Appendix C.
Geotechnical Exploration Report

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GEOTECHNICAL EXPLORATION REPORT
NEW MAKERSPACE BUILDING
FRANKLIN ELEMENTARY SCHOOL
2400 MONTANA AVENUE
SANTA MONICA, LOS ANGELES COUNTY
CALIFORNIA

Prepared For

SANTA MONICA-MALIBU
UNIFIED SCHOOL DISTRICT
2828 FOURTH STREET
SANTA MONICA, CALIFORNIA 90405-4308

Prepared By

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Project No. 11428.035

January 5, 2022

January 5, 2021

Project No. 11428.035

Santa Monica-Malibu Unified School District
2828 Fourth Street
Santa Monica, California 90405-4308

Attention: Mr. Kevin Klaus

Subject: Geotechnical Exploration Report
New Makerspace Building
Franklin Elementary School
2400 Montana Avenue
Santa Monica, Los Angeles County, California

Per our April 4, 2021 proposal, authorized on October 5, 2021; Leighton Consulting, Inc. (Leighton) is pleased to present this geotechnical and geologic exploration report for the subject project. This report is intended to meet requirements of Section 1803A.2 of the 2019 California Building Code (CBC) and the CGS's Note 48 checklist for review of engineering geology and seismology reports for California public schools.

This site **is** located within a currently designated Alquist-Priolo Special Studies Zone for surface fault rupture. This site is **not** located within a currently designated liquefaction hazard zone. Based on our review of geologic literature (references) and subsurface exploration, the potential for surface fault rupture at the site is considered low. As is the case for most of Southern California, strong ground shaking has and will occur at this site.

Specific recommendations for site grading, foundations, and other geotechnical aspects of the project are presented in this report.

We appreciate this opportunity to be of service. If you have any questions regarding this report or if we can be of further service, please call us at your convenience at **(866) *LEIGHTON***, directly at the phone extensions or e-mail addresses listed below:

Respectfully submitted,

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EMH/JAR/CK/lr/dlm

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1.0 INTRODUCTION

1.1 Site Description and Proposed Development

Franklin Elementary is an active Kindergarten through 5th grade school located at 2400 Montana Avenue in the City of Santa Monica within a residential neighborhood. The school campus location (latitude 34.0391°, longitude -118.4851°) and immediate vicinity are shown on Figure 1, *Site Location Map*.

The campus is a rectangular parcel of land developed with one- to two-story classroom buildings, a playfield, an asphalt concrete (AC) blacktop, and a parking lot. The campus is bounded on the northwest by Montana Avenue, the northeast by 24th Place, the southeast by Idaho Avenue, and the southwest by 23rd Place. According to the United States Geological Survey (USGS) 7.5-Minute Beverly Hills Quadrangle (USGS, 1981), the site surface is relatively flat with an approximate elevation (El.) of ± 255 to +265 feet mean sea level (msl). Review of the ALTA Survey (PSOMAS, 2021) indicates that the ground surface ranges from approximately El +285.4 feet on north end of our Geologic Section A-A' to El. +258.5 feet on south end, see Figure 2, *Exploration Location Map.*

Our understanding of the proposed development is based on review of your *Request for Qualifications/Proposal for Geotechnical Services, SMMUSD Elementary and Middle School Assessment Projects* issued on July 15, 2021; and the undated *Masterplan* for Franklin Elementary School prepared by dsk Architects. As currently conceived, the project consists of the construction of a new one-story Makerspace building with a footprint of 4,150 square feet to in the blacktop area. Ancillary improvements consist of three new basketball courts near the southwest corner of campus to be constructed with a secondary function as a fire access road. No subterranean levels are currently planned. The footprint of the proposed new classroom building is shown on Figure 2.

1.2 Purpose and Scope of Exploration

The purpose of our geotechnical exploration was to evaluate the subsurface soil conditions and perform a fault hazard evaluation for the new Makerspace building site through review of available data and subsurface explorations to provide geotechnical recommendations to aid in design and construction of the project as currently proposed. The scope of this geotechnical exploration included the following tasks:

- ***Background Review*** – A background review was performed of readily available geotechnical, civil, and geological documents pertinent to the project site. References reviewed in preparation of this report are listed in Section 8.0.

- ***Field Exploration*** – Our field exploration was performed September 16, 2021 and consisted of two (2) hollow-stem auger borings (designated LB-1 and LB-2) drilled to approximate depths ranging from of 31½ to 51½ feet below ground surface (bgs) and three (3) continuous-core borings (CB-1, CB-2 and CB-3) drilled to 50 feet bgs. In addition, five (5) cone penetrometer test (CPT) soundings (designated CPT-1 through CPT-5) were advanced to an approximate depth of 50 feet bgs. The continuous core borings and CPTs were located along a north-south oriented transect roughly perpendicular to the average strike of the inferred location of Santa Monica Fault Zone (approximately N86°W).

  Prior to the field exploration, the borings and CPT's were marked and Underground Service Alert (USA) was notified for utility clearance. In addition, a private utility locator was utilized to locate any unknown or unmarked utilities in the areas of the proposed boring locations prior to drilling.

  During drilling of the hollow-stem auger borings (LB-1 through LB-2), bulk and relatively undisturbed drive samples were obtained from the borings for geotechnical laboratory testing. Relatively undisturbed samples were collected from the borings using a Modified California Ring sampler conducted in accordance with ASTM Test Method D3550. Standard Penetration Tests (SPT) were also performed within the hollow-stem auger borings in accordance with ASTM Test Method D1586. The samplers were driven for a total penetration of 18 inches, unless practical refusal was encountered, using a 140-pound automatic hammer falling freely for 30 inches. The number of blows per 6 inches of penetration was recorded on the boring logs.

  The continuous-core borings were sampled with a 5-foot long, 3-inch diameter core barrel to total depth. Core runs were stored in wood core boxes, hand scraped to remove the surface rind of disturbed material, and then logged by professional and engineering geologists from our staff. Continuous core samples were stored in boxes for further review and photo documentation.

  All the borings were logged in the field by a geologist from our technical staff. Each soil sample collected was reviewed and described in accordance with the Unified Soil Classification System (USCS). The samples were sealed and packaged for transportation to our laboratory. After completion of drilling, all of the borings were backfilled with excess soils generated during the exploration. The boring (hollow stem and continuous core), CPT logs are presented in Appendix A, *Exploration Logs*. The approximate locations of the explorations are shown on Figure 2, *Exploration Location Map*.

- ***Shear Wave Velocity*** - Shear wave velocities were profiled at 5-foot intervals to a depth of 50 feet bgs in CPT-4 (Figure 2) to estimate average S-wave velocities of the upper 30 meters (Vs_{30}). The average shear wave velocity recorded onsite is approximately 1131 feet per second (ft/sec). The shear wave velocity report is included in Appendix A. Based on collected velocities and in accordance with the 2019 California Building Code, the Pleistocene age soils at this site classified as Seismic Site Class D.

- ***Laboratory Testing*** – Geotechnical laboratory tests were conducted on selected bulk and undisturbed soil samples obtained from our borings. This laboratory testing program was designed to evaluate geotechnical (physical) characteristics of site soil. A description of geotechnical laboratory test-procedures and results are presented in Appendix B, *Laboratory Test Results*. The following laboratory tests were performed:

  - In-situ Moisture Content and Dry Density (ASTM D2216 and ASTM D2937);
  - Expansion Index (ASTM D4829);
  - Modified Proctor Compaction Test (ASTM D1557);
  - Direct Shear (ASTM D 3080);
  - R Value (DOT CA Test 301);
  - Consolidation (ASTM D2435); and
  - Corrosivity (Soluble Sulfate ASTM C1580, Soluble Chloride ASTM C1411-09, pH ASTM D4972, and Resistivity ASTM G187-12a).

  The in-situ moisture and density of soil samples at depths are shown on the borings logs included in Appendix A. The results of the remaining laboratory tests are presented in Appendix B.

- ***Core Sample Review and Soil Age Dating*** **–** In cooperation with Earth Consultants International (ECI), core samples were laid out side by side and arranged by surface elevation to interpret subsurface stratigraphy and correlate adjacent cores. Descriptions of the soils exposed in the core borings were used to estimate the age of sediments to the total depth of the exploration. Detailed core logs are presented in Appendix A. Our stratigraphic correlation and interpretation of subsurface conditions are presented on Plate 1, *Geotechnical Cross Section AA'.* Soil age dating, core review, and core photos are presented in Appendix C, *Soil Age Data and Core Review.*

- ***Engineering Analysis*** – Data obtained from field explorations and geotechnical laboratory testing was evaluated and analyzed to develop geotechnical conclusions and provide recommendations in accordance with the 2019 California Building Code and the California Geological Survey's (CGS) Note 48 (November 2019 version). Subsurface interpretations prepared for this campus are presented on Plate 1, *Geotechnical Cross Section AA'* (in pocket).

- ***Report Preparation*** - Results of our geologic hazards review and geotechnical exploration have been summarized in this report, presenting our findings, conclusions and geotechnical design recommendations for design and construction of the new Franklin Elementary School Makerspace Building as currently proposed.

It should be noted that the recommendations in this report are subject to the limitations presented in Section 7.0 of the report.

2.0 GEOTECHNICAL FINDINGS

2.1 Geologic Setting

The site is in the Santa Monica Plain, an uplifted and inclined alluvial surface within the southwestern block of the Los Angeles Basin (Hoots, 1931; Poland and Piper, 1956). The Los Angeles Basin (Basin), a structural trough, is a northwest-trending, alluviated lowland plain approximately 50 miles long and 20 miles wide. Mountains and hills that generally expose Late Cretaceous to Late Pleistocene-age sedimentary and igneous rocks bound the Basin along the north, northeast, east and southeast (Yerkes, 1965). The Basin is part of the Peninsular Ranges geomorphic province of California characterized by sub parallel blocks sliced longitudinally by young, steeply dipping northwest-trending fault zones. The Basin, located at the northerly terminus of the Peninsular Ranges, is the site of active sedimentation and the strata are interpreted to be as much as 31,000 feet thick in the center of the synclinal trough of the Central Block of the Los Angeles Basin.

The Santa Monica Plain formed during the Pleistocene epoch by continental aggradation and has since been uplifted and heavily incised by both current and former drainage patterns (Hoots, 1931). As shown on Figure 3, *Regional Geology Map,* the area of the Santa Monica Plain where the Franklin Elementary School campus is located is mapped as being underlain by Quaternary old alluvial fan deposits, map symbol Qof..

2.2 Local Geologic Units and Subsurface Conditions

Presented below are brief descriptions of the geologic units encountered in the exploratory borings completed at the site by Leighton. Detailed descriptions of the geologic units encountered are presented on the boring logs in Appendix A. Geotechnical conditions described on the logs represent the conditions at the actual exploratory excavation locations. Other variations may occur beyond and/or between the excavations. Lines of demarcation between the geologic units and the various earth materials on the logs represent approximated boundaries, and (unless otherwise noted) actual transitions may be gradual. The locations of the subsurface explorations are shown on Figure 2 and a subsurface profile based on data obtained and interpreted from the borings and CPTs is shown on Plate *1.*

Artificial fill (Afu) materials were encountered underlying existing pavements within the exploratory borings and interpreted in the CPTs. Local geology was interpreted from published regional geologic maps of the area (Yerkes and Campbell, 2005;

Dibblee, 1991). Figure 3, *Regional Geology Map*, illustrates the approximate distribution of geologic units at the site. Native geologic units underlying the artificial fill materials consist of Quaternary old alluvial fan deposits (map symbol: Qof).

Undocumented Artificial Fill (Map Symbol: Afu): Artificial fill materials were encountered to a depth of approximately 2 to 4 feet. Fill, as encountered, is characterized as dark brown to reddish brown sandy lean clay to silty clay with varying amounts of slaty gravel. No documentation or records related to fill placement was available at the time of this report preparation. Therefore, for purposes of this report, all fill encountered onsite and anticipated in future explorations is considered undocumented and unsuitable for support of new improvements in its current condition.

Quaternary Old Alluvial Fan Deposits (Map Symbol: Qof): The Pleistocene alluvial fan deposits encountered directly beneath the artificial fill generally consist of brown, dark grayish brown, and reddish brown silty clay and sandy clay locally channelized with sand and slaty gravels. In general, the fine-grained material ranges from very stiff to hard. The channelized coarse-grained soils consist of a series of fining upward sequences and range from medium dense to very dense.

The stratigraphy of the subsurface soils encountered in each soil boring is presented on the boring logs (Appendix A). The general subsurface conditions across the site, interpreted from the boring and CPT data are shown on Plate 1.

2.3 Corrosion

Corrosion: In general, soil resistivity, which is a measure of how easily electrical current flows through soils, is the most influential factor for ferrous corrosivity. Based on findings of studies presented in the American Society for Testing and Materials (ASTM) STP 1013 titled “Effects of Soil Characteristics on Corrosion” (February, 1989), an approximate relationship between soil resistivity and soil corrosiveness was developed as shown in Table 1 below.

Table 1 - Soil Corrosivity as a Function of Resistivity

Soil Resistivity (ohm-cm)	Classification of Soil Corrosiveness
0 to 900	Very severe corrosion
900 to 2,300	Severely corrosive
2,300 to 5,000	Moderately corrosive
5,000 to 10,000	Mildly corrosive
10,000 to >100,000	Very mildly corrosive

Sulfate Exposure: Sulfate ions in the soil can lower the soil resistivity and can be highly aggressive to Portland cement concrete by combining chemically with certain constituents of the concrete, principally tricalcium aluminate. This reaction is accompanied by expansion and eventual disruption of the concrete matrix. A potentially high sulfate content could also cause corrosion of reinforcing steel in concrete. Section 1904A of the 2019 California Building Code (CBC) defers to the American Concrete Institute's (ACI's) ACI 318-14 for concrete durability requirements. Table 19.3.1.1 of ACI 318-14 lists "*Exposure categories and classes*," including sulfate exposure as follows:

Table 2A - Sulfate Concentration and Exposure

Soluble Sulfate in Water (parts-per-million)	Water-Soluble Sulfate (SO_4) in soil (percentage by weight)	ACI 318-14 Sulfate Class
0-150	0.00 - 0.10	S0 (negligible)
150-1,500	0.10 - 0.20	S1 (moderate*)
1,500-10,000	0.20 - 2.00	S2 (severe)
>10,000	>2.00	S3 (very severe)

*or seawater

A representative composite, near surface (0-5 feet) bulk soil sample collected from LB-2, characterized as a Clayey Silty Sand (SC-SM) was tested to evaluate corrosion potential. The chemical analysis test results for the onsite soil from our geotechnical exploration are included in Appendix B of this report and are summarized below.

Table 3 - Corrosivity Test Results

Test Parameter	Test Results LB-2 0-5'	General Classification of Hazard
Water-Soluble Sulfate-SO_4 in Soil (ppm)	177	Negligible sulfate exposure to buried concrete
Water-Soluble Chloride in Soil (ppm)	60	Non-corrosive to buried concrete (per Caltrans Specifications)
pH	8.04	Mildly alkaline
Minimum Resistivity (saturated, ohm-cm)	4,800	Moderately Corrosive to buried ferrous pipes

Additional corrosion testing is recommended upon completion of grading to confirm the findings and conclusions presented above.

2.4 Expansive Soils

Expansion Index (EI) testing of one representative bulk sample collected from boring LB-2 within the upper 5 feet indicates an expansion index (EI) of 11, corresponding to a very low potential for expansion. Given the clayey nature of the near surface soils expansion potential is anticipated to vary, and for purposes of this report, the expansion properties of the soil below the proposed new classroom should be considered as low (EI=21 to 50). Additional testing of soils upon completion of grading should be performed to confirm the results of the initial testing.

Based on geotechnical laboratory testing performed on selected soil samples collected from the site and review of previous laboratory test results, a synopsis of geotechnical properties of the site soils is provided in Table 3 below. Geotechnical laboratory testing results are presented in Appendix B.

Table 4 - Soil Geotechnical Properties Synopsis

Parameters	Soil Properties
In-situ Moisture:	Dry to very moist
In-situ Density:	Stiff to hard/Medium dense to dense
Swell/Expansion Potential:	swell/expansion potential is **low**
Collapse Potential:	Not susceptible to collapse when wetted
Strength:	Adequate to provide structural support
Corrosivity:	No sulfate attack of concrete but **moderately corrosive to ferrous metals**.

2.5 Groundwater

Groundwater was not encountered in our borings or CPTs to the maximum depth explored of 51½ feet bgs. Historic groundwater levels, as interpreted from the Beverly Hills 7.5 Minute Quadrangle, Los Angeles County, California (CGS, 1998) indicate historic high groundwater was at a level of approximately 40 to 50 feet bgs.

Review of environmental data reported through the State Water Resources Control Board (see http://geotracker.waterboards.ca.gov/) shows that a series of eight monitoring wells were installed in association with a leaking underground storage tank remediation at Providence St. Johns medical Center; located approximately 0.6 miles south of the project site. Groundwater levels as measured within these monitoring wells was documented at depths ranging from approximately 110 to 132 feet bgs. Groundwater is not expected to pose a constraint to the proposed development as currently planned.

2.6 Soil Age Estimates

The State Mining and Geology Board (in accordance with the Alquist-Priolo Earthquake Fault Zoning Act) defines an active fault as one which has had surface displacement within Holocene time (most recently, per the CGS website, defined at about the last 11,700 years). Needed, therefore, are exposures of geologic materials at least 11,700 years old (Holocene). If these materials are tectonically displaced, then the causative fault is deemed to be active. Currently, the only allowable mitigation is setback for habitable structures, the widths of which vary depending on fault geometry and complexity.

Accordingly, to date the core boring exposures collected from the campus, we used relative (soil stratigraphy) age dating techniques (Appendix C).

2.6.1 Soil-Stratigraphic Age Estimates

The services of ECI were retained to describe the soils exposed in two core borings, CB-1 through CB-3 (Appendix A). The age of the soil is based on a series of pedogenic development factors that when summed, yield an age estimate by comparing those factors to other dated soils in similar geographic and climatic conditions.

ECI's analysis (Appendix C) indicates that the study area is underlain by a thick, cumulic surface soil developed in generally fine-grained sediments deposited by gravity, either by slopewash or sheetflow processes. This surface soil has a noticeable concentration of translocated clay in the form of clay films distributed throughout an argillic (Bt) soil horizon section that is between 3 and 4 feet thick. The redder colors of the matrix and clay films are in the 7.5YR hue. The soil-age regressions used suggest an age for this soil of about 26,000 years, and an estimated age for the entire 50-foot-thick section captured in the cores of between about 56,000 and 164,000 years. Correlation with the world-wide Quaternary sea level curves and paleo-climate records compiled for the southern California region suggest that the stratigraphic section captured in the cores dates to between about 27,000 and 126,000 years. Thus, the entire section is Pleistocene. Specifics of this method are provided in the report included in Appendix C, *Soil Age Data and Core Review*

2.7 Fault Summary

We mapped the surface locations of the borings (hollow-stem auger and core borings and CPTs emplaced across the property and their relative elevation using a ZipLevel™. The elevations of these points (PSOMAS, 2021) were used to prepare a detailed cross-section that shows the stratigraphic units and soils interpreted from the continuously sampled core borings and CPTs. Two of the three borings evaluated exposed a buried soil at a depth of approximately 27 feet. This soil was not present in the core of CB-1, but several primary stratigraphic units above and below this buried soil, in addition to the surface soil described above, were observed in all three borings at similar depths, suggesting that the area is not underlain by active faults. The interpreted cross section (Plate 1) prepared across the study area, which included cone penetration test (CPT) data in addition to the borehole data, also shows that several layers can be correlated across, with no vertical breaks or discontinuities to suggest faulting. Groundwater was not encountered in any of the borings and therefore no groundwater barriers were observed.

Given that this Pleistocene-aged soil extends unbroken across the study area, we conclude that any faults underlying the site at depth greater than 50 feet are not active. Therefore, based on this data **no** fault related setbacks are required or recommended for this site.

3.0 GEOLOGIC/SEISMIC HAZARDS

Geologic and seismic hazards include surface fault rupture, seismic shaking, liquefaction, seismically-induced settlement, lateral spreading, seismically-induced landslides, flooding, seismically-induced flooding, seiches and tsunamis. The following sections discuss these hazards and their potential impact at the project site.

3.1 Faulting

Based on our review of available geologic literature and aerial photographs, the site **is** located within a currently established *Alquist-Priolo (AP) Earthquake Fault Zone* (Bryant and Hart, 2007, CGS, 2018) for the Santa Monica Fault. The limits of the AP Zone for the Santa Monica Fault Zone (SMFZ), as mapped by CGS (2018), are located approximately 580 feet north and 1300 feet south of the proposed Makerspace building footprint. The AP Zone was established based on recommendations provided in the Fault Evaluation Report 259 (FER 259) prepared by CGS and dated June 28, 2017 (CGS, 2017). Therefore, a fault hazard assessment is mandated by the State for the proposed development.

Academic investigations (Dolan, J.F., Sieh, K., and Rockwell, T.K., 2000) have mapped the 40-km long, oblique left-lateral reverse Santa Monica fault zone as extending through Los Angeles, Santa Monica and offshore paralleling the Malibu coastline. Their work indicates the SMFZ has undergone at least six surface ruptures in the past 50,000 years. Based on poorly constrained soil age estimates, at least two or three probable events are interpreted to have occurred after burial of a well-dated prominent paleosol about 16,000 years old. This data led academic researchers to assign a 7,000 to 8,000 Pleistocene-Holocene recurrence interval for large surface rupture events, which is much longer than the hypothetical 1,900-3,000 year recurrence interval calculated for a 6.9-7.0 Mw event generated by rupture of the entire SMFZ. The younger recurrence interval is predicated on a postulated fault (F4 in Dolan et al., 2000) that does not break Holocene soil or offset buried paleosols; however, this interpreted fault was obscured by a utility trench during fault trenching operations. It is highly likely given the steep dip angle of the faults recorded both at the Veterans Hospital (Dolan, et al., 2000) and at University High School (MACTEC, 2004) are upper plate normal faults and not the actual Santa Monica thrust fault. Not all researchers agree as to the activity of various segments. Investigations conducted along the north branch suggest the north branch, which may be a series of upper plate boundary faults may be active. Investigations conducted on the southern branch have either concluded lack of faulting or Pleistocene faulting capped by unbroken soils of middle to early Pleistocene age such as has been interpreted here at Franklin Elementary.

