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Project No. 171654-10A

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Subject: **Preliminary Geotechnical Interpretive Report, Proposed Commercial Development, Assessor's Parcel Number 943-210-012, Lot Number 6 of Parcel Map 14/93, Located at 39730 Calle Contento, Temecula, Riverside County, California**

Earth Strata Geotechnical Services is pleased to present our preliminary geotechnical interpretive report for the proposed commercial development, Assessor's Parcel Number 943-210-012, located at 39730 Calle Contento in City of Temecula, Riverside County, California. This work was performed in accordance with the scope of work described in our proposal, dated February 7, 2017. The purpose of this study is to evaluate the nature, distribution, engineering properties, and geologic strata underlying the site with respect to the proposed development.

Earth Strata Geotechnical Services appreciates the opportunity to offer our consultation and advice on this project. In the event that you have any questions, please do not hesitate to contact the undersigned at your earliest convenience.

Respectfully submitted,

EARTH STRATA GEOTECHNICAL SERVICES

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- Figure 1 – Vicinity Map (Page 2)
- Figure 2 – Regional Geologic Map (Page 5)
- APPENDIX A – References (Rear of Text)
- APPENDIX B – Exploratory Logs (Rear of Text)
- APPENDIX C – Laboratory Procedures and Test Results (Rear of Text)
- APPENDIX D – Seismicity (Rear of Text)
- APPENDIX E – General Earthwork and Grading Specifications (Rear of Text)
- Plate 1 – Geotechnical Map (In Pocket)

INTRODUCTION

Earth Strata Geotechnical Services is pleased to present our preliminary geotechnical interpretive report for the proposed development. The purpose of this study was to evaluate the nature, distribution, engineering properties, and geologic strata underlying the site with respect to the proposed development, and then provide preliminary grading and foundation design recommendations based on the plans you provided. The general location of the subject property is indicated on the Vicinity Map, Figure 1. The plans you provided were used as the base map to show geologic conditions within the subject site, see Geotechnical Map, Plate 1.

SITE DESCRIPTION

The subject property is located at 39730 Calle Contento in the City of Temecula, Riverside County, California. The approximate location of the site is shown on the Vicinity Map, Figure 1.

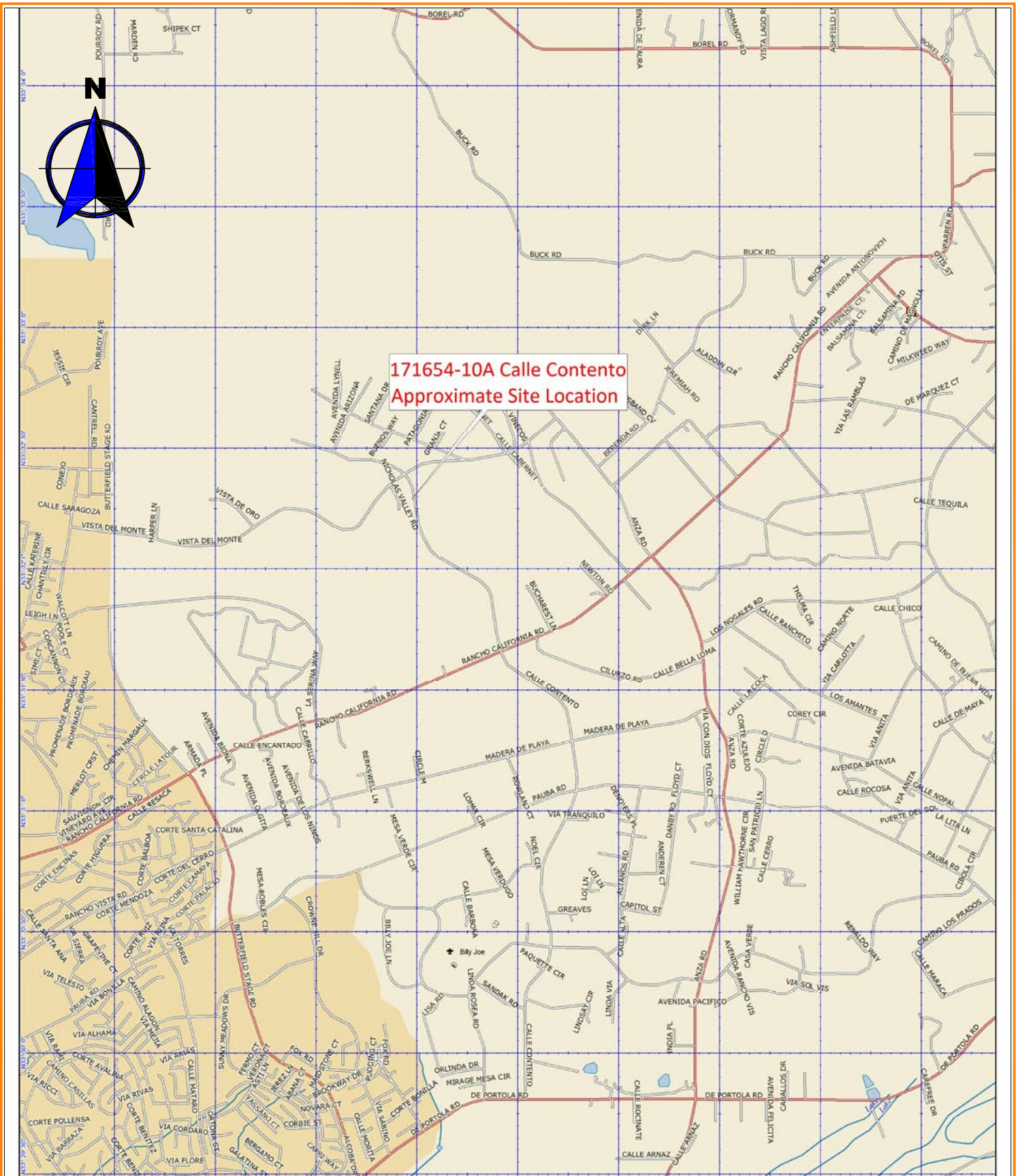
The subject property is comprised of approximately 19.43 acres of partially developed land. The site has been graded, in association with the existing one story agricultural building and building pad. Topographic relief at the subject property is relatively moderate with the terrain being generally gently sloping, with a one story agricultural building located in the southern portion of the site. Elevations at the site range from approximately 1,265 to 1,405 feet above mean sea level (msl), for a difference of about 40± feet across the entire site. Drainage within the subject property generally flows to the west.

The site is currently bordered by residential and commercial developments. Most of the vegetation on the site consists of an existing vineyard and sparse amounts of shrubs and small to large trees.

PROPOSED DEVELOPMENT AND GRADING

The proposed commercial development is expected to consist of concrete, wood or steel framed one- and/or two-story structures utilizing slab on grade construction with associated streets, landscape areas, and utilities. The current development plans include four (4) building pads positioned throughout the site. The plans provided by you were utilized in our exploration and form the base for our Geotechnical Map, Plate 1.

Figure 1
Vicinity Map



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FIELD EXPLORATION AND LABORATORY TESTING

Field Exploration

Subsurface exploration within the subject site was performed on February 28, 2017 and March 3, 2017 for the exploratory excavations. A hand-auger was utilized to excavate four (4) borings throughout the site to a maximum depth of 5.5 feet. A truck mounted hollow-stem-auger was utilized to drill three (3) additional borings to a maximum depth of 11½ feet. An underground utilities clearance was obtained from Underground Service Alert of Southern California, prior to the subsurface exploration.

Earth materials encountered during exploration were classified and logged in general accordance with the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) of ASTM D 2488. Upon completion of laboratory testing, exploratory logs and sample descriptions may have been reconciled to reflect laboratory test results with regard to ASTM D 2487.

Associated with the subsurface exploration was the collection of bulk (disturbed) samples and relatively undisturbed samples of earth materials for laboratory testing and analysis. The relatively undisturbed samples were obtained with a 3 inch outside diameter modified California split-spoon sampler lined with 1-inch-high brass rings. Samples obtained using a hollow stem auger drill rig, were mechanically driven with successive 30 inch drops of a 140-pound automatic trip safety hammer. The blow count per one-foot increment was recorded in the boring logs. The samples were placed in sealed containers and transported to our laboratory for testing and analysis. The approximate exploratory locations are shown on Plate 1 and descriptive logs are presented in Appendix B.

Laboratory Testing

Maximum dry density/optimum moisture content, expansion potential, pH, resistivity, sulfate content, chloride content, and in-situ density/moisture content were determined for selected undisturbed and bulk samples of earth materials, considered representative of those encountered. An evaluation of the test data is reflected throughout the Conclusions and Recommendations section of this report. A brief description of laboratory test criteria and summaries of test data are presented in Appendix C.

FINDINGS

Regional Geology

Regionally, the site is located in the Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are characterized by northwest trending steep mountain ranges separated by sediment filled elongated valleys. The dominant structural geologic features reflect the northwest trend of the province. Associated with and subparallel to the San Andreas Fault are the San Jacinto Fault, Newport-Inglewood, and the Whittier-Elsinore Fault. The Santa Ana Mountains abut the west side of the Elsinore Fault while the Perris Block forms the other side of the fault zone to the east. The Perris Block is bounded to the east by the San Jacinto Fault. The northern perimeter of the Los Angeles basin forms part of a northerly dipping blind thrust fault at the boundary between the Peninsular Ranges Province and the Transverse Range Province.

The mountainous regions within the Peninsular Ranges Province are comprised of Pre-Cretaceous, metasedimentary, and metavolcanic rocks along with Cretaceous plutonic rocks of the Southern California Batholith. The low lying areas are primarily comprised of Tertiary and Quaternary non-marine alluvial sediments consisting of alluvial deposits, sandstones, claystones, siltstones, conglomerates, and occasional volcanic units. A map illustrating the regional geology is presented on the Regional Geologic Map, Figure 2.

Local Geology

The earth materials on the site are primarily comprised of artificial fill. A general description of the dominant earth materials observed on the site is provided below:

- Artificial Fill, Undocumented (map symbol Afu): Undocumented artificial fill materials were encountered throughout the site in the upper 7 feet of the pad area. These materials are typically locally derived from the native materials and consist generally of light brown to dark brown silty sand and poorly-graded, silty sand. These materials are generally inconsistent consolidated fills.
- Quaternary Young Alluvial Deposits (Qya): Quaternary young alluvium was encountered below the artificial fill and was mapped at the surface in the topographically low portions of the site to a maximum depth of 11.5 feet. These young alluvial deposits consist predominately of interlayered brown to yellow brown, fine to coarse grained silty sand and clayey sand. These deposits were generally noted to be in a slightly moist, medium dense state.

Faulting

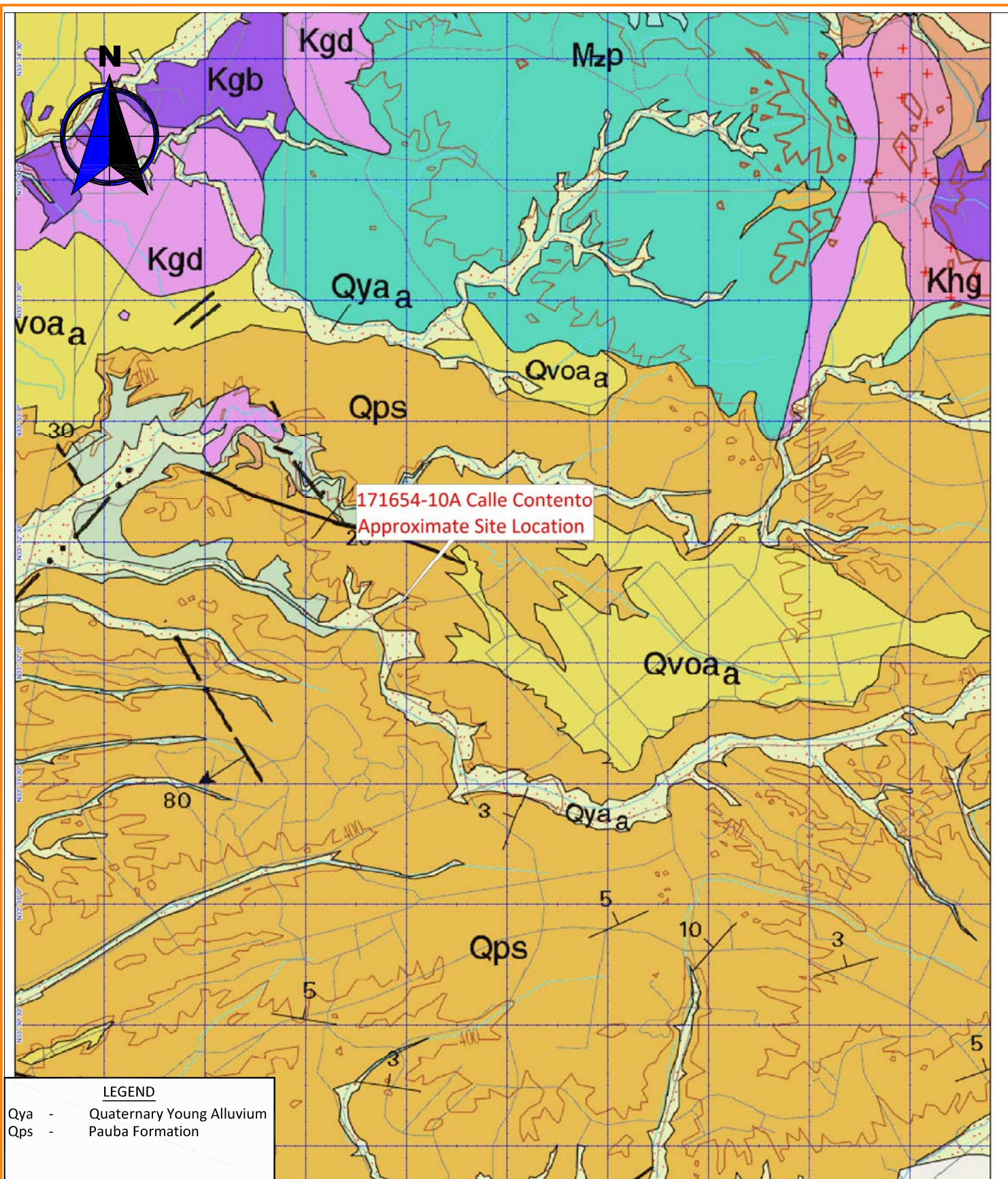
The project is located in a seismically active region and as a result, significant ground shaking will likely impact the site within the design life of the proposed project. The geologic structure of the entire southern California area is dominated by northwest-trending faults associated with the San Andreas Fault system, which accommodates for most of the right lateral movement associated with the relative motion between the Pacific and North American tectonic plates. Known active faults within this system include the Newport-Inglewood, Whittier-Elsinore, San Jacinto and San Andreas Faults.

