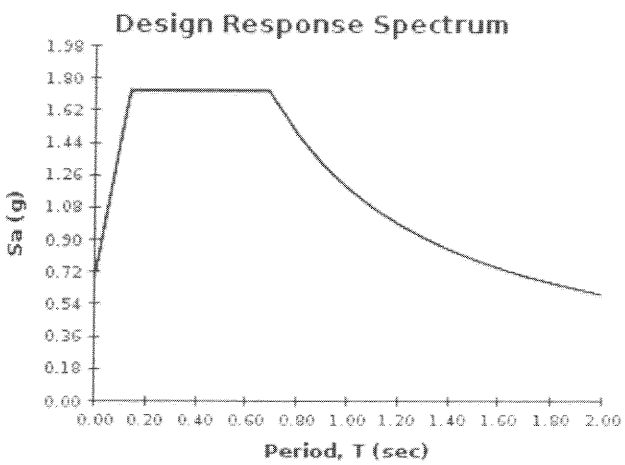


USGS–Provided Output

S_S =	2.597 g	S_{MS} =	2.597 g	S_{DS} =	1.731 g
S_1 =	1.191 g	S_{M1} =	1.786 g	S_{D1} =	1.191 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.





For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

Although this information is a product of the U.S. Geological Survey, we provide no warranty, expressed or implied, as to the accuracy of the data contained therein. This tool is not a substitute for technical subject-matter knowledge.

USGS Design Maps Detailed Report

ASCE 7-10 Standard (33.77062°N, 116.95°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1]	S_S = 2.597 g
From Figure 22-2 [2]	S_1 = 1.191 g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20, • Moisture content w ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4-1: Site Coefficient F_a

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
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 S_S

For Site Class = D and S_S = 2.597 g, F_a = 1.000

Table 11.4-2: Site Coefficient F_v

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at 1-s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 1.191 g, F_v = 1.500

Equation (11.4–1): $S_{MS} = F_a S_S = 1.000 \times 2.597 = 2.597$ g

Equation (11.4–2): $S_{M1} = F_v S_1 = 1.500 \times 1.191 = 1.786$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

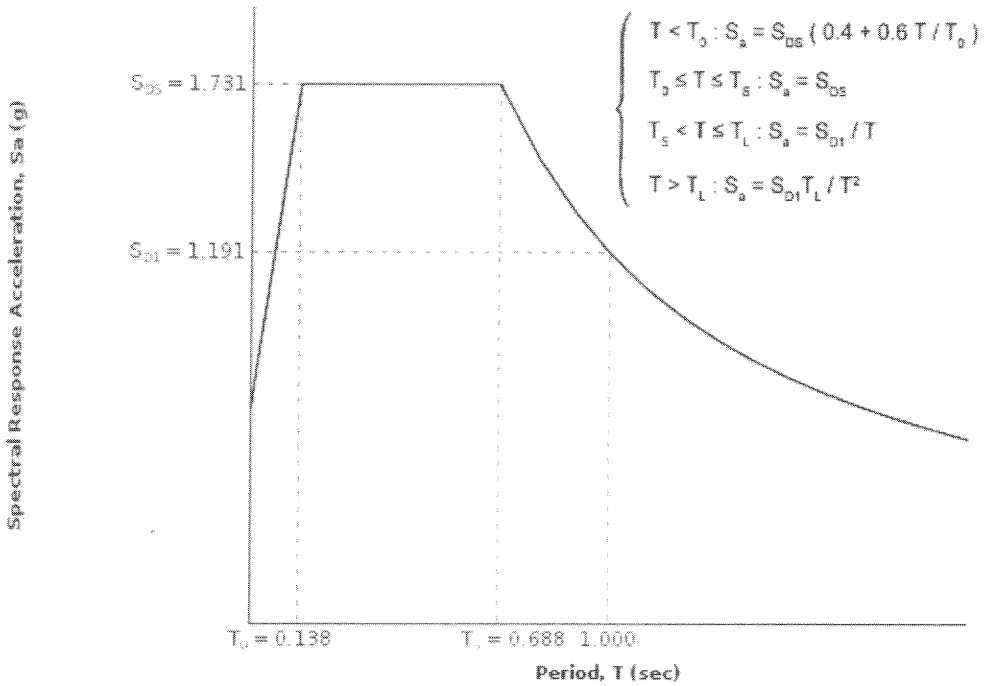
Equation (11.4–3): $S_{DS} = \frac{2}{3} S_{MS} = \frac{2}{3} \times 2.597 = 1.731$ g

Equation (11.4–4): $S_{D1} = \frac{2}{3} S_{M1} = \frac{2}{3} \times 1.786 = 1.191$ g

Section 11.4.5 — Design Response Spectrum

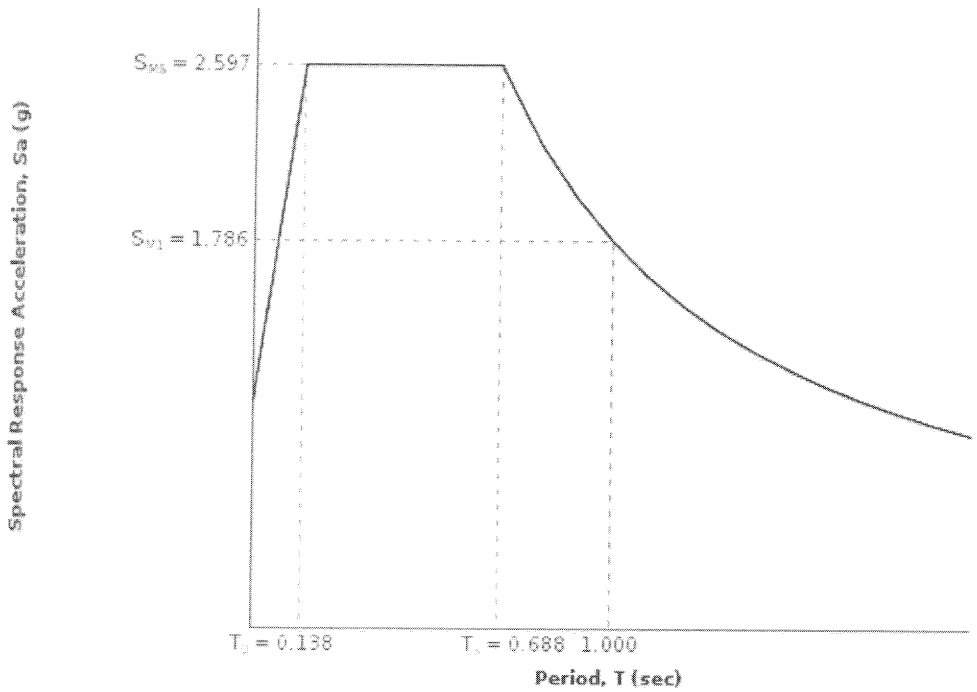
From Figure 22-12 [3] $T_L = 8$ seconds

Figure 11.4–1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



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

From Figure 22-7 [4] PGA = 0.998

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.000 \times 0.998 = 0.998$ 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 = 0.998 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} = 0.944

From Figure 22-18 [6] C_{R1} = 0.916

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 1.731 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 1.191 g, Seismic Design Category = D

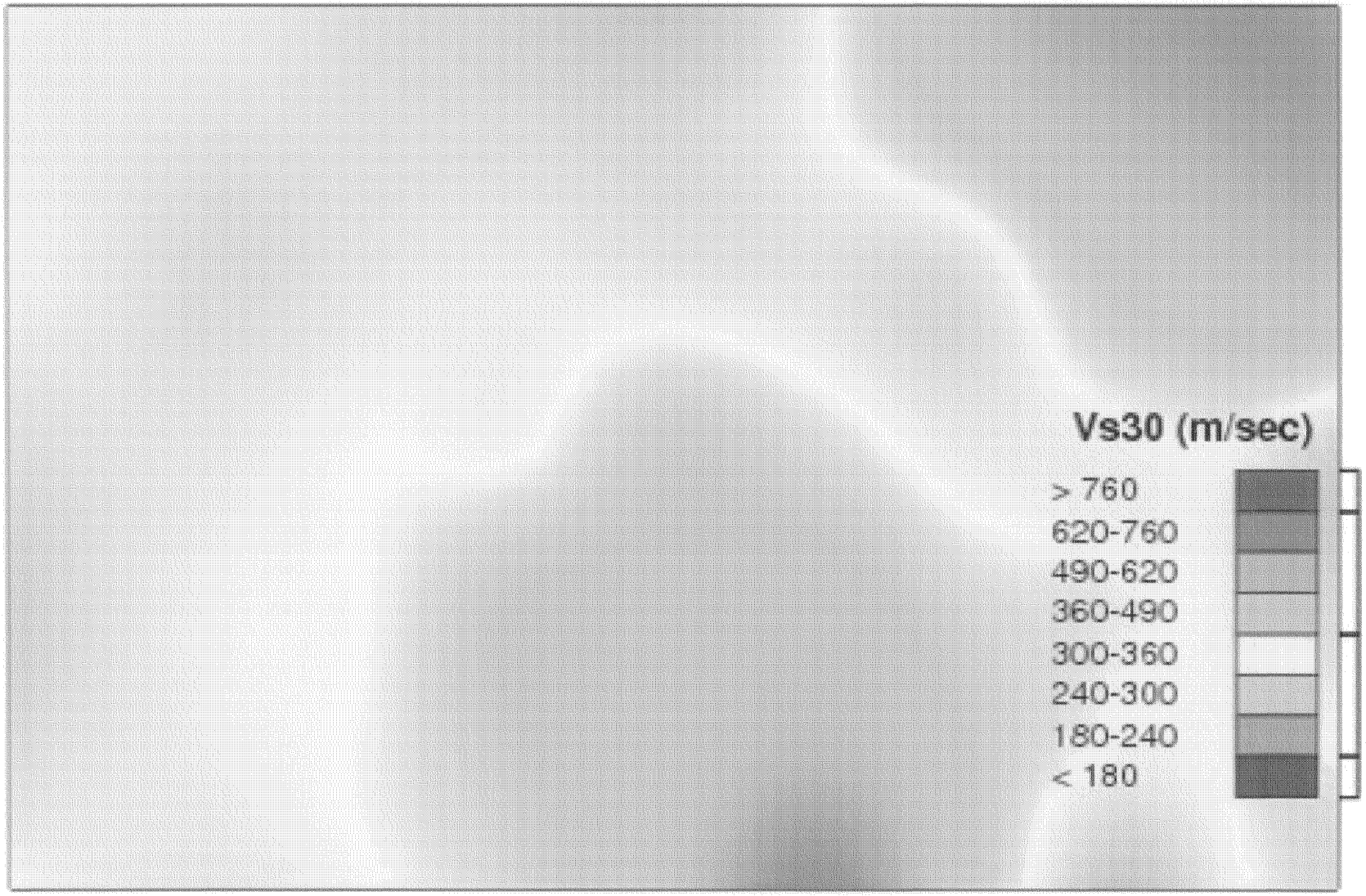
Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = E

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf



2016 Nov 7 17:10:37

-116.979164	33.787498	282
-116.970833	33.787498	275
-116.962502	33.787498	263
-116.954170	33.787498	256
-116.945831	33.787498	248
-116.937500	33.787498	292
-116.929169	33.787498	410
-116.920830	33.787498	506
-116.912498	33.787498	570
-116.979164	33.779167	279
-116.970833	33.779167	255
-116.962502	33.779167	274
-116.954170	33.779167	282
-116.945831	33.779167	272
-116.937500	33.779167	269
-116.929169	33.779167	264
-116.920830	33.779167	384
-116.912498	33.779167	439
-116.979164	33.770832	268
-116.970833	33.770832	279
-116.962502	33.770832	298
-116.954170	33.770832	296
-116.945831	33.770832	354
-116.937500	33.770832	324
-116.929169	33.770832	281
-116.920830	33.770832	288
-116.912498	33.770832	284
-116.979164	33.762501	261
-116.970833	33.762501	293
-116.962502	33.762501	302
-116.954170	33.762501	372
-116.945831	33.762501	371
-116.937500	33.762501	405
-116.929169	33.762501	335
-116.920830	33.762501	307
-116.912498	33.762501	282
-116.979164	33.754166	274
-116.970833	33.754166	282
-116.962502	33.754166	306
-116.954170	33.754166	351
-116.945831	33.754166	416
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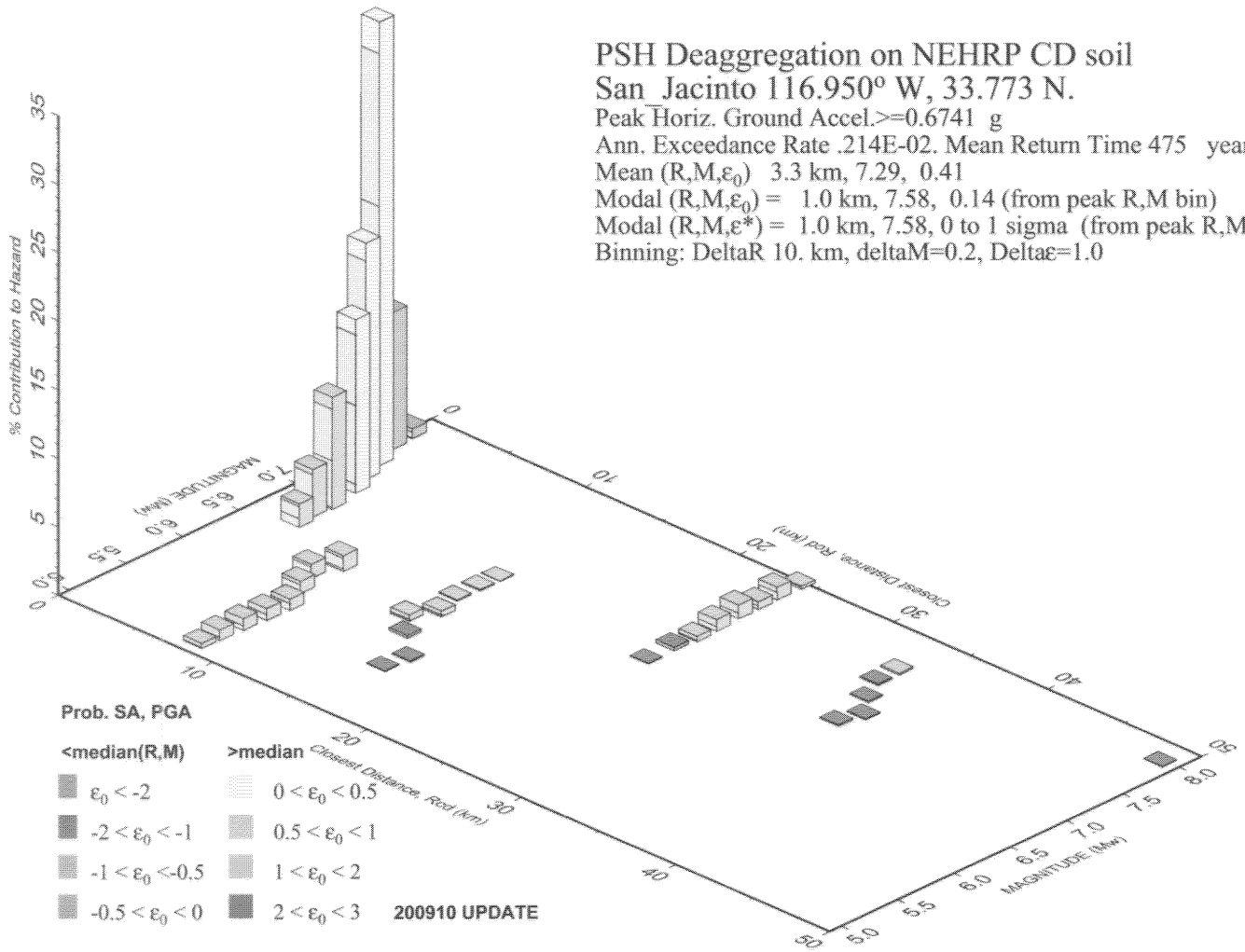
-116.929169	33.754166	370
-116.920830	33.754166	268
-116.912498	33.754166	311



GMT 2016 Nov 7 17:14:03 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 360. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

San_Jacinto_2016.11.07_17.13.56
*** Deaggregation of Seismic Hazard at One Period of Spectral Accel. ***
*** Data from U.S.G.S. National Seismic Hazards Mapping Project, 2008 version ***
PSHA Deaggregation. %contributions. site: San_Jacinto long: 116.950 W., lat: 33.773 N.
Vs30(m/s)= 360.0 (some WUS atten. models use Site Class not Vs30).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 475 yrs. Exceedance PGA =0.6741 g. Weight * Computed_Rate_Ex 0.214E-02
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.02814
#This deaggregation corresponds to Mean Hazard w/all GMPEs

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
8.0	5.05	0.365	0.285	0.080	0.000	0.000	0.000	0.000
8.1	5.20	0.801	0.588	0.213	0.000	0.000	0.000	0.000
8.2	5.40	0.871	0.538	0.333	0.000	0.000	0.000	0.000
8.2	5.60	0.873	0.415	0.458	0.000	0.000	0.000	0.000
15.9	5.60	0.071	0.071	0.000	0.000	0.000	0.000	0.000
8.3	5.80	0.811	0.324	0.476	0.011	0.000	0.000	0.000
16.0	5.80	0.095	0.095	0.000	0.000	0.000	0.000	0.000
7.4	6.01	0.907	0.266	0.591	0.050	0.000	0.000	0.000
14.2	6.02	0.219	0.198	0.021	0.000	0.000	0.000	0.000
6.7	6.20	1.024	0.198	0.739	0.087	0.000	0.000	0.000
13.1	6.20	0.461	0.346	0.115	0.000	0.000	0.000	0.000
7.3	6.41	1.141	0.203	0.775	0.164	0.000	0.000	0.000
13.8	6.38	0.405	0.272	0.134	0.000	0.000	0.000	0.000
2.7	6.64	1.715	0.209	0.867	0.627	0.012	0.000	0.000
13.2	6.60	0.085	0.057	0.028	0.000	0.000	0.000	0.000
2.4	6.80	3.491	0.399	1.753	1.311	0.028	0.000	0.000
13.3	6.80	0.105	0.059	0.045	0.000	0.000	0.000	0.000
24.2	6.80	0.055	0.055	0.000	0.000	0.000	0.000	0.000
2.5	6.96	8.181	0.863	3.783	3.422	0.113	0.000	0.000
13.3	6.97	0.068	0.034	0.035	0.000	0.000	0.000	0.000
24.1	7.04	0.262	0.215	0.047	0.000	0.000	0.000	0.000
35.1	7.00	0.105	0.105	0.000	0.000	0.000	0.000	0.000
2.2	7.21	12.648	1.134	5.093	5.742	0.679	0.000	0.000
24.2	7.23	0.404	0.307	0.097	0.000	0.000	0.000	0.000
35.5	7.18	0.093	0.093	0.000	0.000	0.000	0.000	0.000
1.5	7.40	17.238	1.366	6.309	8.397	1.167	0.000	0.000
24.1	7.42	0.836	0.522	0.313	0.000	0.000	0.000	0.000
34.3	7.36	0.084	0.079	0.005	0.000	0.000	0.000	0.000
1.0	7.58	32.407	2.328	11.137	16.473	2.469	0.000	0.000
24.0	7.63	1.049	0.626	0.422	0.000	0.000	0.000	0.000
33.5	7.57	0.097	0.081	0.016	0.000	0.000	0.000	0.000
0.3	7.80	9.956	0.661	3.105	5.155	1.035	0.000	0.000
24.0	7.81	0.563	0.299	0.264	0.000	0.000	0.000	0.000
33.4	7.76	0.130	0.100	0.030	0.000	0.000	0.000	0.000
0.2	7.99	0.740	0.047	0.229	0.390	0.073	0.000	0.000
23.9	7.98	0.953	0.403	0.550	0.000	0.000	0.000	0.000
48.8	7.99	0.057	0.051	0.005	0.000	0.000	0.000	0.000
24.0	8.19	0.205	0.067	0.134	0.004	0.000	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%): 100.0
Mean src-site R= 3.3 km; M= 7.29; eps0= 0.41. Mean calculated for all sources.
Modal src-site R= 1.0 km; M= 7.58; eps0= 0.14 from peak (R,M) bin
MODE R*= 1.0km; M*= 7.58; EPS.INTERVAL: 0 to 1 sigma % CONTRIB.= 16.473