Based on our review of geologic literature (references) and subsurface exploration, the potential for surface fault rupture at the site is considered low. Plate 1 presents our interpretation of the subsurface stratigraphy. Based predominantly on the continuous-core boring and CPT transect, our interpretation of subsurface stratigraphy shows multiple laterally continuous stratum extending across the footprint of the new classroom footprint within the underlying Pleistocene age alluvial fan deposits.

Several active and potentially active faults are mapped within approximately 10 km (6.2 miles) of the site. Figure 4, *Regional Fault and Historical Seismicity Map*, shows the proximity of known active and potentially active faults within the region.

Santa Monica Fault: The California Geological Survey (CGS, 2018) has zoned the Santa Monica Fault, which is the closest known fault to the site, currently mapped as crossing the southwest corner the Franklin Elementary campus with average strike of the inferred location of Santa Monica Fault Zone as approximately N86°W. This fault zone trends roughly east-west along the southern boundary of the Santa Monica Mountains. Included in the Transverse Ranges Southern Boundary fault system, which consists of east-west trending, left-lateral and oblique-reverse movements along several active faults. The SMFZ consists of one or more strands, is about 40 km (24.8 miles) in length, and is one of a series of reverse, left-lateral oblique-slip structures that extend more than 200 km (125 miles) across southern California and accommodate westward motion of the Transverse Ranges (Dolan *et al*., 1997). Pleistocene or Holocene movement has been postulated, but not directly proven along some upper plate secondary fault segments related to the SMFZ (Dolan *et al.*, 2000). Recurrence interval and recency of movement along many fault segments are neither well documented nor understood, mainly because intense urbanization has modified or destroyed any surface traces of the fault (Hill *et al*., 1979). Southern California Earthquake Center (SCEC) identifies the most recent rupture as Late Quaternary with intervals between events unknown.

The State of California Geological Survey (CGS, 2018) has established an Earthquake fault Zone based on the criteria of “sufficiently active” and “well defined” (Bryant and Hart, 2007) in their FER 259 dated June 28, 2017.

Malibu Coast Fault: Located approximately 2.5 miles (3.9 km) northeast of the project site. The fault exhibits left-lateral oblique displacement, with a reported vertical slip rate component of about 0.4 millimeters per year (Lajoie et al., 1979) and a horizontal slip rate component of 0.3 millimeters per year (Petersen et al., 1996). The entire 23-mile-long fault zone is considered to be a potential source in the present statewide probabilistic seismic hazard model and is considered capable of generating a maximum magnitude earthquake of 6.7 (Petersen et al., 1996).

Newport-Inglewood Fault: The onshore southeast-trending Newport-Inglewood fault zone (NIFZ), located approximately 5.4 miles (8.7 km) east of the site, is discontinuous at the surface and consists of a series of primarily left-stepping *en echelon* fault strands, each up to 6.5 km (4 miles) long that extend from near Beverly Hills south to Newport Beach, a distance of approximately 65 km (41 miles). At Newport Beach, the fault continues offshore where it lines up with the deeply incised Newport Submarine Canyon and is comprised of five strands and three step overs. To the south, back onshore, the fault continues as the Rose Canyon fault, extending in a southeasterly direction through San Diego and the international border to Baja California, where it continues as the Agua Blanca fault. Overall, from Beverly Hills to Baja California, the fault zone is more than 300 km (185 miles) long. At least five earthquakes of magnitude 4.9 or larger have been associated with the NIFZ since 1920 (Barrows, 1974). Estimated maximum deterministic magnitude earthquake is generally modeled between magnitude 6.5 and 7.5.

Hollywood Fault: Located approximately 5.4 miles (8.7 km) northeast of the site, the Hollywood Fault begins near the Los Angeles River and eastern edge of the Santa Monica Mountains and extends westward for approximately 9½ miles where it is thought to shift its locus of active deformation to the area near the West Beverly Hills Lineament (WBHL), where faulting takes a left step to the Santa Monica Fault. The Hollywood Fault is deemed capable of producing a magnitude 6.4 to 6.6 earthquake (Dolan et al., 1997). Investigators have estimated the lateral slip rate to be about 1.0 ±0.5 mm/year, with a vertical slip rate to be 0.25 mm/year (Dolan et al., 1997). Conversely, a lower slip rate of 0.04 - 0.4 mm/year (Ziony and Yerkes, 1985) leads to a long return period.

Recent detailed geologic and geotechnical studies have provided cumulative physical evidence for Holocene displacements resulting in an Alquist-Priolo Special Study Zone being established for the Hollywood Fault (CGS, 2014).

Exposures identified in prior explorations (Crook and Proctor, 1992), coupled with bulk-soil radiocarbon ages provide scant evidence for an early to mid-Holocene age for the most recent surface rupture approximately 6,000 years to 11,000 years ago; suggesting a long period of quiescence between surface rupturing on the Hollywood Fault (Dolan, 1997, 2000) (Ziony and Yerkes, 1985).

Palos Verdes Fault: The main trace of the onshore Palos Verde Hills (PVH) fault is recognized as a general topographic escarpment along the northeast margin of Palos Verdes Hills, based on the presence of linear drainages, saddles, and tilted or uplifted surfaces (Fischer and others, 1987). The PVH fault is reportedly a high-angle southwest-dipping dextral oblique fault (with reverse component) which forms the southwestern boundary of the Los Angeles basin at the Palos Verdes uplift (Wright, 1991, McNeilan and others, 1996). The sense of movement is dominantly right-lateral as interpreted by Stephenson et al. (1995). The ratio of horizontal to vertical offset is on the order of 7:1 to 8:1, as estimated by McNeilan and others (1996). Most of the PVH section may have a larger reverse component than the other sections due to the change in strike of the fault.

Little or no historic seismicity has been recorded on its onshore trend. The fault is thought to be capable of producing a magnitude 6.0 to 7.0 earthquake; however, the fault geometry most likely precludes fault rupture over its entire length of 80 kilometers (www.scec.org/fault_index/palos). The fault, penetrated by deep oil exploration wells in the seafloor offshore to the southeast, apparently cuts the seafloor and is thus considered active. Onshore, the character of the fault changes along with its strike direction due to compression. However, extensive deformation of the 120,000-year-old marine terrace on the peninsula, and the apparent Holocene folding of the Gaffey Street anticline, a feature related to drag movement along the Palos Verdes fault, are possible indications of the faults potential activity.

3.2 Historical Seismicity

An evaluation of historical seismicity from significant past earthquakes related to the site was performed (see Figure 4). Peak ground accelerations (PGA) at the site resulting from significant past earthquakes between 1800 to 2018, with magnitudes 4.0 or greater, were estimated using the EQSEARCH computer program (Blake, 2000) with 2018 updates. This historical seismicity search was performed for a 100-kilometer (62-mile) radius from the project site, and is included in Appendix D, *Seismicity Data*. The largest earthquake magnitude found in the search was the magnitude 7.7 earthquake, known as the Arvin-Tehachapi quake that occurred on July 21, 1952 approximately 73 miles (117 kilometers) from the site producing an estimated PGA of approximately 0.05g at the site. The largest estimated PGA found in the search was approximately 0.23g from the 1994 magnitude 6.7 Northridge Earthquake located approximately 12½ miles (20 kilometers) north of the site.

Review of additional data publicly available from the Center for Engineering Strong Motion Data (CESMD) website (http://strongmotioncenter.org/) was reviewed for stations near the project site. The data reviewed indicates that a site (CGS Station 24048) located near the corner of 19th Street and Wilshire, approximately 0.5 mile southwest of the project site, experienced a PGA of 0.15g from the March 17, 2014 magnitude 4.4 Encino Earthquake. Another (CSMIP Station 24202-Providence St. Johns Hospital) approximately 0.6 mile to the south of the project site experienced a PGA of 0.03g from the magnitude 5.4 Chino Hills Earthquake on July 29, 2008. We are unaware of any reported damage to this campus as a result of earthquakes occurring over the last century.

3.3 Liquefaction and Lateral Spreading

Liquefaction is the loss of soil strength due to a buildup of excess pore-water pressure during strong and long-duration ground shaking. Liquefaction is associated primarily with loose (low density), saturated, relatively uniform fine- to medium-grained, clean cohesionless soils. As shaking action of an earthquake progresses, soil granules are rearranged and the soil densifies within a short period. This rapid densification of soil results in a buildup of pore-water pressure. When the pore-water pressure approaches the total overburden pressure, soil shear strength reduces abruptly and temporarily behaves similar to a fluid. For liquefaction to occur there must be:

(1) loose, clean granular soils,

(2) shallow groundwater, **and**

(3) strong, long-duration ground shaking.

Review of both the Beverly Hills Quadrangle Seismic Hazard Zone Map (CGS, 1999) and the City of Santa Monica Geologic Hazards map (City of Santa Monica, 2014) indicates that the site is not within an area potentially susceptible to liquefaction (Figure 5, *Seismic Hazard Map*). The site is mapped within an area identified on the City of Santa Monica Geologic Hazards as a low Liquefaction Risk.

The site is underlain by stiff to hard clays interbedded with medium dense to dense sands and slaty gravels and groundwater is interpreted below a depth of 50 feet. Given these factors, the potential for liquefaction and lateral spreading to affect the site is considered low.

3.4 Seismically-Induced Settlement

Seismically-induced settlement consists of dry dynamic settlement (above groundwater) and liquefaction-induced settlement (below groundwater). These settlements occur primarily within loose to moderately dense sandy soil due to reduction in volume during and shortly after an earthquake event.

Based on our analysis, the total seismically-induced settlement is expected to be on the order of ½ inch or less. Accordingly, seismically-induced differential settlement is expected to be on the order of ¼ inch over 40 feet.

3.5 Seismically-Induced Landslides

The proposed project site is not located in an area mapped as potentially susceptible to seismically-induced landslides (Figure 5, *Seismic Hazard Map*). No landslides are mapped or known to exist at the project site or vicinity. The site is relatively flat and is not located adjacent to a significant slope. The potential for seismically induced landslides to affect the site is low.

3.6 Flooding

As shown on Figure 6, *Flood Hazard Zone Map*, the site is located outside of areas recognized by the Federal Emergency Management Agency (FEMA) to within 0.2% annual flood potential (FEMA, 2008). Earthquake-induced flooding can be caused by failure of dams or other water-retaining structures as a result of an earthquake. As shown on Figure 7, *Dam inundation Map*, the site is located outside of a dam inundation area due to the absence of such structures near the site, therefore the potential for earthquake-induced flooding at the site is considered low.

3.7 Seiches and Tsunamis

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. Tsunamis are sea waves generated by large-scale disturbance of the ocean floor that induces a rapid displacement of the water column above.

The most frequent causes of tsunamis are shallow underwater earthquakes and submarine landslides.

The site is not located within the tsunami run up area as mapped on the Los Angeles Tsunami Hazard: Maximum Run-up map (CalEMA, 2010). The run up area indicates zones along the Pacific Coast below an elevation of 42 feet (msl) are susceptible to tsunami inundation. The project site is topographically at least 120 feet above the areas identified to have a potential for Tsunamis impact. In addition, the site is not located within a tsunami inundation area as mapped by the State of California (CGS, 2009).

Based on the site's elevation of approximately 258 feet above sea level and the lack of nearby enclosed water bodies, the risks associated with tsunamis and seiches are considered negligible.

4.0 FINDINGS AND CONCLUSIONS

Presented below is a summary of findings and conclusions based upon the results of our evaluation of the project site:

- This site **is** located within a currently designated Alquist-Priolo Special Studies Zone (CGS, 2018) for surface fault rupture. Based on our subsurface interpretation and soil age dating, active faults do not underlie the explored area.
- Pleistocene-aged soil extends unbroken across the study area and any faults underlying the site at depth >50 feet are not active. No fault related setbacks are required or recommended for this site
- The site is **not** located within a designated liquefaction hazard zone. The site is not located in any geologic or seismic hazard zone that could preclude the development of the proposed project. As is the case for most of Southern California, strong ground shaking has and will occur at this site.
- The site is underlain by undocumented artificial fill to a depth of approximately 2 to 4 feet overlying native alluvial valley deposits generally consisting of stiff to hard clays interbedded with medium dense to dense sands; with varying proportions of predominantly slate gravels.
- Groundwater was not encountered during the current exploration. Groundwater is not expected to pose a constraint to construction. The historic high groundwater level at the site was interpreted to be on the order of 40 to 50 feet bgs.
- The potential for liquefaction and liquefaction-induced ground failure to occur at the site is considered low.
- The potential seismically-induced settlement at the site is estimated to be on the order of ½ inch or less.
- Based on our observations and testing, the onsite soils that will be in contact with the planned structures are expected to have a low expansion potential. Additional testing is recommended at completion of grading.
- Concrete in contact with the onsite soil is expected to have negligible exposure to water-soluble sulfates a nd low exposure to chloride in the soil. The onsite soil, however, is considered moderately corrosive to ferrous metal.

- The subsurface materials are anticipated to be readily excavated using conventional earthmoving equipment in good working condition.
- The proposed improvements may be supported on conventional spread footings established on engineered fill or undisturbed natural soils.

Based on the results of this study, it is our opinion that the subject site is suitable for the proposed project from a geotechnical viewpoint. Geotechnical recommendations for the proposed development are presented in the following sections and are intended to provide sufficient geotechnical information to develop the project plans in accordance with the 2019 edition of the California Building Code (CBC) requirements.

5.0 RECOMMENDATIONS

The following recommendations have been developed based on the exhibited engineering properties of the onsite soils and their anticipated behavior during and after construction. Recommendations are specifically provided for design of foundations, seismic design considerations, floor slabs, retaining structures, paving, and grading. The proposed structure may be supported on spread-type shallow footing foundation systems established on engineered fill or undisturbed natural soils. Leighton should review the grading plan, foundation plans and specifications when they are available to verify that the recommendations presented in this report have been properly interpreted and incorporated.

Loading and bearing pressure diagrams should be provided for our review once prepared to confirm recommendations and settlement estimates remain valid for the project as currently proposed.

5.1 Grading

Project earthwork is expected to include complete demolition/removal of existing surface pavements, landscaping, utilities and complete overexcavation and recompaction of any remaining undocumented fill soils below new improvement footprints as described in the following subsections.

5.1.1 Site Preparation

After the site is cleared, the soils should be carefully observed for the removal of all unsuitable deposits. We recommend that after removal of pavements, hardscape, and existing utilities, all undocumented fill soils should be removed and recompacted within the proposed improvement footprint. Undocumented fill was encountered as deep as 4 feet bgs in our borings. Deeper fill may be encountered between boring locations.

This overexcavation bottom should extend horizontally either the thickness of fill below spread footings or at least 5 feet horizontally beyond the outside edges of proposed footings, whichever is deeper. Overexcavation is not required for footings established directly on undisturbed natural soils. Any underground obstructions encountered should be removed. Utility lines should be removed or rerouted where interfering with proposed construction. *It is essential that excavation not undermine foundations of the existing buildings and structures that will remain in place along the boundaries project. As-Built details of any structure to remain should be* *provided to Leighton and the structural engineer prior to incorporation into the new design.*

Areas outside the classroom footprint limits, planned for new asphalt and/or concrete pavement, should be over-excavated to a minimum depth of 24 inches below existing or finish grade, or 18 inches below proposed pavement sections; whichever is deeper.

Resulting removal excavation bottom-surfaces should be observed by Leighton prior to placement of any backfill or new construction. After these over-excavations are completed, and prior to fill placement, exposed surfaces should be scarified to a minimum depth of 8 inches, moisture-conditioned to 2 percent above optimum moisture content, and recompacted (proof rolled) to a minimum 90 percent relative compaction as determined by ASTM D 1557 (modified Proctor compaction curve).

5.1.2 Earthwork Observation and Testing

Leighton Consulting, Inc. should observe and test all grading and earthwork, to check that the site is properly prepared, the selected fill materials are satisfactory, and that placement and compaction of fills has been performed in accordance with our recommendations and the project specifications. Sufficient notification to us prior to earthwork is essential. Project plans and specifications should incorporate recommendations contained in the text of this report.

Variations in site conditions are possible and may be encountered during construction. To confirm correlation between soil data obtained during our field and laboratory testing and actual subsurface conditions encountered during construction, and to observe conformance with approved plans and specifications, it is essential that we be retained to perform continuous or intermittent review during earthwork, excavation and foundation construction phases. Therefore, conclusions and recommendations presented in this report are contingent upon us performing construction observation services.

5.1.3 Fill Placement and Compaction

Onsite soils free of organics, debris and oversized material (greater-than 6 inches in largest dimension) are suitable for use as compacted structural fill. However, any soil to be placed as fill, whether onsite or imported material, should be first viewed by Leighton and then tested if and as necessary, prior to approval for use as compacted fill. All structural fill must be free of hazardous materials.

All fill soil should be placed in thin, loose lifts, moisture-conditioned, as necessary, to 2 percent above optimum moisture content and compacted to a minimum 90% relative compaction as determined by ASTM D 1557 standard test method (modified Proctor compaction curve) within building footprints. Aggregate base for pavement sections should be compacted to a minimum of 95% relative compaction. At least the upper 12 inches of the exposed soils in roadways and access drives, parking lots and (concrete – paver) flatwork areas, should be compacted to at least 95 percent relative compaction based on ASTM Test Method D 1557.

Fill Materials: The onsite soils, less any deleterious material or organic matter, can be used in required fills. Cobbles or slaty clasts larger than 6 inches in largest diameter should not be used in the fill. Any required import material should consist of relatively non-expansive soils with a very low Expansion Index (EI<20). All proposed import materials should be approved by the geotechnical engineer of record prior to being placed at the site.

Surface Drainage: Water should not be allowed to pond or accumulate anywhere except in detention basins. Pad drainage should be designed to collect and direct surface water away from structures to approved drainage facilities. Hardscape drains should be installed and drain to storm water disposal systems. Drainage patterns approved at the time of fine grading should be maintained throughout the life of proposed structures. Irrigation and/or percolation should not be allowed for at least 10 feet horizontally around buildings.

5.1.4 Reuse of Concrete and Asphalt in Fill Pulverized demolition concrete free of rebar and other materials and demolished asphalt pavement can be pulverized to particles no-larger-than (≤) 3-inches and mixed with site soils for use in compacted fill. Blended pulverized concrete and asphalt should be mixed with at least 25% soils by weight. Such materials must be free of and segregated from any hazardous materials and/or organic material of any kind.

5.1.5 Temporary Excavations

All temporary excavations, including utility trenches, retaining wall excavations, and other excavations should be performed in accordance with project plans, specifications and all State of California Occupational Safety and Health Administration (CalOSHA) requirements.

No surcharge loads should be permitted within a horizontal distance equal to the height of cut or 5 feet, whichever is greater from the top of the slope, unless the cut is shored appropriately. Excavations that extend below an imaginary plane inclined at 45 degrees below the edge of any adjacent existing site foundations should be properly shored to maintain support of these structures.

Temporary excavations should be treated in accordance with CalOSHA excavation regulations. The sides of excavations should be shored or sloped accordingly. CalOSHA allows the sides of unbraced excavations, up to a maximum height of 20 feet, to be cut to a ¾:1 (horizontal:vertical) slope for Type A soils, 1:1 for Type B soils, and 1½:1 for Type C soils.

The onsite soils within the proposed structural depths generally conform to CalOSHA Type C soils. CalOSHA regulations are applicable in areas with no restriction of surrounding ground deformations. Shoring should be designed for areas with deformation restrictions. The soil type should be verified or revised based on geotechnical observation and testing during construction, as soil classifications may vary over short horizontal distances. Heavy construction loads, such as those resulting from stockpiles and heavy machinery, should be kept a minimum distance equivalent to the excavation height or 5 feet, whichever is greater, from the excavation unless the excavation is shored and these surcharges are considered in the design of the shoring system.

5.1.6 Trench Backfill

Pipeline trenches should be backfilled with compacted fill in accordance with this report, and applicable *Standard Specifications For Public Works Construction* (Greenbook), current edition standards. Backfill in and above the pipe zone should be as follows:

- ***Pipe Zone****:* Any proposed pipe should be placed on properly placed bedding materials. Pipe bedding should extend to a depth in accordance to the pipe manufacturer's specification. The pipe bedding should extend to least 1 foot over the top of the conduit. The bedding material may consist of compacted free-draining sand, gravel, or crushed rock. If sand is used, the sand should have a sand equivalent greater than 30. As an alternate, the pipe bedding zone can be backfilled with Controlled Low Strength Material (CLSM) consisting of at least one sack of Portland cement per cubic-yard of sand, conforming to Section 201-6 of the 2021 Edition of the Standard Specifications for Public Works Construction (Greenbook). CLSM bedding should be placed to 1 foot over the top of the conduit, and vibrated. CLSM should not be jetted.

  Where granular backfill is used in utility trenches adjacent moisture sensitive subgrades and foundation soils, we recommend that a cut-off "plug" of impermeable material be placed in these trenches at the perimeter of buildings, and at pavement edges adjacent to irrigated landscaped areas. A "plug" can consist of a 5-foot long section of clayey soils with more than 35-percent passing the No. 200 sieve, or a Controlled Low Strength Material (CLSM) consisting of one sack of Portland-cement plus one sack of bentonite per cubic-yard of sand. CLSM should generally conform to Section 201-6 of the "Greenbook". This is intended to reduce the likelihood of water permeating trenches from landscaped areas, then seeping along permeable trench backfill into the building and pavement subgrades, resulting in wetting of moisture sensitive subgrade earth materials under buildings and pavements.

- ***Over Pipe Zone****:* Above the pipe zone, trenches can be backfilled with excavated on-site soils free of debris, organic and oversized material larger than 3 inches in largest dimension. As an option, the whole trench can be backfilled with one-sack CLSM same as presented above for the pipe bedding zone. Native soil backfill over the pipe-bedding zone should be placed in thin lifts, moisture conditioned, as necessary, and mechanically compacted using a minimum standard of 90% relative compaction relative to the ASTM D 1557 laboratory maximum dry density within building footprints. The upper 12-inches under hardscape, parking, paver etc. should be compacted to 95% relative compaction. Backfill above the pipe zone should **not** be jetted. In any case, backfill above the pipe zone (bedding) should be observed and tested by Leighton.

5.1.7 Corrosion Protection Measures

Water-soluble sulfates in soil can react adversely with concrete. As referenced in the 2019 California Building Code (CBC), Section 1904A, concrete subject to exposure to sulfates shall comply with requirements set forth in ACI 318. Based on laboratory testing results of the onsite soils from subsurface explorations, concrete structures in contact with the onsite soil will likely have **"negligible"** exposure to water-soluble sulfates in the soil. Therefore, common Type II Portland cement may be used for concrete construction in contact with site soils. Subgrade soil should be tested for water-soluble sulfate content prior to final design of the concrete structures once grading is complete. Import fill soil should be geotechnically tested for corrosivity and sulfate attack before import to the site. Further testing of import soils should include analytical testing for chemicals of concern prior to import and acceptance.