No active faults are known to project through the site and the site is not located within an Alquist-Priolo Earthquake Fault Zone, established by the State of California to restrict the construction of new habitable structures across identifiable traces of known active faults. An active fault is defined by the State of California as having surface displacement within the past 11,000 years or during the Holocene geologic time period. Based on our mapping of the subject site, review of current and historical aerial imagery, lack of lineaments indicative of active faulting, and the data compiled during the preparation of this report, it is our interpretation that the potential for surface rupture to adversely impact the proposed structures is very low to remote.

Based on our review of regional geologic maps and applicable computer programs (USGS 2008 Interactive Deaggregation, Caltrans ARS online, and USGS Earthquake Hazard Programs), the Murrieta Hot Springs Fault with an approximate source to site distance of 0.55 kilometers is the closest known active fault anticipated to produce the highest ground accelerations for shorter periods (<1.25 seconds), with an anticipated maximum modal magnitude of 7.76; the Elsinore Fault (Temecula Section) with an approximate source to site distance of 7.57 kilometers is the closest known active fault anticipated to

produce the highest ground accelerations for longer periods (>1.25 seconds), with an anticipated maximum modal magnitude of 7.7. A list of faults as well as a list of significant historical seismic events within a 100km radius of the subject site are included in Appendix D.

Figure 2
Regional Geologic Map



REFERENCES: Morton, D.M., Hauser, Rachel M., and Ruppert, Kelly R., 2004, Preliminary Digital Geologic Map of the Santa Ana and San Bernadino 30' x 60' Quadrangle, Southern California, Version 2.0: U.S. Geological Survey Open-File Report 99-0172.

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Landslides

Landslide debris was not observed during our subsurface exploration and no ancient landslides are known to exist on the site. No landslides are known to exist, or have been mapped, in the vicinity of the site. Geologic mapping of the site conducted during our investigation, and review of aerial imagery of the site, reveal no geomorphic expressions indicative of landsliding.

CONCLUSIONS AND RECOMMENDATIONS

General

From geotechnical and engineering geologic points of view, the subject property is considered suitable for the proposed development, provided the following conclusions and recommendations are incorporated into the plans and are implemented during construction.

Earthwork

Earthwork and Grading

The provisions of the 2016 California Building Code (CBC), including the General Earthwork and Grading Specifications in the last Appendix of this report, should be applied to all earthwork and grading operations, as well as in accordance with all applicable grading codes and requirements of the appropriate reviewing agency. Unless specifically revised or amended herein, grading operations should also be performed in accordance with applicable provisions of our General Earthwork and Grading Specifications within the last appendix of this report.

Clearing and Grubbing

Vegetation including trees, grasses, weeds, brush, shrubs, or any other debris should be stripped from the areas to be graded and properly disposed of offsite. In addition, laborers should be utilized to remove any roots, branches, or other deleterious materials during grading operations.

Earth Strata Geotechnical Services should be notified at the appropriate times to provide observation and testing services during Clearing and Grubbing operations. Any buried structures or unanticipated conditions should be brought to our immediate attention.

Excavation Characteristics

Based on the results of our exploration and experience with similar projects in similar settings, the near surface earth materials, will be readily excavated with conventional earth moving equipment.

Groundwater

Groundwater was not observed during our subsurface exploration. Local well data indicates current regional groundwater highs approximately 331 feet below ground surface. It should be noted that

localized groundwater could be encountered during grading due to the limited number of exploratory locations or other factors.

Ground Preparation for Fill Areas

For each area to receive compacted fill, the removal of low density, compressible earth materials, such as topsoil and undocumented artificial fill, should continue until firm competent alluvium is encountered. Removal excavations are subject to verification by the project engineer, geologist or their representative. Prior to placing compacted fills, the exposed bottom in each removal area should be scarified to a depth of 6 inches or more, watered or air dried as necessary to achieve near optimum moisture conditions and then compacted to a minimum of 90 percent of the maximum dry density determined by ASTM D 1557.

The intent of remedial grading is to diminish the potential for hydro-consolidation, slope instability, and/or settlement. Remedial grading should extend beyond the perimeter of the proposed structures a horizontal distance equal to the depth of excavation or a minimum of 5 feet, whichever is greater. For cursory purposes the anticipated removal depths are shown on the enclosed Geotechnical Map, Plate 1. In general, the anticipated removal depths should vary from 5 to 7 feet below existing grade.

Wet Removals

Wet alluvial materials will probably not be encountered within the low lying areas of the site. If removals of wet alluvial materials are required, special grading equipment and procedures can greatly reduce overall costs. Careful planning by an experienced grading contractor can reduce the need for special equipment, such as swamp cats, draglines, excavators, pumps, and top loading earthmovers. Possible solutions may include the placement of imported angular rock and/or geotextile ground reinforcement. More specific recommendations can be provided based on the actual conditions encountered. Drying or mixing of wet materials with dry materials will be needed to bring the wet materials to near optimum moisture prior to placing wet materials into compacted fills.

Oversize Rock

Oversize rock is not expected to be encountered during grading. Oversize rock that is encountered (i.e., rock exceeding a maximum dimension of 12 inches) should be disposed of offsite or stockpiled onsite and crushed for future use. The disposal of oversize rock is discussed in greater detail in General Earthwork and Grading Specifications within the last appendix of this report.

Compacted Fill Placement

Compacted fill materials should be placed in 6 to 8 inch maximum (uncompacted) lifts, watered or air dried as necessary to achieve uniform near optimum moisture content and then compacted to a minimum of 90 percent of the maximum dry density determined by ASTM D 1557.

Import Earth Materials

Should import earth materials be needed to achieve final design grades, all potential import materials should be free of deleterious/oversize materials, non-expansive, and approved by the project geotechnical consultant prior to delivery onsite.

Fill Slopes

When properly constructed, fill slopes up to 10 feet high with inclinations of 2:1 (h:v) or flatter are considered to be grossly stable. Keyways are required at the toe of all fill slopes higher than 5 feet and steeper than 5:1 (h:v). Keyways should be a minimum of 10 feet wide and 2 feet into competent earth materials, as measured on the downhill side. In order to establish keyway removals, backcuts should be cut no steeper than 1:1 or as recommended by the geotechnical engineer or engineering geologist. Compacted fill should be benched into competent earth materials.

Cut Slopes

When properly constructed, cut slopes into older alluvium up to 10 feet high with inclinations of 2:1 (h:v) or flatter are considered grossly stable. Cut slopes should be observed by the engineering geologist or his representative during grading, but are anticipated to be stable.

Stabilization Fills

Currently, stabilization fills will not be required for cut slopes in the alluvium. Our engineering geologist or his representative should be called to evaluate all slopes during grading. In the event that unfavorable geologic conditions are encountered, recommendations for stabilization fills or flatter slopes will be provided.

Fill Over Cut Slopes

The fill portion of fill over cut slopes should not be constructed until the cut portion of the slope has been cut to finish grade. The earth materials and geologic structure exposed along the cut slope should be evaluated with regard to suitability for compacted fills or foundations and for stability. If the cut materials are determined to be competent, then the construction of the keyway and subdrain system may commence or additional remedial recommendations will be provided.

Temporary Backcuts

It is the responsibility of the grading contractor to follow all Cal-OSHA requirements with regard to excavation safety. Where existing developments are upslope, adequate slope stability to protect those developments must be maintained. Temporary backcuts will be required to accomplish removals of unsuitable materials and possibly, to perform canyon removals, stabilization fills, and/or keyways. Backcuts should be excavated at a gradient of 1:1 (h:v) or flatter. Flatter backcuts may be required where geologic structure or earth materials are unfavorable. It is imperative that grading schedules minimize the exposure time of the unsupported excavations. All excavations should be stabilized within 30 days of initial excavation.

Cut/Fill Transitions

Cut/fill transitions should be eliminated from all building areas where the depth of fill placed within the “fill” portion exceeds proposed footing depths. This is to diminish distress to structures resulting from excessive differential settlement. The entire foundation of each structure should be founded on a uniform bearing material. This should be accomplished by overexcavating the “cut” portion and replacing the excavated materials as properly compacted fill. Refer to the following table for recommended depths of overexcavation.

DEPTH OF FILL (“fill” portion)	DEPTH OF OVEREXCAVATION (“cut” portion)
Up to 5 feet	Equal Depth
5 to 10 feet	5 feet
Greater than 10 feet	One-half the thickness of fill placed on the “fill” portion (10 feet maximum)

Overexcavation of the “cut” portion should extend beyond the building perimeter a horizontal distance equal to the depth of overexcavation or a minimum of 5 feet, whichever is greater.

Cut Areas

In cut areas, an area a minimum of 5 feet beyond the footprint of the proposed structures should overexcavated until; competent bottoms are achieved; to a minimum 3 feet below the proposed foundations; or per the Overexcavation Table above; (whichever is greater) and replaced with compacted fill. Final determination of areas that require overexcavation should be determined in the field by a representative of Earth Strata Geotechnical Services.

Shrinkage, Bulking and Subsidence

Volumetric changes in earth material quantities will occur when poorly consolidated earth materials are replaced with properly compacted fill. Estimates of the percent shrinkage/bulking factors for the various geologic units observed on the subject property are based on in-place densities and on the estimated average percent of relative compaction achieved during grading.

GEOLOGIC UNIT	SHRINKAGE (%)
Artificial Fill	5 to 10
Alluvium	10 to 15

Subsidence from scarification and recompaction of exposed bottom surfaces is expected to be negligible to approximately 0.01 foot.

The estimates of shrinkage/bulking and subsidence are intended as an aid for project engineers in determining earthwork quantities. Since many variables can affect the accuracy of these estimates, they should be used with caution and contingency plans should be in place for balancing the project.

Geotechnical Observations

Clearing operations, removal of unsuitable materials, and general grading procedures should be observed by the project geotechnical consultant or his representative. No compacted fill should be placed without observations by the geotechnical consultant or his representative to verify the adequacy of the removals.

The project geotechnical consultant or his representative should be present to observe grading operations and to check that minimum compaction requirements and proper lift thicknesses are being met, as well as to verify compliance with the other recommendations presented herein.

Post Grading Considerations

Slope Landscaping and Maintenance

Adequate slope and building pad drainage is essential for the long term performance of the subject site. The gross stability of graded slopes should not be adversely affected, provided all drainage provisions are properly constructed and maintained. Engineered slopes should be landscaped with deep rooted, drought tolerant maintenance free plant species, as recommended by the project landscape architect.

Site Drainage

Control of site drainage is important for the performance of the proposed project. Roof gutters are recommended for the proposed structures. Pad and roof drainage should be collected and transferred to driveways, adjacent streets, storm-drain facilities, or other locations approved by the building official in non-erosive drainage devices. Drainage should not be allowed to pond on the pad or against any foundation or retaining wall. Drainage should not be allowed to flow uncontrolled over any descending slope. Planters located within retaining wall backfill should be sealed to prevent moisture intrusion into the backfill. Planters located next to structures should be sealed to the depth of the footings. Drainage control devices require periodic cleaning, testing and maintenance to remain effective.

At a minimum, pad drainage should be designed at the minimum gradients required by the CBC. To divert water away from foundations, the ground surface adjacent to foundations should also be graded at the minimum gradients required per the CBC.

Utility Trenches

All utility trench backfill should be compacted at near optimum moisture to a minimum of 90 percent of the maximum dry density determined by ASTM test method D 1557-00. For utility trench backfill within pavement areas the upper 6 inches of subgrade materials should be compacted to 95 percent of the maximum dry density determined by ASTM D 1557-00. This includes within the street right-of-ways, utility easements, under footings, sidewalks, driveways and building floor slabs, as well as within or adjacent to any slopes. Backfill should be placed in approximately 6 to 8 inch maximum loose lifts and then mechanically compacted with a hydro-hammer, rolling with a sheepsfoot, pneumatic tampers, or similar equipment. The utility trenches should be tested by the

project geotechnical engineer or their representative to verify minimum compaction requirements are obtained.

In order to minimize the penetration of moisture below building slabs, all utility trenches should be backfilled with compacted fill, lean concrete or concrete slurry where they undercut the perimeter foundation. Utility trenches that are proposed parallel to any building footings (interior and/or exterior trenches), should not be located within a 1:1 (h:v) plane projected downward from the outside bottom edge of the footing.

SEISMIC DESIGN CONSIDERATIONS

Ground Motions

Structures are required to be designed and constructed to resist the effects of seismic ground motions as provided in the 2016 California Building Code Section 1613. The design is dependent on the site class, occupancy category I, II, III, or IV, mapped spectral accelerations for short periods (S_s), and mapped spectral acceleration for a 1-second period (S_1).

In order for structural design to comply with the 2016 CBC, the USGS "US Seismic Design Maps" online tool was used to compile spectral accelerations for the subject property based on data and maps jointly compiled by the United States Geological Survey (USGS) and the California Geological Survey (CGS). The data found in the following table is based on the Maximum Considered Earthquake (MCE) with 5% damped ground motions having a 2% probability of being exceeded in 50 years (2,475 year return period).

The seismic design coefficients were determined by a combination of the site class, mapped spectral accelerations, and occupancy category. The following seismic design coefficients should be implemented during design of the proposed structures. Summaries of the Seismic Hazard Deaggregation graphs and test data are presented in Appendix D.