Principal sources (faults, subduction, random seismicity having > 3% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
California A-faults	90.52	2.7	7.43	0.30
CA Compr. crustal gridded	9.06	8.8	5.94	1.36

Individual fault hazard details if its contribution to mean hazard > 2%:

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)

San_Jacinto_2016.11.07_17.13.56

San Jacinto;SJV aPriori	10.95	2.7	6.95	0.56	58.9
San Jacinto;SBV+SJV aPriori	6.83	2.7	7.31	0.39	58.9
San Jacinto;A+C aPriori	19.58	1.7	7.48	0.23	-147.5
San Jacinto;SBV+SJV+A+C aPriori	7.97	0.2	7.76	0.02	-130.9
San Jacinto;SJV MoBal	2.58	2.7	6.95	0.57	58.9
San Jacinto;SBV+SJV MoBal	2.28	2.7	7.31	0.39	58.9
San Jacinto;SJV+A MoBal	3.09	0.2	7.46	0.04	-130.9
San Jacinto;A+C MoBal	7.27	1.7	7.48	0.23	-147.5
San Jacinto;SBV+SJV+A MoBal	3.12	0.2	7.62	0.03	-130.9
San Jacinto;SJV+A+C MoBal	3.12	0.2	7.63	0.02	-130.9
San Jacinto;SBV+SJV+A+C MoBal	3.15	0.2	7.76	0.02	-130.9
San Jacinto (SB to C) Unsegmente	10.07	0.6	7.29	0.13	-131.5

#**********End of deaggregation corresponding to Mean Hazard w/all GMPEs **********#

PSHA Deaggregation. %contributions. site: San_Jacinto long: 116.950 W., lat: 33.773 N.
Vs30(m/s)= 360.0 (some WUS atten. models use Site Class not Vs30).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 475 yrs. Exceedance PGA =0.6741 g. Weight * Computed_Rate_Ex 0.854E-03
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.03023
#This deaggregation corresponds to Boore-Atkinson 2008

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
7.8	5.21	0.037	0.037	0.000	0.000	0.000	0.000	0.000
7.8	5.40	0.058	0.058	0.000	0.000	0.000	0.000	0.000
8.0	5.60	0.079	0.079	0.000	0.000	0.000	0.000	0.000
8.1	5.80	0.097	0.094	0.004	0.000	0.000	0.000	0.000
7.2	6.01	0.149	0.130	0.020	0.000	0.000	0.000	0.000
14.2	6.03	0.026	0.026	0.000	0.000	0.000	0.000	0.000
6.6	6.20	0.198	0.149	0.049	0.000	0.000	0.000	0.000
13.3	6.20	0.073	0.073	0.000	0.000	0.000	0.000	0.000
7.1	6.41	0.226	0.155	0.071	0.000	0.000	0.000	0.000
14.3	6.39	0.079	0.079	0.000	0.000	0.000	0.000	0.000
2.4	6.65	0.622	0.093	0.325	0.202	0.002	0.000	0.000
13.7	6.60	0.028	0.026	0.001	0.000	0.000	0.000	0.000
24.5	6.61	0.028	0.028	0.000	0.000	0.000	0.000	0.000
2.3	6.80	1.289	0.143	0.661	0.478	0.008	0.000	0.000
13.7	6.80	0.038	0.033	0.005	0.000	0.000	0.000	0.000
24.4	6.80	0.045	0.045	0.000	0.000	0.000	0.000	0.000
34.0	6.80	0.043	0.043	0.000	0.000	0.000	0.000	0.000
2.5	6.96	3.350	0.321	1.742	1.267	0.020	0.000	0.000
13.7	6.98	0.028	0.020	0.008	0.000	0.000	0.000	0.000
24.2	7.04	0.212	0.167	0.044	0.000	0.000	0.000	0.000
35.1	7.00	0.104	0.104	0.000	0.000	0.000	0.000	0.000
2.2	7.21	4.952	0.404	2.175	2.259	0.114	0.000	0.000
13.8	7.20	0.024	0.009	0.014	0.001	0.000	0.000	0.000
24.2	7.23	0.318	0.249	0.069	0.000	0.000	0.000	0.000
35.6	7.18	0.085	0.085	0.000	0.000	0.000	0.000	0.000
1.5	7.40	7.265	0.490	2.785	3.616	0.373	0.000	0.000
24.1	7.42	0.546	0.303	0.244	0.000	0.000	0.000	0.000
34.4	7.36	0.077	0.072	0.005	0.000	0.000	0.000	0.000
1.0	7.58	12.685	0.782	4.509	6.535	0.859	0.000	0.000
24.0	7.63	0.686	0.411	0.275	0.000	0.000	0.000	0.000
33.5	7.57	0.080	0.064	0.016	0.000	0.000	0.000	0.000
0.4	7.79	4.726	0.257	1.536	2.551	0.382	0.000	0.000
24.0	7.80	0.354	0.160	0.194	0.000	0.000	0.000	0.000
33.4	7.76	0.101	0.072	0.028	0.000	0.000	0.000	0.000
48.7	7.79	0.023	0.023	0.000	0.000	0.000	0.000	0.000
0.2	7.99	0.310	0.017	0.099	0.168	0.026	0.000	0.000
23.9	7.97	0.563	0.213	0.350	0.000	0.000	0.000	0.000
48.8	7.99	0.047	0.041	0.005	0.000	0.000	0.000	0.000
24.0	8.18	0.124	0.035	0.084	0.004	0.000	0.000	0.000

San_Jacinto_2016.11.07_17.13.56
Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%): 39.9
Mean src-site R= 3.9 km; M= 7.39; eps0= 0.45. Mean calculated for all sources.
Modal src-site R= 1.0 km; M= 7.58; eps0= 0.17 from peak (R,M) bin
MODE R*= 1.0km; M*= 7.58; EPS.INTERVAL: 0 to 1 sigma % CONTRIB.= 6.535

Principal sources (faults, subduction, random seismicity having > 3% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
California A-faults	38.33	3.5	7.43	0.39

Individual fault hazard details if its contribution to mean hazard > 2%:

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)
San Jacinto;SJV aPriori	4.34	2.7	6.95	0.62	58.9
San Jacinto;SBV+SJV aPriori	2.68	2.7	7.31	0.46	58.9
San Jacinto;A+C aPriori	7.96	1.7	7.48	0.28	-147.5
San Jacinto;SBV+SJV+A+C aPriori	3.35	0.2	7.76	0.05	-130.9
San Jacinto;SJV MoBal	1.02	2.7	6.95	0.62	58.9
San Jacinto;SBV+SJV MoBal	0.90	2.7	7.31	0.46	58.9
San Jacinto;SJV+A MoBal	1.30	0.2	7.46	0.07	-130.9
San Jacinto;A+C MoBal	2.96	1.7	7.48	0.28	-147.5
San Jacinto;SBV+SJV+A MoBal	1.31	0.2	7.62	0.06	-130.9
San Jacinto;SJV+A+C MoBal	1.31	0.2	7.63	0.06	-130.9
San Jacinto;SBV+SJV+A+C MoBal	1.32	0.2	7.76	0.05	-130.9
San Jacinto (SB to C) Unsegmente	4.27	0.7	7.29	0.17	-131.5

#**********End of deaggregation corresponding to Boore-Atkinson 2008 **********#

PSHA Deaggregation. %contributions. site: San_Jacinto long: 116.950 W., lat: 33.773 N.
Vs30(m/s)= 360.0 (some WUS atten. models use Site Class not Vs30).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 475 yrs. Exceedance PGA =0.6741 g. Weight * Computed_Rate_Ex 0.195E-03
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.00000
#This deaggregation corresponds to Campbell-Bozorgnia 2008

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
7.8	5.05	0.049	0.049	0.000	0.000	0.000	0.000	0.000
7.9	5.21	0.138	0.138	0.000	0.000	0.000	0.000	0.000
8.1	5.40	0.201	0.183	0.017	0.000	0.000	0.000	0.000
8.2	5.60	0.221	0.178	0.042	0.000	0.000	0.000	0.000
15.6	5.60	0.007	0.007	0.000	0.000	0.000	0.000	0.000
8.2	5.80	0.196	0.152	0.044	0.000	0.000	0.000	0.000
15.7	5.81	0.011	0.011	0.000	0.000	0.000	0.000	0.000
7.4	6.01	0.203	0.159	0.044	0.000	0.000	0.000	0.000
13.9	6.03	0.035	0.035	0.000	0.000	0.000	0.000	0.000
6.7	6.20	0.238	0.162	0.076	0.000	0.000	0.000	0.000
12.8	6.20	0.084	0.084	0.000	0.000	0.000	0.000	0.000
7.2	6.41	0.284	0.163	0.121	0.000	0.000	0.000	0.000
13.5	6.38	0.076	0.076	0.000	0.000	0.000	0.000	0.000
3.8	6.63	0.205	0.089	0.116	0.000	0.000	0.000	0.000
13.1	6.60	0.020	0.019	0.001	0.000	0.000	0.000	0.000
3.0	6.80	0.297	0.128	0.169	0.000	0.000	0.000	0.000
13.1	6.80	0.021	0.019	0.001	0.000	0.000	0.000	0.000
2.6	6.96	0.685	0.279	0.378	0.027	0.000	0.000	0.000
13.1	6.95	0.010	0.009	0.001	0.000	0.000	0.000	0.000
2.1	7.22	1.165	0.325	0.658	0.182	0.000	0.000	0.000
24.5	7.20	0.006	0.006	0.000	0.000	0.000	0.000	0.000
1.5	7.40	1.414	0.404	0.778	0.231	0.000	0.000	0.000
24.5	7.41	0.009	0.009	0.000	0.000	0.000	0.000	0.000
1.1	7.57	2.572	0.669	1.424	0.479	0.000	0.000	0.000
24.2	7.61	0.009	0.009	0.000	0.000	0.000	0.000	0.000
0.4	7.79	0.898	0.224	0.496	0.179	0.000	0.000	0.000
0.2	7.99	0.057	0.014	0.032	0.012	0.000	0.000	0.000
23.9	7.98	0.006	0.006	0.000	0.000	0.000	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%): 9.1
Mean src-site R= 3.0 km; M= 7.10; eps0= 1.26. Mean calculated for all sources.
Modal src-site R= 1.1 km; M= 7.57; eps0= 1.12 from peak (R,M) bin
MODE R*= 1.1km; M*= 7.57; EPS.INTERVAL: 0 to 1 sigma % CONTRIB.= 1.424

Principal sources (faults, subduction, random seismicity having > 3% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
California A-faults	7.12	1.5	7.42	1.19

Individual fault hazard details if its contribution to mean hazard > 2%:

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)
San Jacinto;SJV aPriori	0.91	2.7	6.96	1.42	58.9
San Jacinto;SBV+SJV aPriori	0.61	2.7	7.31	1.21	58.9
San Jacinto;A+C aPriori	1.69	1.7	7.48	1.14	-147.5
San Jacinto;SBV+SJV+A+C aPriori	0.62	0.2	7.75	1.09	-130.9
San Jacinto;SJV MoBal	0.21	2.7	6.96	1.43	58.9
San Jacinto;SBV+SJV MoBal	0.20	2.7	7.31	1.21	58.9
San Jacinto;SJV+A MoBal	0.25	0.2	7.45	1.09	-130.9
San Jacinto;A+C MoBal	0.63	1.7	7.48	1.14	-147.5
San Jacinto;SBV+SJV+A MoBal	0.25	0.2	7.62	1.09	-130.9
San Jacinto;SJV+A+C MoBal	0.25	0.2	7.63	1.09	-130.9
San Jacinto;SBV+SJV+A+C MoBal	0.25	0.2	7.75	1.09	-130.9
San Jacinto (SB to C) Unsegmente	0.76	0.4	7.31	1.16	-131.5

#**********End of deaggregation corresponding to Campbell-Bozorgnia 2008 **********#

PSHA Deaggregation. %contributions. site: San_Jacinto long: 116.950 W., lat: 33.773 N.
Vs30(m/s)= 360.0 (some WUS atten. models use Site Class not Vs30).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 475 yrs. Exceedance PGA =0.6741 g. Weight * Computed_Rate_Ex 0.109E-02
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.05476
#This deaggregation corresponds to Chiou-Youngs 2008

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
8.1	5.05	0.305	0.268	0.037	0.000	0.000	0.000	0.000
8.1	5.20	0.626	0.520	0.106	0.000	0.000	0.000	0.000
8.2	5.40	0.613	0.485	0.127	0.000	0.000	0.000	0.000
15.7	5.41	0.045	0.045	0.000	0.000	0.000	0.000	0.000
8.3	5.60	0.573	0.395	0.178	0.000	0.000	0.000	0.000
15.9	5.60	0.063	0.063	0.000	0.000	0.000	0.000	0.000
8.3	5.80	0.518	0.299	0.219	0.000	0.000	0.000	0.000
16.1	5.80	0.079	0.079	0.000	0.000	0.000	0.000	0.000
7.5	6.01	0.555	0.250	0.305	0.000	0.000	0.000	0.000
14.3	6.02	0.157	0.154	0.003	0.000	0.000	0.000	0.000
6.8	6.20	0.588	0.197	0.391	0.000	0.000	0.000	0.000
13.1	6.20	0.305	0.274	0.031	0.000	0.000	0.000	0.000
7.4	6.41	0.631	0.200	0.431	0.000	0.000	0.000	0.000
13.8	6.38	0.251	0.219	0.032	0.000	0.000	0.000	0.000
2.7	6.64	0.888	0.102	0.418	0.356	0.010	0.000	0.000
13.0	6.60	0.037	0.033	0.004	0.000	0.000	0.000	0.000
2.4	6.80	1.743	0.154	0.801	0.768	0.021	0.000	0.000
13.0	6.80	0.046	0.036	0.010	0.000	0.000	0.000	0.000
2.5	6.96	4.308	0.314	1.801	2.100	0.093	0.000	0.000
13.0	6.97	0.030	0.020	0.010	0.000	0.000	0.000	0.000
23.9	7.05	0.045	0.045	0.000	0.000	0.000	0.000	0.000
2.2	7.21	6.246	0.393	2.192	3.133	0.528	0.000	0.000
24.1	7.23	0.105	0.097	0.008	0.000	0.000	0.000	0.000
1.5	7.39	9.004	0.488	2.845	4.800	0.871	0.000	0.000
24.1	7.41	0.212	0.145	0.067	0.000	0.000	0.000	0.000
1.0	7.58	16.047	0.816	4.832	8.829	1.569	0.000	0.000
24.0	7.62	0.398	0.260	0.138	0.000	0.000	0.000	0.000

San_Jacinto_2016.11.07_17.13.56

0.3	7.79	5.275	0.236	1.411	2.974	0.653	0.000	0.000
23.9	7.81	0.207	0.137	0.070	0.000	0.000	0.000	0.000
33.4	7.77	0.029	0.028	0.001	0.000	0.000	0.000	0.000
0.2	7.99	0.373	0.017	0.099	0.210	0.047	0.000	0.000
23.9	7.98	0.366	0.171	0.194	0.000	0.000	0.000	0.000
24.0	8.18	0.098	0.043	0.055	0.000	0.000	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%): 50.9
Mean src-site R= 3.0 km; M= 7.25; eps0= 0.23. Mean calculated for all sources.
Modal src-site R= 1.0 km; M= 7.58; eps0= -0.05 from peak (R,M) bin
MODE R*= 1.0km; M*= 7.58; EPS.INTERVAL: 0 to 1 sigma % CONTRIB.= 8.829

Principal sources (faults, subduction, random seismicity having > 3% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
California A-faults	45.07	2.2	7.42	0.09
CA Compr. crustal gridded	5.79	8.9	5.87	1.25

Individual fault hazard details if its contribution to mean hazard > 2%:

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)
San Jacinto;SJV aPriori	5.71	2.7	6.95	0.38	58.9
San Jacinto;SBV+SJV aPriori	3.54	2.7	7.31	0.19	58.9
San Jacinto;A+C aPriori	9.93	1.7	7.48	0.03	-147.5
San Jacinto;SBV+SJV+A+C aPriori	4.00	0.2	7.76	-0.19	-130.9
San Jacinto;SJV MoBal	1.35	2.7	6.95	0.38	58.9
San Jacinto;SBV+SJV MoBal	1.18	2.7	7.31	0.19	58.9
San Jacinto;SJV+A MoBal	1.54	0.2	7.46	-0.16	-130.9
San Jacinto;A+C MoBal	3.69	1.7	7.48	0.03	-147.5
San Jacinto;SBV+SJV+A MoBal	1.56	0.2	7.62	-0.17	-130.9
San Jacinto;SJV+A+C MoBal	1.56	0.2	7.63	-0.17	-130.9
San Jacinto;SBV+SJV+A+C MoBal	1.58	0.2	7.76	-0.19	-130.9
San Jacinto (SB to C) Unsegmente	5.04	0.6	7.29	-0.06	-131.5

#**********End of deaggregation corresponding to Chiou-Youngs 2008 **********#

********** Southern California **********

GEOTECHNICAL INVESTIGATION
RANCHO SAN JACINTO DEVELOPMENT
NEC ESPLANADE AVENUE & HEWITT STREET
SAN JACINTO, CALIFORNIA

-Prepared By-

Sladden Engineering

800 East Florida Avenue
Hemet, California 92543
(951) 766-8777

Sladden Engineering

45090 Golf Center Parkway, Suite F, Indio, CA 92201 (760) 863-0713 Fax (760) 863-0847
6782 Stanton Avenue, Suite C, Buena Park, CA 90621 (714) 523-0952 Fax (714) 523-1369
450 Egan Avenue, Beaumont, CA 92223 (951) 845-7743 Fax (951) 845-8863
800 E. Florida Avenue, Hemet, CA 92543 (951) 766-8777 Fax (951) 766-8778

November 10, 2016

Project No. 644-16051
16-11-138

WMR Residential Investments, Inc.
27127 Calle Arroyo, Suite 1910
San Juan Capistrano, California 92675

Subject: Geotechnical Investigation

Project: Proposed Rancho San Jacinto Development
NEC Esplanade Avenue and Hewitt Street
San Jacinto, California

Sladden Engineering is pleased to present the results of our geotechnical investigation for the proposed residential development to be constructed on the subject site located on the northeast corner of Esplanade Avenue and Hewitt Street in the City of San Jacinto, California. Our services were completed in accordance with our proposal for geotechnical engineering services dated September 28, 2016 and your authorization to proceed with the work. The purpose of our investigation was to explore the subsurface conditions at the site in order to provide recommendations for foundation design and site preparation. Evaluation of environmental issues and hazardous wastes was not included within the scope of services provided.

The opinions, recommendations and design criteria presented in this report are based on our field exploration program, laboratory testing and engineering analyses. Based on the results of our investigation, it is our professional opinion that the proposed project should be feasible from a geotechnical perspective provided that the recommendations presented in this report are implemented into project design and carried out during construction.

We appreciate the opportunity to provide service to you on this project. If you have any questions regarding this report, please contact the undersigned.

Respectfully submitted,
SLADDEN ENGINEERING

Matthew J. Cohrt
Principal Geologist

PROFESSIONAL GEOLOGIST
Matthew J. Cohrt
No. 2634
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Brett L. Anderson
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
BRETT L. ANDERSON
No. C45389
Exp. 9/30/18
CIVIL ENGINEERING
STATE OF CALIFORNIA

James W. Minor III
Staff Geologist

SER/jm

Copies: 4Addressee

GEOTECHNICAL INVESTIGATION
PROPOSED RANCHO SAN JACINTO DEVELOPMENT
NEC ESPLANADE AVENUE & HEWITT STREET
SAN JACINTO, CALIFORNIA

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PSH Deaggregation Output

INTRODUCTION

This report presents the results of the geotechnical investigation performed by Sladden Engineering (Sladden) for the proposed residential development to be constructed on the subject site located on the northeast corner of Esplanade Avenue and Hewitt Street in the City of San Jacinto, California. The site is situated at approximately 33.7733 degrees North latitude and 116.9498 degrees West longitude. The approximate location of the site is indicated on the Site Location Map (Figure 1).