Based on corrosivity test results, the onsite soil is considered moderately corrosive to ferrous metals. Therefore, based on these results, ferrous pipe buried in moist to wet site earth materials should be avoided by using high-density polyethylene (HDPE), polyvinyl chloride (PVC) and/or other non-ferrous pipe when possible. Ferrous pipe can also be protected by polyethylene bags, tap or coatings, di-electric fittings or other means to separate the pipe from on-site soils.

5.2 Foundations

The proposed new structures may be supported on a shallow spread footing foundation system established on engineered fill or undisturbed natural soils.

5.2.1 Shallow Spread Footings

Footings for proposed structures should have a minimum embedment of 3 feet and have a minimum width of 18 inches. Footings for proposed temporary structures may be supported directly on grade.

Bearing Value: Footings or post-tensioned concrete slabs with thickened edges established on engineered fill or undisturbed natural soils may be designed to impose an allowable bearing pressure of 3,000 pounds per square foot (psf).

The excavations should be deepened as necessary to extend into satisfactory soils.

The ultimate bearing capacity can be taken as 9,000 psf. This value does not incorporate a factor of safety and may only be used for an ultimate bearing capacity check with appropriate factored loads.

The recommended bearing value is a net value, and the weight of concrete in the footings can be taken as 50 pounds per cubic foot (pcf); the weight of soil backfill can be neglected when determining the downward loads.

Settlement: The above recommended allowable bearing capacities are generally based on a total post-construction settlement of about ½ inch for column loads not exceeding 300 kips.

Differential settlement due to static loading is generally estimated at ¼ inch over a horizontal distance of 40 feet. Once developed by the structural engineer, we should review total dead and sustained live loads for each column including plan location and span distance, to evaluate if differential settlements between dissimilarly loaded columns will be tolerable. Excessive differential settlement can be mitigated with the use of reduced bearing pressures, deeper footing embedment, possibly changing overexcavation schemes and using imported base material under spread footings, or possibly other methods.

Lateral Resistance: Soil resistance available to withstand lateral loads on a shallow foundation is a function of the frictional resistance along the base of the footing and the passive resistance that may develop as the face of the structure tends to move into the soil. The frictional resistance between the base of the foundation and the subgrade soil may be computed using a coefficient of friction of 0.35. The passive resistance may be computed using an equivalent fluid pressure of 300 pounds-per-cubic-foot (pcf), assuming there is constant contact between the footing and undisturbed soil. The passive resistance can be increased by one-third when considering short-duration wind or seismic loads. The friction resistance and the passive resistance of the soils can be combined without reduction in determining the total lateral resistance.

Uplift Resistance: To evaluate uplift resistance provided by the dead weight of soils above the footing, the frustum of soil above the footing may be estimated by a 30 degree outward projection from vertical. A unit weight of 120 pcf may be used for the soil volume within the frustum.

To evaluate uplift resistance provided by the shear resistance soils above the footing, an allowable shear value of 75 psf may be used along vertical shear planes from the bottom of the footing to the ground surface along the perimeter the footings. A factor of safety of 3 was used to develop the allowable shear value.

5.2.2 Modulus of Subgrade Reaction

For foundations established in undisturbed natural soil or engineered fill, an initial unit modulus of subgrade reaction (k_1) value of 150 pounds per cubic inch (pci) may be used.

The k_1 value presented herein, which corresponds to a 1-foot-square footing, should be reduced as shown below to incorporate foundation size effects:

$$k = k_1 \left(\frac{B+1}{2B}\right)^2$$

where B is the square footing width.

Leighton should review the resulting foundation deformation contours developed by the structural engineer for conformance with geotechnical settlement estimates.

5.2.3 Flagpole-Type Foundations

Canopy structures, light poles, and fencing may be supported on flagpole-type foundations. Flagpole-type foundations may be designed to impose an allowable vertical bearing pressure of 3,000 psf and an allowable lateral bearing pressure of 600 psf per foot below grade. The allowable vertical and lateral bearing pressures may be increased by one-third for short-duration loading such as wind or seismic loading. The recommended bearing value is a net value, and the weight of concrete in the flagpole footings can be taken as 50 pounds per cubic foot.

5.3 Seismic Design Parameters

To accommodate effects of ground shaking produced by regional seismic events, seismic design can be performed by the project structural engineer in accordance with the 2019 CBC. The table below, *2019 CBC Mapped Seismic Parameters*, lists seismic design parameters based on the 2019 CBC, Section 1613A.3 (ASCE 7-16) methodology:

Table 5 - 2019 CBC Mapped Seismic Parameters

Categorization/Coefficients	Code-Based (1) (2)
Site Longitude (decimal degrees) West	-118.4851
Site Latitude (decimal degrees) North	34.0391
Site Class	D
Mapped Spectral Response Acceleration at 0.2s Period, S_s	1.962
Mapped Spectral Response Acceleration at 1s Period, S_1	0.701
Short Period Site Coefficient at 0.2s Period, F_a	1.0
Long Period Site Coefficient at 1s Period, F_v	null*
Adjusted Spectral Response Acceleration at 0.2s Period, S_{MS}	1.962
Adjusted Spectral Response Acceleration at 1s Period, S_{M1}	null*
Design Spectral Response Acceleration at 0.2s Period, S_{DS}	1.308
Design Spectral Response Acceleration at 1s Period, S_{D1}	null*
Design Peak Ground Acceleration, PGA_M	0.921

1. All were derived from the SEA web page: https://seismicmaps.org/
2. All coefficients in units of g (spectral acceleration)
3. See Appendix C for details of the seismic evaluation.
4. *Requires C_s calculation, see below.

Based on the 2019 CBC Table 1613.2.3(2), the long period site coefficient should be determined in accordance with Section 11.4.8 of ASCE 7-16 since the mapped spectral response acceleration at 1 second is greater than 0.2g for Site Class D. In accordance with Section 11.4.8 of ASCE 7-16, a site-specific seismic analysis is required; however, the values provided herein may be utilized if design is performed in accordance with exception (2) in Section 11.4.8 of ASCE 7-16, with special requirements for the seismic response coefficient (Cs). The project structural engineer should review the seismic parameters.

The 2019 CBC site-specific seismic design parameters are summarized below. Details, including the site-specific response spectra are presented in Appendix D.

Table 6 - Site-Specific 2019 CBC Seismic Design Parameters

Categorization/Coefficients	Design Value
Adjusted Spectral Response Acceleration at 0.2s Period, S_{MS}	2.212g
Adjusted Spectral Response Acceleration at 1s Period, S_{M1}	1.402g
Design Spectral Response Acceleration at 0.2s Period, S_{DS}	1.474g
Design Spectral Response Acceleration at 1s Period, S_{D1}	0.935g
Design Peak Ground Acceleration, PGA_M	0.907g

5.4 Slabs-on-Grade

Concrete slabs-on-grade should be designed by the structural engineer in accordance with 2019 CBC requirements for soils with a low expansion potential. More stringent requirements may be required by the structural engineer and/or architect; however, slabs-on-grade should have the following minimum recommended components:

- ***Subgrade:*** The near-surface soils are characterized as clayey silty, are low expansive and will shrink and swell with changes in the moisture content. Therefore, floor slabs-on-grade and adjacent concrete flatwork should be underlain by at least 24 inches of relatively non-expansive fill (EI<20). Slab-on-grade subgrade soil should be moisture conditioned to 2% over optimum moisture content, to a minimum depth of 18 inches within building footprints and compacted to 90% of the modified proctor (ASTM D 1557) laboratory maximum density prior to placing either a moisture barrier, steel and/or concrete. Onsite soil may be suitable for this use; however additional expansion testing should be performed upon completion of grading to verify expansive properties of onsite soil.

- ***Moisture Barrier:*** A moisture barrier consisting of at least 15-mil-thick Stego-wrap vapor barriers (see: http://www.stegoindustries.com/products/stego_wrap_vapor_barrier.php), or equivalent, should then be placed below slabs where moisture-sensitive floor coverings or equipment will be placed.

- ***Reinforced Concrete**:* A conventionally reinforced concrete slab-on-grade with a thickness of at least 5 inches within the building footprint and 6-inches for exterior SOG be placed in pedestrian areas without heavy loads. Reinforcing steel should be designed by the structural engineer, but as a minimum should be No. 3 rebar placed at 18 inches on-center, each direction (perpendicularly), mid-depth in the slab. A modulus of subgrade reaction (k) as a linear spring constant, of 75 pounds-per-square-inch per inch deflection (pci) can be used for design of heavily loaded slabs-on-grade, assuming a linear response up to deflections on the order of ¾ inch.

  Minor cracking of concrete after curing due to expansion, drying and shrinkage is normal and will occur. However, cracking is often aggravated by a high water-to-cement ratio, high concrete temperature at the time of placement, small nominal aggregate size, and rapid moisture loss due to hot, dry, and/or windy weather conditions during placement and curing. Cracking due to temperature and moisture fluctuations can also be expected. The use of low-slump concrete or low water/cement ratios can reduce the potential for shrinkage cracking

5.4.1 Utilities and Trenches

Open or backfilled trenches paralleling any new or existing footings to remain shall not be below a 1:1 projection from outer lowest edge of footings or slab on grade. Where pipes cross under footings the footings shall be specifically designed by the engineer in charge. Pipe sleeves shall be provided where pipes cross through footings or footing walls and sleeve clearances shall be designed to account for potential settlement of not less than 1 inch around the pipe. Alternate and approved clearances can be provided by the design professional in charge of the utility.

5.5 Lateral Earth Pressures

Recommended lateral earth pressures are provided as equivalent fluid unit weights, in psf/ft. or pcf. These values do not contain an appreciable factor of safety, so the structural engineer should apply the applicable factors of safety and/or load factors during design.

On-site soils may be suitable to be used as retaining wall backfill due to its low expansion potential (Appendix C), however, field and laboratory verification are recommended before use. Site soils can be variable in composition and expansive characteristics, See Section 2.4. Should site soil be desired for reuse behind retaining walls the material should be tested to ensure Expansion potential is less than 20 (EI<20). Recommended lateral earth pressures for retaining walls backfilled with sandy soils with drained conditions as shown on Figure 8 are as follows:

Table 7 - Retaining Wall Design Earth Pressures

Retaining Wall Condition (Level Backfill)	Equivalent Fluid Pressure (pounds-per-cubic-foot)*
Active (cantilever)	35
At-Rest (braced)	55
Passive Resistance (compacted fill)	300
Seismic Increment (add to active pressure)	30

*Only for level and drained properly compacted backfill

Walls that are free to rotate or deflect may be designed using active earth pressure. For walls that are fixed against rotation, the at-rest pressure should be used. For seismic condition, the pressure should be distributed as an inverted triangular distribution and the dynamic thrust should be applied at a height of 0.6H above the base of the wall.

Retaining Wall Surcharges: In addition to the above lateral forces due to retained earth, surcharge due to above grade loads on the wall backfill, such as existing building foundations, should be considered in design of retaining walls.

Vertical surcharge loads behind a retaining wall on or in backfill within a 1:1 (horizontal:vertical) plane projection up and out from the retaining wall toe, should be considered as lateral and vertical surcharge. Unrestrained (cantilever) retaining walls should be designed to resist one-third of these surcharge loads applied as a uniform horizontal pressure on the wall. Braced walls should also be designed to resist an additional uniform horizontal-pressure equivalent to one-half of uniform vertical surcharge loads. Consideration should be given to underpinning existing structures to remain in this zone, to reduce surcharge loads on the wall and to reduce the potential for inducing damaging settlement within these existing buildings, due to soil movement within the wall influence zone.

In areas where autos and pickup trucks will drive, we suggest assuming a uniform vertical surcharge of 300 psf, which would result in active and at-rest horizontal surcharges of 100 psf and 150 psf, respectively. This should be doubled in areas of heavy construction traffic (such as concrete trucks, heavy equipment delivery-trucks, etc.). If crane outrigger loads or other point load sources are applied as wall surcharge, this will require additional analyses based on load source and location relative to the wall.

5.5.1 Sliding and Overturning Total depth of retained earth for design of walls and for uplift resistance, should be measured as the vertical height of the stem below the ground surface at the wall face for stem design, or measured at the heel of the footing for overturning and sliding. A soil unit weight of 120 pcf may be assumed for calculating the actual weight of the soil over the wall footing, if drained, or 60 pcf if submerged, for properly compacted backfill.

5.5.2 Drainage

Adequate drainage may be provided by a subdrain system positioned behind the walls. Typically, this system consists of a 4-inch minimum diameter perforated pipe placed near the base of the wall (perforations placed downward). The pipe should be bedded and backfilled with pervious backfill material described in Section 300-3.5.2 of the Standard Specifications for Public Works Construction (Green Book), 2021 Edition. This pervious backfill should extend at least 2 feet out from the wall and to within 2 feet of the outside finished grade. This pervious backfill and pipe should be wrapped in filter fabric, such as Mirafi 140N or equivalent, placed as described in Section 300-8.1 of the Standard Specifications for Public Works Construction (Green Book). The subdrain outlet should be connected to a free-draining outlet or sump.

Miradrain, Geotech Drainage Panels, or Enkadrain drainage geocomposites, or similar, may be used for wall drainage as an alternative to the Class 2 Permeable Material or drain rock backfill, particularly where horizontal space is limited adjacent to shoring (where walls are cast against shoring). These drainage panels should be connected to the perforated drainpipe at the base of the wall.

5.6 Pavement Design

To provide support for paving, the subgrade soils should be prepared as recommended in Section 5.1, Grading. Compaction of the subgrade, including trench backfills, to at least 90 to 95 percent as recommended relative compaction based on ASTM Test Method D 1557 and achieving a firm, hard and unyielding surface will be important for paving support. The upper 12-inches of pavement subgrade should be compacted to 95% relative compaction. The preparation of the paving area subgrade should be performed immediately prior to placement of the base course. Proper drainage of the paved areas should be provided since this will reduce moisture infiltration into the subgrade and increase the life of the paving.

5.6.1 Base Course

The base course for both asphalt concrete and Portland Cement Concrete paving should meet the specifications for Class 2 Aggregate Base as defined in Section 26 of the latest edition of the State of California, Department of Transportation, and Standard Specifications. Alternatively, the base course could meet the specifications for untreated base as defined in Section 200-2 of the latest edition of *Standard Specifications for Public Works Construction* (Greenbook). Crushed Miscellaneous Base (CMB) may be used for the base course provided the geotechnical consultant evaluates and tests it before delivery to the site.

5.6.2 Asphalt Concrete

The required asphalt paving and base thicknesses will depend on the expected wheel loads and volume of traffic (Traffic Index or TI). Assuming that the paving subgrade will consist of the onsite or comparable soils with an R-value of at least 35 (see test result in Appendix B) compacted to at least 90 percent relative compaction based on ASTM Test Method D 1557 below 12-inches and 95% relative compaction in the upper 12 inches, the minimum recommended paving thicknesses are presented in the following table:

Area	Traffic Index	Asphalt Concrete (inches)	Base Course (inches)
Light Truck	5	3	4½
Heavy Truck	6	4	5½
Main Drives	7	4	8½

The asphalt paving sections were determined using the Caltrans design method. We can determine the recommended paving and base course thicknesses for other Traffic Indices if required. Careful inspection is recommended to verify that the recommended thicknesses or greater are achieved, and that proper construction procedures are followed.

5.6.3 Portland Cement Concrete Paving

Portland Cement Concrete (PCC) paving and walks supported on clayey onsite soils should be underlain by at least 18 inches of engineered fill consisting of relatively non-expansive (EI < 20) soils. We have assumed that such a subgrade will have an R-value of at least 40, which will need to be verified during grading. Onsite soils are anticipated to have an EI<20, therefore, we expect that relatively non-expansive (EI<20) may not need to be imported for PCC paving.

PCC paving sections were determined in accordance with procedures developed by the Portland Cement Association. Concrete paving sections for a range of Traffic Indices are presented in the table below. We have assumed that the PCC will have a compressive strength $\left(f_c^{'}\right)$ of at least 4,000 pounds per square inch (psi).

Area	Traffic Index	Portland Cement Concrete (inches)	Base Course (inches)
Light Truck	5	5½	4
Heavy Truck	6	6½	4
Main Drives	7	7	4

The paving should be provided with expansion joints at regular intervals no more than 15 feet in each direction. Load transfer devices, such as dowels or keys, are recommended at joints in the paving to reduce possible offsets. The paving sections in the above table have been developed based on the strength of unreinforced concrete. Steel reinforcing may be added to the paving to reduce cracking and to prolong the life of the paving.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Excavations

Based on our field observations, caving of cohesionless strata and loose fill soils will likely be encountered in unshored excavations. To protect workers entering excavations, excavations should be performed in accordance with OSHA and Cal-OSHA requirements, and the current edition of the California Construction Safety Orders, see:

http://www.dir.ca.gov/title8/sb4a6.html

Contractors should be advised that fill soils should be considered Type C soils as defined in the California Construction Safety Orders. As indicated in Table B-1 of Article 6, Section 1541.1, Appendix B, of the California Construction Safety Orders, excavations less-than (<) 20 feet deep within Type C soils should be sloped back no steeper than 1½:1 (horizontal:vertical), where workers are to enter the excavation. This may be impractical near adjacent existing utilities and structures; so shoring may be required depending on trench depth and locations. Stiff undisturbed native clays will stand steeper.

During construction, soil conditions should be regularly evaluated to verify that conditions are as anticipated. The contractor is responsible for providing the "competent person" required by OSHA standards to evaluate soil conditions. Close coordination between the competent person and Leighton Consulting, Inc. should be maintained to facilitate construction while providing safe excavations.

Excavations must not undermine foundations for existing buildings. Excavations must not encroach within a 1:1 (horizontal:vertical) wedge extending down and out from existing shallow footings to remain. Shoring or underpinning of existing building foundations may be required depending upon final footprint and floor elevations.

6.2 Geotechnical Services During Construction

Our geotechnical recommendations are contingent upon Leighton Consulting, Inc., providing geotechnical observation and testing services during earthwork and foundation construction. There is a potential for encountering deeper undocumented fill, underground obstructions or otherwise unacceptable existing soils between or beyond our boring locations. We are unaware of any existing fill placement documentation for this site. Therefore, inconsistent existing fill materials may be encountered during construction, possibly requiring revised geotechnical recommendations.

Our geotechnical recommendations provided in this report are based on information available at the time the report was prepared and may change as plans are developed. Additional geotechnical exploration, testing and/or analysis may be required should the proposed location of the building change drastically from its currently proposed footprint (Figure 2). Leighton Consulting, Inc. should review site grading, foundation, and shoring plans when available, to comment further on geotechnical aspects of this project and check to see general conformance of final project plans to recommendations presented in this report.

Leighton Consulting, Inc. should be retained to provide geotechnical observation and testing during excavation and all phases of earthwork. Our conclusions and recommendations should be reviewed and verified by us during construction and revised accordingly if geotechnical conditions encountered vary from our findings and interpretations. Geotechnical observation and testing should be provided:

- During all excavation,
- During compaction of all fill materials,
- After excavation of all footings and prior to placement of concrete,
- During utility trench backfilling and compaction,
- During pavement subgrade and base preparation, and/or
- If and when any unusual geotechnical conditions are encountered.

7.0 LIMITATIONS

Leighton's work was performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or similar localities. No other warranty, express or implied, is made as to the conclusions and professional opinions included in this report. As in many projects, conditions revealed in excavations may be at variance with our current findings. If this occurs, the changed conditions must be evaluated by the geotechnical consultant and additional recommendations be obtained, as warranted.

The identification and testing of hazardous, toxic or contaminated materials were outside the scope of Leighton's work. Should such materials be encountered at any time, or their existence is suspected, all measures stipulated in local, county, state and federal regulations, as applicable, should be implemented.

This report is issued with the understanding that it is the responsibility of the owner or a duly authorized agent acting on behalf of the owner, to ensure that the information and recommendations contained herein are brought to the attention of the necessary design consultants for the project and incorporated into the plans; and that the necessary steps are taken to see that the contracts carry out such recommendations in the field.

The findings of this report are considered valid as of the present date. However, changes in the condition of a property can occur with the passage of time, whether due to natural processes or the work of man on the subject or adjacent properties. In addition, changes in standards of practice may occur from legislation or the broadening of knowledge. Accordingly, the findings of this report may at some future time be invalidated wholly or partially by changes outside Leighton's control.

The conclusions and recommendations in this report are based in part upon data that were obtained from a necessarily limited number of observations, site visits, excavations, samples and testes. Such information can be obtained only with respect to the specific locations explored, and therefore may not completely define all subsurface conditions throughout the site. The nature of many sites is that differing geotechnical and/or geological conditions can occur within small distances and under varying climatic conditions. Furthermore, changes in subsurface conditions can and do occur over time. Therefore, the findings, conclusions, and recommendations presented in this report should be considered preliminary if unanticipated conditions are encountered and additional explorations, testing and analyses may be necessary to develop alternative recommendations.

This report has been prepared for the express use of Santa Monica Malibu Unified School District and its design consultants, and only as related expressly to the assessment of the geotechnical constraints of developing the subject site and for construction purposes. This report may not be used by others or for other projects without the express written consent of Santa Monica - Malibu Unified School District and our firm.

If parties other than Leighton are engaged to provide construction geotechnical services, they must be notified that they will be required to assume complete responsibility for the geotechnical phase of the project by concurring with the findings and recommendations in this report or by providing alternative recommendations. Any persons using this report for bidding or construction purposes should perform such independent investigations as they deem necessary to satisfy themselves as to the surface and/or subsurface conditions to be encountered and the procedures to be used in the performance of work on the subject site.