2016 CBC	FACTOR
Site Location	Latitude: 33.537709° (North) Longitude: -117.075181° (West)
Site Class	D
Mapped Spectral Accelerations for short periods, S_s	1.622
Mapped Spectral Accelerations for 1-Second Period, S_1	0.658
Maximum Considered Earthquake Spectral Response Acceleration for Short Periods, S_{ms}	1.622
Maximum Considered Earthquake Spectral Response Acceleration for 1-Second Period, S_{m1}	0.988
Design Spectral Response Acceleration for Short Periods, S_{DS}	1.082
Design Spectral Response Acceleration for 1-Second Period, S_{D1}	0.658
Seismic Design Category	D
Importance Factor Based on Occupancy Category	II

We performed the probabilistic seismic hazard assessment for the site in accordance with the 2016 CBC, Section 1803.5.11 and 1803.5.12. The probabilistic seismic hazard maps and data files were jointly prepared by the United States Geological Survey (USGS) and the California Geological Survey (CGS) and can be found at the CGS Probabilistic Seismic Hazards Mapping Ground Motion Page. Actual ground shaking intensities at the site may be substantially higher or lower based on complex variables such as the near source directivity effects, depth and consistency of earth materials, topography, geologic structure, direction of fault rupture, and seismic wave reflection, refraction, and attenuation rates. The mean peak ground acceleration was calculated to be 0.635 g.

Secondary Seismic Hazards

Secondary effects of seismic shaking considered as potential hazards include several types of ground failure as well as induced flooding. Different types of ground failure, which could occur as a consequence of severe ground shaking at the site, include landslides, ground lurching, shallow ground rupture, and liquefaction/lateral spreading. The probability of occurrence of each type of ground failure depends on the severity of the earthquake, distance from faults, topography, the state of subsurface earth materials, groundwater conditions, and other factors. Based on our experience, subsurface exploration, and laboratory testing, all of the above secondary effects of seismic activity are considered unlikely.

Seismically induced flooding is normally a consequence of a tsunami (seismic sea wave), a seiche (i.e., a wave-like oscillation of surface water in an enclosed basin that may be initiated by a strong earthquake) or failure of a major reservoir or retention system up gradient of the site. Since the site is at an elevation of more than 1,250 feet above mean sea level and is located more than 25 miles inland from the nearest coastline of the Pacific Ocean, the potential for seismically induced flooding due to a tsunami is considered nonexistent. Since no enclosed bodies of water lie adjacent to or up gradient of the site, the likelihood for induced flooding due to a dam failure or a seiche overcoming the dam's freeboard is considered nonexistent.

TENTATIVE FOUNDATION DESIGN RECOMMENDATIONS

General

Provided grading is performed in accordance with the recommendations of this report, shallow foundations are considered feasible for support of the proposed structures. Tentative foundation recommendations are provided herein and graphic presentations of relevant recommendations may also be included on the enclosed map.

Allowable Bearing Values

An allowable bearing value of 2,000 pounds per square foot (psf) is recommended for design of 24-inch square pad footings and 12-inch-wide continuous footings founded at a minimum depth of 12 inches below the lowest adjacent final grade. This value may be increased by 20 percent for each additional 1-foot of width and/or depth to a maximum value of 2,500 psf. Recommended allowable bearing values include both dead and frequently applied live loads and may be increased by one third when designing for short duration wind or seismic forces.

Settlement

Based on the settlement characteristics of the earth materials that underlie the building sites and the anticipated loading, we estimate that the maximum total settlement of the footings will be less than approximately $\frac{3}{4}$ inch. Differential settlement is expected to be about $\frac{1}{2}$ inch over a horizontal distance of approximately 20 feet, for an angular distortion ratio of 1:480. It is anticipated that the majority of the settlement will occur during construction or shortly after the initial application of loading.

The above settlement estimates are based on the assumption that the grading and construction are performed in accordance with the recommendations presented in this report and that the project geotechnical consultant will observe or test the earth material conditions in the footing excavations.

Lateral Resistance

Passive earth pressure of 250 psf per foot of depth to a maximum value of 2,500 psf may be used to establish lateral bearing resistance for footings. For areas covered with hardscape, passive earth pressure may be taken from the surface. For areas without hardscape, the first 3 feet of the soil profile must be neglected when calculating passive earth pressure. A coefficient of friction of 0.36 times the dead load forces may be used between concrete and the supporting earth materials to determine lateral sliding resistance. The above values may be increased by one-third when designing for short duration wind or seismic forces. When combining passive and friction for lateral resistance, the passive component should be reduced by one third. In no case shall the lateral sliding resistance exceed one-half the dead load for clay, sandy clay, sandy silty clay, silty clay, and clayey silt.

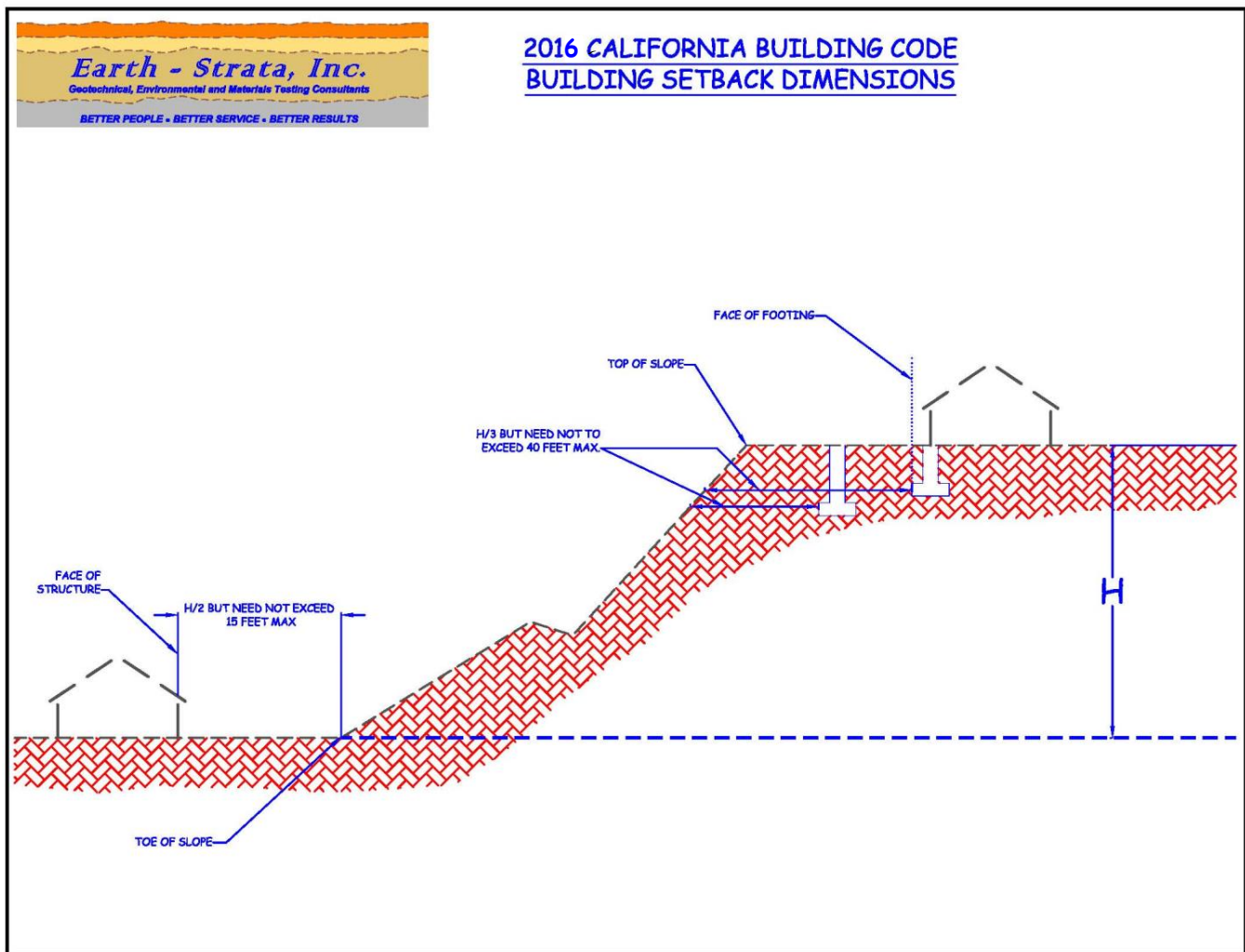
The above lateral resistance values are based on footings for an entire structure being placed directly against either compacted fill or competent alluvium.

Structural Setbacks and Building Clearance

Structural setbacks are required per the 2016 California Building Code (CBC). Additional structural setbacks are not required due to geologic or geotechnical conditions within the site. Improvements constructed in close proximity to natural or properly engineered and compacted slopes can, over time, be affected by natural processes including gravity forces, weathering, and long term secondary settlement. As a result, the CBC requires that buildings and structures be setback or footings deepened to resist the influence of these processes.

For structures that are planned near ascending and descending slopes, the footings should be embedded to satisfy the requirements presented in the CBC, Section 1808.7 as illustrated in the following Foundation Clearances from Slopes diagram.

FOUNDATION CLEARANCES FROM SLOPES



When determining the required clearance from ascending slopes with a retaining wall at the toe, the height of the slope shall be measured from the top of the wall to the top of the slope.

Foundation Observations

In accordance with the 2016 CBC and prior to the placement of forms, concrete, or steel, all foundation excavations should be observed by the geologist, engineer, or his representative to verify that they have been excavated into competent bearing materials. The excavations should be per the approved plans, moistened, cleaned of all loose materials, trimmed neat, level, and square. Any moisture softened earth materials should be removed prior to steel or concrete placement.

Earth materials from foundation excavations should not be placed in slab on grade areas unless the materials are tested for expansion potential and compacted to a minimum of 90 percent of the maximum dry density.

Expansive Soil Considerations

Preliminary laboratory test results indicate onsite earth materials exhibit an expansion potential of **VERY LOW** as classified in accordance with 2016 CBC Section 1803.5.3 and ASTM D4829-03. Additional, testing for expansive soil conditions should be conducted upon completion of rough grading. The following recommendations should be considered the very minimum requirements, for the earth materials tested. It is common practice for the project architect or structural engineer to require additional slab thickness, footing sizes, and/or reinforcement.

Very Low Expansion Potential (Expansion Index of 20 or Less)

Our laboratory test results indicate that the earth materials onsite exhibit a **VERY LOW** expansion potential as classified in accordance with 2016 CBC Section 1803.5.3 and ASTM D4829-03. Since the onsite earth materials exhibit expansion indices of 20 or less, the design of slab on ground foundations is exempt from the procedures outlined in Section 1808.6.1 or 1808.6.2.

Footings

- Exterior continuous footings may be founded at the minimum depths below the lowest adjacent final grade (i.e. 18-inch minimum depth for one and two-story, and 24-inch minimum depth for three-story construction). Interior continuous footings for one-, two-, and three-story construction may be founded at a minimum depth of 12 inches below the lowest adjacent final grade. All continuous footings should have a minimum width of 12, 15, and 18 inches, for one-, two-, and three-story structures, respectively per Table 1809.7 of the 2016 CBC, and should be reinforced with a minimum of two (2) No. 4 bars, one (1) top and one (1) bottom.
- Exterior pad footings intended to support roof overhangs, such as second story decks, patio covers and similar construction should be a minimum of 24 inches square and founded at a minimum depth of 18 inches below the lowest adjacent final grade. No special reinforcement of the pad footings will be required.

Building Floor Slabs

- Building floor slabs should be a minimum of 4 inches thick and reinforced with a minimum of No. 3 bars spaced a maximum of 24 inches on center, each way. All floor slab reinforcement should be supported on concrete chairs or bricks to ensure the desired placement at mid-depth.
- Interior floor slabs, within living or moisture sensitive areas, should be underlain by a minimum 10-mil thick moisture/vapor barrier to help reduce the upward migration of moisture from the underlying earth materials. The moisture/vapor barrier used should meet the performance standards of an ASTM E 1745 Class A material, and be properly installed in accordance with ACI publication 318-05. It is the responsibility of the contractor to ensure that the moisture/vapor barriers are free of openings, rips, or punctures prior to placing concrete. As an option for additional moisture reduction, higher strength concrete, such as a minimum 28-day compressive strength of 5,000 pounds per square inch (psi) may be used. Ultimately, the design of the moisture/vapor barrier system and recommendations for concrete placement and curing are the purview of the foundation engineer, taking into consideration the project requirements

provided by the architect and owner.

- Garage floor slabs should be a minimum of 5 inches thick and should be reinforced in a similar manner as living area floor slabs. Garage floor slabs should be placed separately from adjacent wall footings with a positive separation maintained with $\frac{3}{8}$ inch minimum felt expansion joint materials and quartered with weakened plane joints. A 12-inch-wide turn down founded at the same depth as adjacent footings should be provided across garage entrances. The turn down should be reinforced with a minimum of two (2) No. 4 bars, one (1) top and one (1) bottom.
- The subgrade earth materials below all floor slabs should be pre-watered to promote uniform curing of the concrete and minimize the development of shrinkage cracks, prior to placing concrete. The pre-watering should be verified by Earth Strata Geotechnical Services during construction.

Corrosivity

Corrosion is defined by the National Association of Corrosion Engineers (NACE) as “a deterioration of a substance or its properties because of a reaction with its environment.” From a geotechnical viewpoint, the “substances” are the reinforced concrete foundations or buried metallic elements (not surrounded by concrete) and the “environment” is the prevailing earth materials in contact with them. Many factors can contribute to corrosivity, including the presence of chlorides, sulfates, salts, organic materials, different oxygen levels, poor drainage, different soil types, and moisture content. It is not considered practical or realistic to test for all of the factors which may contribute to corrosivity.

The potential for concrete exposure to chlorides is based upon the recognized Caltrans reference standard “Bridge Design Specifications”, under Subsection 8.22.1 of that document, Caltrans has determined that “Corrosive water or soil contains more than 500 parts per million (ppm) of chlorides”. Based on limited preliminary laboratory testing, the onsite earth materials have chloride contents *less* than 500 ppm. As such, specific requirements resulting from elevated chloride contents are not required.