Our investigation was conducted in order to evaluate the engineering properties of the subsurface materials, to evaluate their *in-situ* characteristics, and to provide engineering recommendations and design criteria for site preparation, foundation design and the design of various site improvements. This study also includes a review of published and unpublished geotechnical and geological literature regarding seismicity at and near the subject site.

PROJECT DESCRIPTION

Based on our preliminary discussions, it is our understanding that the proposed project will consist of constructing a residential development on the site. Sladden anticipates that the new project will also include new concrete flatwork, landscape areas, an onsite infiltration basin and various other site improvements. For our analyses we expect that the proposed new structures will consist of a relatively lightweight wood-frame structures supported on conventional spread footings and concrete slabs-on-grade.

Sladden anticipates that grading will consist of minor cuts and fills in order to accomplish the desired pad elevation and to provide adequate gradients for site drainage. This does not include the removal and re-compaction of the primary foundation bearing soil within the building envelopes. Upon completion of the precise grading plans, Sladden should be retained to ensure that the recommendations presented within in this report are incorporated into the design of the proposed project.

Structural foundation loads were not available at the time of this report. Based on our experience with relatively lightweight structures, we expect that isolated column loads will be less than 20 kips and continuous wall loads will be less than 2.0 kips per linear foot. If these assumed loads vary significantly from the actual loads, we should be consulted to verify the applicability of the recommendations provided.

SCOPE OF SERVICES

The purpose of our investigation was to determine specific engineering characteristics of the surface and near surface soil in order to develop foundation design criteria and recommendations for site preparation. Exploration of the site was achieved by drilling four (4) exploratory boreholes to depths of between approximately 21 and 51 feet below the existing ground surface (bgs). Specifically, our site characterization consisted of the following tasks:

- Site reconnaissance to assess the existing surface conditions on and adjacent to the site.
- Advancing four (4) exploratory boreholes to depths between approximately 21 and 51 feet bgs in order to characterize the subsurface soil conditions. Representative samples of the soil were classified in the field and retained for laboratory testing and engineering analyses.
- The performance of laboratory testing on selected samples to evaluate their engineering characteristics.
- The review of available geologic literature and discuss potential geologic hazards.
- The performance of engineering analyses to develop recommendations for foundation design and site preparation.
- The preparation of this report summarizing our work at the site.

SITE CONDITIONS

The site consists of an area of approximately 14.58 acres and identified as APN 437-310-029. The site is located on the northeast corner of Esplanade Avenue and Hewitt Street in the City of San Jacinto, California. The site is vacant and bounded by developed properties to the north, a baseball field to the east, Esplanade Avenue to the south and Hewitt Street to the west.

In general the site is relatively level with no discernable trends in surface gradients. According to the USGS 7.5′ Hemet Quadrangle map (USGS, 2016), the site is situated at an elevation of approximately 1,585 feet above mean sea level (MSL).

No natural ponding water or surface seepage was observed at or near the site during our field investigation conducted on October 13, 2016. Site drainage appears to be controlled via sheet flow and surface infiltration.

GEOLOGIC SETTING

The project site is located in the Peninsular Ranges Physiographic Province of California. The Peninsular Ranges are mountainous areas that extend from the western edge of the continental borderland to the Salton Trough and from the Transverse Ranges Physiographic Province in the north to the tip of Baja California in the south. The Peninsular Ranges Physiographic Province is characterized by northwest-trending topographic and structural features that locally include the San Jacinto Structural Block. The San Jacinto Structural Block is a northwest-southeast trending elongated structural block bounded on the southwest by the San Jacinto Fault and by the San Andreas Fault Zone to the northeast. The province is characterized by elongated, northwest-southeast trending mountain ranges and valleys and is truncated at its northern margin by the east-west grain of the Transverse Ranges. Mountainous areas of the Peninsular Ranges Physiographic Province generally consist of Igneous, metasedimentary and metavolcanic rocks. However, plutonic rocks of the Southern California Batholith are the dominant basement rock exposed (Jahns, 1954).

The site has been mapped by Dibblee (2003) to be immediately underlain by Quaternary-age alluvium. The geologic setting for the site and site vicinity is illustrated on the Regional Geologic Map, Figure 2.

SUBSURFACE CONDITIONS

The subsurface conditions at the site were investigated by drilling four (4) exploratory boreholes on-site. The approximate locations of the boreholes are illustrated on the Borehole Location Photograph (Figure 3). The boreholes were advanced using a truck-mounted Mobile B-61 drill rig equipped with 8-inch outside diameter (O.D.) hollow stem augers. A representative of Sladden was present to log the materials encountered and retrieve samples for laboratory testing and engineering analysis.

During our field investigation a mantle of fill/disturbed soil was encountered to a maximum depth of three (3) feet below existing grade. Underlying the fill soil and extending to the maximum depth explored, native alluvium was encountered. The site soil consists of interbedded silty sand (SM), sand (SP) and sandy silt (ML) that was encountered to the maximum depths explored. Generally the native earth materials appeared optimum moisture content with densities increasing with depth.

The final logs represent our interpretation of the contents of the field logs, and the results of the laboratory observations and tests of the field samples. The final logs are included in Appendix A of this report. The stratification lines represent the approximate boundaries between soil types although the transitions may be gradual and variable across the site.

Groundwater was not encountered during our field investigation on October 13, 2016. Based on our exploratory bores and our review of groundwater level data (CDWR, 2016) groundwater levels in the site vicinity have been recorded in excess of 100 feet bgs. Accordingly, groundwater should not be a factor during construction of the proposed project.

SEISMICITY AND FAULTING

The southwestern United States is a tectonically active and structurally complex region, dominated by northwest trending dextral faults. Faults in the region are often part of complex fault systems composed of numerous subparallel faults that splay or step from main fault traces. Strong seismic shaking could be produced by any of these faults during the design life of the proposed project.

Sladden considers the most significant geologic hazard to the project to be the potential for moderate to severe seismic shaking that is likely to occur during the design life of the project. The proposed project is located in the highly seismic Southern California region within the influence of several fault systems that are considered to be active or potentially active. An active fault is defined by the State of California as a "sufficiently active and well defined fault" that has exhibited surface displacement within the Holocene epoch (about the last 11,000 years). A potentially active fault is defined by the State as a fault with a history of movement within Pleistocene time (between 11,000 and 1.6 million years ago).

Based on our research, the site is not currently located within any State of California or County of Riverside designated fault zone (CDMG, 1980; RCPR, 2016). Table 1 lists the closest known potentially active faults that was generated in part using the EQFAULT computer program (Blake, 2000), as modified using the fault parameters from The Revised 2002 California Probabilistic Seismic Hazard Maps (Cao et al, 2003). This table does not identify the probability of reactivation or the on-site effects from earthquakes occurring on any other faults in the region.

TABLE 1
CLOSEST KNOWN ACTIVE FAULTS

Fault Name	Distance (Km)	Maximum Event
San Jacinto-San Jacinto Valley	<2.0	6.9
San Jacinto-Anza	4.8	7.2
San Andreas-Southern	26.8	7.2*
San Andreas-San Bernardino	26.8	7.5*
Elsinore-Temecula	35.9	6.8
San Jacinto-San Bernardino	38.0	6.7
Elsinore Glen Ivy	38.0	6.8
Elsinore-Julian	39.6	7.1
San Andreas – Coachella	44.4	7.2

*8.2 for multiple segment rupture

2013 CBC DESIGN PARAMETERS

Sladden has reviewed the 2013 California Building Code (CBC) and summarized the current seismic design parameters for the proposed structure. The seismic design category for a structure may be determined in accordance with Section 1613 of the 2013 CBC or ASCE7. According to the 2013 CBC, Site Class D may be used to estimate design seismic loading for the proposed structure. The 2013 CBC Seismic Design Parameters are summarized below. The project Design Map Reports are included within Appendix C.

Risk Category (Table 1.5-1): I/II/III
Site Class (Table 1613.3.2): D
Ss (Figure 1613.3.1): 2.576g
S1 (Figure 1613.3.1): 1.181g
Fa (Table 1613.3.3(1)): 1.0
Fv (Table 1613.5.3(2)): 1.5
Sms (Equation 16-37 {Fa X Ss}): 2.576g
Sm1 (Equation 16-38 {Fv X S1}): 1.771g
SDS (Equation 16-39 {2/3 X Sms}): 1.717g
SD1 (Equation 16-40 {2/3 X Sm1}): 1.181g
Seismic Design Category: E

GEOLOGIC HAZARDS

The subject site is located in an active seismic zone and will likely experience strong seismic shaking during the design life of the proposed project. In general, the intensity of ground shaking will depend on several factors including: the distance to the earthquake focus, the earthquake magnitude, the response characteristics of the underlying materials, and the quality and type of construction. Geologic hazards and their relationship to the site are discussed below.

I. Surface Rupture. Surface rupture is expected to occur along preexisting, known active fault traces. However, surface rupture could potentially splay or step from known active faults or rupture along unidentified traces. Based on our review of Jennings (1994), CDMG (1980), Dibblee (2003) and RCPR (2016) known faults are not mapped on or projecting towards the site. In addition, no signs of active surface faulting were observed during our review of non-stereo digitized photographs of the site and site vicinity (Google, 2016; Terra Server 2002). Finally, no signs of active surface fault rupture or secondary seismic effects (lateral spreading, lurching etc.) were identified on-site during our field investigation. Therefore, it is our opinion that risks associated with primary surface ground rupture should be considered "low".

II. Ground Shaking. The site has been subjected to past ground shaking by faults that traverse through the region. Strong seismic shaking from nearby active faults is expected to produce strong seismic shaking during the design life of the proposed project. A probabilistic approach was employed to the estimate the peak ground acceleration (a_{max}) that could be experienced at the site. Based on the USGS Interactive Deaggregation (USGS, 2008) and shear wave velocity (Vs30) of 360 m/s (USGS, 2016a), the site could be subjected to ground motions on the order of 0.67g. The peak ground acceleration at the site is judged to have a 475 year return period and a 10 percent chance of exceedence in 50 years.

III. Liquefaction/ Dry Sand Settlement. Liquefaction is the process in which loose, saturated granular soil loses strength as a result of cyclic loading. The strength loss is a result of a decrease in granular sand volume and a positive increase in pore pressures. Generally, liquefaction can occur if all of the following conditions apply: liquefaction-susceptible soil, groundwater within a depth of 50 feet or less, and strong seismic shaking.

Groundwater data available at CDWR (2016) indicates groundwater depths greater than 100 feet bgs in the vicinity of the site. Based on the depth to groundwater it is Sladden's professional opinion that risks associated with liquefaction should be considered "low".

IV. Tsunamis and Seiches. Because the site is situated at an elevated inland location, and is not immediately adjacent to any impounded bodies of water, risk associated with tsunamis and seiches is considered negligible.

V. Slope Failure, Landsliding, Rock Falls. The site is located on relatively flat ground and not immediately adjacent to any slopes or hillsides. Therefore, it is our professional opinion that risks associated with slope instability should be considered "negligible".

VI. Expansive Soil. Expansion Index testing of select samples was performed in order to evaluate expansive potential of the materials underlying the site. Based the results of our laboratory testing (EI=14), the materials underlying the site are considered to have a "very low" expansive potential. Accordingly, risk of structural damage associated with volumetric changes in the underlying earth materials should be "low".

VII. Settlement. Settlement resulting from the anticipated foundation loads should be minimal provided that the recommendations included in this report are considered in foundation design and construction. The ultimate settlement is estimated to be less than one inch when using the recommended bearing pressures. As a practical matter, differential settlement between footings can be assumed as one-half of the total settlement.

VIII. Subsidence. Land subsidence can occur in valleys where aquifer systems have been subjected to extensive groundwater pumping, such that groundwater pumping exceeds groundwater recharge. Generally, pore water reduction can result in a rearrangement of skeletal grains and could result in elastic (recoverable) or inelastic (unrecoverable) deformation of an aquifer system.

Locally, no fissures or other surficial evidence of subsidence were observed at or near the subject site. However, site specific effects resulting from long term regional subsidence is beyond the scope of our investigation.

IX. Flooding and Erosion. No signs of flooding or erosion were observed during our field investigation conducted on October 13, 2016. Risks associated with flooding and erosion should be evaluated and mitigated by the project design Civil Engineer.

X. Debris Flows. Debris flows are viscous flows consisting of poorly sorted mixtures of sediment and water and are generally initiated on slopes steeper than approximately six horizontal to one vertical (6H:1V)(Boggs, 2001). Based on the flat nature of the site and the composition of the surface soil, we judge that risks associated with debris flows should be considered remote.

CONCLUSIONS

Based on the results of our investigation, it is our professional opinion that the project should be feasible from a geotechnical perspective provided that the recommendations included in this report are incorporated into foundation design and carried out through construction. The main geotechnical concern in the design and construction of the proposed project is the loose condition of the near surface soil.

Because of the presence of artificial fill soil and the loose conditions of the near surface soil, remedial grading including over-excavation and re-compaction is recommended for the proposed building areas. We recommend that remedial grading within the proposed building areas include the removal and re-compaction of loose surface soil. Specific recommendations for site preparation are presented in the Earthwork and Grading section of this report.

Groundwater was not encountered within our bores and groundwater is expected to be in excess of 50 feet below the existing ground surface in the vicinity of the site.

Caving did occur to varying degrees within each of our exploratory bores and the surface soil may be susceptible to caving within deeper excavations. All excavations should be constructed in accordance with the normal CalOSHA excavation criteria. On the basis of our observations of the materials encountered, we anticipate that the subsoil will conform to that described by CalOSHA as Type B or C. Soil conditions should be verified in the field by a "Competent person" employed by the Contractor.

The following preliminary design recommendations present more detailed design criteria that have been developed on the basis of our field and laboratory investigation.

EARTHWORK AND GRADING

All earthwork including excavation, backfill and preparation of the subgrade soil, should be performed in accordance with the geotechnical recommendations presented in this report and portions of the local regulatory requirements, as applicable. All earthwork should be performed under the observation and testing of a qualified soil engineer. The following geotechnical engineering recommendations for the proposed project are based on observations from the field investigation program, laboratory testing and geotechnical engineering analyses.

a. Stripping. Areas to be graded should be cleared of the vegetation, associated root systems and debris. All areas scheduled to receive fill should be cleared of old fills and any irreducible matter. The strippings should be removed off-site, or stockpiled for later use in landscape areas. Existing fill soil should be removed in its entirety and replaced as engineered fill. Voids left by obstructions should be properly backfilled in accordance with the compaction recommendations of this report.

b. Preparation of the Building Areas. In order to achieve firm and uniform bearing conditions, we recommend over-excavation and recompaction throughout the building areas. All artificial fill and low density native soil should be removed to a depth of approximately 3 feet below existing grade or 3 feet below the bottom of the footings, whichever is deeper. Remedial grading should extend laterally, a minimum of 5 feet beyond the building limits. The exposed surface should then be scarified, moisture conditioned to near optimum moisture content and compacted to at least 90 percent relative compaction, the previously removed soil may then be replaced as engineered fill.

c. Compaction. Soil to be used as engineered fill should be free of organic material, debris, and other deleterious substances, and should not contain irreducible matter greater than six (6) inches in maximum dimension. All fill materials should be placed in thin lifts not exceeding six inches in a loose condition. If import fill is required, the material should be of a non-expansive nature and should meet the following criteria:

Plastic Index	Less than 12
Liquid Limit	Less than 35
Percent Soil Passing #200 Sieve	Between 15% and 35%
Maximum Aggregate Size	3 inches

The subgrade and all fill material should be compacted with acceptable compaction equipment, to at least 90 percent relative compaction. The bottom of the exposed subgrade should be observed by a representative of Sladden Engineering prior to fill placement. Compaction testing should be performed on all lifts in order to verify proper placement of the fill materials. Table 2 provides a summary of the excavation and compaction recommendations.

TABLE 2
SUMMARY OF RECOMMENDATIONS

*Remedial Grading	Excavation and/or recompaction within the building envelopes and extending laterally for 5 feet beyond the building limits and to a minimum depth of 3 feet below existing grade or 3 feet below the bottom of the footings, whichever is deeper.
Native / Import Engineered Fill	Place in thin lifts not exceeding 6 inches in a loose condition, compact to a minimum of 90 percent relative compaction.
Asphalt Concrete Sections	Compact the top 12 inches to at least 95 percent compaction within 2 percent of optimum moisture content.

*Actual depth may vary and should be determined by a representative of Sladden Engineering in the field during construction.

d. Shrinkage and Subsidence. Volumetric shrinkage of the material that is excavated and replaced as controlled compacted fill should be anticipated. We estimate that this shrinkage could vary from 20 to 25 percent. Subsidence of the surfaces that are scarified and compacted should be between 1 and 2 tenths of a foot. This will vary depending upon the type of equipment used, the moisture content of the soil at the time of grading and the actual degree of compaction attained.

FOUNDATIONS: CONVENTIONAL SHALLOW SPREAD FOOTINGS

Conventional shallow spread footings may be used for building support. Load bearing walls may be supported on continuous spread footings and interior columns may be supported on isolated pad footings. All footings should be founded upon properly engineered fill and should have a minimum embedment depth of 18 inches measured from the lowest adjacent finished grade. Continuous and isolated footings should have minimum widths of 18 inches and 24 inches, respectively. Continuous and isolated footings placed on compact engineered fill soil may be designed using allowable (net) bearing pressures of 1800 and 2000 pounds per square foot (psf), respectively. Allowable increases of 250 psf for each additional 1 foot in width and 250 psf for each additional 6 inches in depth may be utilized, if desired. The maximum allowable bearing pressure should be 3,000 psf. The allowable bearing pressures apply to combined dead and sustained live loads.

The allowable bearing pressure may be increased by one-third when considering transient live loads, including seismic and wind forces. All footings should be reinforced in accordance with the project structural engineer's recommendations.

Based on the allowable bearing pressures recommended above, total static settlement of the shallow footings is anticipated to be less than one-inch, provided that foundation area preparation conforms to the recommendations described in this report. Differential static settlement is anticipated to be approximately one-half of the total settlement for similarly loaded footings spaced up to approximately 50 feet apart. The previously discussed seismic settlement should also be considered in design.

Lateral load resistance for the spread footings will be developed by passive soil pressure against the sides of the footings below grade and by friction acting at the base of the concrete footings bearing on compacted fill. An allowable passive pressure of 250 psf per foot of depth may be used for design purposes. An allowable coefficient of friction 0.40 may be used for dead and sustained live loads to compute the frictional resistance of the footing placed directly on compacted fill. Under seismic and wind loading conditions, the passive pressure or the frictional resistance may be increased by one-third.

All footing excavations should be observed by a representative of the project geotechnical consultant to verify adequate embedment depths prior to placement of forms, steel reinforcement or concrete. The excavations should be trimmed neat, level and square. All loose, disturbed, sloughed or moisture-softened soils and/or any construction debris should be removed prior to concrete placement. Excavated soil generated from footing and/or utility trenches should not be stockpiled within the building envelope or in areas of exterior concrete flatwork.

SLABS-ON-GRADE

In order to reduce the risk of heave, cracking and settlement, concrete slabs-on-grade should be placed on properly compacted soil as outlined in the previous sections of this report. The slab subgrades should remain near optimum moisture content and should not be permitted to dry prior to concrete placement. All slab subgrades should be firm and unyielding. Disturbed soil should be removed and then replaced and compacted to a minimum of 90 percent relative compaction.

Slab thickness and reinforcement should be determined by the structural engineer. All slab reinforcement should be supported on concrete chairs to ensure that reinforcement is placed at slab mid-height. Final slab-on-grade designs should be in accordance with the structural engineer's recommendations.