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Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific imes

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependen

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

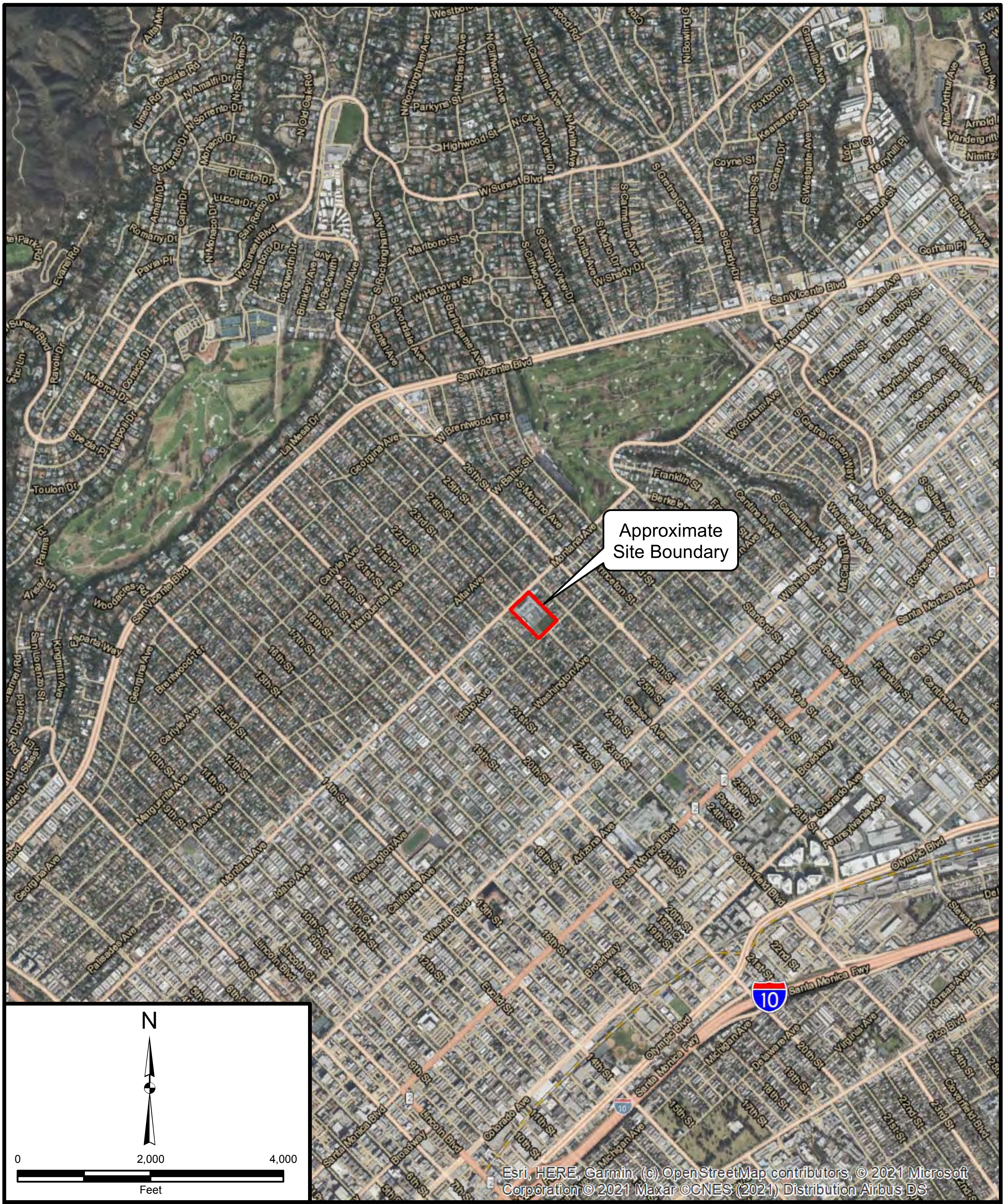
The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mol

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org



Project: 11428.035	Eng/Geol: CCK/EMH	**SITE LOCATION MAP** SMMUSD - Franklin Elementary School 2400 Montana Avenue Santa Monica, California	**FIGURE 1**
Scale:1 " = 2,000 '	Date: October 2021		Leighton
Base Map: ESRI ArcGIS Online 2021 Thematic Information: Leighton Author: Leighton Geomatics (btran)			

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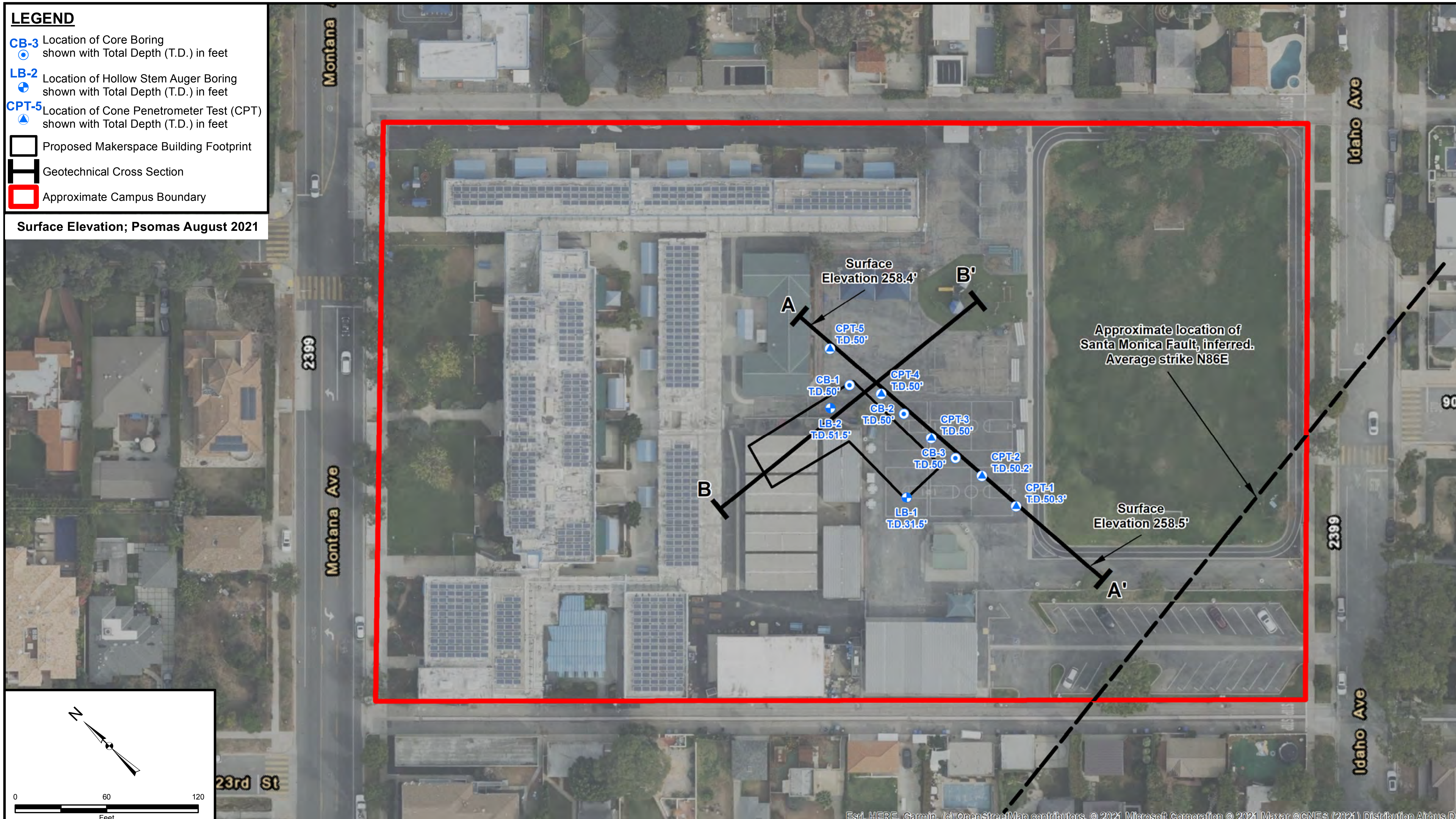

Project: 11428.035	Eng/Geol: CCK/EMH
Scale: 1 " = 60 '	Date: January 2022

Base Map: ESRI ArcGIS Online 2022

Author: Leighton Geomatics (btran)

EXPLORATION LOCATION MAP

SMMUSD - Franklin Elementary School
2400 Montana Avenue
Santa Monica, California

FIGURE 2

Leighton

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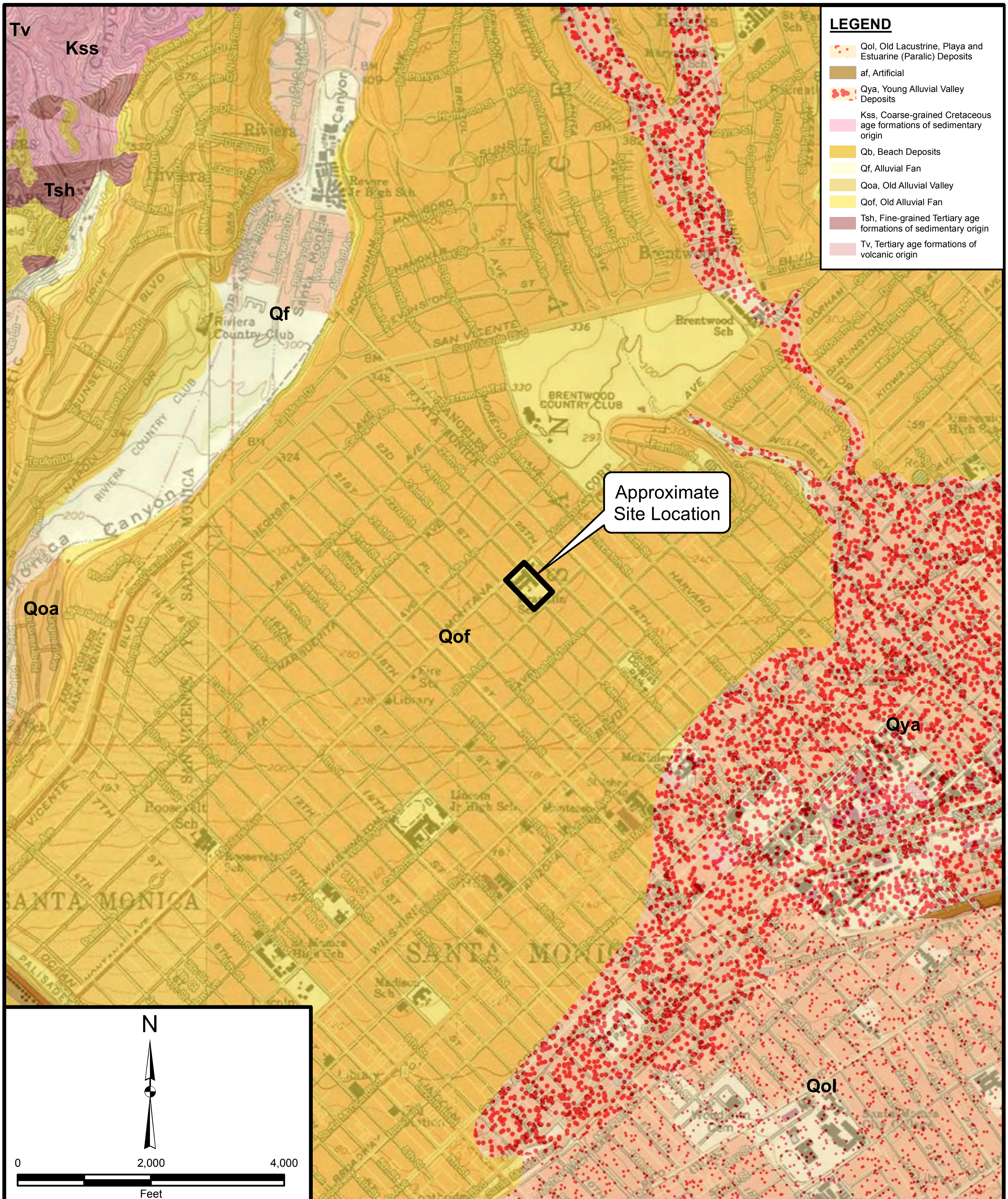

Project: 11428.035	Eng/Geol: CCK/EMH
Scale:1 " = 2,000 '	Date: October 2021

Base Map: ESRI ArcGIS Online 2021
Socal Preliminary Geology, 2010

Author: Leighton Geomatics (btran)

REGIONAL GEOLOGY MAP

SMMUSD - Franklin Elementary School
2400 Montana Avenue
Santa Monica, California

FIGURE 3

Leighton

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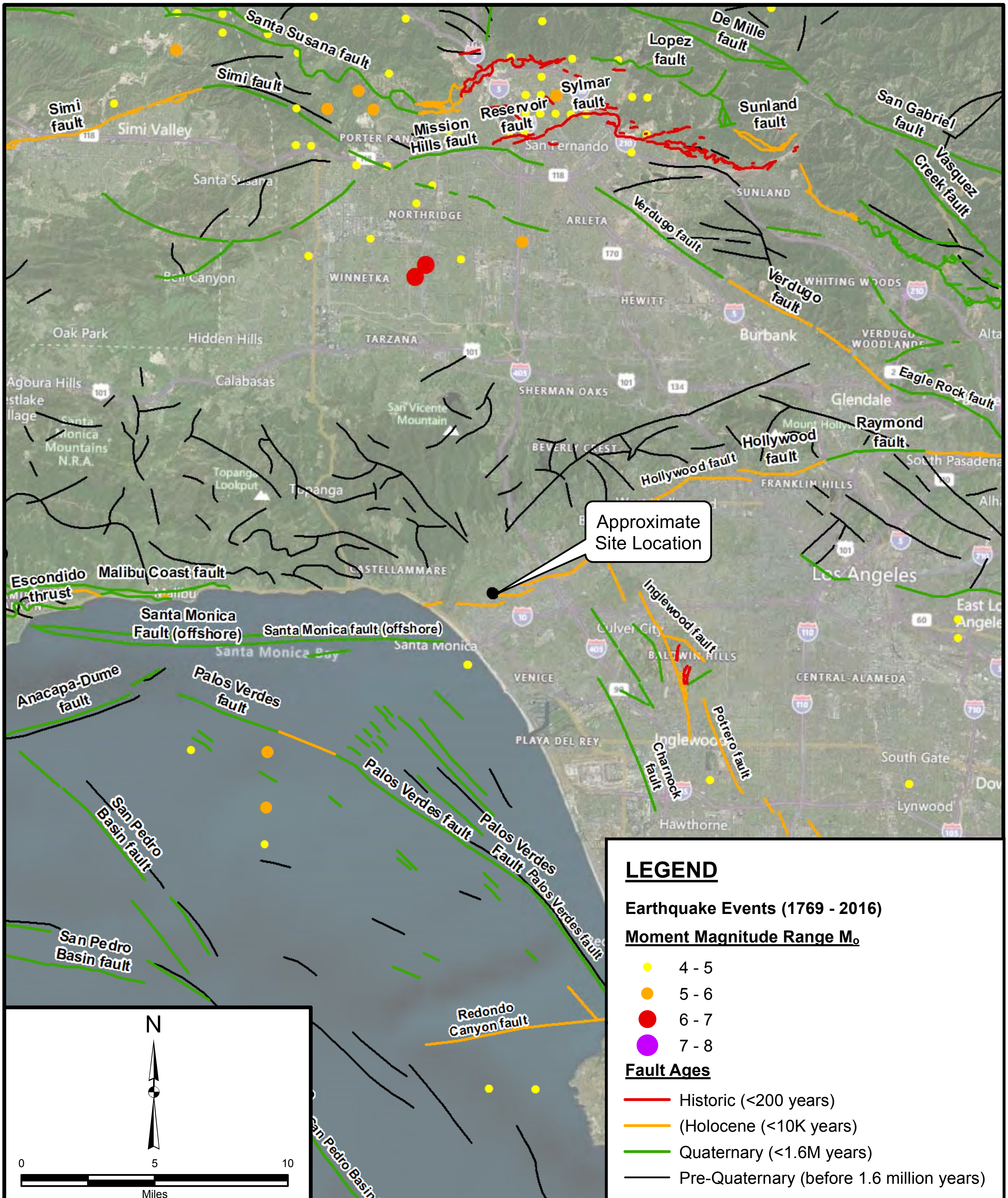

Project: 11428.035	Eng/Geol: CCK/EMH
Scale:1 " = 5 miles	Date: October 2021

Reference: ESRI ArcGIS Online 2021
Bryant, W. A. (compiler), 2005, Digital Database of Quaternary and Younger Faults from the Fault Activity Map of California, version 2.0: CGS, USGS, SCEC.
Author: Leighton Geomatics (btran)

REGIONAL FAULT AND HISTORICAL SEISMICITY MAP

SMMUSD - Franklin Elementary School
2400 Montana Avenue
Santa Monica, California

FIGURE 4

Leighton

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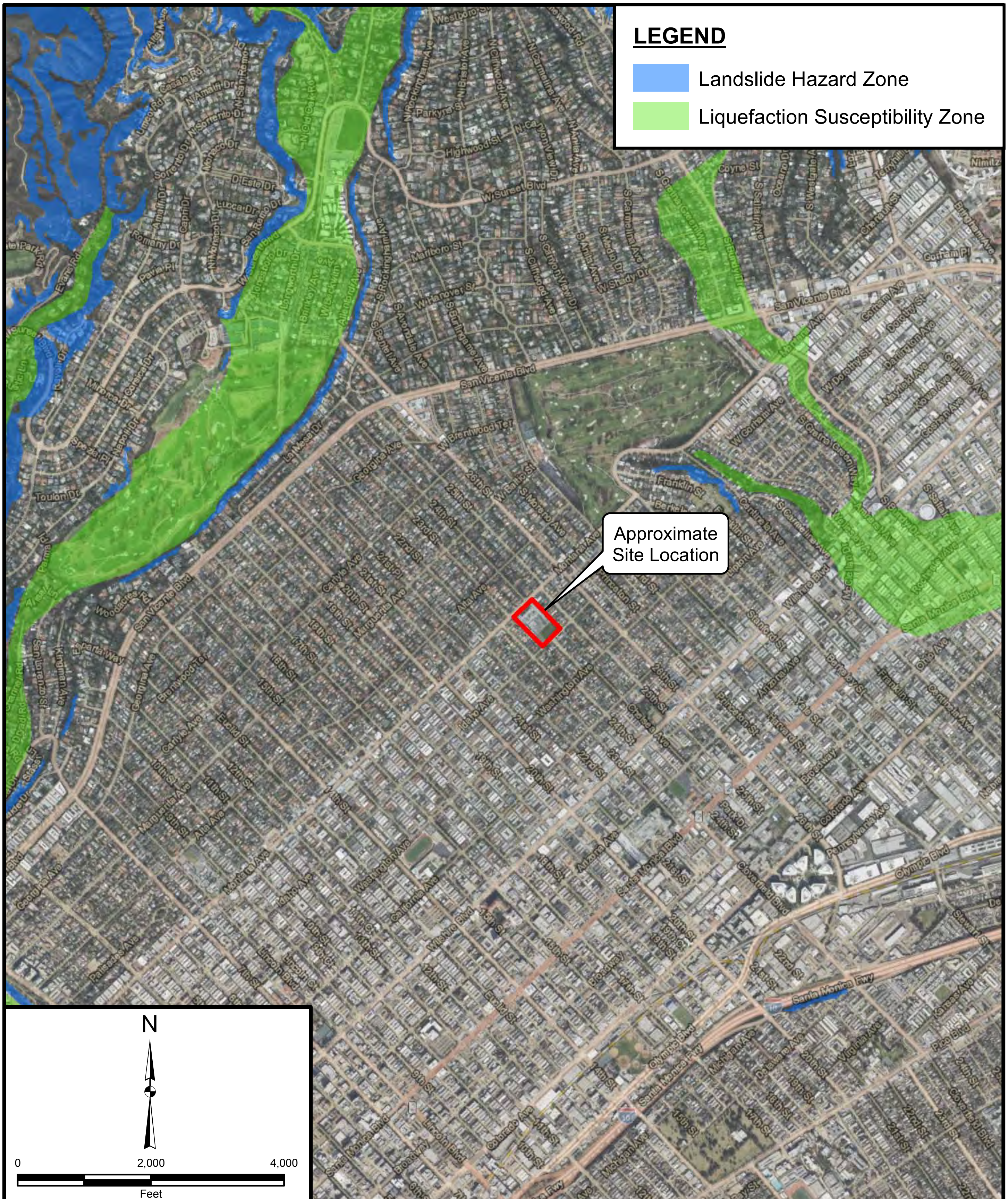

Project: 11428.035	Eng/Geol: CCK/EMH
Scale:1 " = 2,000 '	Date: October 2021
Base Map: ESRI ArcGIS Online 2021	
Author: Leighton Geomatics (btran)	

SEISMIC HAZARD MAP

SMMUSD - Franklin Elementary School
2400 Montana Avenue
Santa Monica, California

FIGURE 5

Leighton

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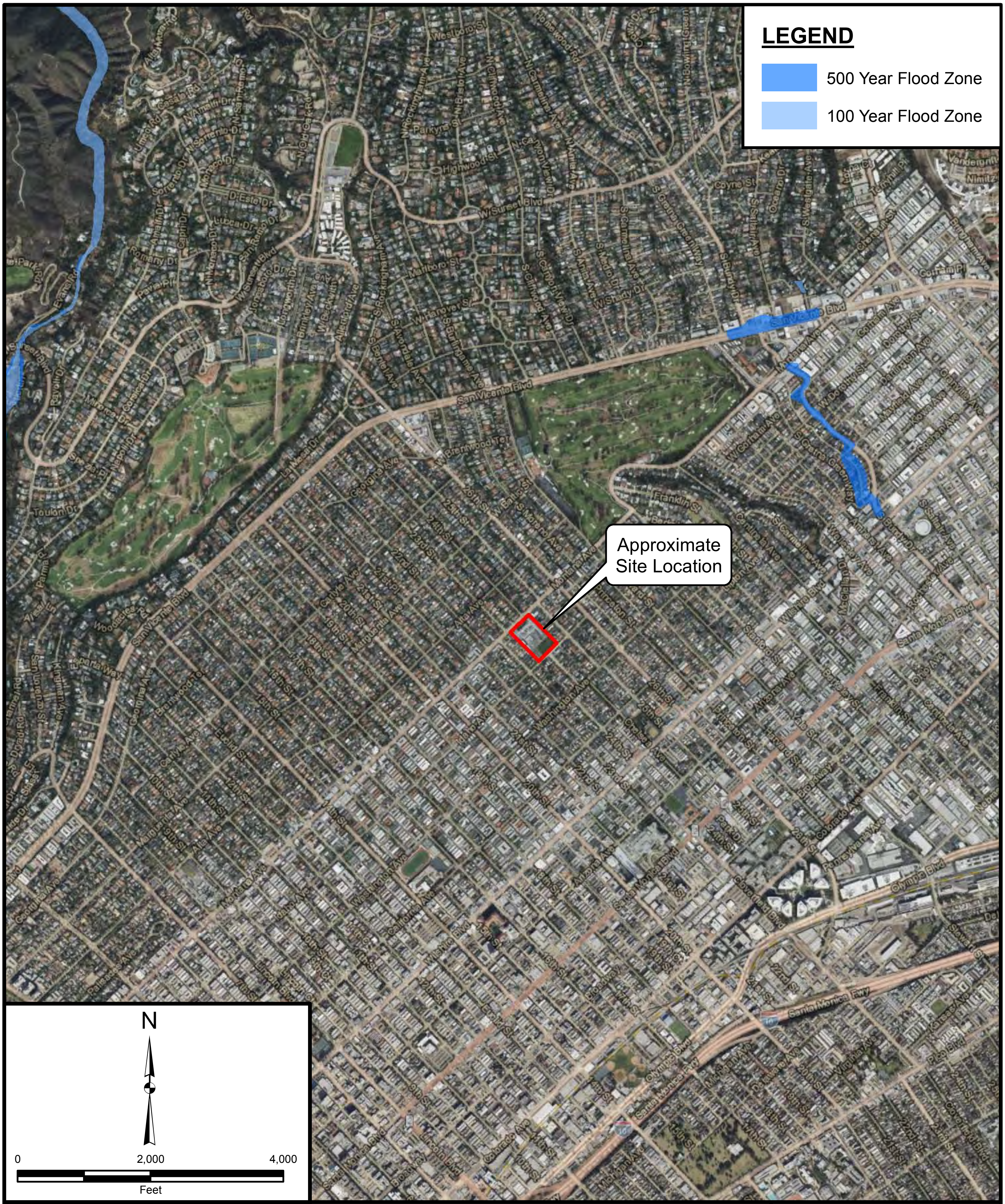