Specific guidelines for concrete mix design are provided in 2016 CBC Section 1904.1 and ACI 318, Section 4.3 Table 4.3.1 when the soluble sulfate content of earth materials exceeds 0.1 percent by weight. Based on limited preliminary laboratory testing, the onsite earth materials are classified in accordance with Table 4.3.1 as having a *negligible* sulfate exposure condition. Therefore, structural concrete in contact with onsite earth materials should utilize Type I or II.

Based on our laboratory testing of resistivity, the onsite earth materials in contact with buried steel should be considered *moderately corrosive*. Additionally, pH values below 9.7 are recognized as being corrosive to most common metallic components including, copper, steel, iron, and aluminum. The pH values for the earth materials tested were *lower* than 9.7. Therefore, any steel or metallic materials that are exposed to the earth materials should be encased in concrete or other measures should be taken to provide corrosion protection.

The preliminary test results for corrosivity are based on limited samples, and the initiation of grading may blend various earth materials together. This blending or imported material could alter and increase the detrimental properties of the onsite earth materials. Accordingly, additional testing for chlorides and sulfates along with testing for pH and resistivity should be performed upon completion of grading. Laboratory test results are presented in Appendix C.

RETAINING WALLS

Active and At-Rest Earth Pressures

Foundations may be designed in accordance with the recommendations provided in the Tentative Foundation Design Recommendation section of this report. The following table provides the minimum recommended equivalent fluid pressures for design of retaining walls a maximum of 8 feet high. The active earth pressure should be used for design of unrestrained retaining walls, which are free to tilt slightly. The at-rest earth pressure should be used for design of retaining walls that are restrained at the top, such as basement walls, curved walls with no joints, or walls restrained at corners. For curved walls, active

pressure may be used if tilting is acceptable and construction joints are provided at each angle point and at a minimum of 15 foot intervals along the curved segments.

MINIMUM STATIC EQUIVALENT FLUID PRESSURES (pcf)		
PRESSURE TYPE	BACKSLOPE CONDITION	
	LEVEL	2:1 (h:v)
Active Earth Pressure	40	63
At-Rest Earth Pressure	60	95

The retaining wall parameters provided do not account for hydrostatic pressure behind the retaining walls. Therefore, the subdrain system is a very important part of the design. All retaining walls should be designed to resist surcharge loads imposed by other nearby walls, structures, or vehicles should be added to the above earth pressures, if the additional loads are being applied within a 1.5:1 (h:v) plane projected up from the heel of the retaining wall footing. As a way of minimizing surcharge loads and the settlement potential of nearby buildings, the footings for the building can be deepened below the 1.5:1 (h:v) plane projected up from the heel of the retaining wall footing.

Upon request and under a separate scope of work, more detailed analyses can be performed to address equivalent fluid pressures with regard to stepped retaining walls, actual retaining wall heights, actual backfill inclinations, specific backfill materials, higher retaining walls requiring earthquake design motions, etc.

Subdrain System

We recommend a perforated pipe and gravel subdrain system be provided behind all proposed retaining walls to prevent the buildup of hydrostatic pressure behind the proposed retaining walls. The perforated pipe should consist of 4-inch minimum diameter Schedule 40 PVC or ABS SDR-35, placed with the perforations facing down. The pipe should be surrounded by 1 cubic foot per foot of $\frac{3}{4}$ - or 1 $\frac{1}{2}$ inch open graded gravel wrapped in filter fabric. The filter fabric should consist of Mirafi 140N or equivalent to prevent infiltration of fines and subsequent clogging of the subdrain system.

In lieu of a perforated pipe and gravel subdrain system, weep holes or open vertical masonry joints may be provided in the lowest row of block exposed to the air to prevent the buildup of hydrostatic pressure behind the proposed retaining walls. Weep holes should be a minimum of 3 inches in diameter and provided at intervals of at least every 6 feet along the wall. Open vertical masonry joints should be provided at a minimum of 32 inch intervals. A continuous gravel fill, a minimum of 1 cubic foot per foot, should be placed behind the weep holes or open masonry joints. The gravel should be wrapped in filter fabric consisting of Mirafi 140N or equivalent.

The retaining walls should be adequately coated on the backfilled side of the walls with a proven waterproofing compound by an experienced professional to inhibit infiltration of moisture through the walls.

Temporary Excavations

All excavations should be made in accordance with Cal-OSHA requirements. Earth Strata Geotechnical Services is not responsible for job site safety.

Retaining Wall Backfill

Retaining wall backfill materials should be approved by the geotechnical engineer or his representative prior to placement as compacted fill. Retaining wall backfill should be placed in lifts no greater than 6 to 8 inches, watered or air dried as necessary to achieve near optimum moisture contents. All retaining wall backfill should be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D 1557. Retaining wall backfill should be capped with a paved surface drain.

CONCRETE FLATWORK

Thickness and Joint Spacing

Concrete sidewalks and patio type slabs should be at least 3½ inches thick and provided with construction or expansion joints every 6 feet or less, to reduce the potential for excessive cracking. Concrete driveway slabs should be at least 4 inches thick and provided with construction or expansion joints every 10 feet or less.

Subgrade Preparation

In order to reduce the potential for unsightly cracking, subgrade earth materials underlying concrete flatwork should be compacted at near optimum moisture to a minimum of 90 percent of the maximum dry density determined by ASTM test method D 1557-00 and then moistened to at least optimum or slightly above optimum moisture content. This moisture should extend to a depth of at least 12 inches below subgrade and be maintained prior to placement of concrete. Pre-watering of the earth materials prior to placing concrete will promote uniform curing of the concrete and minimize the development of shrinkage cracks. The project geotechnical engineer or his representative should verify the density and moisture content of the earth materials and the depth of moisture penetration prior to placing concrete.

Cracking within concrete flatwork is often a result of factors such as the use of too high a water to cement ratio and/or inadequate steps taken to prevent moisture loss during the curing of the concrete. Concrete distress can be reduced by proper concrete mix design and proper placement and curing of the concrete. Minor cracking within concrete flatwork is normal and should be expected.

GRADING PLAN REVIEW AND CONSTRUCTION SERVICES

This report has been prepared for the exclusive use of **Mr. Reza James** and their authorized representative. It likely does not contain sufficient information for other parties or other uses. Earth Strata Geotechnical Services should be engaged to review the final design plans and specifications prior to construction. This is to verify that the recommendations contained in this report have been properly incorporated into the project plans and specifications. Should Earth Strata Geotechnical Services not be accorded the

opportunity to review the project plans and specifications, we are not responsible for misinterpretation of our recommendations.

We recommend that Earth Strata Geotechnical Services be retained to provide geologic and geotechnical engineering services during grading and foundation excavation phases of the work. In order to allow for design changes in the event that the subsurface conditions differ from those anticipated prior to construction.

Earth Strata Geotechnical Services should review any changes in the project and modify and approve in writing the conclusions and recommendations of this report. This report and the drawings contained within are intended for design input purposes only and are not intended to act as construction drawings or specifications. In the event that conditions encountered during grading or construction operations appear to be different than those indicated in this report, this office should be notified immediately, as revisions may be required.

REPORT LIMITATIONS

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable soils engineers and geologists, practicing at the time and location this report was prepared. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

Earth materials vary in type, strength, and other geotechnical properties between points of observation and exploration. Groundwater and moisture conditions can also vary due to natural processes or the works of man on this or adjacent properties. As a result, we do not and cannot have complete knowledge of the subsurface conditions beneath the subject property. No practical study can completely eliminate uncertainty with regard to the anticipated geotechnical conditions in connection with a subject property. The conclusions and recommendations within this report are based upon the findings at the points of observation and are subject to confirmation by Earth Strata Geotechnical Services based on the conditions revealed during grading and construction.

This report was prepared with the understanding that it is the responsibility of the owner or their representative, to ensure that the conclusions and recommendations contained herein are brought to the attention of the other project consultants and are incorporated into the plans and specifications. The owners' contractor should properly implement the conclusions and recommendations during grading and construction, and notify the owner if they consider any of the recommendations presented herein to be unsafe or unsuitable.

APPENDIX A

REFERENCES

APPENDIX A

References

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APPENDIX B
EXPLORATORY LOGS

Geotechnical Boring Log B-1						
Date: February 28, 2017			Project Name: Calle Contento			
Project Number: 171654-10A			Logged By: JCF			
Drilling Company: N/A			Type of Rig: Hand Auger			
Drive Weight (lbs): -			Drop (in): - Hole Diameter (in): -			
Top of Hole Elevation (ft): See Map			Hole Location: See Geotechnical Map			
Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0		0-5.5'				Artificial Fill, Undocumented (Afu)
		1'	110.1	4.7	SM	Silty SAND; brown, dry, loose, fine to coarse sand, trace clay and gravel
		3'	105.3	5.3		
5					SP-SM	Poorly-Graded, Silty SAND; dark brown, slightly moist, medium dense, fine to coarse sand with gravel, trace clay
		5'	110.9	4.9		
						Total Depth: 5.5 feet
						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log B-2

Date: February 28, 2017	Project Name: Calle Contento	Page: 1 of 1
Project Number: 171654-10A	Logged By: JCF	
Drilling Company: N/A	Type of Rig: Hand Auger	
Drive Weight (lbs): -	Drop (in): -	Hole Diameter (in): -
Top of Hole Elevation (ft): See Map	Hole Location: See Geotechnical Map	

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						Artificial Fill, Undocumented (Afu)
		1'	109.6	3.9	SM	Silty SAND; light brown, slightly moist, loose, fine to coarse sand with gravel, trace clay
		3'	109.3	5.2	SP-SM	Poorly-Graded, Silty SAND; dark brown, slightly moist, medium dense, fine to coarse sand with gravel, trace clay
5		5'	102.4	5.8		Light brown below 4 feet
						Total Depth 5.5 feet
						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log B-3

Date: February 28, 2017	Project Name: Calle Contento	Page: 1 of 1
Project Number: 171654-10A	Logged By: JCF	
Drilling Company: N/A	Type of Rig: Hand Auger	
Drive Weight (lbs): -	Drop (in): -	Hole Diameter (in): -
Top of Hole Elevation (ft): See Map	Hole Location: See Geotechnical Map	

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						Artificial Fill, Undocumented (Afu)
		2'	113.6	5.8	SM	Silty SAND; light brown, slightly moist, loose, fine to coarse sand with gravel, trace clay
		4'	100.2	5.2	SP-SM	Poorly-Graded, Silty SAND; dark brown, medium dense, fine to coarse sand with gravel, trace clay
5						Light yellowish brown below 4 feet
						Total Depth: 5 feet
						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log B-4

Date: February 28, 2017	Project Name: Calle Contento	Page: 1 of 1
Project Number: 171654-10A	Logged By: JCF	
Drilling Company: N/A	Type of Rig: Hand Auger	
Drive Weight (lbs): -	Drop (in): -	Hole Diameter (in): -
Top of Hole Elevation (ft): See Map	Hole Location: See Geotechnical Map	

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						Artificial Fill, Undocumented (Afu)
		1'	108.5	5.2	SM	Silty SAND; light brown, slightly moist, loose, fine to coarse sand with gravel, trace clay
		3'	112.2	7.3	SP-SM	Poorly-Graded, Silty SAND ; dark brown, slightly moist, medium dense, fine to coarse sand with gravel, trace clay
5		5'	96.0	4.7		Yellowish brown, with clay below 4 feet
						No Recovery at 5 feet
						Total Depth: 5.5 feet
						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log B-5

Date: March 3, 2017	Project Name: Calle Contento	Page: 1 of 1
Project Number: 171654-10A	Logged By: JCF	
Drilling Company: Drilling It	Type of Rig: Simco 2800	
Drive Weight (lbs): 140	Drop (in): 30	Hole Diameter (in): 8
Top of Hole Elevation (ft): See Map	Hole Location: See Geotechnical Map	

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						Artificial Fill, Undocumented (Afu):
					SM	Silty SAND; dark brown, slightly moist, medium dense, fine to coarse sand
	19	2.5'	119.0	6.3		with clay and trace gravel
5						
	19	5'	106.7	7.5		
	22	7.5'	109.5	5.7		Quaternary Young Alluvial Deposits (Qya):
					SP-SC	Poorly-graded, Clayey SAND; yellowish brown, slightly moist, medium dense,
10						fine to medium sand with gravel
	30	10'	101.8	6.0		
						Practical Refusal at 11.5'
						Total Depth 11.5'
						No Groundwater
15						
20						
25						
30						

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Geotechnical Boring Log B-6

Date: March 3, 2017	Project Name: Calle Contento	Page: 1 of 1
Project Number: 171654-10A	Logged By: JCF	
Drilling Company: Drilling It	Type of Rig: Simco 2800	
Drive Weight (lbs): 140	Drop (in): 30	Hole Diameter (in): 8
Top of Hole Elevation (ft): See Map	Hole Location: See Geotechnical Map	

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						Artificial Fill, Undocumented (Afu):
					SM	Silty SAND; dark brown, slightly moist, medium dense, fine to coarse sand
	17	2.5'	104.4	5.6		with clay and trace gravel
5						
	23	5'	110.5	6.5		
	24	7.5'	108.7	7.2		Quaternary Young Alluvial Deposits (Qya):
		7'-10'			SC	Clayey SAND; yellowish brown, slightly moist, medium dense, fine to medium sand with gravel
10		10'				
						No Recovery at 10'
						Practical Refusal at 11.5'
						Total Depth 11.5'
15						No Groundwater
20						
25						
30						

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Geotechnical Boring Log B-7

Date: March 3, 2017	Project Name: Calle Contento	Page: 1 of 1
Project Number: 171654-10A	Logged By: JCF	
Drilling Company: Drilling It	Type of Rig: Simco 2800	
Drive Weight (lbs): 140	Drop (in): 30	Hole Diameter (in): 8
Top of Hole Elevation (ft): See Map	Hole Location: See Geotechnical Map	

Depth (ft)	Blow Count Per Foot	Sample Depth	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						Artificial Fill, Undocumented (Afu):
					SC	Clayey SAND; dark brown, slightly moist, medium dense, fine to medium sand with trace gravel
	42	2.5'	118.2	6.0		
5						
	33	5'	106.2	6.0		
	18	7.5'	110.2	8.4		Quaternary Young Alluvial Deposits (Qya):
					SP-SM	Poorly-graded, Silty SAND; yellowish brown, slightly moist, medium dense, fine to coarse sand with clay and gravel
10	30	10'	105.5	8.2		
						Practical Refusal at 11.5'
						Total Depth 11.5'
						No Groundwater
15						
20						
25						
30						

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APPENDIX C

LABORATORY PROCEDURES AND TEST RESULTS

APPENDIX C

Laboratory Procedures and Test Results

Laboratory testing provided quantitative and qualitative data involving the relevant engineering properties of the representative earth materials selected for testing. The representative samples were tested in general accordance with American Society for Testing and Materials (ASTM) procedures and/or California Test Methods (CTM).