Slabs with moisture sensitive surfaces should be underlain with a moisture vapor retarder consisting of a polyvinyl chloride (pvc) membrane such as 10-mil Visqueen, or equivalent. All laps within the membrane should be sealed and at least 2 inches of clean sand should be placed over the membrane to promote uniform curing of the concrete. To reduce the potential for punctures, the membrane should be placed on a pad surface that has been graded smooth without any sharp protrusions. If a smooth surface can not be achieved by grading, consideration should be given to placing a 1-inch thick leveling course of sand across the pad surface prior to placement of the membrane.

PRELIMINARY PAVEMENT DESIGN

Asphalt concrete pavements should be designed in accordance with Topic 608 of the Caltrans Highway Design Manual based on R-Value and Traffic Index. An R-Value of 60 was assumed to develop the following preliminary pavement sections. On-site and any imported soils should be tested for R-Value after grading. Actual R-Value of subgrade soil should be consistent with the pavement design. For Pavement design, a Traffic Index (TI) of 6.0 was used for the light duty pavements. We assumed Asphalt Concrete (AC) over Class II Aggregate Base (AB). The preliminary flexible pavement design is as follows:

RECOMMENDED ASPHALT PAVEMENT SECTION LAYER THICKNESS	
Pavement Material	**Recommended Thickness**
	TI = 6.0
Asphalt Concrete Surface Course	3.0 inches
Class II Aggregate Base Course	4.0 inches
Compacted Subgrade Soil	12.0 inches

Asphalt concrete should conform to Sections 203 and 302 of the latest edition of the Standard Specifications for Public Works Construction ("Greenbook"). Class II aggregate base should conform to Section 26 of the Caltrans Standard Specifications, latest edition. The aggregate base course should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Method D 1557.

CORROSION SERIES

The soluble sulfate concentrations of the surface soil were determined to be 20 parts per million (ppm). The soil is considered to have a "negligible" corrosion potential with respect to concrete. The use of Type V cement and special sulfate resistant concrete mixes should not be necessary. Soluble sulfate content of the surface soil should be reevaluated after grading and appropriate concrete mix designs should be established based upon post-grading test results.

The pH levels of the surface soil was determined to be 8.4. Based on soluble chloride concentration testing (50 ppm), the soil is considered to have a "negligible" corrosion potential with respect to normal grade steel. The minimum resistivity of the surface soil was found to be 2,300 ohm-cm, that indicates the site soil is considered to have a "moderate" corrosion potential with respect to ferrous metal installations. A corrosion expert should be retained to provide appropriate corrosion protection measures for corrosion susceptible installations.

UTILITY TRENCH BACKFILL

All utility trench backfill should be compacted to a minimum of 90 percent relative compaction. Trench backfill materials should be placed in lifts no greater than six inches in a loose condition, moisture conditioned (or air-dried) as necessary to achieve near optimum moisture conditions, and then mechanically compacted in place to a minimum relative compaction of 90 percent. A representative of the project geotechnical consultant should test the backfill to verify adequate compaction.

EXTERIOR CONCRETE FLATWORK

To minimize cracking of concrete flatwork, the subgrade soil below concrete flatwork areas should first be compacted to a minimum relative compaction of 90 percent. A representative of the project geotechnical consultant should observe and verify the density and moisture content of the soil prior to pouring concrete.

DRAINAGE

All final grades should be provided with positive gradients away from foundations to provide rapid removal of surface water runoff to an adequate discharge point. No water should be allowed to be pond on or immediately adjacent to foundation elements. In order to reduce water infiltration into the subgrade soil, surface water should be directed away from building foundations to an adequate discharge point. Subgrade drainage should be evaluated upon completion of the precise grading plans and in the field during grading.

LIMITATIONS

The findings and recommendations presented in this report are based upon an interpolation of the soil conditions between the exploratory bore locations and extrapolation of these conditions throughout the proposed building areas. Should conditions encountered during grading appear different than those indicated in this report, this office should be notified.

The use of this report by other parties or for other projects is not authorized. The recommendations of this report are contingent upon monitoring of the grading operation by a representative of Sladden Engineering. All recommendations are considered to be tentative pending our review of the grading operation and additional testing, if indicated. If others are employed to perform any soil testing, this office should be notified prior to such testing in order to coordinate any required site visits by our representative and to assure indemnification of Sladden Engineering.

We recommend that a pre-job conference be held on the site prior to the initiation of site grading. The purpose of this meeting will be to assure a complete understanding of the recommendations presented in this report as they apply to the actual grading performed.

ADDITIONAL SERVICES

Once completed, final project plans and specifications should be reviewed by us prior to construction to confirm that the full intent of the recommendations presented herein have been applied to design and construction. Following the review of plans and specifications, observation should be performed by the Soil Engineer during construction to document that foundation elements are founded on/or penetrate into the recommended soil, and that suitable backfill soil is placed upon competent materials and properly compacted at the recommended moisture content.

Tests and observations should be performed during grading by the Soil Engineer or his representative in order to verify that the grading is being performed in accordance with the project specifications. Field density testing shall be performed in accordance with acceptable ASTM test methods. The minimum acceptable degree of compaction should be 90 percent for subgrade soil and 95 percent for Class II aggregate base as obtained by the ASTM Test Method D1557. Where testing indicates insufficient density, additional compactive effort shall be applied until retesting indicates satisfactory compaction.

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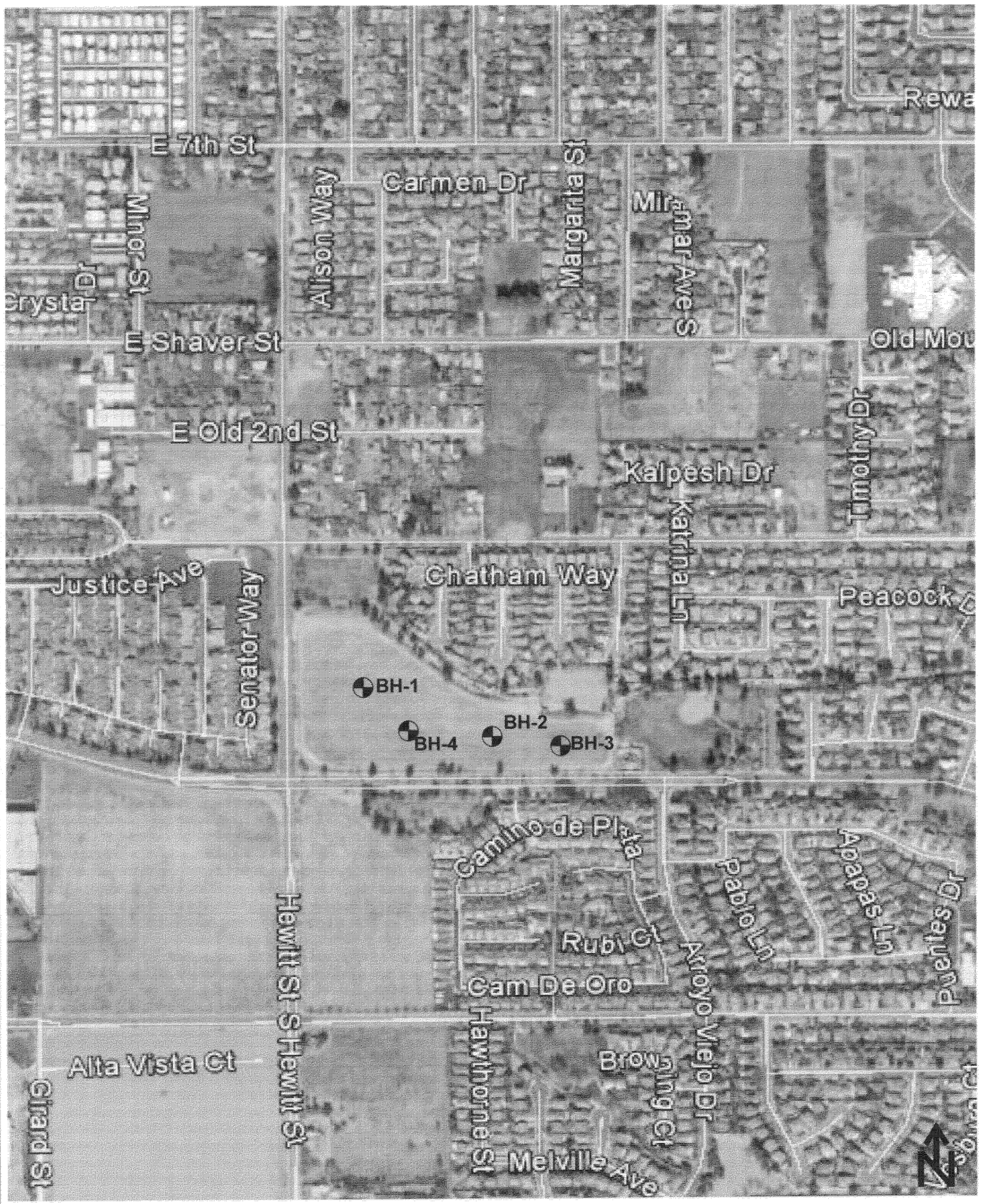
FIGURES

SITE LOCATION MAP
REGIONAL GEOLOGIC MAP
BOREHOLE LOCATION PHOTOGRAPH

Sladden Engineering	SITE LOCATION MAP	FIGURE 1
	Project Number: 644-16051	
	Report Number: 16-11-138	
	Date: November 8, 2016	



Sladden Engineering	BOREHOLE LOCATION PHOTOGRAPH		FIGURE 3
	Project Number:	644-16051	
	Report Number:	16-11-138	
	Date:	November 8, 2016	

APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

For our field investigation four (4) exploratory bores were excavated on October 13, 2016 utilizing a truck mounted rig (Mobile B-61) equipped with 8-inch outside diameter (O.D.) augers. Continuous logs of the materials encountered were made by a representative of Sladden Engineering. Materials encountered in the boreholes were classified in accordance with the Unified Soil Classification System which is presented in this appendix.

Representative undisturbed samples were obtained within our borings by driving a thin-walled steel penetration sampler (California split spoon sampler) or a Standard Penetration Test (SPT) sampler with a 140 pound automatic-trip hammer dropping approximately 30 inches (ASTM D1586). The number of blows required to drive the samplers 18 inches was recorded in 6-inch increments and blowcounts are indicated on the boring logs.

The California samplers are 3.0 inches in diameter, carrying brass sample rings having inner diameters of 2.5 inches. The standard penetration samplers are 2.0 inches in diameter with an inner diameter of 1.5 inches. Undisturbed samples were removed from the sampler and placed in moisture sealed containers in order to preserve the natural soil moisture content. Bulk samples were obtained from the excavation spoils and samples were then transported to our laboratory for further observations and testing.

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			TYPICAL NAMES	
COARSE GRAINED SOILS MORE THAN HALF IS LARGER THAN No.200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN No.4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY-GRADED GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN No.4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN HALF IS SMALLER THAN No.200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS & 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, CLEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS: LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

EXPLANATION OF BORE LOG SYMBOLS

California Split-spoon Sample

Unrecovered Sample

Standard Penetration Test Sample

Groundwater depth

Note: The stratification lines on the borelogs represent the approximate boundaries between the soil types; the transitions may be gradual.

SLADDEN ENGINEERING

BORE LOG

Drill Rig:	Mobil B-61	Date Drilled:	10/13/2016
Elevation:	1585 Feet (MSL)	Boring No:	BH-1

Sample	Blow Counts	Bulk Sample	Expansion Index	% Minus #200	% Moisture	Density, pcf	Depth (Feet)	Graphic Lithology	Description
	14/15/15	1	14	66.9	6.9	101.7	2		Sandy Silt (ML); grayish brown, slightly moist, very stiff, low plasticity (Fill).
	5/8/11			18.0	1.4	99.1	4		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
	5/7/8			49.1	3.9		8		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
	5/9/15			80.3	17.3	101.1	12		Clayey Silt (ML); grayish brown, moist, stiff, low to medium plasticity with sand (Qa).
	8/9/10			35.0	7.5		16		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qal).
	11/11/8			19.6	7.8	110.5	20		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
	3/4/14			52.6	20.0		24		Clayey Silt (ML); grayish brown, moist, very stiff, low to medium plasticity with sand (Qa).
	7/13/17			65.8	19.8	106.3	28		Sandy Silt (ML); grayish brown, moist, very stiff, low plasticity (Qa).
	7/8/8			32.3	12.1		32		Silty Sand (SM); grayish brown, moist, medium dense, fine- to coarse-grained (Qa).
	12/23/34			6.9	3.5	113.7	36		Gravelly Sand (SP); grayish brown, slightly moist, dense, fine- to coarse-grained (Qa).
	5/8/8			44.5	15.8		40		Silty Sand (SM); grayish brown, moist, medium dense, fine- to coarse-grained (Qa).
							44		
							48		
							50		

Completion Notes:
Terminated at ~51.5 Feet bgs.
No Bedrock Encountered.
No Groundwater or Seepage Encountered.

PROPOSED RANCHO SAN JACINTO DEVELOPMENT
NEC ESPLANADE AVENUE & HEWITT STREET, SAN JACINTO

Project No: 644-16051
Report No: 16-11-138

SLADDEN ENGINEERING

BORE LOG

Drill Rig:	Mobil B-61	Date Drilled:	10/13/2016
Elevation:	1585 Feet (MSL)	Boring No:	BH-2

Sample	Blow Counts	Bulk Sample	Expansion Index	% Minus #200	% Moisture	Density, pcf	Depth (Feet)	Graphic Lithology	Description
							2		Silty Sand (SM); grayish brown, dry to slightly moist, fine- to coarse-grained (Fill).
	5/3/4			35.1	2.7		6		Silty Sand (SM); grayish brown, slightly moist, loose, fine- to coarse-grained (Qa).
	13/15/15			72.0	7.1	103.7	12		Sandy Silt (ML); grayish brown, moist, very stiff, low plasticity with trace gravel (Qa).
	14/15/15			21.6	2.5		16		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
	7/11/16			38.1	11.0	99.6	22		Silty Sand (SM); grayish brown, moist, medium dense, fine- to coarse-grained (Qa).
	7/12/12			4.7	2.0		26		Gravelly Sand (SP); light gray, slightly moist, medium dense, fine- to coarse-grained (Qa).
	15/13/23			6.7	2.3	110.6	32		Gravelly Sand (SP); light gray, slightly moist, medium dense, fine- to coarse-grained (Qa).
	11/14/15			18.1	5.9		36		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
	15/24/36			39.4	18.3	114.7	42		Silty Sand (SM); grayish brown, moist, dense, fine- to coarse-grained (Qa).
	15/16/22			4.5	2.1		46		Gravelly Sand (SP); light gray, slightly moist, dense, fine- to coarse-grained (Qa).
	25/50-4"			26.7	8.9	117.7	50		Silty Sand (SM); grayish brown, moist, very dense, fine- to coarse-grained (Qa).

Completion Notes:
Terminated at ~51.5 Feet bgs.
No Bedrock Encountered.
No Groundwater or Seepage Encountered.

PROPOSED RANCHO SAN JACINTO DEVELOPMENT
NEC ESPLANADE AVENUE & HEWITT STREET, SAN JACINTO

Project No: 644-16051
Report No: 16-11-138

SLADDEN ENGINEERING

BORE LOG

Drill Rig:	Mobil B-61	Date Drilled:	10/13/2016
Elevation:	1585 Feet (MSL)	Boring No:	BH-3

Sample	Blow Counts	Bulk Sample	Expansion Index	% Minus #200	% Moisture	Density, pcf	Depth (Feet)	Graphic Lithology	Description
							2		Silty Sand (SM); grayish brown, slightly moist, fine- to coarse-grained (Fill).
	5/9/13			57.8	9.6	93.3	6		Sandy Silt (ML); grayish brown, moist, stiff, low plasticity with trace gravel (Qa).
	7/10/7			71.4	11.2		10		Sandy Silt (ML); grayish brown, moist, very stiff, low plasticity with trace gravel and clay (Qa).
	15/27/50-5"			20.5	3.3	126.3	16		Silty Sand (SM); grayish brown, moist, very dense, fine- to coarse-grained (Qa).
	9/12/12			3.5	1.3		20		Gravelly Sand (SP); light gray, slightly moist, medium dense, fine- to coarse-grained (Qa).
							22		Terminated at ~21.5 Feet bgs. No Bedrock Encountered. No Groundwater or Seepage Encountered.
							24		
							26		
							28		
							30		
							32		
							34		
							36		
							38		
							40		
							42		
							44		
							46		
							48		
							50		

Completion Notes:

PROPOSED RANCHO SAN JACINTO DEVELOPMENT
NEC ESPLANADE AVENUE & HEWITT STREET, SAN JACINTO

Project No: 644-16051
Report No: 16-11-138

SLADDEN ENGINEERING

BORE LOG

Drill Rig:	Mobil B-61	Date Drilled:	10/13/2016
Elevation:	1585 Feet (MSL)	Boring No:	BH-4

Sample	Blow Counts	Bulk Sample	Expansion Index	% Minus #200	% Moisture	Density, pcf	Depth (Feet)	Graphic Lithology	Description
							0		Silty Sand (SM); grayish brown, dry to moist, fine- to coarse-grained (Fill).
	5/7/6			19.3	1.9		5		Silty Sand (SM); grayish brown, slightly moist, medium dense, fine- to coarse-grained (Qa).
	6/11/12			54.4	10.5	102.3	10		Sandy Silt (ML); grayish brown, moist, stiff, low plasticity with trace gravel and clay (Qa).
	3/4/6			71.7	21.8		15		Sandy Silt (ML); grayish brown, moist, stiff, low plasticity with trace gravel and clay (Qa).
	13/26/30			20.0	5.4	119.1	20		Silty Sand (SM); grayish brown, slightly moist, dense, fine- to coarse-grained (Qa).
							22		Terminated at ~21.5 Feet bgs. No Bedrock Encountered. No Groundwater or Seepage Encountered.

Completion Notes:

PROPOSED RANCHO SAN JACINTO DEVELOPMENT
NEC ESPLANADE AVENUE & HEWITT STREET, SAN JACINTO

Project No: 644-16051
Report No: 16-11-138

APPENDIX B

LABORATORY TESTING

APPENDIX B

LABORATORY TESTING

Representative bulk and relatively undisturbed soil samples were obtained in the field and returned to our laboratory for additional observations and testing. Laboratory testing was generally performed in two phases. The first phase consisted of testing in order to determine the compaction of the existing natural soil and the general engineering classifications of the soil underlying the site. This testing was performed in order to estimate the engineering characteristics of the soil and to serve as a basis for selecting samples for the second phase of testing. The second phase consisted of soil mechanics testing. This testing including consolidation, shear strength and expansion testing was performed in order to provide a means of developing specific design recommendations based on the mechanical properties of the soil.

CLASSIFICATION AND COMPACTION TESTING

Unit Weight and Moisture Content Determinations: Each undisturbed sample was weighed and measured in order to determine its unit weight. A small portion of each sample was then subjected to testing in order to determine its moisture content. This was used in order to determine the dry density of the soil in its natural condition. The results of this testing are shown on the Boring Logs.

Maximum Density-Optimum Moisture Determinations: Representative soil types were selected for maximum density determinations. This testing was performed in accordance with the ASTM Standard D1557-91, Test Method A. The results of this testing are presented graphically in this appendix. The maximum densities are compared to the field densities of the soil in order to determine the existing relative compaction to the soil.

Classification Testing: Soil samples were selected for classification testing. This testing consists of mechanical grain size analyses. This provides information for developing classifications for the soil in accordance with the Unified Soil Classification System which is presented in the preceding appendix. This classification system categorizes the soil into groups having similar engineering characteristics. The results of this testing is very useful in detecting variations in the soil and in selecting samples for further testing.

SOIL MECHANIC'S TESTING

Expansion Testing: One (1) bulk sample was selected for Expansion testing. Expansion testing was performed in accordance with the UBC Standard 18-2. This testing consists of remolding 4-inch diameter by 1-inch thick test specimens to a moisture content and dry density corresponding to approximately 50 percent saturation. The samples are subjected to a surcharge of 144 pounds per square foot and allowed to reach equilibrium. At that point the specimens are inundated with distilled water. The linear expansion is then measured until complete.