Project: 11428.035	Eng/Geol: CCK/EMH
Scale:1 " = 2,000 '	Date: October 2021

Base Map: ESRI ArcGIS Online 2021
Reference: CA DWR, FEMA
Author: Leighton Geomatics (btran)

FLOOD HAZARD ZONE MAP

SMMUSD - Franklin Elementary School
2400 Montana Avenue
Santa Monica, California

FIGURE 6

Leighton

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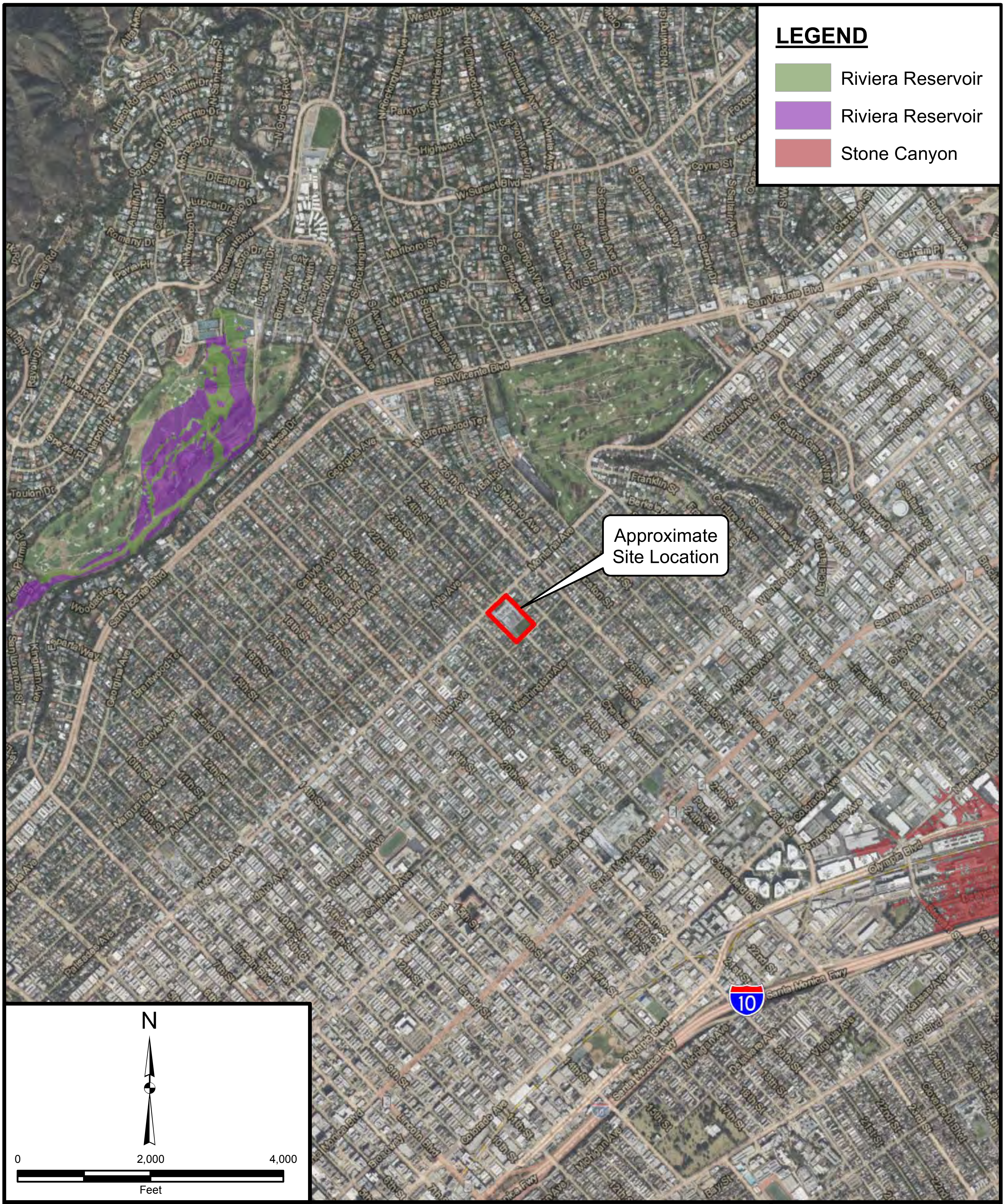

Project: 11428.035	Eng/Geol: CCK/EMH
Scale:1 " = 2,000 '	Date: October 2021

Base Map: ESRI ArcGIS Online 2021

Author: Leighton Geomatics (btran)

DAM INUNDATION MAP

SMMUSD - Franklin Elementary School
2400 Montana Avenue
Santa Monica, California

FIGURE 7

Leighton

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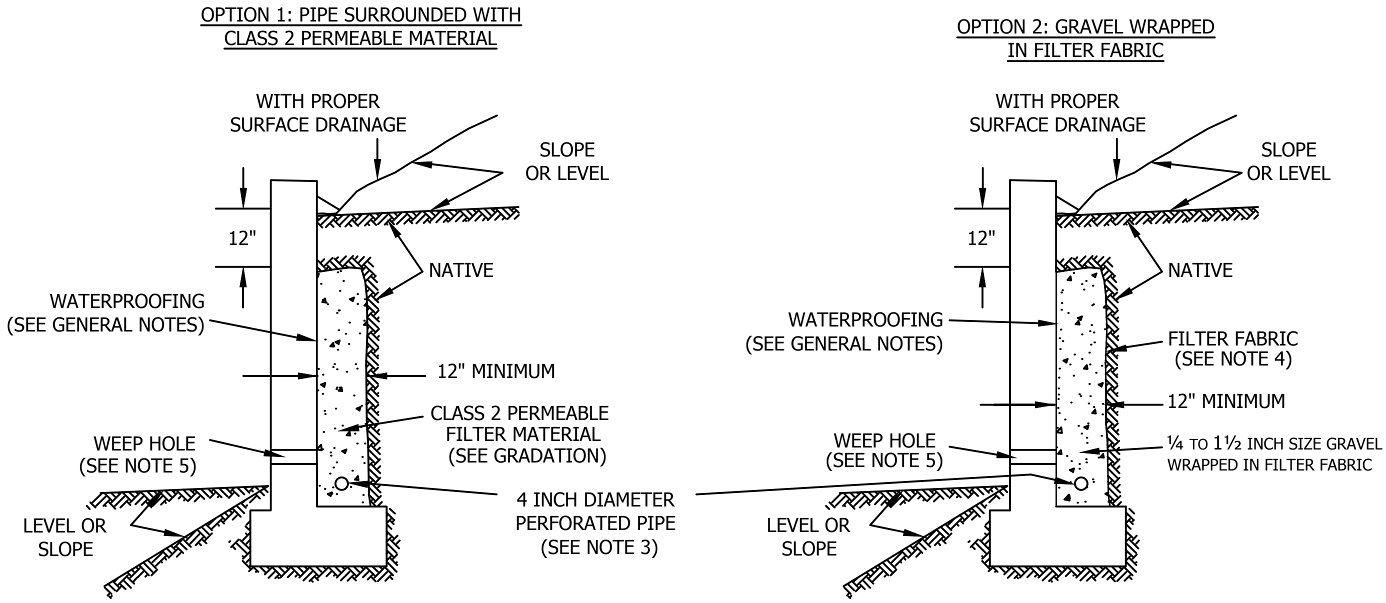
SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50



Class 2 Filter Permeable Material Gradation
Per Caltrans Specifications

Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

GENERAL NOTES:

* Waterproofing should be provided where moisture nuisance problem through the wall is undesirable.
* Water proofing of the walls is not under purview of the geotechnical engineer
* All drains should have a gradient of 1 percent minimum
*Outlet portion of the subdrain should have a 4-inch diameter solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding)
*Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

Notes:
1) Sand should have a sand equivalent of 30 or greater and may be densified by water jetting.
2) 1 Cu. ft. per ft. of 1/4- to 1 1/2-inch size gravel wrapped in filter fabric
3) Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down. Perforations should be 3/8 inch in diameter placed at the ends of a 120-degree arc in two rows at 3-inch on center (staggered)
4) Filter fabric should be Mirafi 140NC or approved equivalent.
5) Weephole should be 3-inch minimum diameter and provided at 10-foot maximum intervals. If exposure is permitted, weepholes should be located 12 inches above finished grade. If exposure is not permitted such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to be discharged through the curb face or equivalent should be provided. For a basement-type wall, a proper subdrain outlet system should be provided.
6) Retaining wall plans should be reviewed and approved by the geotechnical engineer.
7) Walls over six feet in height are subject to a special review by the geotechnical engineer and modifications to the above requirements.

RETAINING WALL BACKFILL AND SUBDRAIN DETAIL FOR WALLS 6 FEET OR LESS IN HEIGHT

WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

Leighton

Figure 8

APPENDIX A

Field Exploration Logs

CORE BORING REPORT

BORING NO.	CB-1
PAGE 1 OF 9	

PROJECT: **Franklin Elementary School**
CLIENT: **SMMUSD**
CONTRACTOR: **Martini Drilling Corporation**
EQUIPMENT USED: **CME-75**

JOB NO.:	**11428.035**
PAGE NO.:	**1 of 9**
ELEVATION:	**258**
DATE START:	**9/16/2021**
DATE FINISH:	**9/16/2021**
DRILLER:	**Martini Drilling Co.**
PREPARED BY:	**JAR**
LOCATION:	**See Figure 2 -**
Exploration Location Map	

GROUND WATER		DEPTH TO:			ORIENTATION		CORE BARREL	
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE	X	VERTICAL	TYPE	
						HORIZONTAL	SIZE	
						INCLINED	Bit (ft)	
						BEARING	Barrel (ft)	
					0	ANG. FROM VERT.	Total (ft)	

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		0-5	1	5	100		See below

@Surface: 3 -inches of Asphalt Concrete over sandy gravel over 1 -inch thick AC

Artificial Fill, undocumented (Afu)

@0.34' to 1': GRAVELLY to very GRAVELLY coarse SAND; dark grayish brown (10YR 4/2) when dry, dark brown (10YR 3/3) when moist; 25-50% coarse-sand- to 1-inch-gravel-sized clasts of weathered subrounded volcanics, siltstone, shale, and Santa Monica slate; no reaction to hydrochloric acid; common to many brick and asphalt fragments; abrupt lower contact.

@1' to 2.7': GRAVELLY SILTY CLAY; brown (10YR 5/3) when dry, dark brown (10YR 3/3) when moist; hard when dry, firm when moist, very sticky and very plastic when wet; ±25% predominantly fine-gravel-sized clasts, with few clasts up to 1½ inches in diameter, of subrounded to rounded volcanics, granitics, siltstone, and Santa Monica slate; no reaction to hydrochloric acid; very few pinhole-sized pores; jumbled matrix; clear lower contact.

Pedogenically Altered Quaternary Alluvial Fan Deposits (Qal)

@2.7' to 4.3': SILTY CLAY; brown (10YR 5/3) when dry, dark brown (10YR 3/3) when moist; moderate coarse subangular blocky breaking to moderate fine to medium subangular blocky soil structure; very hard when dry, very firm when moist, sticky to very sticky and very plastic when wet; ±5% angular, fine- to medium-gravel-sized clasts of siltstone and Santa Monica slate; trace fine sand; no reaction to hydrochloric acid; very few fine root casts; few pinhole- and 1-mm-sized pores; mottled; clear lower contact.

@4.3' to 5': SILTY CLAY LOAM to SILTY CLAY; brown (10YR 5/3) with dark grayish brown (10YR 4/2) clay films when dry, dark brown (10YR 3/3) with very dark grayish brown (10YR 3/2) clay films when moist; weak medium subangular blocky breaking to weak fine subangular blocky soil structure and single-grained; hard when dry, firm when moist, sticky and very plastic when wet; very few thin clay films lining clast pockets; <5% scattered coarse-sand- to fine-gravel-sized clasts of angular Santa Monica slate;

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

CORE BORING REPORT

BORING NO. **CB-1**

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		5-10	1	5	100		micaceous; no reaction to hydrochloric acid; few to common fine root casts; many pinhole-sized pores; mottled; lower contact not observed. @5' to 5.9': SILTY CLAY; grayish brown (10YR 5/2) with brown (10YR 4/3) clay films when dry, brown (10YR 4/3) with dark yellowish brown (10YR 4/4) clay films when moist; moderate to strong coarse to very coarse subangular blocky breaking to moderate to strong medium subangular blocky soil structure; very hard when dry, firm to very firm when moist, sticky to very sticky and plastic to very plastic when wet; common thin to moderately thick clay films on ped faces, common thick clay films in pores, and common thin to moderately thick clay films lining clast pockets; ±10% fine- to medium-gravel-sized clasts of subrounded to rounded siltstone and Santa Monica slate; slightly micaceous; no reaction to hydrochloric acid; few pinhole-sized pores; smells organic; clear lower contact. @5.9' to 7.05': SILTY CLAY; brown to yellowish brown (7.5-10YR 5/4) with brown (7.5-10YR 5/3) clay films when dry, brown to yellowish brown (7.5-10YR 4/4) with dark brown (7.5-10YR 3/3) clay films when moist; moderate to strong very coarse angular blocky breaking to moderate to strong fine to medium angular blocky soil structure; very hard to extremely hard when dry, very firm when moist, sticky and plastic when wet; few thin clay films on ped faces; <5% scattered coarse-sand- to fine-gravel-sized clasts of angular Santa Monica slate; no reaction to hydrochloric acid; few fine root casts; common to many pinhole-sized pores; abrupt to clear lower contact. @7.05' to 7.9': SANDY CLAY to SILTY CLAY; brown to yellowish brown (7.5-10YR 5/4) with brown (7.5-10YR 5/3) clay films when dry, brown to dark yellowish brown (7.5-10YR 4/4) with brown (7.5-10YR 4/3) clay films when moist; strong coarse angular blocky breaking to strong medium angular blocky soil structure; very hard when dry, very firm when moist, sticky to very sticky and plastic to very plastic when wet; common thin to moderately thick clay films on ped faces; ±10% medium-gravel-sized clasts, with few clasts up to ¾-inch in diameter, of subrounded to rounded weathered volcanics, siltstone, and Santa Monica slate; no reaction to hydrochloric acid; very few fine root casts; few to common pinhole-sized pores; gradual lower contact. @7.9' to 9.1': SANDY CLAY; brown (7.5-10YR 5/3) with brown (7.5-10YR 4/3) clay films when dry, brown to dark yellowish brown (7.5-10YR 4/4) with dark brown (7.5-10YR 3/3) clay films when moist; moderate medium to coarse angular blocky breaking to moderate fine angular blocky soil structure; hard to very hard when dry, very firm when moist, very sticky and very plastic when wet; few to common thin clay films on ped faces and few thin clay films lining clast pockets; ±10% fine-gravel-sized clasts, with few clasts up to 1-inch in diameter, of subrounded to rounded weathered siltstone and Santa Monica slate; no reaction to hydrochloric acid; few root holes; common to many pinhole-sized pores; gradual lower contact. @9.1' to 11.3': SILTY CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) with light olive brown to brown (2.5Y-10YR 5/3) clay films when dry, olive brown to dark yellowish brown (2.5Y-10YR 4/4) with olive brown to dark yellowish brown (2.5Y-10YR 4/4) clay films when moist; strong coarse angular blocky breaking to strong medium angular blocky soil structure; very hard when dry, very firm when moist, sticky to very sticky and very plastic when wet; common thin to moderately thick clay films on ped faces; <5% predominantly fine-gravel-sized clasts, with trace sand and few clasts up to ¾-inch in diameter, of angular to subangular weathered siltstone and Santa Monica slate; no reaction to hydrochloric acid; few pinhole-sized pores; faint bedding; abrupt lower contact.
10							

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

Leighton

CORE BORING REPORT

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		10-15	2	4.75	95		
15							

<u>Quaternay Alluvial Fan and/or Mudflow Deposits, mostly unaltered (Qal_{mf})</u>
@11.3' to 12.75': Clast-supported GRAVEL; light olive brown to brown (2.5Y-10YR 5/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with yellowish brown (10YR 5/4) iron oxide stains when moist; >75% predominantly fine-gravel-sized clasts, with few clasts up to 2¼ inches in diameter, of rounded very weathered siltstone and slightly weathered Santa Monica slate in a coarse sand matrix; poorly sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains on fracture faces; clasts are broken due to drilling; abrupt erosional lower contact.

@12.75' to 13.9': SANDY CLAY; light olive brown to brown (2.5Y-10YR 5/3) with olive brown to brown (2.5Y-10YR 4/3) clay films when dry, olive brown to dark yellowish brown (2.5Y-10YR 4/4) with olive brown to dark yellowish brown (2.5Y-10YR 4/4) clay films when moist; strong coarse subangular blocky breaking to strong fine to medium subangular blocky soil structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; few moderately thick clay films lining clast pockets; <10% fine-gravel-sized clasts, with few clasts up to ¼-inch in diameter, of subangular to subrounded weathered siltstone and unweathered Santa Monica slate; slightly micaceous; no reaction to hydrochloric acid; few pinhole-sized pores; clear to gradual lower contact.

@13.9' to 14.75': SANDY CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) with light olive brown to brown (2.5Y-10YR 5/3) clay films when dry, olive brown to brown (2.5Y-10YR 4/3) with olive brown to dark yellowish brown (2.5Y-10YR 4/4) clay films when moist; moderate coarse subangular blocky breaking to moderate fine to medium subangular blocky soil structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; few thin clay films lining clast pockets; <10% coarse-gravel-sized clasts, with few clasts up to ½-inch in diameter, of subangular to subrounded very weathered to grussified siltstone and weathered Santa Monica slate; no reaction to hydrochloric acid; very slight iron oxide stains; few root casts; abrupt lower contact.

@14.75' to 15': NO RECOVERY

@15' to 15.3': Clast-supported GRAVEL; light yellowish brown to pale brown (2.5Y-10YR 6/3) with grayish brown (10YR 5/2) clay films when dry, olive brown to brown (2.5Y-10YR 4/3) with olive brown to brown (2.5Y-10YR 4/3) clay films when moist; few thin clay films coating clasts; >75% fine- to coarse-gravel-sized clasts of predominantly subrounded to rounded weathered Santa Monica slate; moderately sorted and clast-supported; no reaction to hydrochloric acid; slight iron oxide stains on clasts; abrupt erosional lower contact.

@15.3' to 16.6': SANDY CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) with olive brown to brown (2.5Y-10YR 4/3) clay films when dry, olive brown to brown (2.5-10YR 4/3) with dark olive brown to dark brown (2.5Y-10YR 3/3) clay films when moist; moderate to strong coarse subangular blocky breaking to moderate fine to medium subangular blocky soil structure; very hard when dry, firm to very firm when moist, very sticky and very plastic when wet; common moderately thick clay films lining clast pockets; ±10% medium-gravel-sized clasts, with few clasts up to ½-inch in diameter, of angular to rounded slightly weathered Santa Monica slate; no reaction to hydrochloric acid; common pinhole-sized pores; abrupt lower contact.

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

Leighton

CORE BORING REPORT

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG
		15-20	2	5	100	
20		20-25	3	5	100	

FIELD CLASSIFICATION AND REMARKS

@16.6' to 17.2': Extremely GRAVELLY coarse SAND; light olive brown to brown (2.5Y-10YR 5/3) with yellow (10YR 7/6) iron oxide and black (10YR 2/1) manganese oxide stains when dry, dark olive brown to dark brown (2.5Y-10YR 3/3) with light yellowish brown (10YR 6/4) iron oxide and black (10YR 2/1) manganese oxide stains when moist; ±50% predominantly coarse-gravel-sized clasts of rounded weathered Santa Monica slate with very few weathered granitics in a coarse sand matrix; poorly sorted and locally clast-supported; no reaction to hydrochloric acid; silt coatings on clasts; common iron oxide and manganese oxide stains on fracture faces; clasts broken due to drilling; fines downward; abrupt lower contact.

@17.2' to 17.6': Gravelly SANDY CLAY to SILTY CLAY; olive brown to brown (2.5-10YR 4/3) with olive brown to dark yellowish brown (2.5Y-10YR 4/4) clay films when moist; faint bedding; common moderately thick clay films lining clast pockets; ±25% coarse-sand- to medium-gravel-sized clasts, with few clasts up to 1½ inches in diameter, of angular to rounded slightly weathered siltstone and Santa Monica slate; slight iron oxide stains on clast fracture faces; few pinhole-sized pores.

@17.6' to 18.7': Clast-supported GRAVEL; grayish brown (2.5Y-10YR 5/2) with pale brown (10YR 6/3) iron oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with yellowish brown (10YR 5/6) iron oxide stains when moist; >75% coarse-gravel-sized clasts, with few clasts up to 1½ inches in diameter, of predominantly subangular to rounded slightly weathered Santa Monica slate; poorly sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; clasts are broken due to drilling; clear erosional lower contact.