Soil Classification: Earth materials encountered during exploration were classified and logged in general accordance with the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) of ASTM D 2488. Upon completion of laboratory testing, exploratory logs and sample descriptions were reconciled to reflect laboratory test results with regard to ASTM D 2487.

Moisture and Density Tests: For select samples moisture content was determined using the guidelines of ASTM D 2216 and dry density determinations were made using the guidelines of ASTM D 2937. These tests were performed on relatively undisturbed samples and the test results are presented on the exploratory logs.

Maximum Density Tests: The maximum dry density and optimum moisture content of representative samples were determined using the guidelines of ASTM D 1557. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
Bulk 1 @ 0-2 feet	Silty SAND	124.0	10.0

Expansion Index: The expansion potential of representative samples was evaluated using the guidelines of ASTM D 4829. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	EXPANSION INDEX	EXPANSION POTENTIAL
Bulk 1 @ 0-2 feet	Silty SAND	0	Very Low

Minimum Resistivity and pH Tests: Minimum resistivity and pH Tests of select samples were performed using the guidelines of CTM 643. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	pH	MINIMUM RESISTIVITY (ohm-cm)
Bulk 1 @ 0-2 feet	Silty SAND	7.5	2.000

Soluble Sulfate: The soluble sulfate content of select samples was determined using the guidelines of CTM 417. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	SULFATE CONTENT (% by weight)	SULFATE EXPOSURE
Bulk 1 @ 0-2 feet	Silty SAND	0.003	Negligible

Chloride Content: Chloride content of select samples was determined using the guidelines of CTM 422. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	CHLORIDE CONTENT (ppm)
Bulk 1 @ 0-2 feet	Silty SAND	230

APPENDIX D

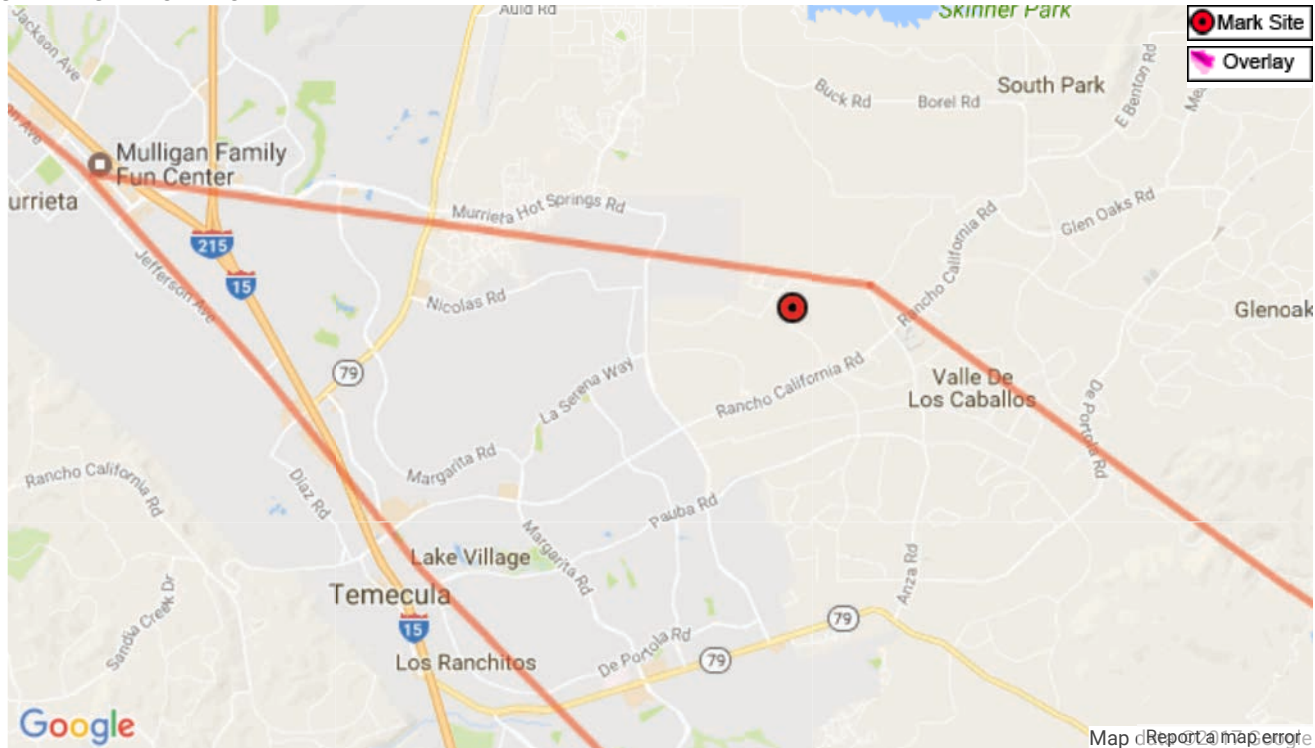
SEISMICITY

CALIFORNIA DEPARTMENT OF TRANSPORTATION

Caltrans ARS Online (v2.3.08)

This web-based tool calculates both deterministic and probabilistic acceleration response spectra for any location in California based on criteria provided in [Appendix B of Caltrans Seismic Design Criteria](#). [More...](#)

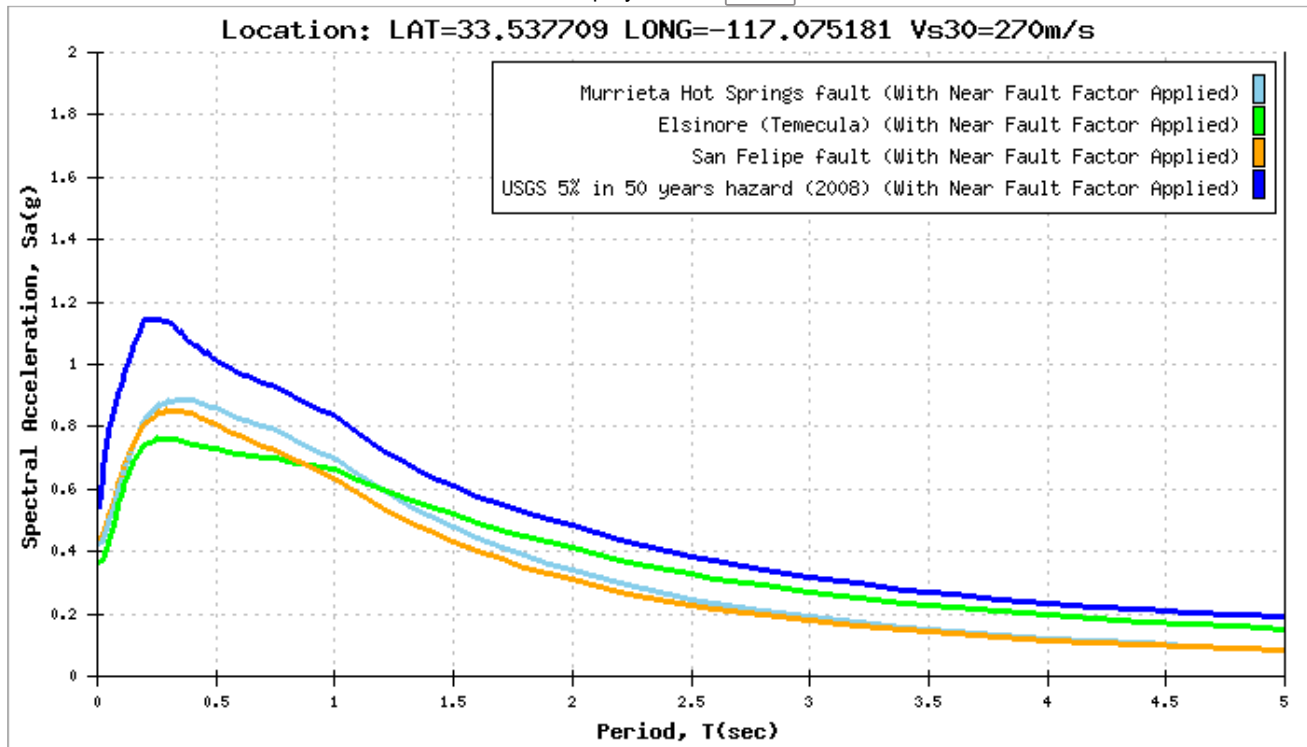
SELECT SITE LOCATION



Latitude: Longitude: Vs30: m/s

CALCULATED SPECTRA

Display Curves: 3 ▾



Tabular Data

Envelope Only

Hide Near Fault

Axis Scale

Show Basin

Apply Near Fault Adjustment To:

NOTE: Caltrans SDC requires application of a Near Fault Adjustment factor for sites less than 25 km (Rrup) from the causative fault.

☒ Deterministic Spectrum Using

0.55 Km Murrieta Hot Springs fault

7.57 Km Elsinore (Temecula)

1.47 Km San Felipe fault

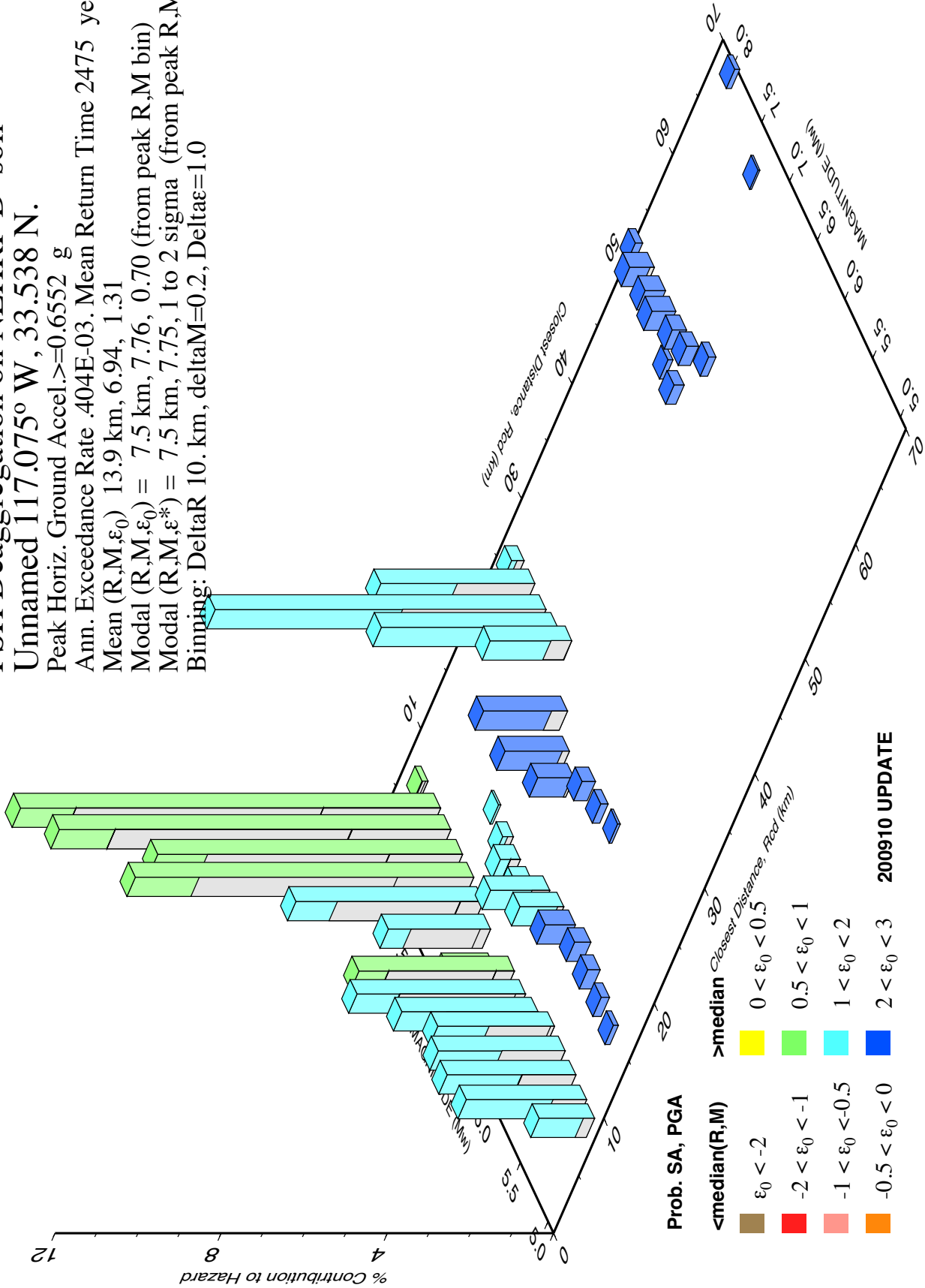
☒ Probabilistic Spectrum Using

0.55 Km (Recommend Performing Deaggregation To Verify)

☒ Show Spectrum with Adjustment Only☐ Show Spectrum with and without near fault Adjustment

OK

PSH Deaggregation on NEHRP D soil
 Unnamed 117.075° W, 33.538 N.
 Peak Horiz. Ground Accel. ≥ 0.6552 g
 Ann. Exceedance Rate .404E-03. Mean Return Time 2475 years
 Mean (R,M,ϵ_0) 13.9 km, 6.94, 1.31
 Modal $(R,M,\epsilon_0) = 7.5$ km, 7.76, 0.70 (from peak R,M bin)
 Modal $(R,M,\epsilon^*) = 7.5$ km, 7.75, 1 to 2 sigma (from peak R,M, ϵ bin)
 Binning: DeltaR 10. km, deltaM=0.2, Delta ϵ =1.0



*** 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: Unnamed long: 117.075 W., lat: 33.538 N.

Vs30(m/s)= 270.0 (some WUS atten. models use Site Class not Vs30).

NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below

Return period: 2475 yrs. Exceedance PGA =0.6552 g. Weight * Computed_Rate_Ex 0.404E-03

#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.00001

#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
8.3	5.05	1.337	1.074	0.263	0.000	0.000	0.000	0.000
8.3	5.20	2.894	2.087	0.807	0.000	0.000	0.000	0.000
14.7	5.21	0.124	0.124	0.000	0.000	0.000	0.000	0.000
8.4	5.40	3.098	1.802	1.295	0.000	0.000	0.000	0.000
15.1	5.41	0.202	0.202	0.000	0.000	0.000	0.000	0.000
8.5	5.60	3.060	1.540	1.505	0.015	0.000	0.000	0.000
15.5	5.60	0.300	0.300	0.000	0.000	0.000	0.000	0.000
8.6	5.80	2.815	1.239	1.482	0.094	0.000	0.000	0.000
15.9	5.80	0.392	0.392	0.000	0.000	0.000	0.000	0.000
7.7	6.01	3.282	1.073	2.070	0.140	0.000	0.000	0.000
15.2	6.02	0.731	0.683	0.048	0.000	0.000	0.000	0.000
24.0	6.02	0.057	0.057	0.000	0.000	0.000	0.000	0.000
7.3	6.20	4.058	1.026	2.789	0.242	0.000	0.000	0.000
14.9	6.20	1.058	0.911	0.147	0.000	0.000	0.000	0.000
23.7	6.21	0.175	0.175	0.000	0.000	0.000	0.000	0.000
7.2	6.40	3.746	0.722	2.579	0.446	0.000	0.000	0.000
14.2	6.40	1.423	1.003	0.420	0.000	0.000	0.000	0.000
23.5	6.42	0.329	0.329	0.000	0.000	0.000	0.000	0.000
5.5	6.60	1.116	0.179	0.726	0.211	0.000	0.000	0.000
13.0	6.60	0.426	0.263	0.163	0.000	0.000	0.000	0.000
21.6	6.63	0.881	0.824	0.057	0.000	0.000	0.000	0.000
6.8	6.79	2.464	0.553	1.663	0.248	0.000	0.000	0.000
12.8	6.80	0.485	0.247	0.237	0.000	0.000	0.000	0.000
22.4	6.79	1.551	1.383	0.168	0.000	0.000	0.000	0.000
7.4	6.97	4.518	1.003	2.963	0.552	0.000	0.000	0.000
13.2	6.96	0.258	0.121	0.136	0.001	0.000	0.000	0.000
24.0	6.97	2.019	1.645	0.375	0.000	0.000	0.000	0.000
54.2	7.03	0.185	0.185	0.000	0.000	0.000	0.000	0.000
7.5	7.17	8.141	1.540	4.775	1.826	0.000	0.000	0.000
13.4	7.21	0.058	0.020	0.034	0.003	0.000	0.000	0.000
27.6	7.21	1.966	1.465	0.500	0.000	0.000	0.000	0.000
49.9	7.21	0.241	0.241	0.000	0.000	0.000	0.000	0.000
53.0	7.23	0.294	0.294	0.000	0.000	0.000	0.000	0.000
7.5	7.36	7.338	1.197	4.379	1.763	0.000	0.000	0.000
26.8	7.40	4.244	3.003	1.242	0.000	0.000	0.000	0.000
49.9	7.42	0.124	0.124	0.000	0.000	0.000	0.000	0.000
52.6	7.42	0.338	0.338	0.000	0.000	0.000	0.000	0.000
66.8	7.38	0.051	0.051	0.000	0.000	0.000	0.000	0.000
7.5	7.57	9.420	1.346	5.700	2.374	0.000	0.000	0.000
26.5	7.58	7.963	4.516	3.447	0.000	0.000	0.000	0.000
52.4	7.59	0.575	0.575	0.000	0.000	0.000	0.000	0.000
7.5	7.76	10.115	1.334	5.959	2.822	0.000	0.000	0.000
26.6	7.79	3.717	1.847	1.870	0.000	0.000	0.000	0.000
52.3	7.77	0.494	0.467	0.026	0.000	0.000	0.000	0.000
7.5	7.98	0.143	0.016	0.075	0.052	0.001	0.000	0.000
26.6	7.99	0.305	0.134	0.171	0.000	0.000	0.000	0.000
52.3	7.97	0.598	0.499	0.099	0.000	0.000	0.000	0.000
69.4	7.98	0.122	0.122	0.000	0.000	0.000	0.000	0.000
52.3	8.18	0.179	0.156	0.024	0.000	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= 13.9 km; M= 6.94; eps0= 1.31. Mean calculated for all sources.

Modal src-site R= 7.5 km; M= 7.76; eps0= 0.70 from peak (R,M) bin

MODE R*= 7.5km; M*= 7.75; EPS.INTERVAL: 1 to 2 sigma % CONTRIB.= 5.959

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

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
California A-faults	67.08	15.9	7.42	1.24
CA Compr. crustal gridded	32.63	9.4	5.94	1.45

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

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)
Elsinore; Glen Ivy aPriori	2.06	20.9	6.83	2.03	-62.0
Elsinore;T aPriori	5.28	7.5	7.00	1.10	-134.7
Elsinore;GI+T aPriori	9.76	7.5	7.25	0.91	-134.7
Elsinore;T+J+CM aPriori	3.67	7.5	7.64	0.74	-134.7
Elsinore;GI+T+J+CM aPriori	3.81	7.5	7.72	0.71	-134.7
San Jacinto;A+C aPriori	5.02	26.6	7.50	1.74	32.5
San Jacinto;SBV+SJV+A+C aPriori	2.46	26.6	7.77	1.61	34.5
Elsinore;T+J+CM MoBal	3.64	7.5	7.64	0.74	-134.7
Elsinore;GI+T+J+CM MoBal	2.18	7.5	7.72	0.71	-134.7
Elsinore aflt, unsegmented	5.22	7.9	7.42	0.83	-133.9

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

PSHA Deaggregation. %contributions. site: Unnamed long: 117.075 W., lat: 33.538 N.

Vs30(m/s)= 270.0 (some WUS atten. models use Site Class not Vs30).

NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below

Return period: 2475 yrs. Exceedance PGA =0.6552 g. Weight * Computed_Rate_Ex 0.188E-03

#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.00000

#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
7.7	5.05	0.105	0.105	0.000	0.000	0.000	0.000	0.000
7.9	5.20	0.274	0.274	0.000	0.000	0.000	0.000	0.000
8.2	5.40	0.363	0.363	0.000	0.000	0.000	0.000	0.000
8.3	5.60	0.432	0.409	0.023	0.000	0.000	0.000	0.000
15.5	5.61	0.030	0.030	0.000	0.000	0.000	0.000	0.000
8.4	5.80	0.476	0.431	0.045	0.000	0.000	0.000	0.000
16.1	5.81	0.070	0.070	0.000	0.000	0.000	0.000	0.000
7.5	6.01	0.678	0.560	0.118	0.000	0.000	0.000	0.000
15.6	6.02	0.174	0.174	0.000	0.000	0.000	0.000	0.000
24.5	6.02	0.028	0.028	0.000	0.000	0.000	0.000	0.000
7.1	6.20	0.909	0.694	0.215	0.000	0.000	0.000	0.000
15.1	6.20	0.279	0.279	0.000	0.000	0.000	0.000	0.000
24.1	6.21	0.095	0.095	0.000	0.000	0.000	0.000	0.000
7.1	6.40	0.853	0.585	0.269	0.000	0.000	0.000	0.000
14.6	6.40	0.394	0.394	0.000	0.000	0.000	0.000	0.000
23.8	6.42	0.191	0.191	0.000	0.000	0.000	0.000	0.000
34.3	6.41	0.041	0.041	0.000	0.000	0.000	0.000	0.000
5.8	6.60	0.281	0.144	0.136	0.001	0.000	0.000	0.000
13.5	6.60	0.157	0.148	0.008	0.000	0.000	0.000	0.000
21.7	6.63	0.723	0.666	0.057	0.000	0.000	0.000	0.000
33.8	6.61	0.028	0.028	0.000	0.000	0.000	0.000	0.000
7.1	6.79	0.987	0.310	0.669	0.008	0.000	0.000	0.000
13.4	6.80	0.184	0.163	0.022	0.000	0.000	0.000	0.000
22.6	6.78	1.342	1.174	0.167	0.000	0.000	0.000	0.000
33.9	6.80	0.038	0.038	0.000	0.000	0.000	0.000	0.000
54.5	6.80	0.030	0.030	0.000	0.000	0.000	0.000	0.000
7.5	6.97	2.043	0.486	1.398	0.159	0.000	0.000	0.000
13.8	6.96	0.104	0.082	0.021	0.001	0.000	0.000	0.000
24.2	6.97	1.825	1.461	0.364	0.000	0.000	0.000	0.000
34.2	6.98	0.026	0.026	0.000	0.000	0.000	0.000	0.000
48.8	6.99	0.050	0.050	0.000	0.000	0.000	0.000	0.000
54.2	7.03	0.185	0.185	0.000	0.000	0.000	0.000	0.000
7.5	7.17	3.639	0.693	2.245	0.701	0.000	0.000	0.000
13.9	7.20	0.036	0.012	0.023	0.002	0.000	0.000	0.000
27.8	7.21	1.604	1.134	0.470	0.000	0.000	0.000	0.000
49.9	7.21	0.241	0.241	0.000	0.000	0.000	0.000	0.000
53.0	7.23	0.294	0.294	0.000	0.000	0.000	0.000	0.000
65.0	7.18	0.026	0.026	0.000	0.000	0.000	0.000	0.000
7.5	7.36	3.304	0.556	2.054	0.694	0.000	0.000	0.000

13.7	7.40	0.028	0.008	0.018	0.002	0.000	0.000	0.000
26.9	7.39	3.336	2.189	1.147	0.000	0.000	0.000	0.000
49.9	7.42	0.124	0.124	0.000	0.000	0.000	0.000	0.000
52.6	7.42	0.338	0.338	0.000	0.000	0.000	0.000	0.000
66.8	7.38	0.051	0.051	0.000	0.000	0.000	0.000	0.000
7.5	7.57	4.316	0.607	2.725	0.983	0.000	0.000	0.000
26.5	7.58	6.150	3.333	2.816	0.000	0.000	0.000	0.000
52.4	7.59	0.562	0.562	0.000	0.000	0.000	0.000	0.000
67.5	7.55	0.032	0.032	0.000	0.000	0.000	0.000	0.000
7.5	7.76	4.584	0.596	2.904	1.084	0.000	0.000	0.000
26.6	7.79	2.604	1.190	1.413	0.000	0.000	0.000	0.000
52.4	7.77	0.455	0.429	0.026	0.000	0.000	0.000	0.000
69.2	7.78	0.040	0.040	0.000	0.000	0.000	0.000	0.000
7.5	7.99	0.060	0.007	0.035	0.017	0.000	0.000	0.000
26.6	7.99	0.202	0.077	0.125	0.000	0.000	0.000	0.000
52.3	7.97	0.555	0.456	0.099	0.000	0.000	0.000	0.000
69.4	7.98	0.115	0.115	0.000	0.000	0.000	0.000	0.000
52.3	8.18	0.138	0.114	0.024	0.000	0.000	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:

Contribution from this GMPE(%): 46.4

Mean src-site R= 18.4 km; M= 7.23; eps0= 1.44. Mean calculated for all sources.

Modal src-site R= 26.5 km; M= 7.58; eps0= 1.60 from peak (R,M) bin

MODE R*= 26.5km; M*= 7.58; EPS.INTERVAL: 1 to 2 sigma % CONTRIB.= 3.333

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

Source Category: % contr. R(km) M epsilon0 (mean values).

California A-faults 39.61 19.4 7.41 1.38

CA Compr. crustal gridded 6.50 10.8 6.13 1.73

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

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

Elsinore; Glen Ivy aPriori 1.73 20.9 6.82 1.97 -62.0

Elsinore;T aPriori 2.42 7.5 7.00 1.15 -134.7

Elsinore;GI+T aPriori 4.31 7.5 7.25 0.98 -134.7

Elsinore;T+J+CM aPriori 1.67 7.5 7.64 0.79 -134.7

Elsinore;GI+T+J+CM aPriori 1.72 7.5 7.72 0.77 -134.7

San Jacinto;A+C aPriori 3.85 26.6 7.50 1.66 32.5

San Jacinto;SBV+SJV+A+C aPriori 1.74 26.6 7.77 1.54 34.5

Elsinore;T+J+CM MoBal 1.66 7.5 7.64 0.79 -134.7

Elsinore;GI+T+J+CM MoBal 0.99 7.5 7.72 0.77 -134.7

Elsinore aflt, unsegmented 2.57 8.1 7.40 0.90 -133.9

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

PSHA Deaggregation. %contributions. site: Unnamed long: 117.075 W., lat: 33.538 N.

Vs30(m/s)= 270.0 (some WUS atten. models use Site Class not Vs30).

NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below

Return period: 2475 yrs. Exceedance PGA =0.6552 g. Weight * Computed_Rate_Ex 0.306E-04

#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

8.0	5.05	0.174	0.174	0.000	0.000	0.000	0.000	0.000
8.2	5.21	0.482	0.480	0.002	0.000	0.000	0.000	0.000
8.4	5.40	0.677	0.616	0.061	0.000	0.000	0.000	0.000
14.3	5.42	0.014	0.014	0.000	0.000	0.000	0.000	0.000
8.5	5.60	0.727	0.626	0.101	0.000	0.000	0.000	0.000
14.9	5.60	0.035	0.035	0.000	0.000	0.000	0.000	0.000
8.5	5.80	0.638	0.520	0.117	0.000	0.000	0.000	0.000
15.3	5.80	0.047	0.047	0.000	0.000	0.000	0.000	0.000
7.7	6.01	0.681	0.553	0.128	0.000	0.000	0.000	0.000
14.6	6.02	0.101	0.101	0.000	0.000	0.000	0.000	0.000
7.2	6.20	0.855	0.670	0.186	0.000	0.000	0.000	0.000
14.6	6.20	0.164	0.164	0.000	0.000	0.000	0.000	0.000
22.9	6.21	0.010	0.010	0.000	0.000	0.000	0.000	0.000
7.2	6.40	0.865	0.570	0.295	0.000	0.000	0.000	0.000
14.0	6.40	0.243	0.243	0.000	0.000	0.000	0.000	0.000

23.2	6.41	0.021	0.021	0.000	0.000	0.000	0.000	0.000
5.1	6.60	0.302	0.130	0.171	0.000	0.000	0.000	0.000
12.7	6.60	0.100	0.096	0.005	0.000	0.000	0.000	0.000
23.2	6.60	0.008	0.008	0.000	0.000	0.000	0.000	0.000
5.5	6.80	0.245	0.118	0.127	0.000	0.000	0.000	0.000
12.5	6.80	0.102	0.094	0.008	0.000	0.000	0.000	0.000
22.9	6.80	0.010	0.010	0.000	0.000	0.000	0.000	0.000
6.3	6.97	0.161	0.100	0.061	0.000	0.000	0.000	0.000
12.8	6.95	0.047	0.043	0.004	0.000	0.000	0.000	0.000
23.6	6.95	0.004	0.004	0.000	0.000	0.000	0.000	0.000
7.5	7.16	0.217	0.150	0.067	0.000	0.000	0.000	0.000
7.5	7.35	0.173	0.115	0.058	0.000	0.000	0.000	0.000
7.5	7.57	0.212	0.132	0.081	0.000	0.000	0.000	0.000
7.5	7.76	0.241	0.143	0.098	0.000	0.000	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:

Contribution from this GMPE(%): 7.6

Mean src-site R= 8.4 km; M= 6.16; eps0= 1.62. Mean calculated for all sources.

Modal src-site R= 7.2 km; M= 6.40; eps0= 1.23 from peak (R,M) bin

MODE R*= 7.2km; M*= 6.20; EPS.INTERVAL: 1 to 2 sigma % CONTRIB.= 0.670

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

Source Category: % contr. R(km) M epsilon0 (mean values).

CA Compr. crustal gridded 6.61 8.6 5.98 1.58

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

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)
Elsinore; Glen Ivy aPriori	0.00	20.9	7.09	2.98	-62.0
Elsinore;T aPriori	0.12	7.5	7.03	2.07	-134.7
Elsinore;GI+T aPriori	0.27	7.5	7.25	1.91	-134.7
Elsinore;T+J+CM aPriori	0.10	7.5	7.64	1.85	-134.7
Elsinore;GI+T+J+CM aPriori	0.10	7.5	7.72	1.84	-134.7
San Jacinto;A+C aPriori	0.00	0.0	0.00	0.00	32.5
San Jacinto;SBV+SJV+A+C aPriori	0.00	26.6	7.92	2.96	34.5
Elsinore;T+J+CM MoBal	0.10	7.5	7.64	1.85	-134.7
Elsinore;GI+T+J+CM MoBal	0.06	7.5	7.72	1.84	-134.7
Elsinore aflt, unsegmented	0.02	7.5	7.44	2.68	-133.9

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

PSHA Deaggregation. %contributions. site: Unnamed long: 117.075 W., lat: 33.538 N.

Vs30(m/s)= 270.0 (some WUS atten. models use Site Class not Vs30).

NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below

Return period: 2475 yrs. Exceedance PGA =0.6552 g. Weight * Computed_Rate_Ex 0.186E-03

#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.00003

#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
8.4	5.05	1.058	0.952	0.106	0.000	0.000	0.000	0.000
14.4	5.05	0.040	0.040	0.000	0.000	0.000	0.000	0.000
8.4	5.20	2.138	1.846	0.291	0.000	0.000	0.000	0.000
14.8	5.21	0.121	0.121	0.000	0.000	0.000	0.000	0.000
8.5	5.40	2.057	1.634	0.423	0.000	0.000	0.000	0.000
15.2	5.40	0.182	0.182	0.000	0.000	0.000	0.000	0.000
8.6	5.60	1.901	1.320	0.581	0.000	0.000	0.000	0.000
15.6	5.60	0.235	0.235	0.000	0.000	0.000	0.000	0.000
8.6	5.80	1.702	1.064	0.638	0.000	0.000	0.000	0.000
15.9	5.80	0.275	0.275	0.000	0.000	0.000	0.000	0.000
7.7	6.01	1.923	0.992	0.932	0.000	0.000	0.000	0.000
15.1	6.02	0.456	0.449	0.007	0.000	0.000	0.000	0.000
23.5	6.01	0.027	0.027	0.000	0.000	0.000	0.000	0.000
7.3	6.20	2.294	1.003	1.291	0.000	0.000	0.000	0.000
14.8	6.20	0.615	0.600	0.015	0.000	0.000	0.000	0.000
23.3	6.21	0.070	0.070	0.000	0.000	0.000	0.000	0.000
7.3	6.40	2.028	0.711	1.317	0.000	0.000	0.000	0.000
14.1	6.40	0.785	0.704	0.081	0.000	0.000	0.000	0.000
23.4	6.41	0.105	0.105	0.000	0.000	0.000	0.000	0.000
5.4	6.60	0.533	0.156	0.372	0.005	0.000	0.000	0.000

12.6	6.60	0.169	0.150	0.019	0.000	0.000	0.000	0.000
21.2	6.61	0.097	0.097	0.000	0.000	0.000	0.000	0.000
6.8	6.79	1.233	0.315	0.875	0.043	0.000	0.000	0.000
12.5	6.80	0.198	0.158	0.040	0.000	0.000	0.000	0.000
21.2	6.77	0.199	0.199	0.000	0.000	0.000	0.000	0.000
7.4	6.97	2.315	0.481	1.525	0.308	0.000	0.000	0.000
12.8	6.96	0.107	0.077	0.029	0.000	0.000	0.000	0.000
21.9	6.98	0.294	0.271	0.023	0.000	0.000	0.000	0.000
7.5	7.17	4.285	0.697	2.462	1.126	0.000	0.000	0.000
27.8	7.23	0.233	0.228	0.004	0.000	0.000	0.000	0.000
7.5	7.36	3.861	0.526	2.267	1.068	0.000	0.000	0.000
26.7	7.41	0.919	0.813	0.106	0.000	0.000	0.000	0.000
7.5	7.57	4.892	0.607	2.894	1.391	0.000	0.000	0.000
26.5	7.59	1.892	1.262	0.631	0.000	0.000	0.000	0.000
7.5	7.76	5.289	0.595	2.956	1.738	0.000	0.000	0.000
26.6	7.80	1.113	0.656	0.456	0.000	0.000	0.000	0.000
52.3	7.77	0.038	0.038	0.000	0.000	0.000	0.000	0.000
7.5	7.98	0.080	0.007	0.038	0.034	0.001	0.000	0.000
26.6	7.99	0.102	0.056	0.046	0.000	0.000	0.000	0.000
52.3	7.96	0.044	0.044	0.000	0.000	0.000	0.000	0.000
52.3	8.16	0.040	0.040	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(%): 46.0

Mean src-site R= 10.3 km; M= 6.77; eps0= 1.13. Mean calculated for all sources.

Modal src-site R= 7.5 km; M= 7.76; eps0= 0.60 from peak (R,M) bin

MODE R*= 7.5km; M*= 7.75; EPS.INTERVAL: 1 to 2 sigma % CONTRIB.= 2.956

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

Source Category: % contr. R(km) M epsilon0 (mean values).

California A-faults 26.52 11.1 7.43 1.00

CA Compr. crustal gridded 19.52 9.2 5.87 1.31

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

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

Elsinore; Glen Ivy aPriori 0.33 20.9 6.85 2.37 -62.0

Elsinore;T aPriori 2.74 7.5 7.00 1.02 -134.7

Elsinore;GI+T aPriori 5.19 7.5 7.25 0.80 -134.7

Elsinore;T+J+CM aPriori 1.90 7.5 7.64 0.64 -134.7

Elsinore;GI+T+J+CM aPriori 1.99 7.5 7.73 0.61 -134.7

San Jacinto;A+C aPriori 1.17 26.6 7.51 1.99 32.5

San Jacinto;SBV+SJV+A+C aPriori 0.72 26.6 7.78 1.80 34.5

Elsinore;T+J+CM MoBal 1.89 7.5 7.64 0.64 -134.7

Elsinore;GI+T+J+CM MoBal 1.14 7.5 7.72 0.61 -134.7

Elsinore aflt, unsegmented 2.63 7.7 7.43 0.76 -133.9

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

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

2008 National Seismic Hazard Maps - Source Parameters

[New Search](#)

Distance in Kilometers	Name	State	Pref Slip Rate (mm/yr)	Dip (degrees)	Dip Dir	Slip Sense	Rupture Top (km)	Rupture Bottom (km)	Length (km)
7.57	Elsinore:GI+T+J+CM	CA	n/a	86	NE	strike slip	0	16	195
7.57	Elsinore:T+J	CA	n/a	86	NE	strike slip	0	17	127
7.57	Elsinore:T+J+CM	CA	n/a	85	NE	strike slip	0	16	169
7.57	Elsinore:W+GI+T	CA	n/a	84	NE	strike slip	0	14	124
7.57	Elsinore:W+GI+T+J	CA	n/a	84	NE	strike slip	0	16	199
7.57	Elsinore:W+GI+T+J+CM	CA	n/a	84	NE	strike slip	0	16	241
7.57	Elsinore:GI+T	CA	5	90	V	strike slip	0	14	78
7.57	Elsinore:GI+T+J	CA	n/a	86	NE	strike slip	0	17	153
7.57	Elsinore:T	CA	5	90	V	strike slip	0	14	52
21.03	Elsinore:W+GI	CA	n/a	81	NE	strike slip	0	14	83
21.03	Elsinore:GI	CA	5	90	V	strike slip	0	13	37
22.68	Elsinore:J	CA	3	84	NE	strike slip	0	19	75
22.68	Elsinore:J+CM	CA	3	84	NE	strike slip	0	17	118
26.57	San Jacinto:A+CC	CA	n/a	90	V	strike slip	0	16	118
26.57	San Jacinto:A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	178
26.57	San Jacinto:A	CA	9	90	V	strike slip	0	17	71
26.57	San Jacinto:A+C	CA	n/a	90	V	strike slip	0	17	118
26.57	San Jacinto:A+CC+B	CA	n/a	90	V	strike	0.1	15	152

						slip			
26.58	San Jacinto:SJV+A+CC+B	CA	n/a	90	V	strike slip	0.1	15	170
26.58	San Jacinto:SBV+SJV+A+CC+B	CA	n/a	90	V	strike slip	0.1	15	215
26.58	San Jacinto:SJV+A+CC	CA	n/a	90	V	strike slip	0	16	136
26.58	San Jacinto:SBV+SJV+A+CC	CA	n/a	90	V	strike slip	0	16	181
26.58	San Jacinto:SJV+A+C	CA	n/a	90	V	strike slip	0	17	136
26.58	San Jacinto:SBV+SJV+A+C	CA	n/a	90	V	strike slip	0	17	181
26.58	San Jacinto:SJV+A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	196
26.58	San Jacinto:SJV+A	CA	n/a	90	V	strike slip	0	17	89
26.58	San Jacinto:SBV+SJV+A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	241
26.58	San Jacinto:SBV+SJV+A	CA	n/a	90	V	strike slip	0	16	134
28.93	San Jacinto:SJV	CA	18	90	V	strike slip	0	16	43
28.93	San Jacinto:SBV+SJV	CA	n/a	90	V	strike slip	0	16	88
49.95	San Jacinto:CC+B	CA	n/a	90	V	strike slip	0.2	14	77
49.95	San Jacinto:CC	CA	4	90	V	strike slip	0	16	43
49.95	San Jacinto:CC+B+SM	CA	n/a	90	V	strike slip	0.2	14	103
52.13	S. San Andreas:CC+BB+NM+SM+NSB+SSB+BG	CA	n/a	85		strike slip	0	14	380
52.13	S. San Andreas:CC+BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	86		strike slip	0.1	13	449
52.13	S. San Andreas:CH+CC+BB+NM+SM+NSB+SSB+BG	CA	n/a	86		strike slip	0	14	442
52.13	S. San Andreas:NM+SM+NSB+SSB+BG	CA	n/a	83		strike slip	0	14	271
52.13	S. San Andreas:NM+SM+NSB+SSB+BG+CO	CA	n/a	84		strike slip	0.1	13	340
52.13	S. San Andreas:CH+CC+BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	86		strike slip	0.1	13	512