Direct Shear Tests: One (1) bulk sample was selected for Direct Shear testing. This test measures the shear strength of the soil under various normal pressures and is used to develop parameters for foundation design and lateral design. Tests were performed using a recompacted test specimen that was saturated prior to tests. Tests were performed using a strain controlled test apparatus with normal pressures ranging from 800 to 2300 pounds per square foot.

Consolidation Test: Two (2) relatively undisturbed samples were selected for consolidation testing. For this test, a one-inch thick test specimen was subjected to vertical loads varying from 575 psf to 11520 psf applied progressively. The consolidation at each load increment was recorded prior to placement of each subsequent load. The specimens were saturated at 575 psf or 720 psf load increment.

Corrosion Series Testing: The soluble sulfate concentrations of the surface soil were determined in accordance with California Test Method Number (CA) 417. The pH and Minimum Resistivity were determined in accordance with CA 643. The soluble chloride concentrations were determined in accordance with CA 422.

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Maximum Density/Optimum Moisture

ASTM D698/D1557

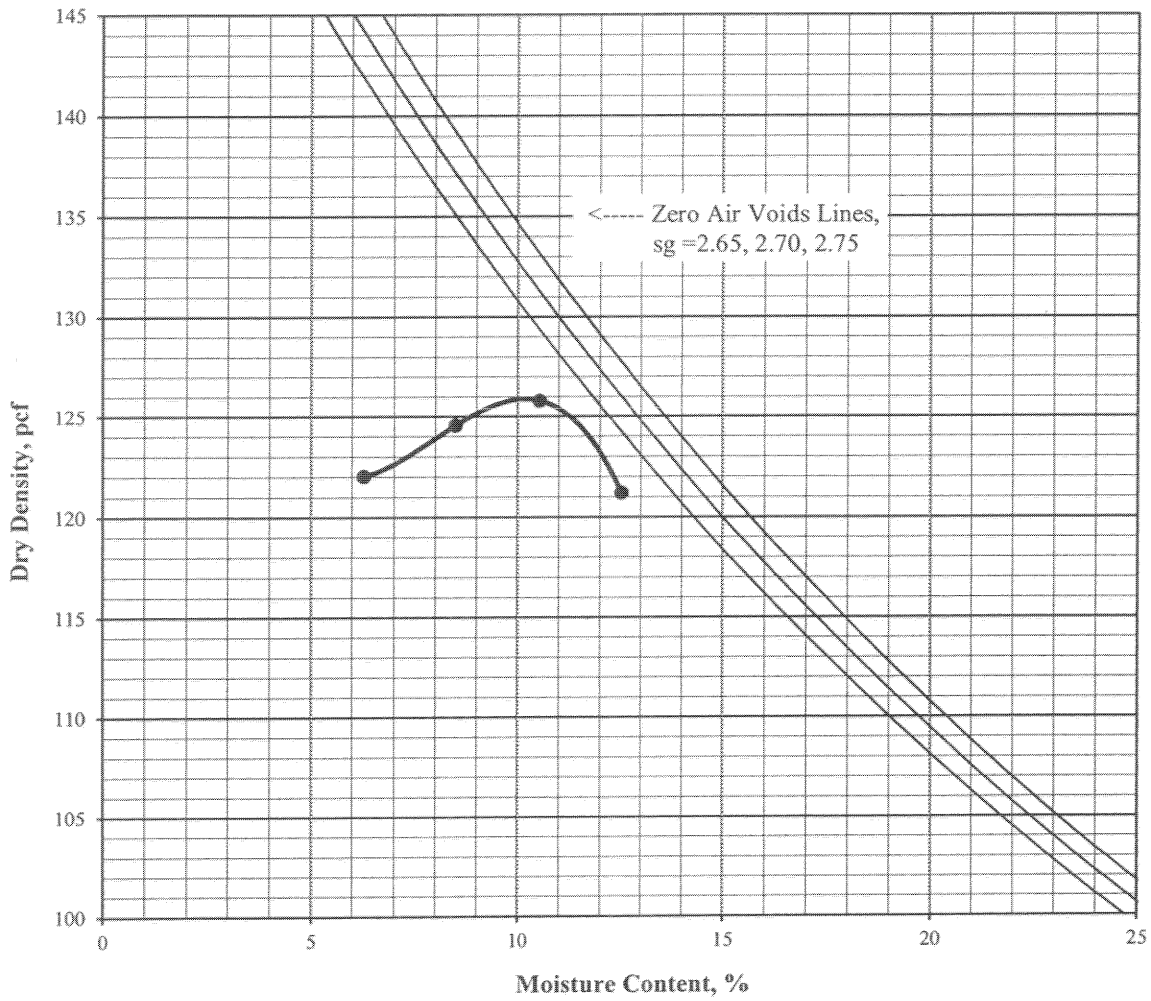
Project Number: 644-16051
Project Name: Rancho San Jacinto Development
Lab ID Number: LN6-16417
Sample Location: BH-1 Bulk 1 @ 0-5'
Description: Dark Brown Silty Sand (SM)

November 3, 2016

ASTM D-1557 A
Rammer Type: Machine

Maximum Density: 126 pcf
Optimum Moisture: 10%

Sieve Size	% Retained
3/4"	
3/8"	
#4	0.7



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Expansion Index

ASTM D 4829

Job Number: 644-16051

November 3, 2016

Job Name: Rancho San Jacinto Development

Lab ID Number: LN6-16417

Sample ID: BH-1 Bulk 1 @ 0-5'

Soil Description: Dark Brown Silty Sand (SM)

Wt of Soil + Ring:	575.1
Weight of Ring:	191.2
Wt of Wet Soil:	383.9
Percent Moisture:	9.0%
Sample Height, in	0.95
Wet Density, pcf:	122.5
Dry Denstiy, pcf:	112.4

% Saturation:	48.6

Expansion **Rack # 1**

Date/Time	11/2/2016	10:15 AM
Initial Reading	0.0000	
Final Reading	0.0140	

Expansion Index **14**

(Final - Initial) x 1000

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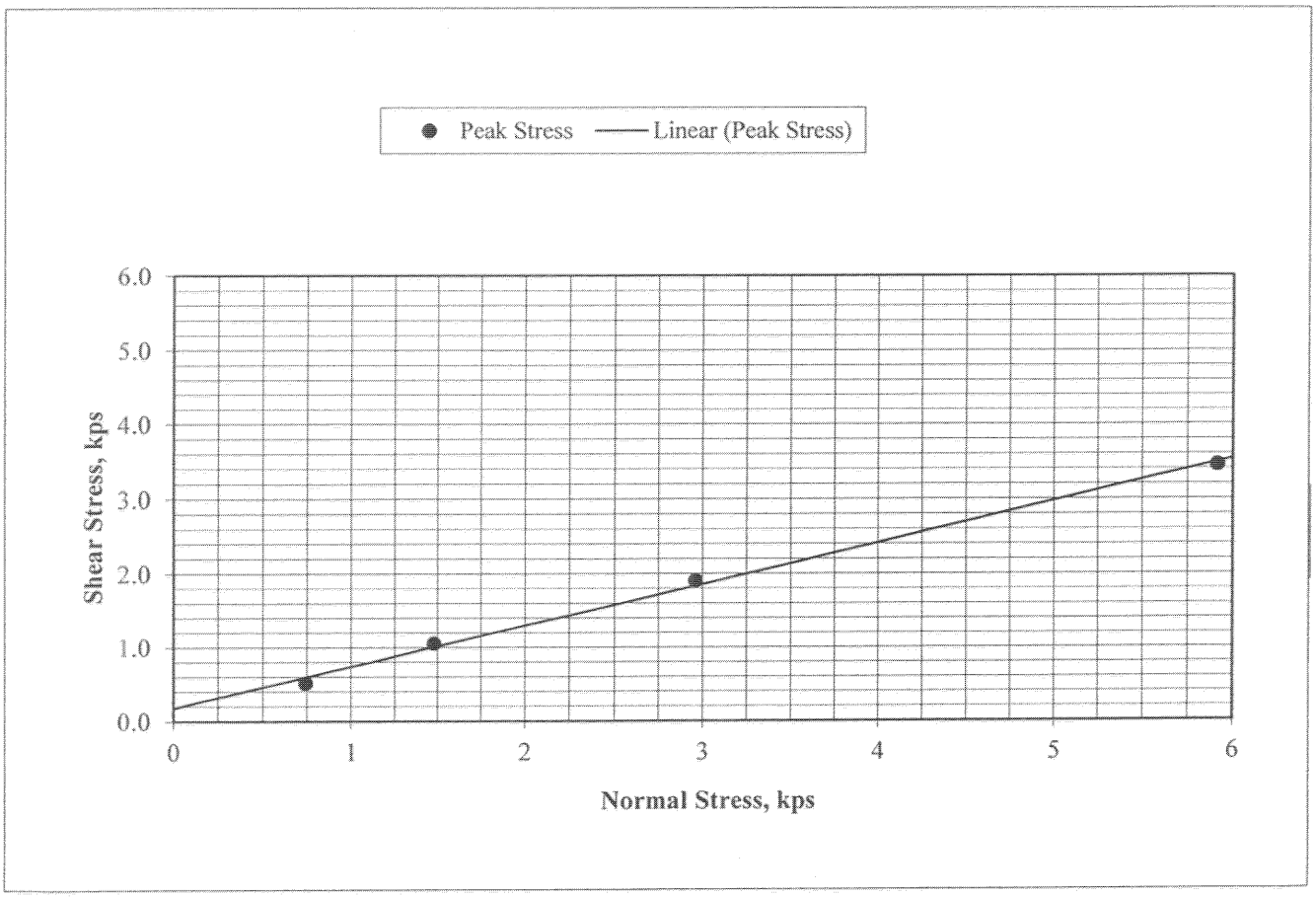
Direct Shear ASTM D 3080-04
(modified for unconsolidated condition)

Job Number:	644-16051		November 3, 2016
Job Name	Rancho San Jacinto Development		Initial Dry Density: 113.2 pcf
Lab ID No.	LN6-16417		Initial Mosture Content: 10.0 %
Sample ID	BH-1 Bulk 1 @ 0-5'		Peak Friction Angle (Ø): 29°
Classification	Dark Brown Silty Sand (SM)		Cohesion (c): 180 psf
Sample Type	Remolded @ 90% of Maximum Density		

Test Results	1	2	3	4	Average
Moisture Content, %	17.9	17.9	17.9	17.9	17.9
Saturation, %	99.1	99.1	99.1	99.1	99.1
Normal Stress, kps	0.739	1.479	2.958	5.916	
Peak Stress, kps	0.512	1.054	1.904	3.450	



Job Number: 644-16051
Job Name: Rancho San Jacinto Development
Date: 11/3/2016

Moisture Adjustment		Remolded Shear Weight	
Wt of Soil:	1,000	Max Dry Density:	126.0
Moist As Is:	2.3	Optimum Moisture:	10.0
Moist Wanted:	10.0		
ml of Water to Add:	75.3	Wt Soil per Ring, g:	150.0

UBC

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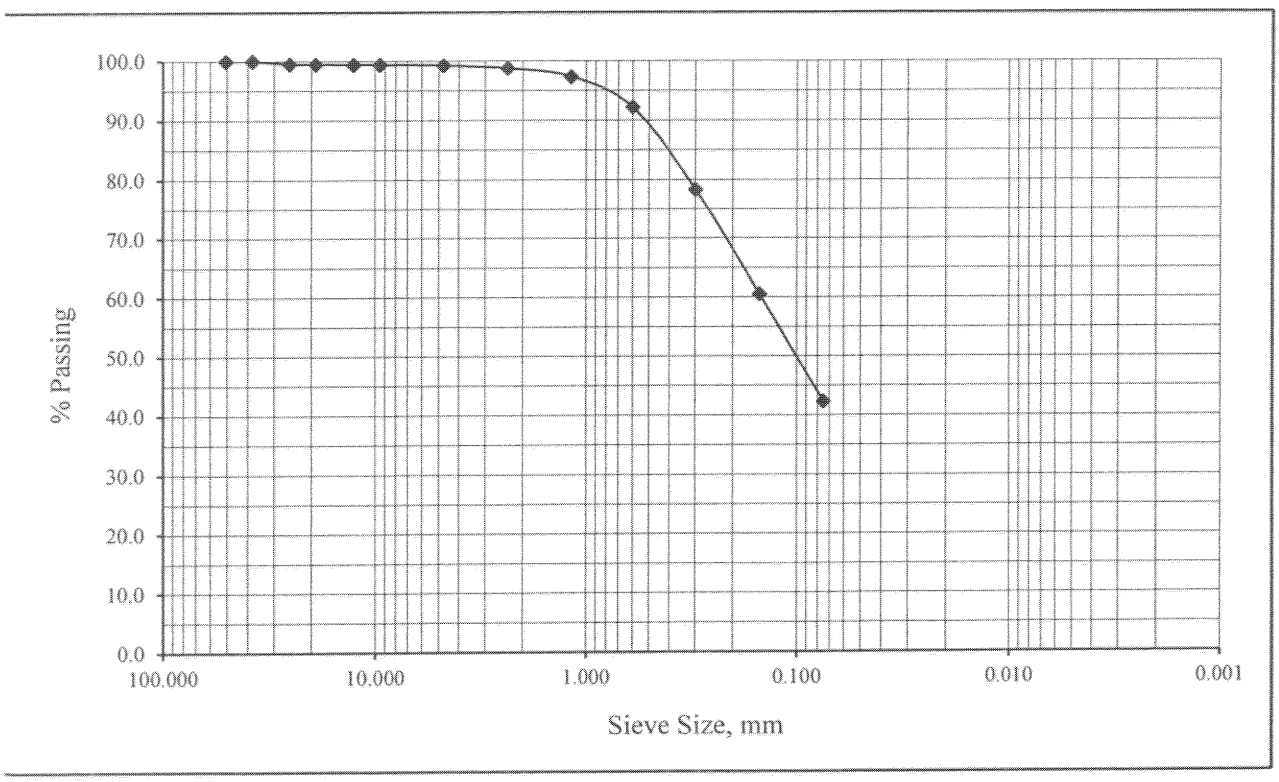
Gradation

ASTM C117 & C136

Project Number: 644-16051 November 3, 2016
Project Name: Rancho San Jacinto Development
Lab ID Number: LN6-16417
Sample ID: BH-1 Bulk 1 @ 0-5' Soil Classification: SM

Sieve Size, in	Sieve Size, mm	Percent Passing
2"	50.8	100.0
1 1/2"	38.1	100.0
1"	25.4	99.5
3/4"	19.1	99.4
1/2"	12.7	99.4
3/8"	9.53	99.4
#4	4.75	99.3
#8	2.36	98.8
#16	1.18	97.4
#30	0.60	92.2
#50	0.30	78.3
#100	0.15	60.6
#200	0.075	42.3



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Gradation

ASTM C117 & C136

Project Number: 644-16051

November 3, 2016

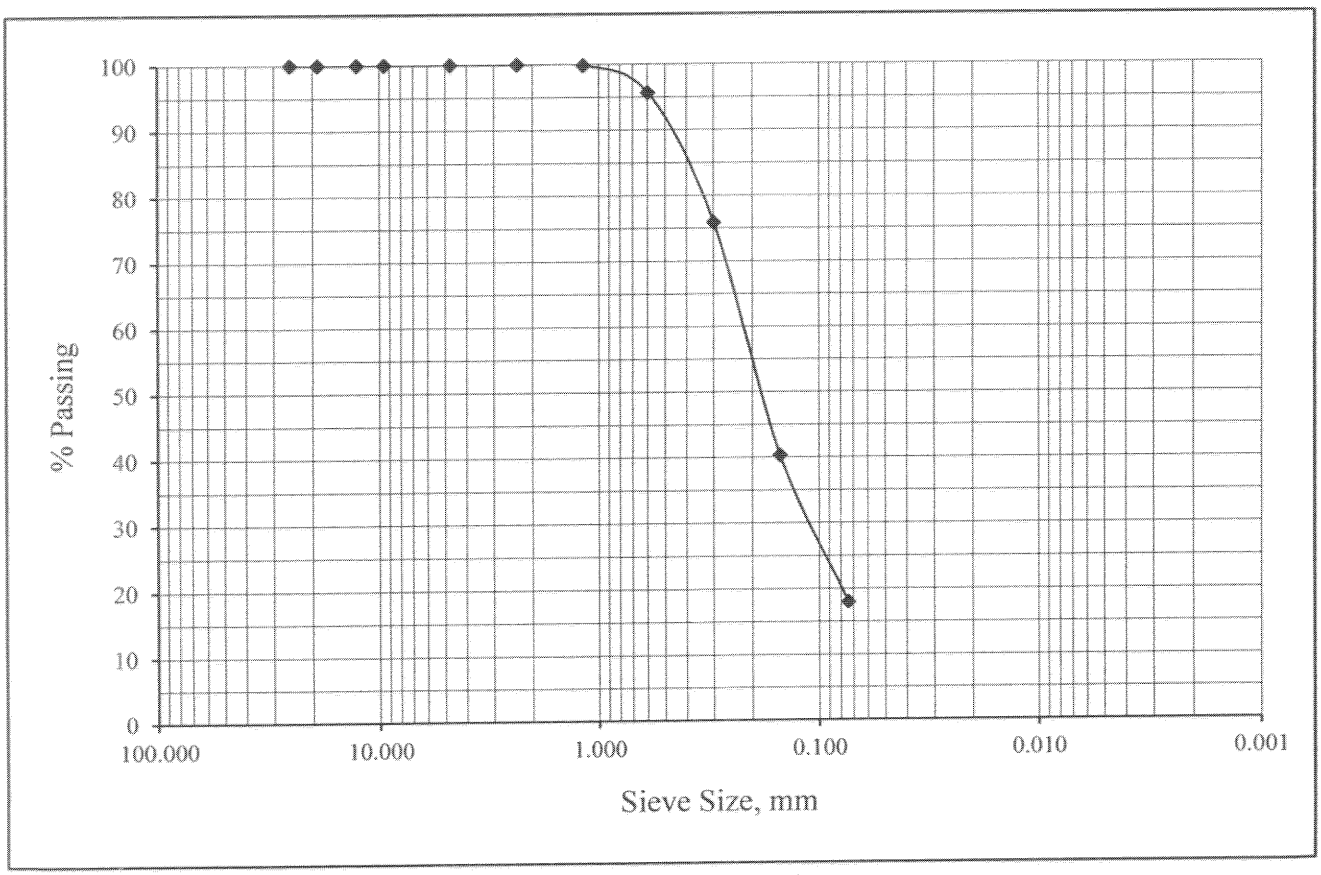
Project Name: Rancho San Jacinto Development

Lab ID Number: LN6-16417

Sample ID: BH-1 R-2 @ 5'

Soil Classification: SM

Sieve Size, in	Sieve Size, mm	Percent Passing
1"	25.4	100.0
3/4"	19.1	100.0
1/2"	12.7	100.0
3/8"	9.53	100.0
#4	4.75	100.0
#8	2.36	100.0
#16	1.18	99.9
#30	0.60	95.7
#50	0.30	75.9
#100	0.15	40.4
#200	0.074	18.0