Quaternary Fluvial Deposits, mostly unaltered (Qal_f)

@18.7' to 19.1': Clast-supported GRAVEL; grayish brown (2.5Y-10YR 5/2) with light yellowish brown (10YR 6/4) iron oxide stains when dry, very dark grayish brown (2.5Y-10YR 3/2) with light yellowish brown to brownish yellow (10YR 6/5) iron oxide stains when moist; >75% fine- to medium-gravel-sized clasts, with few clasts up to ½-inch in diameter, of predominantly rounded slightly weathered Santa Monica slate; moderately sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; slightly coarsens downward; abrupt erosional lower contact.

@19.1' to 22.65': Clast-supported GRAVEL; light olive brown to brown (2.5Y-10YR 5/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with yellowish brown (10YR 5/4) iron oxide stains when moist; >75% fine- to coarse-gravel-sized clasts, with few clasts up to 1 inch in diameter, of predominantly subangular to subrounded slightly weathered Santa Monica slate and few grussified granitics at basal contact; moderately sorted and clast-supported in a coarse-sand matrix; no reaction to hydrochloric acid; common silt coating on clasts; common iron oxide stains on clasts and parting surfaces; abrupt to clear, erosional lower contact.

@22.65' to 23.2': Clast-supported GRAVEL; grayish brown (2.5Y-10YR 5/2) with pale brown (10YR 6/3) iron oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with yellowish brown (10YR 5/6) iron oxide stains when moist; >75% coarse-sand- to coarse-gravel-sized clasts, with few clasts up to

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

Leighton

CORE BORING REPORT

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
25							
		25-30	3	5	100		

2¼ inches in diameter at basal contact, of predominantly subrounded weathered Santa Monica slate; moderately sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; slightly coarsens downward; clear erosional lower contact.

@19.1' to 22.65': Clast-supported GRAVEL; light olive brown to brown (2.5Y-10YR 5/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with yellowish brown (10YR 5/4) iron oxide stains when moist; >75% fine- to coarse-gravel-sized clasts, with few clasts up to 1 inch in diameter, of predominantly subangular to subrounded slightly weathered Santa Monica slate and few grussified granitics at basal contact; moderately sorted and clast-supported in a coarse-sand matrix; no reaction to hydrochloric acid; common silt coating on clasts; common iron oxide stains on clasts and parting surfaces; abrupt to clear, erosional lower contact.

@23.2' to 23.9': Clast-supported GRAVEL; grayish brown (2.5Y-10YR 5/2) with brownish yellow (10YR 6/6) iron oxide and black (10YR 2/1) manganese oxide stains when dry, very dark grayish brown (2.5Y-10YR 3/2) with yellowish brown (10YR 5/6) iron oxide and black (10YR 2/1) manganese oxide stains when moist; >75% coarse-sand- to coarse-gravel-sized clasts, with few clasts up to 2 inches in diameter, of predominantly subrounded weathered Santa Monica slate; moderately sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide and manganese oxide stains on clasts and parting surfaces; slightly coarsens downward; clear erosional lower contact. [Fluvial deposit]

@23.9' to 25.5': Clast-supported GRAVEL; light brownish gray (2.5Y-10YR 6/2) with light yellowish brown (10YR 6/4) iron oxide and black (10YR 2/1) manganese oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with yellowish brown (10YR 5/6) iron oxide and black (10YR 2/1) manganese oxide stains when moist; >75% coarse-sand- to fine-gravel-sized clasts, with few clasts up to 1¼ inches in diameter, of predominantly subrounded weathered Santa Monica slate; moderately sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide and manganese oxide stains on clasts and parting surfaces; slightly coarsens downward; clear erosional lower contact. [Fluvial deposit]

@25.5' to 26.3': Clast-supported GRAVEL; grayish brown (2.5Y-10YR 5/2) with light yellowish brown (10YR 6/4) iron oxide and black (10YR 2/1) manganese oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with yellowish brown (10YR 5/6) iron oxide and black (10YR 2/1) manganese oxide stains when moist; >75% coarse-sand- to coarse-gravel-sized clasts, with few clasts up to 2 inches in diameter, of subangular to subrounded weathered siltstone, shale, and Santa Monica slate; moderately sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide and manganese oxide stains on clasts and parting surfaces; slightly fines downward; broken Santa Monica slate clast at top and a gravelly sand lens at bottom; clear to gradual lower contact. [Debris flow deposit]

@26.3' to 28.1': Gravelly coarse SAND grading down to coarse GRAVEL; grayish brown (2.5Y-10YR 5/2) with light yellowish brown (10YR 6/4) iron oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with dark yellowish brown (10YR 4/6) iron oxide stains when moist; >75% coarse-sand- to coarse-gravel-sized clasts, with few clasts up to 2 inches in diameter, of subangular to subrounded weathered granitics, siltstone, shale, and Santa Monica slate; moderately sorted and locally clast-supported; no reaction to hydrochloric acid; silica coatings on clasts; common iron oxide stains clast parting surfaces; coarsens downward; clear to gradual lower contact. [Fluvial deposit]

@29' to 29.6': Clast-supported GRAVEL; grayish brown (2.5Y-10YR 5/2)

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

CORE BORING REPORT

BORING NO. **CB-1**

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
30		30-35	4	5	100		
35							

with light yellowish brown (10YR 6/4) iron oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with yellowish brown (10YR 5/6) iron oxide stains when moist; >75% coarse-gravel-sized clasts, with few clasts up to 1-inch in diameter, of subangular to rounded weathered granitics, siltstone, shale, and Santa Monica slate in a coarse sand matrix; somewhat jumbled and clast-supported; no reaction to hydrochloric acid; common iron oxide and manganese oxide stains on clasts and parting surfaces; abrupt to clear, erosional lower contact. [Debris flow deposit]

@28.1' to 29': Clast-supported GRAVEL; grayish brown (2.5Y-10YR 5/2) with light yellowish brown (10YR 6/4) iron oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with yellowish brown (10YR 5/6) iron oxide stains when moist; >75% coarse-sand- to fine-gravel-sized clasts, with few clasts up to 1½ inches in diameter, of predominantly angular to subrounded weathered Santa Monica slate; somewhat jumbled and clast-supported; no reaction to hydrochloric acid; common iron oxide and manganese oxide stains on clasts and parting surfaces; slightly coarsens downward; clear erosional lower contact. [Debris flow deposit]

@29.6' to 30.8': Clast-supported GRAVEL; light yellowish brown to pale brown (2.5Y-10YR 6/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, light olive brown to brown (2.5Y-10YR 5/3) with yellowish brown (10YR 5/6) iron oxide stains when moist; >75% coarse-sand- to coarse-gravel-sized clasts, with few clasts up to 1½ inches in diameter, of predominantly subrounded to rounded weathered siltstone, shale, and Santa Monica slate; moderately sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide and manganese oxide stains on clasts and parting surfaces; slightly coarsens downward; clasts are broken due to drilling; clear erosional lower contact. [Fluvial deposit]

@30.8' to 31.9': Clast-supported GRAVEL; light yellowish brown to pale brown (2.5Y-10YR 6/3) with brownish yellow (10YR 6/6) iron oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with yellowish brown (10YR 5/6) iron oxide stains when moist; >75% coarse-sand- to fine-gravel-sized clasts, with few clasts up to ¾-inch in diameter, of predominantly subangular to rounded weathered volcanics, siltstone, shale, and Santa Monica slate and few grussified granitics; poorly sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; clasts are broken due to drilling; abrupt erosional lower contact.

@31.9' to 32.05': Clast-supported GRAVEL; light yellowish brown to pale brown (2.5Y-10YR 6/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with yellowish brown (10YR 5/6) iron oxide stains when moist; >75% fine- to coarse-gravel-sized clasts, with few clasts up to 1¼ inches in diameter, of predominantly subangular to rounded weathered Santa Monica slate; poorly sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; clasts are broken due to drilling; abrupt erosional lower contact.

@32.05' to 33.2': GRAVEL in a medium to coarse SAND matrix; light brownish gray (2.5Y-10YR 6/2) with light yellowish brown (10YR 6/4) iron oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with brownish yellow (10YR 6/6) iron oxide stains when moist; >75% fine-gravel-sized clasts, with few clasts up to 1½ inches in diameter, of predominantly subrounded to rounded weathered Santa Monica slate and few weathered volcanics and siltstone; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; slightly coarsens downward; clasts are broken due to drilling; abrupt erosional lower contact. [Fluvial deposit]

@33.2' to 33.9': GRAVEL in a coarse SAND matrix; light brownish gray (2.5Y-10YR 6/2) with light yellowish brown (10YR 6/4) iron oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with yellowish brown (10YR 5/6) iron oxide stains when moist; >75% fine-gravel-sized to ½-inch-sized clasts, with few clasts up to 3 inches in diameter, of predominantly subrounded to rounded weathered Santa Monica slate and very few weathered siltstone; no reaction to hydrochloric acid; common iron oxide stains on clasts

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

Leighton

CORE BORING REPORT

BORING NO. **CB-1**

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		35-40	4	5	100		
40							

and parting surfaces; slightly coarsens downward; clasts are broken due to drilling; clear erosional lower contact. [Fluvial deposit]

@33.9' to 35.45': GRAVEL in a coarse SAND matrix; light brownish gray (2.5Y-10YR 6/2) with light yellowish brown (10YR 6/4) iron oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with yellowish brown (10YR 5/5) iron oxide stains when moist; >75% fine-gravel-sized to ¾-inch-sized clasts, with few clasts up to 2 inches in diameter, of predominantly rounded slightly weathered Santa Monica slate and very few weathered siltstone; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; clasts are broken due to drilling; abrupt erosional lower contact.

@29.6' to 30.8': Clast-supported GRAVEL; light yellowish brown to pale brown (2.5Y-10YR 6/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, light olive brown to brown (2.5Y-10YR 5/3) with yellowish brown (10YR 5/6) iron oxide stains when moist; >75% coarse-sand- to coarse-gravel-sized clasts, with few clasts up to 1½ inches in diameter, of predominantly subrounded to rounded weathered siltstone, shale, and Santa Monica slate; moderately sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide and manganese oxide stains on clasts and parting surfaces; slightly coarsens downward; clasts are broken due to drilling; clear erosional lower contact. [Fluvial deposit]

@35.45' to 35.8': Clast-supported GRAVEL; light yellowish brown to pale brown (2.5Y-10YR 6/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with yellowish brown (10YR 5/4) iron oxide stains when moist; >75% fine- to coarse-gravel-sized clasts, with few clasts up to 1-inch in diameter, of predominantly subangular to subrounded slightly weathered Santa Monica slate and very few weathered volcanics and siltstone; poorly sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; clasts are broken due to drilling; abrupt erosional lower contact.

@35.8' to 37.2': Clast-supported GRAVEL; light brownish gray (2.5Y-10YR 6/2) with light yellowish brown (10YR 6/4) iron oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with yellowish brown (10YR 5/5) iron oxide stains when moist; >75% fine-gravel-sized clasts, with few clasts up to 1-inch in diameter, of predominantly subangular to subrounded slightly weathered Santa Monica slate and very few weathered volcanics and siltstone; poorly sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; clasts are broken due to drilling; abrupt erosional lower contact.

Quaternary Slopewash and/or Mudflow Deposits, unaltered (Qal_{fg}

@37.2' to 37.55': SILTY CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) with brown (7.5YR 5/4) burned layers when dry, olive brown to dark yellowish brown (2.5Y-10YR 4/4) with brown (7.5YR 4/4) burned layers when moist; few baked zones and/or burned layers scattered throughout; moderate to strong coarse subangular blocky breaking to strong medium subangular blocky soil structure; very hard when dry, very firm when moist, sticky and plastic to very plastic when wet; <5% scattered coarse-sand- to medium-gravel-sized clasts of subrounded Santa Monica slate; slightly micaceous; no reaction to hydrochloric acid; very few pinhole-sized pores; clear lower contact.

@37.55' to 38': CLAY LOAM to SILTY CLAY LOAM; light yellowish brown to pale brown (2.5Y-10YR 6/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, olive brown to dark yellowish brown (2.5Y-10YR 4/4) with yellowish brown (10YR 5/6) iron oxide stains when moist; few fine sand lenses; moderate coarse subangular blocky breaking to weak to moderate fine subangular blocky structure; hard when dry, firm when moist, slightly sticky to sticky and plastic when wet; <5% fine-gravel-sized clasts of rounded shale; slightly micaceous; no reaction to hydrochloric acid; slight iron oxide stains; few root casts; few pinhole-sized pores; clear lower contact.

@38' to 38.3': SILTY CLAY LOAM to SILTY CLAY; pale yellow to very pale brown (2.5Y-10YR 7/3) with light yellowish brown (10YR 6/4) iron

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

Leighton

CORE BORING REPORT

BORING NO. **CB-1**

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		40-45	5	5	100		(see below)
45							

oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with yellowish brown (10YR 5/4) iron oxide stains when moist; weak to moderate medium angular blocky breaking to weak fine angular blocky structure and single-grained; slightly hard and slightly fragic when dry, friable to firm when moist, slightly sticky to sticky and plastic when wet; <5% scattered fine- to coarse-sand with very few fine-gravel-sized clasts of subrounded Santa Monica slate; slightly micaceous; no reaction to hydrochloric acid; slight iron oxide stains; common pinhole-sized pores; abrupt to clear lower contact.

@38.3' to 40': CLAY LOAM to SILTY CLAY LOAM; light yellowish brown to pale brown (2.5Y-10YR 6/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, light olive brown to brown (2.5Y-10YR 5/3) with yellowish brown (10YR 5/4) iron oxide stains when moist; many thin wispy clay and silt laminations; weak to moderate medium angular blocky breaking to very weak fine angular blocky structure; slightly hard when dry, firm when moist, slightly sticky to sticky and plastic when wet; <5% fine-gravel-sized clasts with scattered fine sand; slightly micaceous; no reaction to hydrochloric acid; slight iron oxide stains; very few pinhole-sized pores; slightly mottled; clear lower contact.

@40.8' to 44.2': CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) with pinkish gray (5YR 6/2) burned layers when dry, olive brown to brown (2.5Y-10YR 4/3) with reddish brown (5YR 4/3) burned layers when moist; thinly laminated; common baked zones throughout, with prominent burned layers at 40.85', 41.3', 41.65'-41.85', and 43.5'; strong coarse angular blocky breaking to strong medium to coarse angular blocky structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; <5% scattered coarse-sand- to gravel-sized clasts; no reaction to hydrochloric acid; very few pinhole-sized pores; gradual lower contact.

@40' to 40.8': SILTY CLAY to CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, olive brown to dark yellowish brown (2.5Y-10YR 4/4) with yellowish brown (10YR 5/4) iron oxide stains when moist; common thin clay and silt laminations; massive breaking to moderate medium angular blocky structure; hard to very hard when dry, very firm when moist, very sticky and very plastic when wet; <5% fine-gravel-sized clasts with few fine to coarse sand lens; no reaction to hydrochloric acid; slight iron oxide stains; clear lower contact.

@44.2' to 45.4': SANDY CLAY to CLAY; brown (10YR 5/3) with yellowish brown (10YR 5/4) clay films when dry, brown (10YR 4/3) with dark brown (10YR 3/3) clay films when moist; thinly laminated; massive breaking to strong coarse angular blocky structure; extremely hard when dry, extremely firm when moist, very sticky and very plastic when wet; few to common moderately thick clay films lining clast pockets; <10% coarse-sand- to fine-gravel-sized clasts of subrounded to rounded Santa Monica slate; no reaction to hydrochloric acid; lower contact not observed.

@45.4' to 47.5': NO RECOVERY

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

CORE BORING REPORT

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
							@45.4' to 47.5': NO RECOVERY
		45-50	5	5	100		@47.5' to 48': Gravelly SILTY CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; moderate medium subangular blocky breaking to moderate fine subangular blocky structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; 10-25% fine- to coarse-gravel-sized clasts of subrounded to rounded siltstone, shale, and Santa Monica slate; no reaction to hydrochloric acid; few pinhole- and ¼-inch-sized pores; slightly disturbed and jumbled; clear lower contact. [Disturbed]
							@48' to 48.2': Gravelly SANDY CLAY to SILTY CLAY; light gray (2.5Y-10YR 7/2) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; moderate medium subangular blocky breaking to moderate fine subangular blocky soil structure; hard when dry, firm when moist, very sticky and very plastic when wet; 10-25% coarse-sand- to fine-gravel-sized clasts rounded Santa Monica slate; slightly micaceous; no reaction to hydrochloric acid; few pinhole-sized pores; slightly disturbed and jumbled; clear lower contact. [Disturbed]
							@48.2' to 50': Fine SANDY CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; strong coarse angular blocky breaking to strong fine angular blocky structure; hard to very hard when dry, firm to very firm when moist, very sticky and very plastic when wet; <5% coarse-sand- to fine-gravel-sized clasts of subrounded Santa Monica slate; slightly micaceous; no reaction to hydrochloric acid; few pinhole- and ¼-inch-sized pores; slightly disturbed and jumbled; lower contact not observed. [Disturbed]
50							TD: 50' bgs No groundwater encountered during drilling. Backfilled with bentonite-cement grout.

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

Leighton

CORE BORING REPORT

BORING NO.	CB-2
PAGE 1 OF 9	

PROJECT: **Franklin Elementary School**
CLIENT: **SMMUSD**
CONTRACTOR: **Martini Drilling Corporation**
EQUIPMENT USED: **CME-75**

JOB NO.:	**11428.035**
PAGE NO.:	**1 of 9**
ELEVATION:	**258**
DATE START:	**9/16/2021**
DATE FINISH:	**9/16/2021**
DRILLER:	**Martini Drilling Co.**
PREPARED BY:	**KD**
LOCATION:	**See Figure 2 -** ***Exploration Location Map***

GROUND WATER		DEPTH TO:			ORIENTATION		CORE BARREL	
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE	X	VERTICAL	TYPE	
						HORIZONTAL	SIZE	
						INCLINED	Bit (ft)	
						BEARING	Barrel (ft)	
					0	ANG. FROM VERT.	Total (ft)	

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		0-5	1	5	100		@surface: 5 -inches of Asphalt Concrete over 10 -inches of Base

@surface: 5 -inches of Asphalt Concrete over 10 -inches of Base

Artificial Fill, undocumented (Afu)
@1.25' to 3.7': SANDY CLAY; dark grayish brown (10YR 4/2) when dry, very dark brown (10YR 2/2) when moist; hard when dry, firm when moist, very sticky and very plastic when wet; 10-25% fine- to coarse-gravel-sized clasts of mixed lithology; no reaction to hydrochloric acid; common concrete and asphalt fragments; jumbled; abrupt to clear lower contact.

Pedogenically Altered Quaternary Alluvial Fan Deposits (Qal)
@3.7' to 5': SANDY CLAY; dark grayish brown (10YR 4/2) when dry, very dark grayish brown (10YR 3/2) when moist; moderate medium subangular blocky breaking to weak to moderate fine subangular blocky soil structure; hard to very hard when dry, very firm when moist, very sticky and very plastic when wet; <10% medium-gravel-sized clasts of subrounded to rounded Santa Monica slate; no reaction to hydrochloric acid; few to common fine root casts; many pinhole-sized and common 1-mm-sized pores; clasts are broken due to drilling; lower contact not observed.

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

CORE BORING REPORT

BORING NO. CB-2

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		5-10	1	5	100		@5' to 5.7': SANDY CLAY; brown (10YR 4/3) with brown (10YR 4/3) clay films when dry, very dark grayish brown (10YR 3/2) with dark brown to very dark grayish brown (10YR 3/2.5) clay films when moist; strong coarse subangular blocky breaking to strong fine to medium subangular blocky soil structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; common moderately thick clay films lining clast pockets; ±10% coarse-sand- to fine-gravel-sized clasts of predominantly subrounded Santa Monica slate; no reaction to hydrochloric acid; few pinhole-sized pores; smells organic; clear lower contact. @5.7' to 6.7': SILTY CLAY to CLAY; brown to yellowish brown (7.5-10YR 5/4) with brown (10YR 5/3) clay films when dry, brown (7.5-10YR 4/3) with dark brown (7.5-10YR 3/3) clay films when moist; strong coarse subangular blocky breaking to moderate fine subangular blocky soil structure; hard when dry, very firm when moist, very sticky and very plastic when wet; many moderately thick clay films on ped faces and common to many moderately thick clay films lining clast pockets; ±10% fine- to medium-gravel-sized clasts of predominantly subrounded to rounded Santa Monica slate; no reaction to hydrochloric acid; common pinhole-sized pores; smells slightly organic; gradual lower contact. @6.7' to 7.55': SANDY CLAY to SILTY CLAY; brown (7.5YR 5/4) with brown (7.5YR 4/4) clay films when dry, brown (7.5YR 4/4) with brown (7.5YR 4/3) clay films when moist; strong coarse angular blocky breaking to strong medium angular blocky soil structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; common to many moderately thick clay films on ped faces, common moderately thick clay films in pores, and many moderately thick clay films lining clast pockets; <10% fine- to coarse-gravel-sized clasts, with few clasts up to ¾-inch in diameter, of subrounded siltstone, shale, and Santa Monica slate; no reaction to hydrochloric acid; few fine root casts; common pinhole-sized pores; trace sand; gradual lower contact. @7.55' to 8.7': SANDY CLAY to CLAY; brown to yellowish brown (7.5-10YR 5/4) with brown to yellowish brown (7.5-10YR 4/4) clay films when dry, brown (7.5YR 4/4) with dark brown (7.5-10YR 3/3) clay films when moist; strong coarse angular blocky breaking to moderate to strong medium angular blocky soil structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; common to many moderately thick clay films on ped faces and common to many thick clay films lining clast pockets; ±10% fine- to medium-gravel-sized clasts of angular to rounded, unweathered to weathered, siltstone and Santa Monica slate; no reaction to hydrochloric acid; few pinhole-sized pores; gradual lower contact. @8.7' to 9.5': SILTY CLAY; light olive brown to yellowish brown (2.5Y-10YR 5/4) with brown (10YR 5/3) clay films when dry, olive brown to dark yellowish brown (2.5Y-10YR 4/4) with dark yellowish brown (10YR 4/4) clay films when moist; strong coarse subangular blocky breaking to strong medium angular blocky soil structure; hard to very hard when dry, very firm when moist, very sticky and very plastic when wet; common thin clay films on ped faces and few to common moderately thick clay films lining clast pockets; ±10% coarse-sand- to coarse-gravel-sized clasts, with few clasts up to ½-inch in diameter, of subangular to subrounded slightly weathered shale, siltstone, and Santa Monica slate; no reaction to hydrochloric acid; very few pinhole-sized pores; faint laminations; clear to gradual lower contact.
10							@9.5' to 11.6': SANDY CLAY; light olive brown to brown (2.5Y-10YR 5/3) with brown (10YR 4/3) clay films when dry, olive brown to brown (2.5Y-10YR 4/3) with dark brown (10YR 3/3) clay films when moist; faint bedding; strong medium angular blocky breaking to strong fine angular blocky soil structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; common moderately thick clay films lining clast pockets; ±10% coarse-sand- to fine-gravel-sized clasts of predominantly subangular to subrounded Santa Monica slate; no reaction to hydrochloric acid; few silt coatings; very few pinhole-sized pores; abrupt to clear lower contact.