52.13	S. San Andreas;NSB+SSB+BG	CA	n/a	75		strike slip	0	14	136
52.13	S. San Andreas;SSB+BG	CA	n/a	71		strike slip	0	13	101
52.13	S. San Andreas;NSB+SSB+BG+CO	CA	n/a	79		strike slip	0.2	12	206
52.13	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB+SSB+BG	CA	n/a	86		strike slip	0.1	13	479
52.13	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	86		strike slip	0.1	13	548
52.13	S. San Andreas;SM+NSB+SSB+BG	CA	n/a	81		strike slip	0	13	234
52.13	S. San Andreas;BG	CA	n/a	58		strike slip	0	13	56
52.13	S. San Andreas;SM+NSB+SSB+BG+CO	CA	n/a	83		strike slip	0.1	13	303
52.13	S. San Andreas;SSB+BG+CO	CA	n/a	77		strike slip	0.2	12	170
52.13	S. San Andreas;BB+NM+SM+NSB+SSB+BG	CA	n/a	84		strike slip	0	14	321
52.13	S. San Andreas;BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	85		strike slip	0.1	13	390
52.13	S. San Andreas;BG+CO	CA	n/a	72		strike slip	0.3	12	125
52.36	S. San Andreas;PK+CH+CC+BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0.1	13	421
52.36	S. San Andreas;CC+BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	14	322
52.36	S. San Andreas;CH+CC+BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	14	384
52.36	S. San Andreas;NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	13	213
52.36	S. San Andreas;NSB+SSB	CA	n/a	90	V	strike slip	0	13	79
52.36	S. San Andreas;SM+NSB+SSB	CA	n/a	90	V	strike slip	0	13	176
52.36	S. San Andreas;SSB	CA	16	90	V	strike slip	0	13	43
52.36	S. San Andreas;BB+NM+SM+NSB+SSB	CA	n/a	90	V	strike slip	0	14	263
52.39	Newport-Inglewood (Offshore)	CA	1.5	90	V	strike slip	0	10	66
52.39	San Jacinto;C	CA	14	90	V	strike	0	17	47

						slip			
52.39	Newport Inglewood Connected alt 1	CA	1.3	89		strike slip	0	11	208
52.39	Newport Inglewood Connected alt 2	CA	1.3	90	V	strike slip	0	11	208
55.27	San Jacinto:SBV	CA	6	90	V	strike slip	0	16	45
55.55	Chino, alt 2	CA	1	65	SW	strike slip	0	14	29
56.07	San Joaquin Hills	CA	0.5	23	SW	thrust	2	13	27
56.35	Rose Canyon	CA	1.5	90	V	strike slip	0	8	70
57.71	Elsinore:W	CA	2.5	75	NE	strike slip	0	14	46
59.69	Chino, alt 1	CA	1	50	SW	strike slip	0	9	24
60.30	Earthquake Valley	CA	2	90	V	strike slip	0	19	20
66.07	Pinto Mtn	CA	2.5	90	V	strike slip	0	16	74
69.29	S. San Andreas:NM+SM+NSB	CA	n/a	90	V	strike slip	0	13	170
69.29	S. San Andreas:CC+BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0	14	279
69.29	S. San Andreas:CH+CC+BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0	14	341
69.29	S. San Andreas:NSB	CA	22	90	V	strike slip	0	13	35
69.29	S. San Andreas:PK+CH+CC+BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0.1	13	377
69.29	S. San Andreas:BB+NM+SM+NSB	CA	n/a	90	V	strike slip	0	14	220
69.29	S. San Andreas:SM+NSB	CA	n/a	90	V	strike slip	0	13	133
77.18	Burnt Mtn	CA	0.6	67	W	strike slip	0	16	21
78.79	Cucamonga	CA	5	45	N	thrust	0	8	28
79.82	Coronado Bank	CA	3	90	V	strike slip	0	9	186
79.82	Palos Verdes Connected	CA	3	90	V	strike slip	0	10	285
80.24	Newport-Inglewood, alt 1	CA	1	88		strike slip	0	15	65

81.68	S. San Andreas:CO	CA	20	90	V	strike slip	0.6	11	69
82.50	Eureka Peak	CA	0.6	90	V	strike slip	0	15	19
83.44	Palos Verdes	CA	3	90	V	strike slip	0	14	99
83.46	Cleghorn	CA	3	90	V	strike slip	0	16	25
83.65	Puente Hills (Coyote Hills)	CA	0.7	26	N	thrust	2.8	15	17
85.65	San Jose	CA	0.5	74	NW	strike slip	0	15	20
88.30	North Frontal (West)	CA	1	49	S	reverse	0	16	50
88.84	San Jacinto:B	CA	4	90	V	strike slip	0.7	13	34
88.84	San Jacinto:B+SM	CA	n/a	90	V	strike slip	0.4	12	61
89.52	Sierra Madre Connected	CA	2	51		reverse	0	14	76
89.52	Sierra Madre	CA	2	53	N	reverse	0	14	57
90.55	Helendale-So Lockhart	CA	0.6	90	V	strike slip	0	13	114
92.21	North Frontal (East)	CA	0.5	41	S	thrust	0	16	27
92.45	Landers	CA	0.6	90	V	strike slip	0	15	95
92.85	Elsinore:CM	CA	3	82	NE	strike slip	0	13	39
96.88	S. San Andreas:N+SM	CA	n/a	90	V	strike slip	0	14	134
96.88	S. San Andreas:PK+CH+CC+BB+N+SM	CA	n/a	90	V	strike slip	0.1	13	342
96.88	S. San Andreas:CH+CC+BB+N+SM	CA	n/a	90	V	strike slip	0	14	306
96.88	S. San Andreas:SM	CA	29	90	V	strike slip	0	13	98
96.88	S. San Andreas:CC+BB+N+SM	CA	n/a	90	V	strike slip	0	14	243
96.88	S. San Andreas:BB+N+SM	CA	n/a	90	V	strike slip	0	14	184
97.72	Puente Hills (Santa Fe Springs)	CA	0.7	29	N	thrust	2.8	15	11
98.52	Lenwood-Lockhart-Old Woman Springs	CA	0.9	90	V	strike slip	0	13	145



Search Results

▼ 3 of 3 earthquakes in map area.

6.6	5km NNE of Ocotillo Wells, CA 1968-04-09 02:28:58 (UTC)	10.0 km
6.4	12km W of Salton City, CA 1954-03-19 09:54:27 (UTC)	6.0 km
6.0	16km WSW of Oasis, CA 1937-03-25 16:49:02 (UTC)	6.0 km

Didn't find what you were looking for?

- Check your [Settings](#).
- [Which earthquakes are included on the map and list?](#)
- [Felt something not shown – report it here.](#)

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 33.53771°N, 117.07518°W

Site Soil Classification Site Class D – “Stiff Soil”

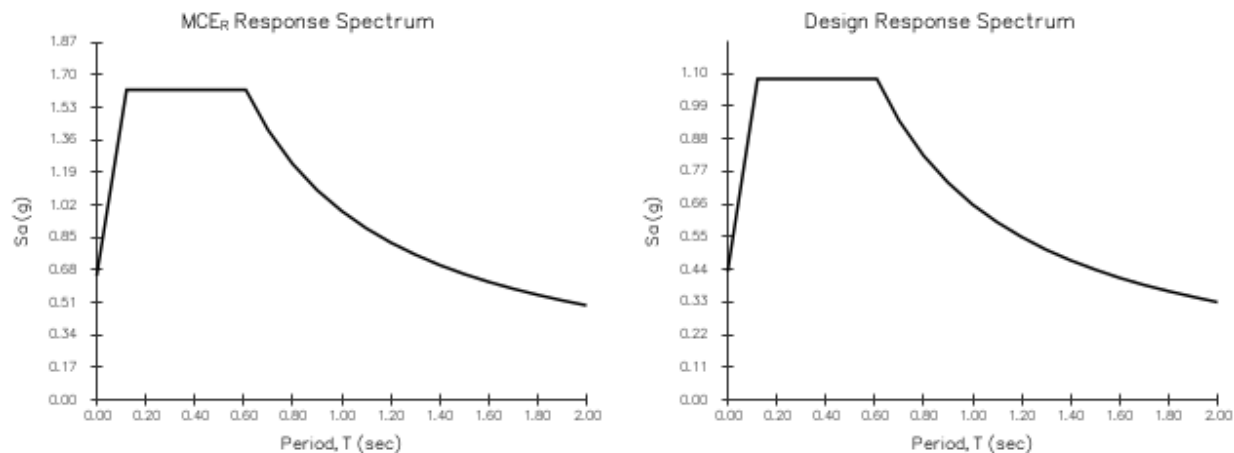
Risk Category I/II/III



USGS-Provided Output

$$\begin{array}{lll}
 S_s = 1.622 \text{ g} & S_{MS} = 1.622 \text{ g} & S_{DS} = 1.082 \text{ g} \\
 S_1 = 0.658 \text{ g} & S_{M1} = 0.988 \text{ g} & S_{D1} = 0.658 \text{ g}
 \end{array}$$

For information on how the S_s and S_1 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.



Design Maps Detailed Report

ASCE 7-10 Standard (33.53771°N, 117.07518°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]

$$S_s = 1.622 \text{ g}$$

From [Figure 22-2](#) ^[2]

$$S_1 = 0.658 \text{ g}$$

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 $S_s = 1.622$ 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 $S_1 = 0.658$ g, $F_v = 1.500$

Equation (11.4-1):

$$S_{MS} = F_a S_S = 1.000 \times 1.622 = 1.622 \text{ g}$$

Equation (11.4-2):

$$S_{M1} = F_v S_1 = 1.500 \times 0.658 = 0.988 \text{ g}$$

Section 11.4.4 — Design Spectral Acceleration Parameters

Equation (11.4-3):

$$S_{DS} = \frac{2}{3} S_{MS} = \frac{2}{3} \times 1.622 = 1.082 \text{ g}$$

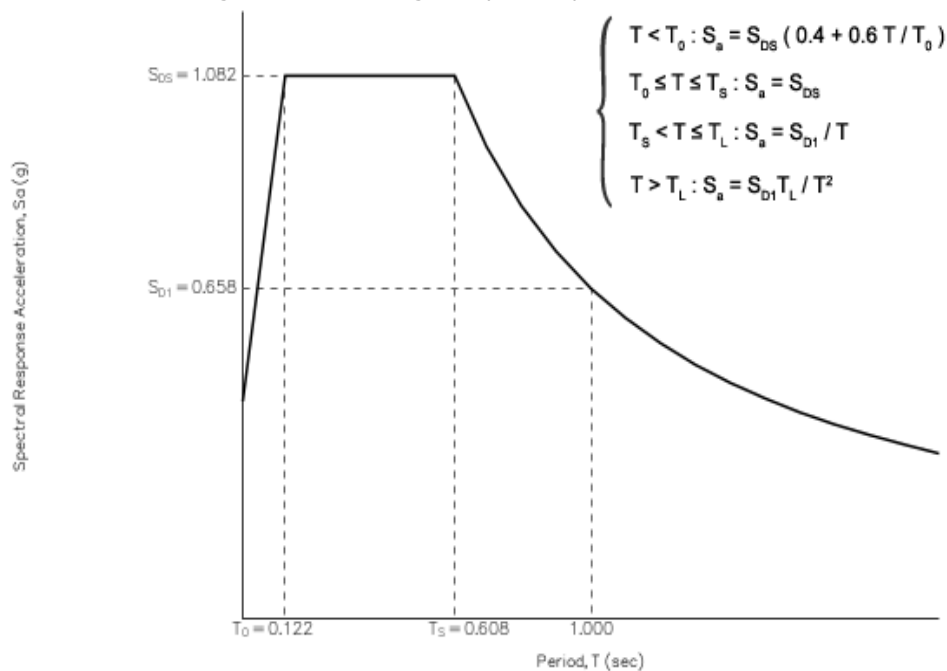
Equation (11.4-4):

$$S_{D1} = \frac{2}{3} S_{M1} = \frac{2}{3} \times 0.988 = 0.658 \text{ g}$$

Section 11.4.5 — Design Response Spectrum

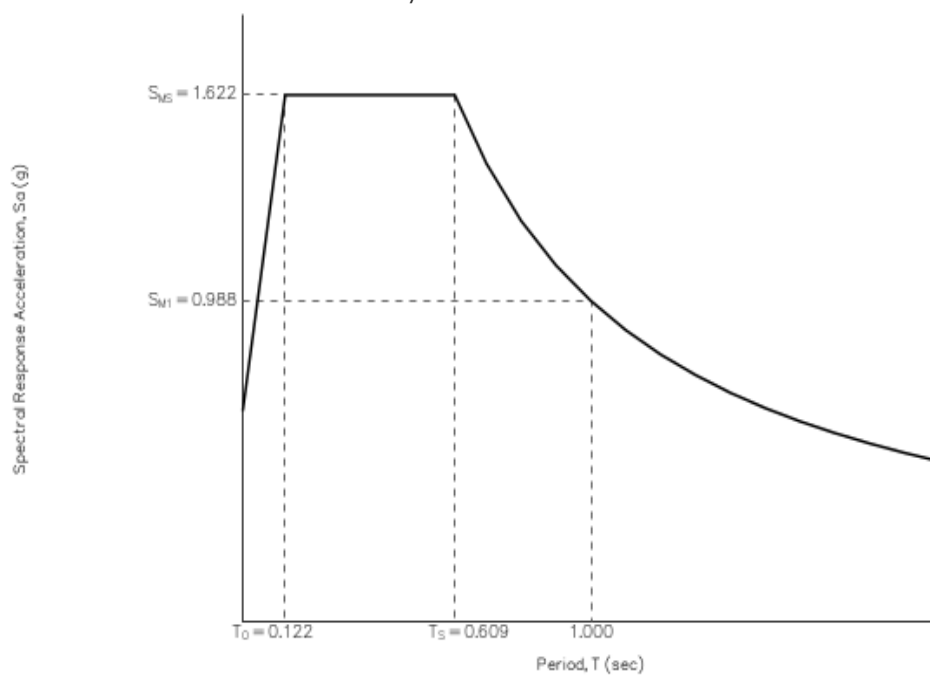
From [Figure 22-12](#) ^[3] $T_L = 8 \text{ seconds}$

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]

$$PGA = 0.635$$

Equation (11.8-1):

$$PGA_M = F_{PGA} PGA = 1.000 \times 0.635 = 0.635 \text{ g}$$

Table 11.8-1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	$PGA \leq 0.10$	$PGA = 0.20$	$PGA = 0.30$	$PGA = 0.40$	$PGA \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	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 $PGA = 0.635 \text{ g}$, $F_{PGA} = 1.000$

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

From [Figure 22-17](#) ^[5]

$$C_{RS} = 0.993$$

From [Figure 22-18](#) ^[6]

$$C_{R1} = 0.983$$

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
$0.167g \leq S_{DS} < 0.33g$	B	B	C
$0.33g \leq S_{DS} < 0.50g$	C	C	D
$0.50g \leq S_{DS}$	D	D	D

For Risk Category = I and $S_{DS} = 1.082 g$, 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
$0.067g \leq S_{D1} < 0.133g$	B	B	C
$0.133g \leq S_{D1} < 0.20g$	C	C	D
$0.20g \leq S_{D1}$	D	D	D

For Risk Category = I and $S_{D1} = 0.658 g$, 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 $\equiv$ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

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

References

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

APPENDIX E
GENERAL EARTHWORK AND GRADING
SPECIFICATIONS