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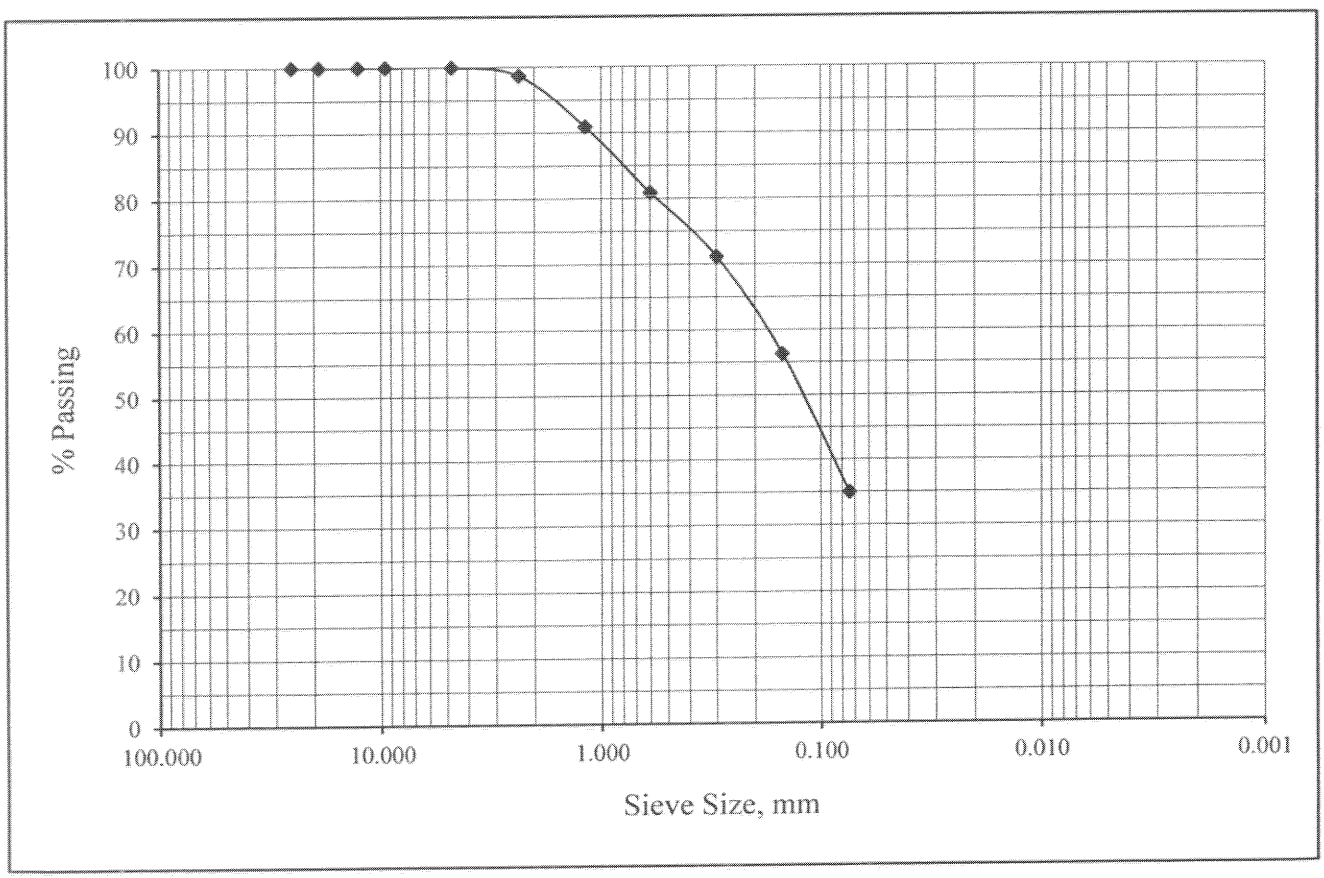
ASTM C117 & C136

November 3, 2016

Project Number: 644-16051
Project Name: Rancho San Jacinto Development
Lab ID Number: LN6-16417
Sample ID: BH-1 S-5 @ 20'

Soil Classification: SM

Sieve Size, in	Sieve Size, mm	Percent Passing
1"	25.4	100.0
3/4"	19.1	100.0
1/2"	12.7	100.0
3/8"	9.53	100.0
#4	4.75	100.0
#8	2.36	98.7
#16	1.18	90.9
#30	0.60	80.9
#50	0.30	71.2
#100	0.15	56.4
#200	0.074	35.0



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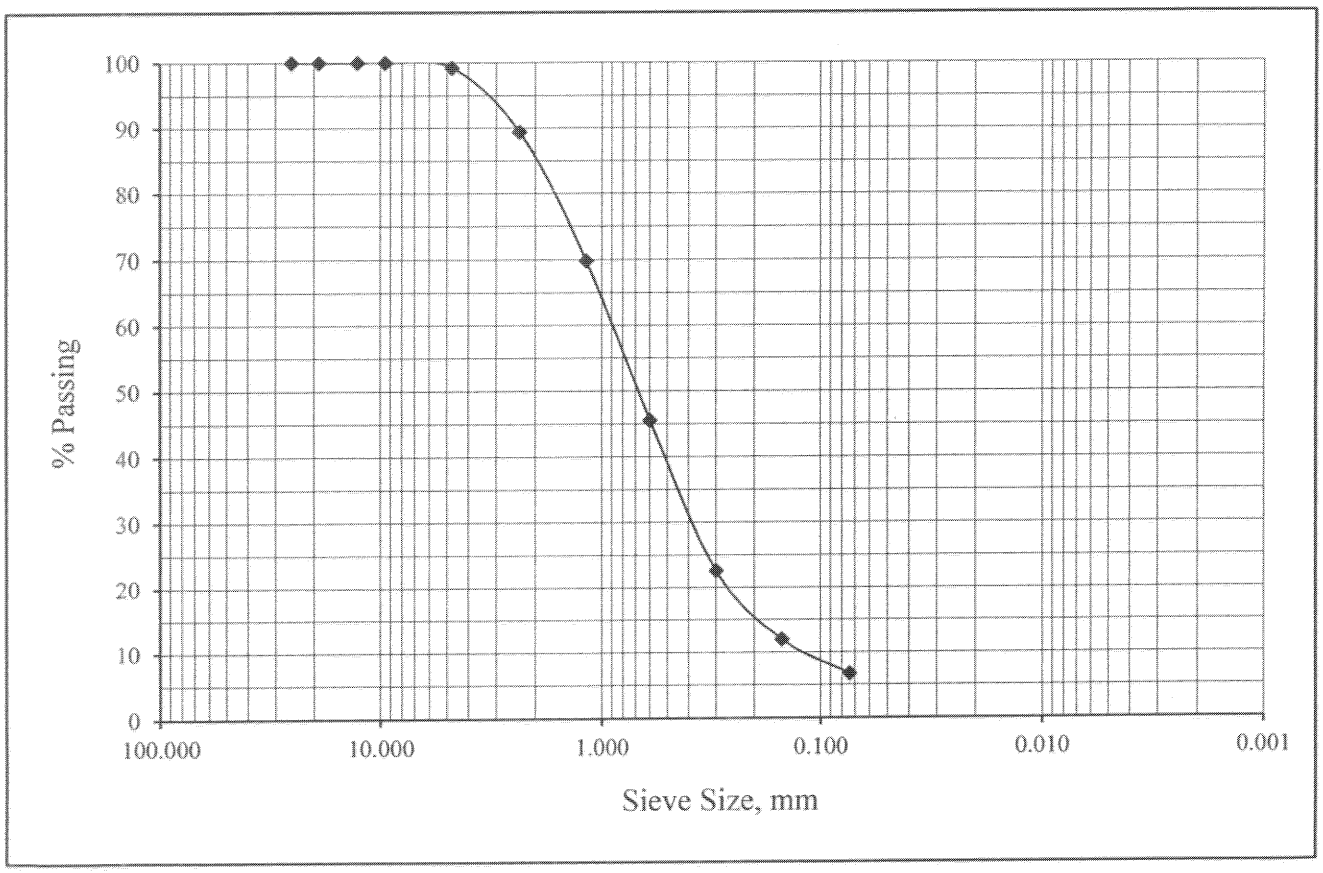
Gradation

ASTM C117 & C136

Project Number: 644-16051 November 3, 2016
Project Name: Rancho San Jacinto Development
Lab ID Number: LN6-16417
Sample ID: BH-2 R-6 @ 30' Soil Classification: SW-SM

Sieve Size, in	Sieve Size, mm	Percent Passing
1"	25.4	100.0
3/4"	19.1	100.0
1/2"	12.7	100.0
3/8"	9.53	100.0
#4	4.75	99.2
#8	2.36	89.4
#16	1.18	69.8
#30	0.60	45.6
#50	0.30	22.6
#100	0.15	12.0
#200	0.074	6.7



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Gradation

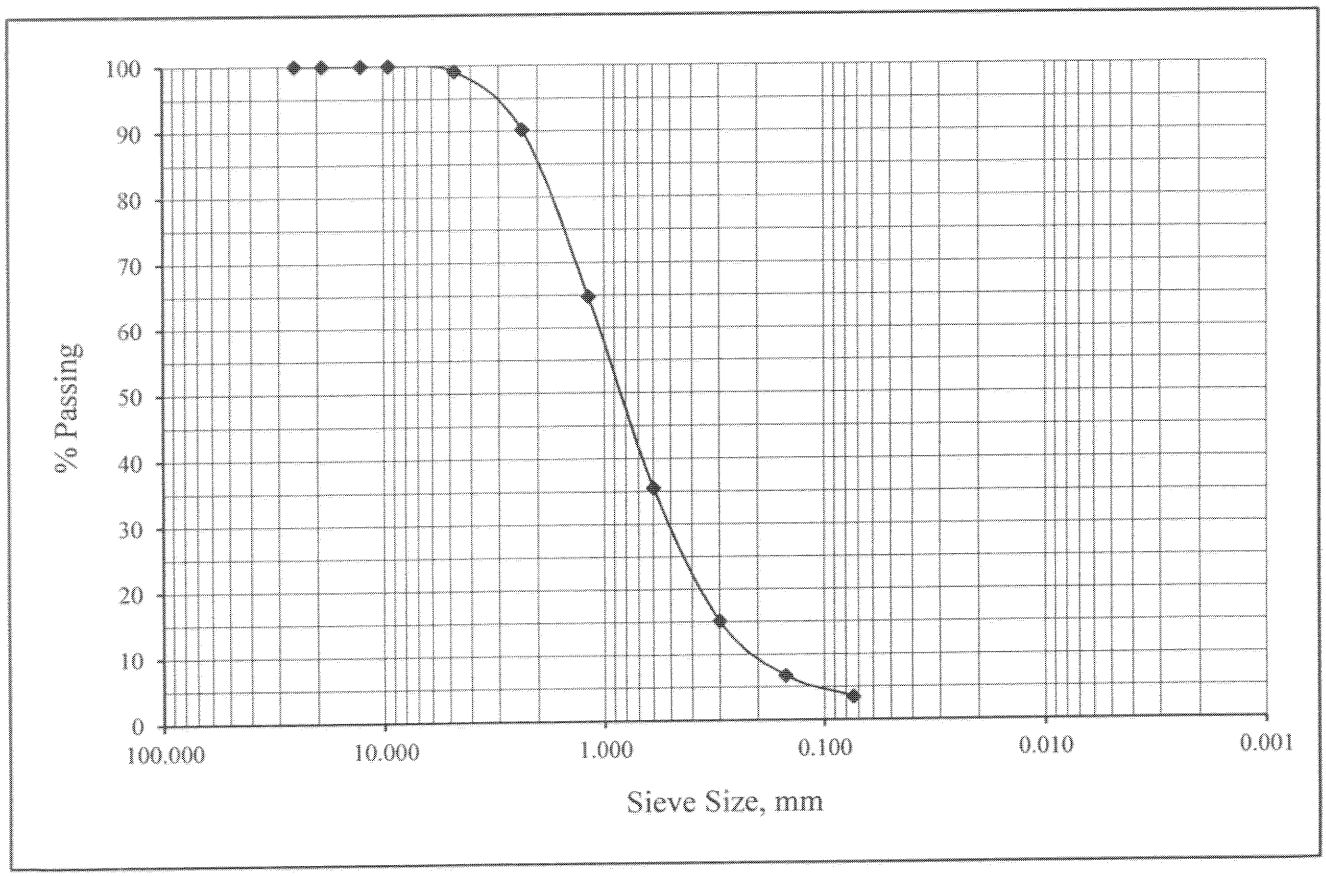
ASTM C117 & C136

Project Number: 644-16051
Project Name: Rancho San Jacinto Development
Lab ID Number: LN6-16417
Sample ID: BH-3 S-4 @ 20'

November 3, 2016

Soil Classification: SP

Sieve Size, in	Sieve Size, mm	Percent Passing
1"	25.4	100.0
3/4"	19.1	100.0
1/2"	12.7	100.0
3/8"	9.53	100.0
#4	4.75	99.1
#8	2.36	90.2
#16	1.18	64.8
#30	0.60	35.6
#50	0.30	15.2
#100	0.15	6.8
#200	0.074	3.5



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One Dimensional Consolidation

ASTM D2435 & D5333

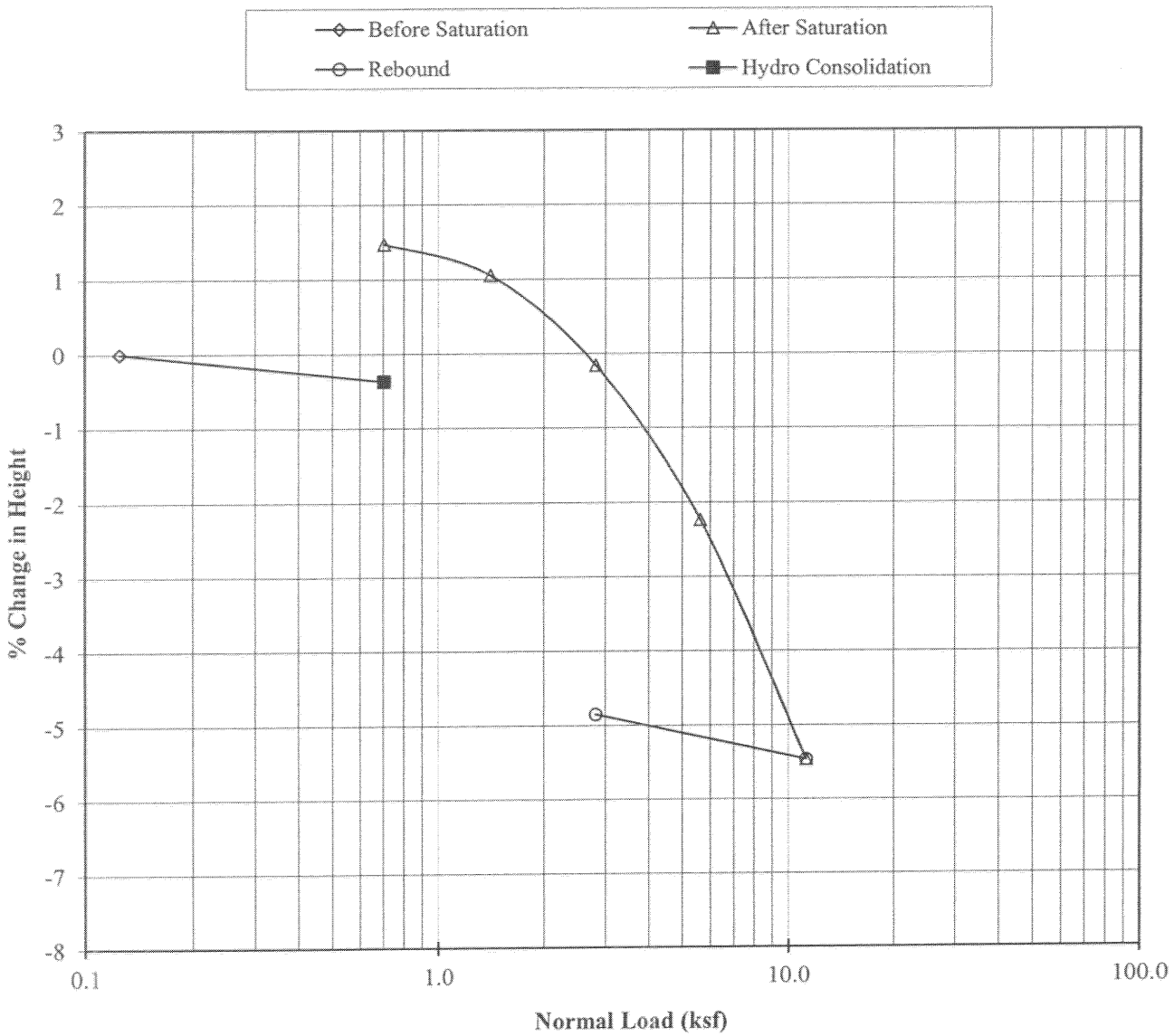
Job Number: 644-16051
Job Name: Rancho San Jacinto Development

November 3, 2016

Lab ID Number: LN6-16417
Sample ID: BH-2 R-2 @ 10'
Soil Description: Gray Brown Silt w/Sand (ML)

Initial Dry Density, pcf:	100.4
Initial Moisture, %:	7.1
Initial Void Ratio:	0.660
Specific Gravity:	2.67

% Change in Height vs Normal Presssure Diagram



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One Dimensional Consolidation

ASTM D2435 & D5333

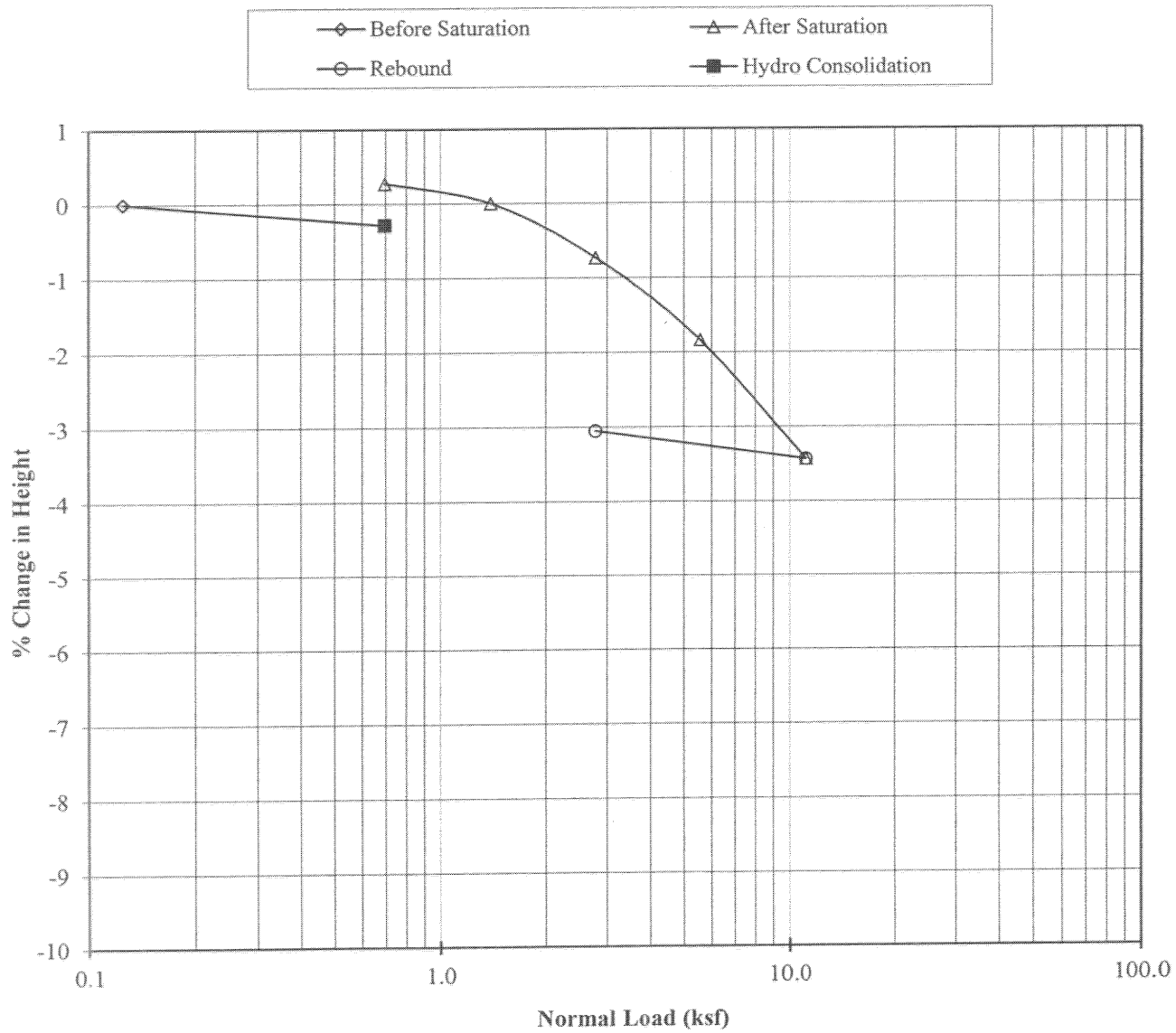
November 3, 2016

Job Number: 644-16051
Job Name: Rancho San Jacinto Development

Lab ID Number: LN6-16417
Sample ID: BH-3 R-1 @ 5'
Soil Description: Dark Brown Sandy Silt (ML)