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

Leighton

CORE BORING REPORT

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		10-15	2	5	100		**Quaternary Alluvial Fan and/or Mudflow Deposits, mostly unaltered (Qal_{mf})** @11.6' to 12.65': Clast-supported GRAVEL; light olive brown to brown (2.5Y-10YR 5/3) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; >75% coarse-sand- to fine-gravel-sized clasts, with few clasts up to 1¼ inches in diameter, of predominantly subrounded slightly weathered Santa Monica slate in a sandy clay matrix; poorly sorted and locally clast-supported; no reaction to hydrochloric acid; common iron oxide stains on clast fracture faces; weathered sandstone clasts at 12.1' that is broken due to drilling; abrupt erosional lower contact. @12.65' to 13.25': Gravelly SAND; grayish brown (2.5Y-10YR 5/2) when dry, dark grayish brown (2.5Y-10YR 4/2) when moist; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; ±50% fine- to medium-gravel-sized clasts, with few clasts up to ½-inch in diameter, of subrounded slightly weathered siltstone, shale, and Santa Monica slate in a coarse sand matrix; moderately sorted and locally clast-supported; no reaction to hydrochloric acid; slight iron oxide stains on clast parting surfaces; abrupt erosional lower contact. @13.25' to 14.2': SILTY CLAY LOAM; light yellowish brown to pale brown (2.5Y-10YR 6/3) with light olive brown to brown (2.5Y-10YR 5/3) clay films when dry, olive brown to dark yellowish brown (2.5Y-10YR 4/4) with olive brown to brown (2.5Y-10YR 4/3) clay films when moist; faint bedding; moderate coarse subangular blocky breaking to moderate fine subangular blocky structure; hard when dry, firm when moist, slightly sticky and plastic when wet; few thin clay films lining clast pockets; ±10% fine- to coarse-gravel-sized clasts of predominantly subrounded slightly weathered Santa Monica slate; no reaction to hydrochloric acid; slight iron oxide stains on clasts; very few pinhole-sized pores; trace sand; abrupt lower contact. @14.2' to 16.65': Clast-supported GRAVEL; grayish brown (2.5Y-10YR 5/2) with light yellowish brown (10YR 6/4) iron oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with yellowish brown (10YR 5/4) iron oxide stains when moist; >75% fine-gravel up to 1-inch-sized clasts of predominantly subrounded to rounded slightly weathered shale and Santa Monica slate and few weathered volcanics; moderately sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains on clasts; coarsens downward; clasts are broken due to drilling; sandy clay lens at 14.7'; abrupt erosional lower contact. [Fluvial deposit]
15							

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

CORE BORING REPORT

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG
		15-20	2	4.6	92	
20		20-25	3	4.6	92	

FIELD CLASSIFICATION AND REMARKS

@16.65' to 17.7': Gravelly SANDY CLAY; light olive brown to brown (2.5Y-10YR 5/3) with yellowish brown (10YR 5/4) clay films when dry, olive brown to dark yellowish brown (2.5Y-10YR 4/4) with dark brown (10YR 3/3) clay films when moist; moderate medium angular blocky breaking to moderate fine angular blocky structure; hard when dry, firm when moist, sticky to very sticky and very plastic when wet; very few thin clay films lining clast pockets; 10-25% coarse-sand- to fine-gravel-sized clasts, with few clasts up to 1-inch in diameter, of subrounded weathered siltstone, shale, and Santa Monica slate; no reaction to hydrochloric acid; silt coatings on clasts; few pinhole-sized pores; abrupt lower contact.

@17.7' to 18.25': Clast-supported GRAVEL; light olive brown to brown (2.5Y-10YR 5/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, olive brown to dark yellowish brown (2.5Y-10YR 4/4) with yellowish brown (10YR 5/4) iron oxide stains when moist; >75% coarse-sand to coarse-gravel-sized clasts, with few clasts up to 1½ inches in diameter, of rounded slightly weathered siltstone, shale, and Santa Monica slate; poorly sorted and clast-supported; clasts broken due to drilling; no reaction to hydrochloric acid; common iron oxide stains on clasts; abrupt lower contact.

@18.25' to 18.5': SILTY CLAY LOAM; light yellowish brown to pale brown (2.5Y-10YR 6/3) with pale brown to brown (10YR 5.5/3) clay films when dry, olive brown to brown (2.5Y-10YR 4/3) with brown (10YR 4/3) clay films when moist; faint laminations; massive breaking to weak very fine subangular blocky structure and single-grained; hard when dry, firm when moist, slightly sticky and plastic when wet; very few thin clay films lining clast pockets; <5% fine-gravel-sized clasts, up to 1/8-inch in diameter, of subrounded slightly weathered Santa Monica slate; scattered coarse sand; no reaction to hydrochloric acid; abrupt lower contact.

<u>Quaternary Fluvial Deposits, mostly unaltered (Qal_f)</u>

@18.5' to 19.1': Clast-supported GRAVEL; light olive brown to yellowish brown (2.5Y-10YR 5/4) with light yellowish brown (10YR 6/4) iron oxide stains when dry, dark olive brown to dark brown (2.5Y-10YR 3/3) with dark yellowish brown (10YR 4/4) iron oxide stains when moist; >75% fine- to coarse-gravel-sized clasts, with few clasts up to 1¼ inches in diameter, of predominantly subrounded to rounded slightly weathered Santa Monica slate and few weathered volcanics; poorly sorted and clast-supported; clasts are broken due to drilling; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; medium- to coarse-sand lens at bottom; clear erosional lower contact.

@19.1' to 19.45': SILTY CLAY; light olive brown to brown (2.5Y-10YR 5/3) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; common wispy silt and clay laminations; moderate coarse subangular blocky breaking to moderate fine subangular blocky structure; hard when dry, firm when moist, sticky and plastic to very plastic when wet; <5% coarse-sand to coarse-gravel-sized clasts of subrounded slightly weathered siltstone, shale, and Santa Monica slate; no reaction to hydrochloric acid; scattered fine sand; abrupt lower contact.

@19.45' to 19.6': Clast-supported GRAVEL; light olive brown to brown (2.5Y-10YR 5/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with brownish yellow (10YR 6/6) iron oxide stains when moist; moderately sorted and clast-supported; faintly coarsening downward; coarse-sand with few fine-gravel-sized clasts at top grading down to coarse-gravel with few clasts up to 1½-inch at the bottom of predominantly rounded slightly weathered Santa Monica slate and few weathered volcanics; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; trace charcoal; clasts are broken due to drilling; abrupt erosional lower contact. [Fluvial deposit]

@19.6' to 20': NO RECOVERY

@20' to 20.6': Clast-supported GRAVEL; light olive brown to brown (2.5Y-10YR 5/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with brownish yellow (10YR 6/6) iron oxide stains when moist; moderately sorted and clast-supported;

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

![Leighton]

CORE BORING REPORT

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
							faintly coarsening downward; coarse-sand with few fine-gravel-sized clasts at top grading down to coarse-gravel with few clasts up to 1½-inch at the bottom of predominantly rounded slightly weathered Santa Monica slate and few weathered volcanics; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; trace charcoal; clasts are broken due to drilling; abrupt erosional lower contact. [Fluvial deposit]
							@20.6' to 20.9': Gravelly SAND; light olive brown to brown (2.5Y-10YR 5/3) when dry, olive brown to dark yellowish brown (2.5Y-10YR 4/4) when moist; >75% coarse-sand- to fine-gravel-sized clasts, with few clasts up to ¼-inch in diameter, of predominantly rounded slightly weathered Santa Monica slate and very few weathered volcanics; moderately sorted; no reaction to hydrochloric acid; abrupt erosional lower contact defined by a stoneline with clasts up to 1½ inches in diameter.
							@20.9' to 21.1': Clast-supported GRAVEL; grayish brown (2.5Y-10YR 5/2) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; moderately to poorly sorted and clast-supported; loose when dry, loose when moist, non-sticky and non-plastic when wet; >75% fine-gravel-sized clasts, with few clasts up to 1/8-inch in diameter, of predominantly subrounded slightly weathered Santa Monica slate in a coarse sand matrix; no reaction to hydrochloric acid; abrupt erosional lower contact.
25							@21.1' to 21.4': SILTY CLAY; light olive brown to brown (2.5Y-10YR 5/3) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; moderate medium subangular blocky breaking to weak fine subangular blocky structure; slightly hard to hard and slightly fragic when dry, firm when moist, sticky and very plastic when wet; ±10% fine- to coarse-gravel-sized clasts, with few clasts up to 1½ inches in diameter, of subrounded slightly weathered siltstone, shale, and Santa Monica slate; no reaction to hydrochloric acid; slight iron oxide and manganese oxide stains on clasts; scattered sand; abrupt lower contact.
							@21.4' to 21.65': Clast-supported GRAVEL; grayish brown (2.5Y-10YR 5/2) with yellowish brown (10YR 5/4) iron oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with dark yellowish brown (10YR 4/4) iron oxide stains when moist; >75% fine- to coarse-gravel-sized clasts, with few clasts up to 1-inch in diameter, of predominantly subrounded weathered Santa Monica slate and few weathered volcanics; moderately to poorly sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; clasts are broken due to drilling; abrupt erosional lower contact.
		25-30	3	3.75	75		@21.65' to 22.15': Gravelly coarse SAND grading down to coarse GRAVEL; grayish brown (2.5Y-10YR 5/2) with yellowish brown (10YR 5/4) iron oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with yellowish brown (10YR 5/6) iron oxide stains when moist; faintly coarsening downward; >75% fine- to coarse-gravel-sized clasts, with few clasts up to 2 inches in diameter, of subrounded weathered siltstone, shale, and Santa Monica slate in a coarse sand matrix; moderately sorted and locally clast-supported; no reaction to hydrochloric acid; common iron oxide stains clast parting surfaces; clasts are broken due to drilling; abrupt erosional lower contact. [Fluvial deposit]
							@22.15' to 22.7': SANDY LOAM to SANDY CLAY lens; grayish brown (2.5Y-10YR 5/2) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; slightly hard and slightly fragic when dry, friable when moist, slightly sticky and slightly plastic when wet; 10-15% coarse-sand- to fine-gravel-sized clasts, with few clasts up to ¾-inch in diameter, of predominantly subrounded slightly weathered Santa Monica slate; no reaction to hydrochloric acid; clasts are broken due to drilling; abrupt lower contact.
							@22.7' to 23.8': Matrix-supported GRAVEL; light brownish gray (2.5Y-10YR 6/2) with light yellowish brown (10YR 6/4) iron oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with yellowish brown (10YR 5/4) iron oxide stains when moist; 50-75% fine- to coarse-gravel-sized clasts, with few clasts up to 1-inch in diameter, of predominantly subrounded to rounded slightly weathered Santa Monica slate and very few grussified

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

Leighton

CORE BORING REPORT

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
30		30-35	4	5	100		
35							

volcanics in a coarse sand matrix; poorly sorted and matrix-supported; no reaction to hydrochloric acid; common iron oxide stains on clast parting surfaces; clasts are broken die to drilling; abrupt to clear, erosional lower contact.

@23.8' to 24.5': Clast-supported GRAVEL; grayish brown (2.5Y-10YR 5/2) with light yellowish brown (10YR 6/4) iron oxide stains when dry, very dark grayish brown (2.5Y-10YR 3/2) with yellowish brown (10YR 5/6) iron oxide stains when moist; 100% coarse-gravel-sized clasts, with few clasts up to 1½ inches in diameter, of predominantly rounded weathered Santa Monica slate and few weathered volcanics and sandstone; poorly sorted; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; loose gravels are broken due to drilling; abrupt erosional lower contact.

@24.5' to 25': Very gravelly SAND; gray (2.5Y-10YR 6/1) with light yellowish brown (10YR 6/3) iron oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with yellowish brown (10YR 5/6) iron oxide stains when moist; moderately sorted and matrix-supported; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; ±50% fine-gravel-sized clasts, with few clasts up to 1 inch in diameter, of predominantly rounded slightly weathered Santa Monica slate in a medium sand matrix; no reaction to hydrochloric acid; common iron oxide stains on clast parting surfaces; clasts are broken due to drilling; lower contact not observed.

@25' to 26.6': Clast-supported GRAVEL; grayish brown (2.5Y-10YR 5/2) with light yellowish brown (10YR 6/4) iron oxide stains when dry, very dark grayish brown (2.5Y-10YR 3/2) with yellowish brown (10YR 5/4) iron oxide stains when moist; poorly sorted and clast-supported; >75% coarse-sand- to fine-gravel-sized clasts, with scattered ¼-inch-sized clasts and a single clast up to 2 inches in diameter at the upper contact, of predominantly subangular to rounded slightly weathered Santa Monica slate and few weathered siltstone and granitics; no reaction to hydrochloric acid; common iron oxide stains on clasts; abrupt lower contact.

@26.6' to 27.3': Clast of Santa Monica slate; gray (10YR 5/1) with yellowish brown (10YR 5/4) iron oxide stains when dry, black (10YR 2/1) with dark yellowish brown (10YR 4/4) iron oxide stains when moist; friable, thinly foliated weathered Santa Monica slate cobble; no reaction to hydrochloric acid; common iron oxide stains on parting surfaces; broken due to drilling; abrupt erosional lower contact.

@27.3' to 30.3': Gravelly CLAY; yellowish brown (10YR 5/4) with brown (7.5YR 4/3) clay films when dry, dark yellowish brown (10YR 3/4) with dark brown (7.5YR 3/3) clay films when moist; massive breaking to strong coarse angular blocky soil structure; very hard to extremely hard when dry, very firm when moist, very sticky and very plastic when wet; common moderately thick clay films on ped faces and many moderately thick clay films lining clast pockets; ±25% coarse-gravel-sized clasts, with few clasts up to 1-inch in diameter, of predominantly subrounded to rounded weathered to very weathered siltstone, shale, and Santa Monica slate; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; few pinhole-sized pores; somewhat jumbled and disorganized matrix; gravel lens at 28.4'; lower contact not observed. [Debris flow]

@30.3' to 30.8': Clast-supported GRAVEL; light olive brown to brown (2.5Y-10YR 5/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, olive brown to brown (2.5-10YR 4/3) with yellowish brown (10YR 5/4) iron oxide stains when moist; slightly coarsens downward; >75% coarse-gravel-sized clasts of predominantly angular to subrounded weathered Santa Monica slate; poorly sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains on clast parting surfaces; clasts are broken due to drilling; abrupt erosional lower contact. [Fluvial deposit]

@30.8' to 31.65': Matrix-supported GRAVEL; light brownish gray (2.5Y-10YR 6/2) with light yellowish brown (10YR 6/4) iron oxide stains when dry, olive brown to dark yellowish brown (2.5Y-10YR 4/4) with yellowish brown (10YR 5/6) iron oxide stains when moist; ±75%

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

ROCKLOG 2006 CONTINUOUS CORE BORINGS 11428.035.GPJ ROCKLOG2012.GDT 1/4/22

Leighton

CORE BORING REPORT

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		35-40	4	4.9	98		
40							

coarse-gravel-sized clasts, with few clasts up to 1-inch in diameter, of predominantly subrounded to rounded slightly weathered shale, siltstone, and Santa Monica slate and few weathered volcanics in a coarse sand matrix; poorly sorted and matrix-supported; no reaction to hydrochloric acid; common iron oxide stains on clast parting surfaces; gradual lower contact.

@31.65' to 32.7': Matrix-supported GRAVEL; light brownish gray (2.5Y-10YR 6/2) with pale brown (10YR 6/3) iron oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with yellowish brown (10YR 5/4) iron oxide stains when moist; ±75% coarse-gravel-sized clasts, with few clasts up to 1-inch in diameter, of predominantly subrounded to rounded slightly weathered Santa Monica slate and few weathered siltstone and volcanics in a medium sand matrix; poorly sorted and matrix-supported; no reaction to hydrochloric acid; slight iron oxide stains on clast parting surfaces; clear erosional lower contact.

@32.7' to 39.5': Clast-supported GRAVEL with few coarse SAND lenses; grayish brown (2.5Y-10YR 5/2) with light yellowish brown (10YR 6/4) iron oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with light yellowish brown to brownish yellow (10YR 6/5) iron oxide stains when moist; >75% fine- to coarse-gravel-sized clasts of predominantly subangular to rounded weathered siltstone, shale, and Santa Monica slate and few grussified granitics; poorly sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; clasts are broken due to drilling; coarse sand lenses at 33.11', 36.15' and 37.75'; abrupt erosional lower contact.

@30.3' to 30.8': Clast-supported GRAVEL; light olive brown to brown (2.5Y-10YR 5/3) with light yellowish brown (10YR 6/4) iron oxide stains when dry, olive brown to brown (2.5-10YR 4/3) with yellowish brown (10YR 5/4) iron oxide stains when moist; slightly coarsens downward; >75% coarse-gravel-sized clasts of predominantly angular to subrounded weathered Santa Monica slate; poorly sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains on clast parting surfaces; clasts are broken due to drilling; abrupt erosional lower contact. [Fluvial deposit]

Quaternary Slopewash and/or Mudflow Deposits, unaltered (Qal_{fg})

@39.5' to 39.75': SILTY CLAY LOAM; light yellowish brown to pale brown (2.5Y-10YR 6/3) when dry, light olive brown to dark yellowish brown (2.5Y-10YR 5/4) when moist; massive breaking to weak to moderate fine subangular blocky structure; slightly hard to hard and slightly fragic when dry, firm when moist, slightly sticky and plastic when wet; ±5% coarse-sand- to fine-gravel-sized clasts of subrounded slightly weathered siltstone and shale; no reaction to hydrochloric acid; few pinhole-sized pores; scattered fine sand; clear lower contact.

@39.75' to 40.7': CLAY; light olive brown to brown (2.5Y-10YR 5/3) when dry, olive brown to dark yellowish brown (2.5Y-10YR 4/4) when moist; moderate coarse subangular blocky breaking to moderate medium subangular blocky structure; hard when dry, firm when moist, very sticky and very plastic when wet; <5% coarse-sand- to fine-gravel-sized clasts of subrounded weathered shale; no reaction to hydrochloric acid; few pinhole-sized pores; slightly gleyed; clear lower contact.

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

Leighton

CORE BORING REPORT

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		40-45	5	5	100		@40.7' to 41.65': Fine SANDY SILT; light brownish gray (2.5Y-10YR 6/2) with light reddish brown (5YR 6/3) burned layers when dry, olive brown to brown (2.5Y-10YR 4/3) with reddish brown (5YR 5/4) burned layers when moist; thinly laminated; moderate coarse subangular blocky breaking to weak fine subangular blocky structure and single-grained; slightly hard when dry, friable when moist, sticky and plastic when wet; ±1% scattered fine sand and fine-gravel-sized clasts of siltstone and shale; no reaction to hydrochloric acid; slight iron oxide stains; few root casts; few pinhole-sized pores; prominent burned layer at 40.7'; clear lower contact.
							@41.65' to 42.1': SILTY LOAM to SILTY CLAY LOAM; grayish brown (2.5Y-10YR 5/2) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; moderate medium subangular blocky breaking to weak fine subangular blocky structure and single-grained; slightly hard and fragic when dry, firm when moist, slightly sticky to sticky and plastic when wet; no reaction to hydrochloric acid; few root casts; few pinhole-sized pores; clear lower contact.
							@42.1' to 44.2': SILTY CLAY with trace SAND grading down to SANDY CLAY; light brownish gray (10YR 6/2) with light yellowish brown (10YR 6/4) iron oxide stains and reddish brown (5YR 5/3) burned layers when dry, olive brown (2.5Y 4/4) with yellowish brown (10YR 5/4) iron oxide stains and reddish brown (5YR 4/4) burned layers when moist; faint bedding; moderate medium subangular breaking to moderate fine angular blocky structure; slightly hard when dry, friable when moist, slightly sticky to sticky and plastic when wet; 0% gravel; scattered sand and slightly micaceous; no reaction to hydrochloric acid; slight iron oxide stains; few to common pinhole-sized pores; slightly gleyed; prominent burned layers at 43.1' and 44.2'; clear lower contact.
							@44.2' to 46.3': CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) with pink (7.5YR 7/4) burned layers when dry, brown (10YR 5/3) with strong brown (7.5YR 5/6) burned layers when moist; common to many thin wavy laminations; strong medium angular blocky breaking to strong fine angular blocky structure; hard when dry, firm when moist, very sticky and very plastic when wet; <5% coarse-sand- to fine-gravel-sized clasts of weathered siltstone and shale; no reaction to hydrochloric acid; common pinhole-sized pores; burned layers throughout and along laminations; clear lower contact.
45							
							@46.3' to 47.2': CLAY; pale brown (10YR 6/3) with brown (7.5YR 5/4) burned layers when dry, dark yellowish brown (10YR 4/4) with brown (7.5YR 4/4) burned layers when moist; moderate to strong coarse angular blocky breaking to moderate medium angular blocky structure; hard to very hard when dry, very firm when moist, very sticky and very plastic when wet; <5% coarse-sand- to fine-gravel-sized clasts of subrounded weathered siltstone and shale; no reaction to hydrochloric acid; trace silica filaments; common root casts and holes; common pinhole-sized pores; trace fine sand; prominent burned layer at 46.5'; abrupt to clear lower contact.