Initial Dry Density, pcf:	97.7
Initial Moisture, %:	9.6
Initial Void Ratio:	0.706
Specific Gravity:	2.67

% Change in Height vs Normal Presssure Diagram



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45090 Golf Center Pkwy., Suite F, Indio, CA 92201 (760) 863-0713 Fax (760) 863-0847
450 Egan Avenue, Beaumont, CA 92223 (951) 845-7743 Fax (951) 845-8863

Date: November 3, 2016

Account No.: 644-16051

Customer: Bill Lo Consultant c/o Blaine Wormer

Location: APN 437-310-029, TTM 37230, San Jacinto

Analytical Report

Corrosion Series

	pH per CA 643	Soluble Sulfates per CA 417 ppm	Soluble Chloride per CA 422 ppm	Min. Resistivity per CA 643 ohm-cm
BH-1 @ 0-5'	8.4	20	50	2300

APPENDIX C

2013 SEISMIC DESIGN MAP AND REPORT
VS30 GRADIENT MAP
PSH DEAGGREGATION OUTPUT

USGS Design Maps Summary Report

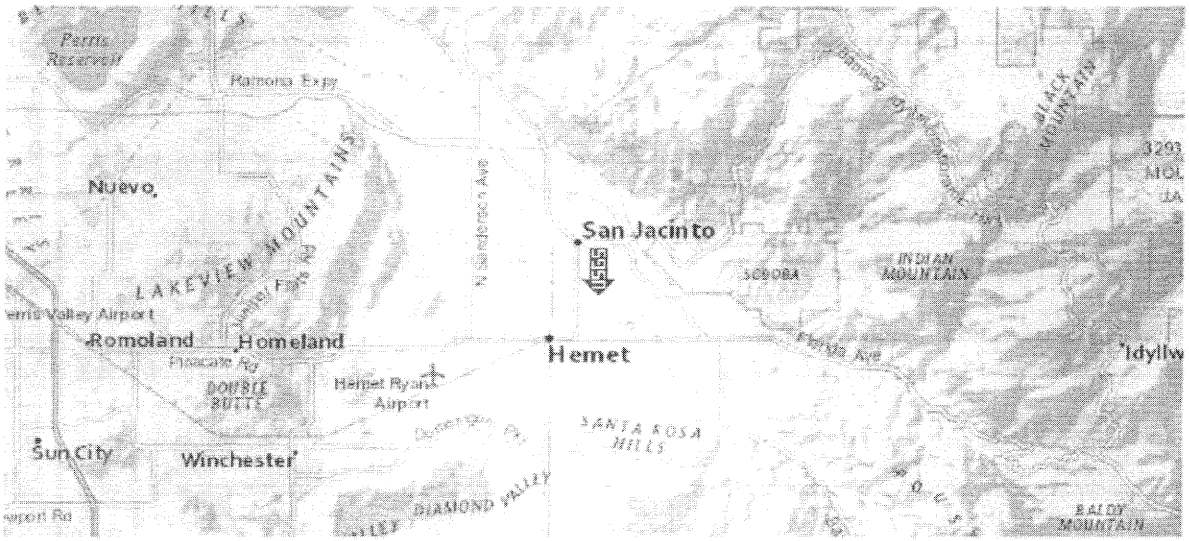
User-Specified Input

Building Code Reference Document ASCE 7-10 Standard
(which utilizes USGS hazard data available in 2008)

Site Coordinates 33.77327°N, 116.94981°W

Site Soil Classification Site Class D – "Stiff Soil"

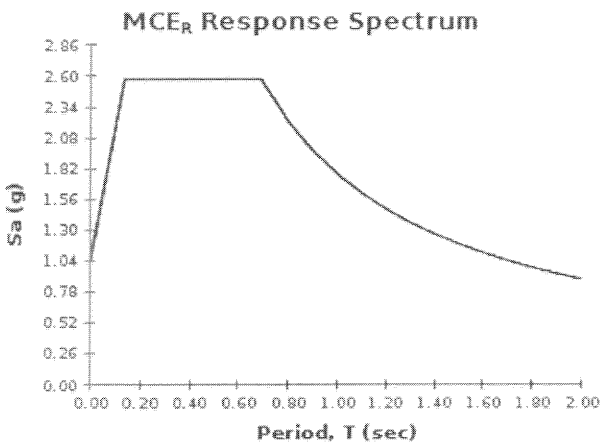
Risk Category I/II/III

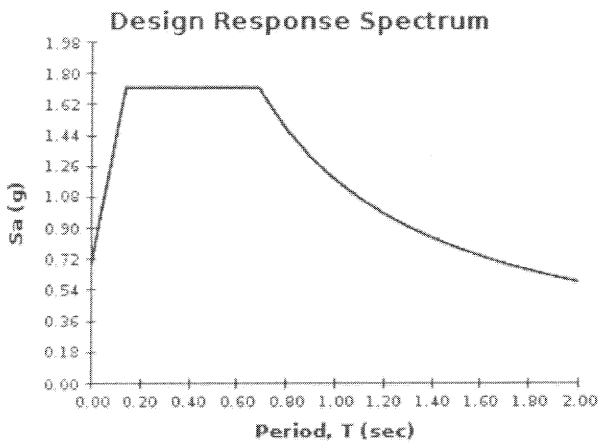


USGS-Provided Output

S_S =	2.576 g	S_{MS} =	2.576 g	S_{DS} =	1.717 g
S_1 =	1.181 g	S_{M1} =	1.771 g	S_{D1} =	1.181 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.





For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

USGS Design Maps Detailed Report

ASCE 7-10 Standard (33.77327°N, 116.94981°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1] $S_S = 2.576$ g

From Figure 22-2 [2] $S_1 = 1.181$ g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20, • Moisture content $w \geq 40\%$, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4-1: Site Coefficient F_a

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at Short Period				
	$S_S \leq 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \geq 1.25$
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 S_S

For Site Class = D and S_S = 2.576 g, F_a = 1.000

Table 11.4-2: Site Coefficient F_v

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at 1-s Period				
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 1.181 g, F_v = 1.500

Equation (11.4–1): $S_{MS} = F_a S_S = 1.000 \times 2.576 = 2.576$ g

Equation (11.4–2): $S_{M1} = F_v S_1 = 1.500 \times 1.181 = 1.771$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

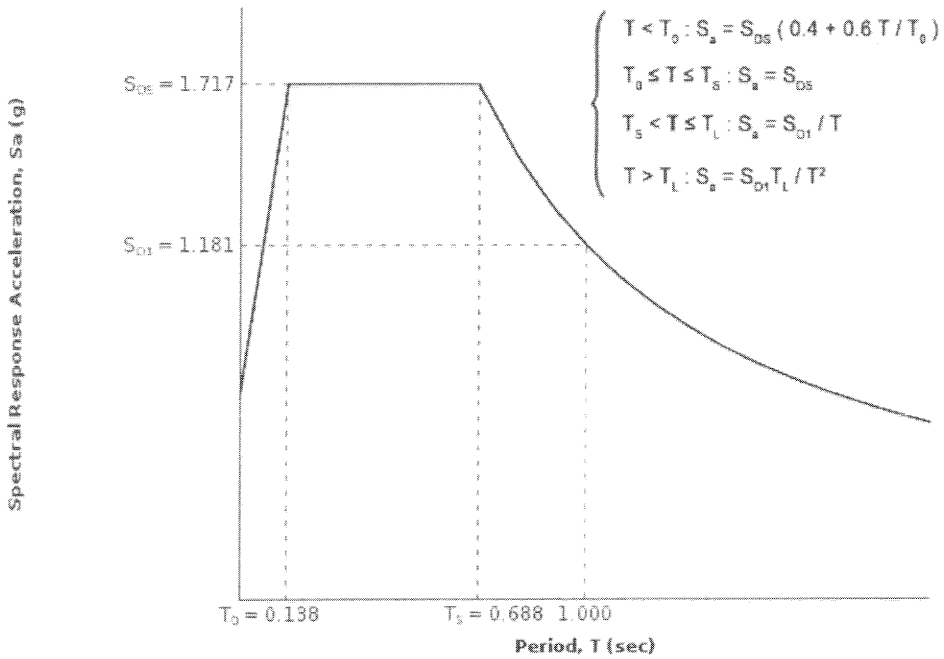
Equation (11.4–3): $S_{DS} = \frac{2}{3} S_{MS} = \frac{2}{3} \times 2.576 = 1.717$ g

Equation (11.4–4): $S_{D1} = \frac{2}{3} S_{M1} = \frac{2}{3} \times 1.771 = 1.181$ g

Section 11.4.5 — Design Response Spectrum

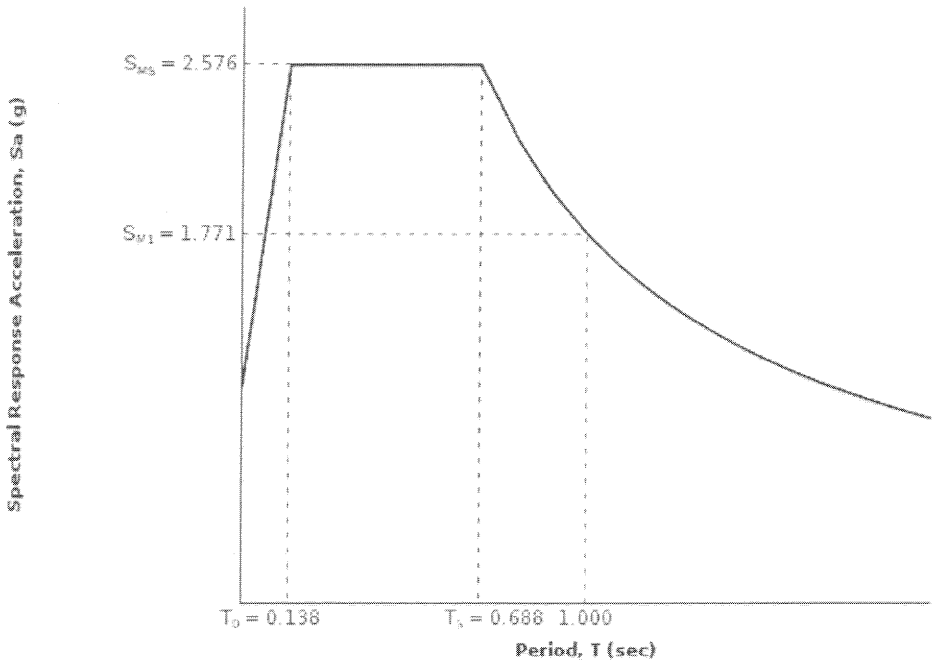
From Figure 22-12 [3] $T_L = 8$ seconds

Figure 11.4–1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



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

From Figure 22-7 [4] PGA = 0.990

Equation (11.8-1): $PGA_M = F_{PGA}PGA = 1.000 \times 0.990 = 0.99$ 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 = 0.990 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} = 0.945

From Figure 22-18 [6] C_{R1} = 0.916

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 1.717 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 1.181 g, Seismic Design Category = D

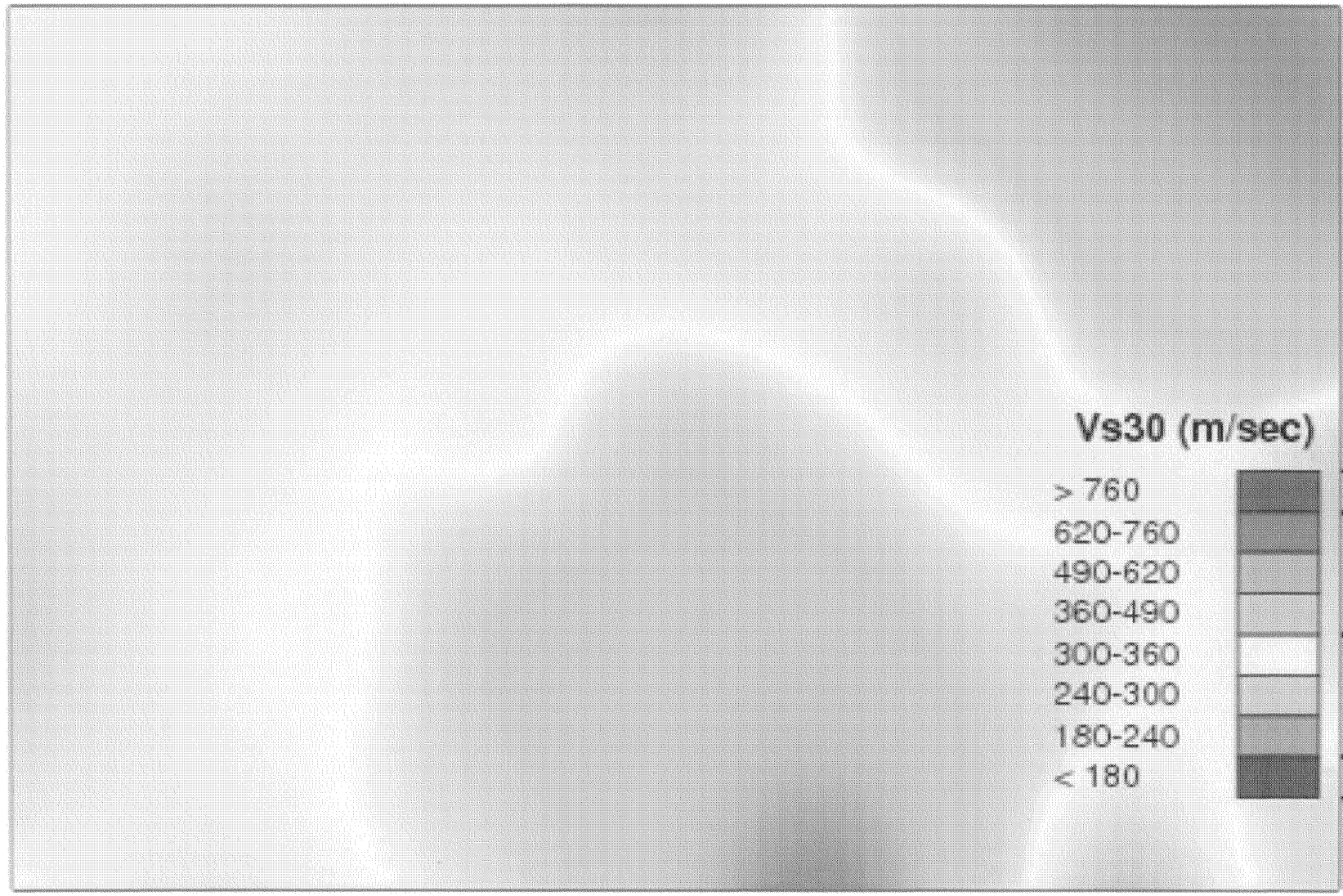
Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = E

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf



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-116.979164 33.787498 282
-116.970833 33.787498 275
-116.962502 33.787498 263
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-116.937500 33.779167 269
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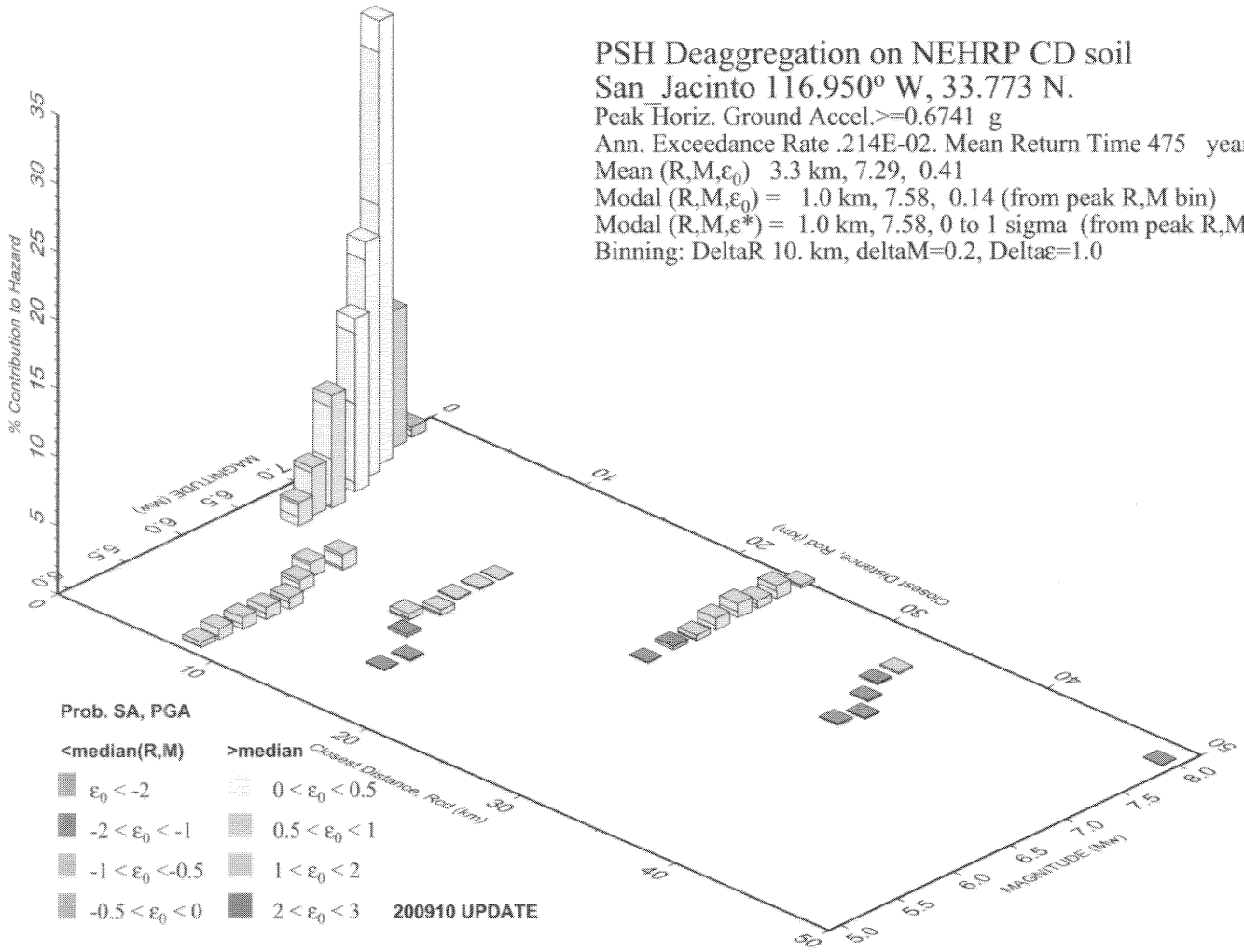

GMT 2016 Nov 7 17:14:03 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 360. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

San_Jacinto_2016.11.07_17.13.56
*** Deaggregation of Seismic Hazard at One Period of Spectral Accel. ***
*** Data from U.S.G.S. National Seismic Hazards Mapping Project, 2008 version ***
PSHA Deaggregation. %contributions. site: San_Jacinto long: 116.950 W., lat: 33.773 N.
 Vs30(m/s)= 360.0 (some WUS atten. models use Site Class not Vs30).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 475   yrs. Exceedance PGA =0.6741   g. Weight * Computed_Rate_Ex 0.214E-02
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.02814
#This deaggregation corresponds to Mean Hazard w/all GMPEs

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
8.0	5.05	0.365	0.285	0.080	0.000	0.000	0.000	0.000
8.1	5.20	0.801	0.588	0.213	0.000	0.000	0.000	0.000
8.2	5.40	0.871	0.538	0.333	0.000	0.000	0.000	0.000
8.2	5.60	0.873	0.415	0.458	0.000	0.000	0.000	0.000
15.9	5.60	0.071	0.071	0.000	0.000	0.000	0.000	0.000
8.3	5.80	0.811	0.324	0.476	0.011	0.000	0.000	0.000
16.0	5.80	0.095	0.095	0.000	0.000	0.000	0.000	0.000
7.4	6.01	0.907	0.266	0.591	0.050	0.000	0.000	0.000
14.2	6.02	0.219	0.198	0.021	0.000	0.000	0.000	0.000
6.7	6.20	1.024	0.198	0.739	0.087	0.000	0.000	0.000
13.1	6.20	0.461	0.346	0.115	0.000	0.000	0.000	0.000
7.3	6.41	1.141	0.203	0.775	0.164	0.000	0.000	0.000
13.8	6.38	0.405	0.272	0.134	0.000	0.000	0.000	0.000
2.7	6.64	1.715	0.209	0.867	0.627	0.012	0.000	0.000
13.2	6.60	0.085	0.057	0.028	0.000	0.000	0.000	0.000
2.4	6.80	3.491	0.399	1.753	1.311	0.028	0.000	0.000
13.3	6.80	0.105	0.059	0.045	0.000	0.000	0.000	0.000
24.2	6.80	0.055	0.055	0.000	0.000	0.000	0.000	0.000
2.5	6.96	8.181	0.863	3.783	3.422	0.113	0.000	0.000
13.3	6.97	0.068	0.034	0.035	0.000	0.000	0.000	0.000
24.1	7.04	0.262	0.215	0.047	0.000	0.000	0.000	0.000
35.1	7.00	0.105	0.105	0.000	0.000	0.000	0.000	0.000
2.2	7.21	12.648	1.134	5.093	5.742	0.679	0.000	0.000
24.2	7.23	0.404	0.307	0.097	0.000	0.000	0.000	0.000
35.5	7.18	0.093	0.093	0.000	0.000	0.000	0.000	0.000
1.5	7.40	17.238	1.366	6.309	8.397	1.167	0.000	0.000
24.1	7.42	0.836	0.522	0.313	0.000	0.000	0.000	0.000
34.3	7.36	0.084	0.079	0.005	0.000	0.000	0.000	0.000
1.0	7.58	32.407	2.328	11.137	16.473	2.469	0.000	0.000
24.0	7.63	1.049	0.626	0.422	0.000	0.000	0.000	0.000
33.5	7.57	0.097	0.081	0.016	0.000	0.000	0.000	0.000
0.3	7.80	9.956	0.661	3.105	5.155	1.035	0.000	0.000
24.0	7.81	0.563	0.299	0.264	0.000	0.000	0.000	0.000
33.4	7.76	0.130	0.100	0.030	0.000	0.000	0.000	0.000
0.2	7.99	0.740	0.047	0.229	0.390	0.073	0.000	0.000
23.9	7.98	0.953	0.403	0.550	0.000	0.000	0.000	0.000
48.8	7.99	0.057	0.051	0.005	0.000	0.000	0.000	0.000
24.0	8.19	0.205	0.067	0.134	0.004	0.000	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%): 100.0
 Mean src-site R=   3.3 km; M= 7.29; eps0=   0.41. Mean calculated for all sources.
Modal src-site R=   1.0 km; M= 7.58; eps0=   0.14 from peak (R,M) bin
 MODE R*=   1.0km; M*= 7.58; EPS.INTERVAL: 0 to 1 sigma % CONTRIB.= 16.473

Principal sources (faults, subduction, random seismicity having > 3% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
California A-faults	90.52	2.7	7.43	0.30
CA Compr. crustal gridded	9.06	8.8	5.94	1.36

Individual fault hazard details if its contribution to mean hazard > 2%:

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)

San_Jacinto_2016.11.07_17.13.56

San Jacinto;SJV aPriori	10.95	2.7	6.95	0.56	58.9
San Jacinto;SBV+SJV aPriori	6.83	2.7	7.31	0.39	58.9
San Jacinto;A+C aPriori	19.58	1.7	7.48	0.23	-147.5
San Jacinto;SBV+SJV+A+C aPriori	7.97	0.2	7.76	0.02	-130.9
San Jacinto;SJV MoBal	2.58	2.7	6.95	0.57	58.9
San Jacinto;SBV+SJV MoBal	2.28	2.7	7.31	0.39	58.9
San Jacinto;SJV+A MoBal	3.09	0.2	7.46	0.04	-130.9
San Jacinto;A+C MoBal	7.27	1.7	7.48	0.23	-147.5
San Jacinto;SBV+SJV+A MoBal	3.12	0.2	7.62	0.03	-130.9
San Jacinto;SJV+A+C MoBal	3.12	0.2	7.63	0.02	-130.9
San Jacinto;SBV+SJV+A+C MoBal	3.15	0.2	7.76	0.02	-130.9
San Jacinto (SB to C) Unsegmente	10.07	0.6	7.29	0.13	-131.5

#*********End of deaggregation corresponding to Mean Hazard w/all GMPEs *********#

PSHA Deaggregation. %contributions. site: San_Jacinto long: 116.950 W., lat: 33.773 N.
Vs30(m/s)= 360.0 (some WUS atten. models use Site Class not Vs30).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 475 yrs. Exceedance PGA =0.6741 g. Weight * Computed_Rate_Ex 0.854E-03
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.03023
#This deaggregation corresponds to Boore-Atkinson 2008

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
7.8	5.21	0.037	0.037	0.000	0.000	0.000	0.000	0.000
7.8	5.40	0.058	0.058	0.000	0.000	0.000	0.000	0.000
8.0	5.60	0.079	0.079	0.000	0.000	0.000	0.000	0.000
8.1	5.80	0.097	0.094	0.004	0.000	0.000	0.000	0.000
7.2	6.01	0.149	0.130	0.020	0.000	0.000	0.000	0.000
14.2	6.03	0.026	0.026	0.000	0.000	0.000	0.000	0.000
6.6	6.20	0.198	0.149	0.049	0.000	0.000	0.000	0.000
13.3	6.20	0.073	0.073	0.000	0.000	0.000	0.000	0.000
7.1	6.41	0.226	0.155	0.071	0.000	0.000	0.000	0.000
14.3	6.39	0.079	0.079	0.000	0.000	0.000	0.000	0.000
2.4	6.65	0.622	0.093	0.325	0.202	0.002	0.000	0.000
13.7	6.60	0.028	0.026	0.001	0.000	0.000	0.000	0.000
24.5	6.61	0.028	0.028	0.000	0.000	0.000	0.000	0.000
2.3	6.80	1.289	0.143	0.661	0.478	0.008	0.000	0.000
13.7	6.80	0.038	0.033	0.005	0.000	0.000	0.000	0.000
24.4	6.80	0.045	0.045	0.000	0.000	0.000	0.000	0.000
34.0	6.80	0.043	0.043	0.000	0.000	0.000	0.000	0.000
2.5	6.96	3.350	0.321	1.742	1.267	0.020	0.000	0.000
13.7	6.98	0.028	0.020	0.008	0.000	0.000	0.000	0.000
24.2	7.04	0.212	0.167	0.044	0.000	0.000	0.000	0.000
35.1	7.00	0.104	0.104	0.000	0.000	0.000	0.000	0.000
2.2	7.21	4.952	0.404	2.175	2.259	0.114	0.000	0.000
13.8	7.20	0.024	0.009	0.014	0.001	0.000	0.000	0.000
24.2	7.23	0.318	0.249	0.069	0.000	0.000	0.000	0.000
35.6	7.18	0.085	0.085	0.000	0.000	0.000	0.000	0.000
1.5	7.40	7.265	0.490	2.785	3.616	0.373	0.000	0.000
24.1	7.42	0.546	0.303	0.244	0.000	0.000	0.000	0.000
34.4	7.36	0.077	0.072	0.005	0.000	0.000	0.000	0.000
1.0	7.58	12.685	0.782	4.509	6.535	0.859	0.000	0.000
24.0	7.63	0.686	0.411	0.275	0.000	0.000	0.000	0.000
33.5	7.57	0.080	0.064	0.016	0.000	0.000	0.000	0.000
0.4	7.79	4.726	0.257	1.536	2.551	0.382	0.000	0.000
24.0	7.80	0.354	0.160	0.194	0.000	0.000	0.000	0.000
33.4	7.76	0.101	0.072	0.028	0.000	0.000	0.000	0.000
48.7	7.79	0.023	0.023	0.000	0.000	0.000	0.000	0.000
0.2	7.99	0.310	0.017	0.099	0.168	0.026	0.000	0.000
23.9	7.97	0.563	0.213	0.350	0.000	0.000	0.000	0.000
48.8	7.99	0.047	0.041	0.005	0.000	0.000	0.000	0.000
24.0	8.18	0.124	0.035	0.084	0.004	0.000	0.000	0.000

San_Jacinto_2016.11.07_17.13.56
Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%): 39.9
Mean src-site R= 3.9 km; M= 7.39; eps0= 0.45. Mean calculated for all sources.
Modal src-site R= 1.0 km; M= 7.58; eps0= 0.17 from peak (R,M) bin
MODE R*= 1.0km; M*= 7.58; EPS.INTERVAL: 0 to 1 sigma % CONTRIB.= 6.535

Principal sources (faults, subduction, random seismicity having > 3% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
California A-faults	38.33	3.5	7.43	0.39

Individual fault hazard details if its contribution to mean hazard > 2%:

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)
San Jacinto;SJV aPriori	4.34	2.7	6.95	0.62	58.9
San Jacinto;SBV+SJV aPriori	2.68	2.7	7.31	0.46	58.9
San Jacinto;A+C aPriori	7.96	1.7	7.48	0.28	-147.5
San Jacinto;SBV+SJV+A+C aPriori	3.35	0.2	7.76	0.05	-130.9
San Jacinto;SJV MoBal	1.02	2.7	6.95	0.62	58.9
San Jacinto;SBV+SJV MoBal	0.90	2.7	7.31	0.46	58.9
San Jacinto;SJV+A MoBal	1.30	0.2	7.46	0.07	-130.9
San Jacinto;A+C MoBal	2.96	1.7	7.48	0.28	-147.5
San Jacinto;SBV+SJV+A MoBal	1.31	0.2	7.62	0.06	-130.9
San Jacinto;SJV+A+C MoBal	1.31	0.2	7.63	0.06	-130.9
San Jacinto;SBV+SJV+A+C MoBal	1.32	0.2	7.76	0.05	-130.9
San Jacinto (SB to C) Unsegmente	4.27	0.7	7.29	0.17	-131.5

#**********End of deaggregation corresponding to Boore-Atkinson 2008 **********#

PSHA Deaggregation. %contributions. site: San_Jacinto long: 116.950 W., lat: 33.773 N.
Vs30(m/s)= 360.0 (some WUS atten. models use Site Class not Vs30).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 475 yrs. Exceedance PGA =0.6741 g. Weight * Computed_Rate_Ex 0.195E-03
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.00000
#This deaggregation corresponds to Campbell-Bozorgnia 2008

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
7.8	5.05	0.049	0.049	0.000	0.000	0.000	0.000	0.000
7.9	5.21	0.138	0.138	0.000	0.000	0.000	0.000	0.000
8.1	5.40	0.201	0.183	0.017	0.000	0.000	0.000	0.000
8.2	5.60	0.221	0.178	0.042	0.000	0.000	0.000	0.000
15.6	5.60	0.007	0.007	0.000	0.000	0.000	0.000	0.000
8.2	5.80	0.196	0.152	0.044	0.000	0.000	0.000	0.000
15.7	5.81	0.011	0.011	0.000	0.000	0.000	0.000	0.000
7.4	6.01	0.203	0.159	0.044	0.000	0.000	0.000	0.000
13.9	6.03	0.035	0.035	0.000	0.000	0.000	0.000	0.000
6.7	6.20	0.238	0.162	0.076	0.000	0.000	0.000	0.000
12.8	6.20	0.084	0.084	0.000	0.000	0.000	0.000	0.000
7.2	6.41	0.284	0.163	0.121	0.000	0.000	0.000	0.000
13.5	6.38	0.076	0.076	0.000	0.000	0.000	0.000	0.000
3.8	6.63	0.205	0.089	0.116	0.000	0.000	0.000	0.000
13.1	6.60	0.020	0.019	0.001	0.000	0.000	0.000	0.000
3.0	6.80	0.297	0.128	0.169	0.000	0.000	0.000	0.000
13.1	6.80	0.021	0.019	0.001	0.000	0.000	0.000	0.000
2.6	6.96	0.685	0.279	0.378	0.027	0.000	0.000	0.000
13.1	6.95	0.010	0.009	0.001	0.000	0.000	0.000	0.000
2.1	7.22	1.165	0.325	0.658	0.182	0.000	0.000	0.000
24.5	7.20	0.006	0.006	0.000	0.000	0.000	0.000	0.000
1.5	7.40	1.414	0.404	0.778	0.231	0.000	0.000	0.000
24.5	7.41	0.009	0.009	0.000	0.000	0.000	0.000	0.000
1.1	7.57	2.572	0.669	1.424	0.479	0.000	0.000	0.000
24.2	7.61	0.009	0.009	0.000	0.000	0.000	0.000	0.000
0.4	7.79	0.898	0.224	0.496	0.179	0.000	0.000	0.000
0.2	7.99	0.057	0.014	0.032	0.012	0.000	0.000	0.000
23.9	7.98	0.006	0.006	0.000	0.000	0.000	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%): 9.1
Mean src-site R= 3.0 km; M= 7.10; eps0= 1.26. Mean calculated for all sources.
Modal src-site R= 1.1 km; M= 7.57; eps0= 1.12 from peak (R,M) bin
MODE R*= 1.1km; M*= 7.57; EPS.INTERVAL: 0 to 1 sigma % CONTRIB.= 1.424

Principal sources (faults, subduction, random seismicity having > 3% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
California A-faults	7.12	1.5	7.42	1.19

Individual fault hazard details if its contribution to mean hazard > 2%:

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)
San Jacinto;SJV aPriori	0.91	2.7	6.96	1.42	58.9
San Jacinto;SBV+SJV aPriori	0.61	2.7	7.31	1.21	58.9
San Jacinto;A+C aPriori	1.69	1.7	7.48	1.14	-147.5
San Jacinto;SBV+SJV+A+C aPriori	0.62	0.2	7.75	1.09	-130.9
San Jacinto;SJV MoBal	0.21	2.7	6.96	1.43	58.9
San Jacinto;SBV+SJV MoBal	0.20	2.7	7.31	1.21	58.9
San Jacinto;SJV+A MoBal	0.25	0.2	7.45	1.09	-130.9
San Jacinto;A+C MoBal	0.63	1.7	7.48	1.14	-147.5
San Jacinto;SBV+SJV+A MoBal	0.25	0.2	7.62	1.09	-130.9
San Jacinto;SJV+A+C MoBal	0.25	0.2	7.63	1.09	-130.9
San Jacinto;SBV+SJV+A+C MoBal	0.25	0.2	7.75	1.09	-130.9
San Jacinto (SB to C) Unsegmente	0.76	0.4	7.31	1.16	-131.5

#*********End of deaggregation corresponding to Campbell-Bozorgnia 2008 *********#

PSHA Deaggregation. %contributions. site: San_Jacinto long: 116.950 W., lat: 33.773 N.
Vs30(m/s)= 360.0 (some WUS atten. models use Site Class not Vs30).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 475 yrs. Exceedance PGA =0.6741 g. Weight * Computed_Rate_Ex 0.109E-02
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.05476
#This deaggregation corresponds to Chiou-Youngs 2008

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
8.1	5.05	0.305	0.268	0.037	0.000	0.000	0.000	0.000
8.1	5.20	0.626	0.520	0.106	0.000	0.000	0.000	0.000
8.2	5.40	0.613	0.485	0.127	0.000	0.000	0.000	0.000
15.7	5.41	0.045	0.045	0.000	0.000	0.000	0.000	0.000
8.3	5.60	0.573	0.395	0.178	0.000	0.000	0.000	0.000
15.9	5.60	0.063	0.063	0.000	0.000	0.000	0.000	0.000
8.3	5.80	0.518	0.299	0.219	0.000	0.000	0.000	0.000
16.1	5.80	0.079	0.079	0.000	0.000	0.000	0.000	0.000
7.5	6.01	0.555	0.250	0.305	0.000	0.000	0.000	0.000
14.3	6.02	0.157	0.154	0.003	0.000	0.000	0.000	0.000
6.8	6.20	0.588	0.197	0.391	0.000	0.000	0.000	0.000
13.1	6.20	0.305	0.274	0.031	0.000	0.000	0.000	0.000
7.4	6.41	0.631	0.200	0.431	0.000	0.000	0.000	0.000
13.8	6.38	0.251	0.219	0.032	0.000	0.000	0.000	0.000
2.7	6.64	0.888	0.102	0.418	0.356	0.010	0.000	0.000
13.0	6.60	0.037	0.033	0.004	0.000	0.000	0.000	0.000
2.4	6.80	1.743	0.154	0.801	0.768	0.021	0.000	0.000
13.0	6.80	0.046	0.036	0.010	0.000	0.000	0.000	0.000
2.5	6.96	4.308	0.314	1.801	2.100	0.093	0.000	0.000
13.0	6.97	0.030	0.020	0.010	0.000	0.000	0.000	0.000
23.9	7.05	0.045	0.045	0.000	0.000	0.000	0.000	0.000
2.2	7.21	6.246	0.393	2.192	3.133	0.528	0.000	0.000
24.1	7.23	0.105	0.097	0.008	0.000	0.000	0.000	0.000
1.5	7.39	9.004	0.488	2.845	4.800	0.871	0.000	0.000
24.1	7.41	0.212	0.145	0.067	0.000	0.000	0.000	0.000
1.0	7.58	16.047	0.816	4.832	8.829	1.569	0.000	0.000
24.0	7.62	0.398	0.260	0.138	0.000	0.000	0.000	0.000

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0.3	7.79	5.275	0.236	1.411	2.974	0.653	0.000	0.000
23.9	7.81	0.207	0.137	0.070	0.000	0.000	0.000	0.000
33.4	7.77	0.029	0.028	0.001	0.000	0.000	0.000	0.000
0.2	7.99	0.373	0.017	0.099	0.210	0.047	0.000	0.000
23.9	7.98	0.366	0.171	0.194	0.000	0.000	0.000	0.000
24.0	8.18	0.098	0.043	0.055	0.000	0.000	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%): 50.9
Mean src-site R= 3.0 km; M= 7.25; eps0= 0.23. Mean calculated for all sources.
Modal src-site R= 1.0 km; M= 7.58; eps0= -0.05 from peak (R,M) bin
MODE R*= 1.0km; M*= 7.58; EPS.INTERVAL: 0 to 1 sigma % CONTRIB.= 8.829

Principal sources (faults, subduction, random seismicity having > 3% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
California A-faults	45.07	2.2	7.42	0.09
CA Compr. crustal gridded	5.79	8.9	5.87	1.25

Individual fault hazard details if its contribution to mean hazard > 2%:

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)
San Jacinto;SJV aPriori	5.71	2.7	6.95	0.38	58.9
San Jacinto;SBV+SJV aPriori	3.54	2.7	7.31	0.19	58.9
San Jacinto;A+C aPriori	9.93	1.7	7.48	0.03	-147.5
San Jacinto;SBV+SJV+A+C aPriori	4.00	0.2	7.76	-0.19	-130.9
San Jacinto;SJV MoBal	1.35	2.7	6.95	0.38	58.9
San Jacinto;SBV+SJV MoBal	1.18	2.7	7.31	0.19	58.9
San Jacinto;SJV+A MoBal	1.54	0.2	7.46	-0.16	-130.9
San Jacinto;A+C MoBal	3.69	1.7	7.48	0.03	-147.5
San Jacinto;SBV+SJV+A MoBal	1.56	0.2	7.62	-0.17	-130.9
San Jacinto;SJV+A+C MoBal	1.56	0.2	7.63	-0.17	-130.9
San Jacinto;SBV+SJV+A+C MoBal	1.58	0.2	7.76	-0.19	-130.9
San Jacinto (SB to C) Unsegmente	5.04	0.6	7.29	-0.06	-131.5

#**********End of deaggregation corresponding to Chiou-Youngs 2008 **********#

********** Southern California **********