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

CORE BORING REPORT

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		45-50	5	5	100		@47.2' to 47.8': SANDY CLAY to CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) with light brown (7.5YR 6/3) burned layers when dry, olive brown to brown (2.5Y-10YR 4/3) with brown (7.5YR 5/4) burned layers when moist; faint laminations; common burned layers along laminations; strong coarse subangular blocky breaking to strong fine to medium subangular blocky structure; slightly hard to hard when dry, firm when moist, very sticky and very plastic when wet; ±1% coarse-sand- to fine-gravel-sized clasts of rounded slightly weathered siltstone and shale; trace sand and micaceous; no reaction to hydrochloric acid; few pinhole-sized pores; slightly gleyed; clear to gradual lower contact.
							@47.8' to 49.2': CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) with light brown (7.5YR 6/4) burned layers when dry, olive brown (2.5Y 4/4) with brown (7.5YR 5/4) burned layers when moist; common to many thin wavy laminations; strong coarse angular blocky breaking to strong fine to medium angular blocky structure; hard to very hard when dry, firm to very firm when moist, very sticky and very plastic when wet; no reaction to hydrochloric acid; few root holes; few pinhole-sized pores; burned layers throughout, with a prominent layer at 48.5'; scattered clay nodules; trace fine sand; clear lower contact.
							@49.2' to 50': CLAY; brown (10YR 5/3) with light reddish brown (5YR 6/4) burned layers when dry, dark yellowish brown (10YR 3/4) with reddish brown (5YR 5/4) burned layers when moist; faint wavy laminations; strong coarse subangular blocky breaking to strong medium subangular blocky structure; hard to very hard when dry, very firm when moist, very sticky and very plastic when wet; trace fine sand and slightly micaceous; no reaction to hydrochloric acid; few root casts; few pinhole-sized pores; burned layers throughout and along laminations; lower contact not observed.
50							TD: 50' bgs No groundwater encountered during drilling. Backfilled with bentonite-cement grout.

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

CORE BORING REPORT

BORING NO.	CB-3
PAGE 1 OF 9	

PROJECT: **Franklin Elementary School**
CLIENT: **SMMUSD**
CONTRACTOR: **Martini Drilling Corporation**
EQUIPMENT USED: **CME-75**

JOB NO.:	**11428.035**
PAGE NO.:	**1 of 9**
ELEVATION:	**258**
DATE START:	**9/16/2021**
DATE FINISH:	**9/16/2021**
DRILLER:	**Martini Drilling Co.**
PREPARED BY:	**KD**
LOCATION:	**See Figure 2 - *Exploration Location Map***

GROUND WATER		DEPTH TO:			ORIENTATION		CORE BARREL	
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE	X	VERTICAL	TYPE	
						HORIZONTAL	SIZE	
						INCLINED	Bit (ft)	
						BEARING	Barrel (ft)	
					0	ANG. FROM VERT.	Total (ft)	

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		0-5	1	5	100		@Surface: 5 -inches of Asphalt Concrete over 10 -inches of Base **<u>Artificial Fill, undocumented (Afu)</u>** @1.25' to 2.2': SANDY CLAY; very dark grayish brown (2.5Y-10YR 3/2) when dry, black (10YR 2/1) when moist; hard when dry; firm when moist; very sticky and very plastic when wet; 15-20% fine-gravel-sized clasts, with few clasts up to ½-inch in diameter, of predominantly subangular to rounded Santa Monica slate and few weathered volcanics and granitics; slightly micaceous; no reaction to hydrochloric acid; scattered concrete fragments; clasts are jumbled and broken; clear lower contact. **<u>Pedogenically Altered Quaternary Alluvial Fan Deposits (Qal)</u>** @2.2' to 3.8': SANDY CLAY to SILTY CLAY; olive brown to brown (2.5Y-10YR 4/3) with olive brown to brown (2.5Y-10YR 4/3) clay films when dry, dark brown (10YR 3/3) with dark brown (10YR 3/3) clay films when moist; moderate coarse angular blocky breaking to moderate fine to medium angular blocky soil structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; few thin clay films lining clast pockets; 10-15% fine-gravel-sized clasts, with few clasts up to ½-inch in diameter, of predominantly Santa Monica slate and few weathered quartzite and granitics; slightly micaceous; no reaction to hydrochloric acid; few fine root casts; very few scattered pinhole-sized pores; organic odor; clear lower contact. @3.8' to 5': SANDY CLAY; brown (10YR 4.5/3) with brown (10YR 4.5/3) clay films when dry, very dark grayish brown to dark brown (10YR 3/2.5) with very dark grayish brown to dark brown (10YR 3/2.5) clay films when moist; weak moderate subangular blocky breaking to weak fine subangular blocky soil structure and single-grained; slightly hard to hard when dry, firm when moist, very sticky and very plastic when wet; few very thin clay films lining clast pockets; ±10% fine-gravel-sized clasts up to ½-inch in diameter, with very few clasts up to 1-inch in diameter, of predominantly subrounded to rounded slightly weathered to weathered Santa Monica slate and few weathered volcanics and granitics; slightly micaceous; no reaction to hydrochloric acid; very few fine rootlets and few root holes; lower contact not observed.

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

ROCKLOG 2006 CONTINUOUS CORE BORINGS 11428.035.GPJ ROCKLOG2012.GDT 1/4/22

Leighton

CORE BORING REPORT

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		5-10	1	5	100		@5' to 5.4': SANDY CLAY; brown (10YR 4/3) with dark grayish brown (10YR 4/2) organic stains and brown (10YR 4/3) clay films when dry, very dark grayish brown (10YR 3/2) with dark grayish brown to very dark grayish brown (10YR 3.5/2) organic stains and very dark grayish brown (10YR 3/2) clay films when moist; moderate coarse subangular blocky breaking to moderate fine to medium subangular blocky soil structure; hard when dry, firm when moist, very sticky and very plastic when wet; few thin clay films lining clast pockets; ±10% fine-gravel-sized clast up to ½-inch in diameter, with few clasts up to 1-inch in diameter, of predominantly subrounded to rounded slightly weathered Santa Monica slate and very few weathered volcanics; slightly micaceous; no reaction to hydrochloric acid; common organic stains; few fine roots and root holes; strong organic odor; many clasts broken due to drilling; clear lower contact.
							@5.4' to 6.5': SANDY CLAY to SILTY CLAY; yellowish brown (10YR 5/4) with brown (10YR 5/3) clay films when dry, dark yellowish brown (10YR 3/4) with brown (10YR 4/3) clay films when moist; moderate to strong coarse angular blocky breaking to moderate medium angular blocky soil structure; very hard when dry, very firm when moist, sticky and very plastic when wet; common thin to moderately thick clay films on ped faces and few thin clay films lining clast pockets; ±10% fine- to medium-gravel-sized clasts of predominantly rounded Santa Monica slate; slightly micaceous; no reaction to hydrochloric acid; few fine root casts and few to common root casts; common pinhole-sized pores; strong organic odor; clear lower contact.
							@6.5' to 8': Fine SANDY CLAY; brown (10YR 5/3) with brown to yellowish brown (7.5-10YR 4/4) clay films when dry, dark yellowish brown (10YR 4/4) with dark brown to dark yellowish brown (7.5-10YR 3/4) clay films when moist; strong coarse angular blocky breaking to strong medium angular blocky soil structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; common moderately thick clay films on ped faces and common moderately thick to thick clay films lining clast pockets; 10-15% coarse-sand- to coarse-gravel-sized clasts, with few clasts up to ½-inch in diameter, of rounded slightly weathered to very weathered siltstone and Santa Monica slate; no reaction to hydrochloric acid; common pinhole-sized pores; clear lower contact.
							@8' to 9.5': SANDY CLAY; brown to yellowish brown (10YR 5/3.5) with brown to dark yellowish brown (7.5YR 4/3-10YR 4/4) clay films when dry, brown (10YR 4/3) with dark brown (7.5YR 3/4) clay films when moist; moderate to strong coarse angular blocky breaking to moderate to strong fine to medium angular blocky soil structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; few thin clay films on ped faces and common to many thick clay films lining clast pockets; 10-25% coarse-sand- to coarse-gravel-sized clasts of slightly weathered to weathered siltstone and Santa Monica slate; slightly micaceous; no reaction to hydrochloric acid; very slight iron oxide stains; common pinhole-sized pores; clear to gradual lower contact.
10							@9.5' to 10.4': SILTY CLAY; light olive brown to brown (2.5Y-10YR 5/3) with brown (7.5YR 4/3) iron oxide stains when dry, dark yellowish brown (10YR 4/4) with dark brown (7.5YR 3/3) iron oxide stains when moist; moderate medium angular blocky breaking to moderate fine angular blocky soil structure; hard to very hard when dry, very firm when moist, sticky and very plastic when wet; <10% coarse-sand- to fine-gravel-sized clasts of predominantly subangular to subrounded Santa Monica slate; no reaction to hydrochloric acid; common iron oxide stains; common to many fine root casts; trace charcoal; abrupt to clear lower contact.

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

CORE BORING REPORT

BORING NO. **CB-3**

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		10-15	2	5	100		@10.4' to 14.25': SANDY CLAY grading to SILTY CLAY; light olive brown to brown (2.5Y-10YR 5/3) with brown (7.5YR 5/4) iron oxide stains when dry, brown (10YR 4/3) with brown (7.5YR 4/4) iron oxide stains when moist; moderate coarse subangular blocky breaking to moderate fine to medium subangular blocky soil structure; hard when dry, firm when moist, sticky to very sticky and very plastic when wet; 5-10% fine-gravel-sized clasts up to ½-inch in diameter of predominantly subrounded Santa Monica slate and few weathered siltstone, volcanics, and granitics; no reaction to hydrochloric acid; slight iron oxide stains on ped faces; few root casts; common pinhole-sized pores; clear lower contact.
							<u>Quaternary Alluvial Fan and/or Mudflow Deposits, mostly unaltered (Qal_{mf})</u> @14.25' to 15.7': Gravelly SANDY CLAY; light olive brown to brown (2.5Y-10YR 5/3) when dry, brown (10YR 4/3) when moist; moderate medium to coarse subangular blocky breaking to moderate fine angular blocky structure; hard when dry, firm when moist, very sticky and plastic when wet; ±25% fine-gravel-sized clasts, up to 1-inch in diameter, of predominantly subrounded to rounded slightly weathered Santa Monica slate and few weathered volcanics; no reaction to hydrochloric acid; common iron oxide stains on clast parting surfaces; few pinhole-sized pores; clasts are commonly broken due to drilling; abrupt to clear lower contact.
15							
							@15.7' to 17.4': SANDY CLAY to SILTY CLAY; light olive brown to brown (2.5Y-10YR 5/3) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; strong coarse subangular blocky breaking to moderate fine to medium angular blocky structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; ±10% coarse-sand- to coarse-gravel-sized clasts, with few clasts up to 1-inch in diameter, of subangular to rounded weathered siltstone, shale, and Santa Monica slate; micaceous; no reaction to hydrochloric acid; few pinhole-sized pores; gradual lower contact.

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

Leighton

CORE BORING REPORT

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		15-20	2	4.9	98		
20		20-25	3	5	100		

@17.4' to 17.8': SANDY CLAY LOAM; light olive brown to brown (2.5Y-10YR 5/3) with reddish brown (2.5YR 5/3) burned layers when dry, brown (10YR 4/3) with dark reddish brown (2.5YR 2.5/3) burned layers when moist; slightly hard and fragic when dry, friable when moist, slightly sticky and slightly plastic to plastic when wet; <10% coarse-sand- to medium-gravel-sized clasts of predominantly subangular to subrounded slightly weathered Santa Monica slate and few weathered volcanics; no reaction to hydrochloric acid; burned layer at 17.5'; clear lower contact.

@17.8' to 18.1': Coarse SANDY CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) with light olive brown to brown (2.5Y-10YR 5/3) clay films when dry, dark grayish brown (2.5Y-10YR 4/2) with brown (10YR 4/3) clay films when moist; thinly laminated; hard when dry, firm when moist, sticky to very sticky and plastic to very plastic when wet; few to common thin clay films lining clast pockets; <10% coarse-sand- to medium-gravel-sized clasts, with few clasts ½-inch in diameter; of predominantly subrounded slightly weathered Santa Monica slate and few weathered volcanics; micaceous; no reaction to hydrochloric acid; few pinhole-sized pores; abrupt lower contact.

Quaternary Fluvial Deposits, mostly unaltered (Qal_f)

@18.1' to 18.65': Gravelly SANDY CLAY; light olive brown (2.5Y 5/3) with brown (10YR 5/3) clay films and brown (7.5YR 5/4) iron oxide stains when dry, dark grayish brown (2.5Y 4/2) with brown (10YR 4/3) clay films and brown (7.5YR 4/4) iron oxide stains when moist; thinly laminated; hard to very hard when dry, firm when moist, very sticky and very plastic when wet; few thin clay films lining clast pockets; ±25% coarse-sand- to coarse-gravel-sized clasts, with few clasts 1-inch in diameter; of subrounded to rounded slightly weathered Santa Monica slate and few weathered volcanics; micaceous; no reaction to hydrochloric acid; few pinhole-sized pores; abrupt erosional lower contact.

@18.65' to 19.55': Locally clast-supported GRAVEL; dark grayish brown (2.5Y-10YR 4/2) when dry, very dark grayish brown (2.5Y-10YR 3/2) when moist; ±75% fine- to coarse-gravel-sized clasts, with few clasts up to 1¾ inches in diameter, of predominantly subangular to rounded slightly weathered Santa Monica slate and few weathered shale and volcanics in a coarse sand matrix; poorly sorted and locally clast-supported; no reaction to hydrochloric acid; clasts are commonly broken due to drilling; abrupt erosional lower contact.

@19.55' to 19.9': SANDY CLAY LOAM; light olive brown to brown (2.5Y-10YR 5/3) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; soft and fragic when dry, friable when moist, slightly sticky and slightly plastic to plastic when wet; ±10% coarse-sand- to medium-gravel-sized clasts of subangular slightly weathered Santa Monica slate and weathered shale; no reaction to hydrochloric acid; moderately sorted; abrupt to clear lower contact.

@19.9' to 20': NO RECOVERY

@20' to 20.55': SANDY CLAY LOAM; light olive brown to brown (2.5Y-10YR 5/3) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; soft and fragic when dry, friable when moist, slightly sticky and slightly plastic to plastic when wet; ±10% coarse-sand- to medium-gravel-sized clasts of subangular slightly weathered Santa Monica slate and weathered shale; no reaction to hydrochloric acid; moderately sorted; abrupt to clear lower contact.

@20.55' to 21.6': SANDY LOAM; olive brown to brown (2.5Y-10YR 4/3) when dry, dark grayish brown (2.5Y-10YR 4/2) when moist; thinly bedded; slightly hard when dry, friable when moist, slightly sticky and slightly plastic to plastic when wet; <10% fine- to medium-gravel-sized clasts of subrounded weathered siltstone, shale, and Santa Monica slate in a fine- to medium-sand matrix; no reaction to hydrochloric acid; beds dip ~5°; abrupt lower contact.

@21.6' to 22': Fine SAND; olive brown to brown (2.5Y-10YR 4/3) when dry, very dark grayish brown (2.5Y-10YR 3/2) when moist; loose to soft and

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

Leighton

CORE BORING REPORT

BORING NO. **CB-3**

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
25		25-30	3	4.7	94		fragic when dry, loose to very friable when moist, non-sticky to slightly sticky and slightly plastic when wet; ±5% scattered coarse-sand- to fine-gravel-sized clasts of subrounded weathered siltstone and shale; no reaction to hydrochloric acid; abrupt lower contact. @22' to 22.55': SILTY CLAY LOAM; light olive brown to brown (2.5Y-10YR 5/3) when dry, dark grayish brown (2.5Y-10YR 4/2) when moist; few to common thinly bedded silt and fine gravel layers; soft to slightly hard and fragic when dry, friable when moist, slightly sticky to sticky and plastic when wet; ±10% scattered coarse-sand- to fine-gravel-sized clasts of subangular to subrounded weathered siltstone, shale, and Santa Monica slate; no reaction to hydrochloric acid; abrupt lower contact. @22.55' to 23.5': Coarse SAND grading down to coarse GRAVEL; dark grayish brown (2.5Y-10YR 4/2) when dry, very dark grayish brown (2.5Y-10YR 3/2) when moist; >75% coarse-sand- to coarse-gravel-sized clasts, with few clasts at the bottom up to 1¼-inch in diameter, of predominantly subrounded slightly weathered Santa Monica slate and few weathered volcanics; moderately to poorly sorted and clast-supported; no reaction to hydrochloric acid; slight iron oxide stains on clast-parting surfaces; slightly coarsens downward; clasts are commonly broken due to drilling; abrupt erosional lower contact. [Fluvial deposit] @23.5' to 23.85': SILTY CLAY LOAM; light yellowish brown to pale brown (2.5Y-10YR 6/3) with strong brown (7.5YR 5/6) iron oxide stains when dry, dark grayish brown (2.5Y-10YR 4/2) with brown (7.5YR 4/4) iron oxide stains when moist; thinly bedded; slightly hard and fragic when dry, friable when moist, slightly sticky to sticky and plastic when wet; <10% scattered coarse-sand- to fine-gravel-sized clasts of subangular to subrounded siltstone, shale, and Santa Monica slate; no reaction to hydrochloric acid; slight iron oxide stains; few pinhole-sized pores; abrupt lower contact. @23.85' to 24.5': Clast-supported GRAVEL; light olive brown to brown (2.5Y-10YR 5/3) with brown (7.5YR 4/4) iron oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with brown (7.5YR 4/4) iron oxide stains when moist; >75% coarse-sand- to coarse-gravel-sized clasts, with very few clasts up to 2 inches in diameter, of predominantly subrounded weathered Santa Monica slate and few weathered shale and volcanics; poorly sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains on clasts and parting surfaces; clasts are commonly broken due to drilling; abrupt erosional lower contact. @24.5' to 26.1': Clast-supported GRAVEL; dark grayish brown (2.5Y-10YR 4/2) when dry, very dark grayish brown (2.5Y-10YR 3/2) when moist; >75% fine- to coarse-gravel-sized clasts, with few clasts up to 2 inches in diameter, of subrounded to rounded slightly weathered siltstone, shale, and Santa Monica slate in a coarse sand matrix; moderately to poorly sorted and clast-supported; no reaction to hydrochloric acid; common iron oxide stains clast parting surfaces; few pinhole-sized pores; slightly coarsens downward; clasts are commonly broken due to drilling; abrupt erosional lower contact. [Fluvial deposit] @26.1' to 26.8': Clast-supported GRAVEL; dark grayish brown (2.5Y-10YR 4/2) with brown (7.5YR 4/3) iron oxide stains when dry, very dark grayish brown (2.5Y-10YR 3/2) with dark brown (7.5YR 3/3) iron oxide stains when moist; >75% coarse-sand- to fine-gravel-sized clasts, with few clasts up to ½-inch in diameter, of subrounded to rounded slightly weathered siltstone, shale, Santa Monica slate, and volcanics; poorly sorted and clast-supported; no reaction to hydrochloric acid; slight iron oxide stains on clast parting surfaces; gravelly sand lens at 26.3'; abrupt erosional lower contact. @26.8' to 27': Clast-supported GRAVEL; light olive brown to brown (2.5Y-10YR 5/3) with strong brown (7.5YR 4/6) iron oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with brown (7.5YR 4/4) iron oxide stains when moist; >75% coarse-gravel-sized clasts, with few clasts up to 1-inch in diameter, of predominantly subangular to subrounded slightly weathered Santa Monica slate; poorly sorted and matrix-supported; no reaction to hydrochloric acid; common iron oxide stains on clast parting surfaces; clasts are commonly broken due to drilling; abrupt erosional lower contact.

FIELD HARDNESS	BEDDING	ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE	WEATHERING
V. HARD - KNIFE CAN'T SCRATCH HARD - SCRATCHES DIFFICULT MOD. HARD - SCRATCHES EASILY SOFT - GROVES V. SOFT - CARVES	V. THIN <2" THIN 2"-12" MEDIUM 12"-36" THICK 36"-120" V. THICK >120"	HORIZONTAL (0-5°) SHALLOW OR LOW ANGLE (5-35°) MODERATELY DIPPING (35-55°) STEEP OR HIGH ANGLE (55-85°) VERTICAL (85-90°)	V. CLOSE <2" CLOSE 2"-12" MOD. CLOSE 12"-36" WIDE 36"-120" V. WIDE >120"	FRESH V. SLIGHT SLIGHT MODERATE MOD. SEVERE V. SEVERE COMPLETE

CORE BORING REPORT

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG
30						
		30-35	4	5	100	
35						

FIELD CLASSIFICATION AND REMARKS

@27' to 29.6': SANDY CLAY; brown (10YR 5/3) with brown (7.5YR 5/4) clay films when dry, dark brown (10YR 3/3) with dark brown (7.5YR 3/3) clay films when moist; strong coarse angular blocky breaking to strong medium angular blocky soil structure; very hard to extremely hard when dry, very firm to extremely firm when moist, very sticky and very plastic when wet; common to many moderately thick clay films on ped faces and common to many moderately thick clay films lining clast pockets; ±15% coarse-gravel-sized clasts, with few clasts up to ¾-inch in diameter, of predominantly subrounded Santa Monica slate and few weathered siltstone and shale; no reaction to hydrochloric acid; somewhat jumbled and poorly sorted; abrupt erosional lower contact. [Debris flow deposits]

@29.6' to 29.7': Gravelly coarse SANDY LOAM; light olive brown to brown (2.5Y-10YR 5/3) with brown (7.5YR 5/4) iron oxide stains when dry, brown (10YR 4/3) with strong brown (7.5YR 5/6) iron oxide stains when moist; poorly sorted and matrix-supported; ±25% coarse-gravel-sized clasts, up to 1-inch in diameter, of predominantly subrounded to rounded slightly weathered Santa Monica slate and few weathered siltstone and granitics; no reaction to hydrochloric acid; slight iron oxide stains on clast-parting surfaces; clasts are broken due to drilling; abrupt erosional lower contact.

@29.7' to 30': NO RECOVERY

@30' to 30.25': Gravelly coarse SANDY LOAM; light olive brown to brown (2.5Y-10YR 5/3) with brown (7.5YR 5/4) iron oxide stains when dry, brown (10YR 4/3) with strong brown (7.5YR 5/6) iron oxide stains when moist; poorly sorted and matrix-supported; ±25% coarse-gravel-sized clasts, up to 1-inch in diameter, of predominantly subrounded to rounded slightly weathered Santa Monica slate and few weathered siltstone and granitics; no reaction to hydrochloric acid; slight iron oxide stains on clast-parting surfaces; clasts are broken due to drilling; abrupt erosional lower contact.

@30.25' to 30.8': GRAVEL in a SILT LOAM matrix; light yellowish brown to pale brown (2.5Y-10YR 6/3) with brown (7.5YR 4/4) iron oxide stains when dry, olive brown to brown (2.5Y-10YR 4/3) with dark brown (7.5YR 3/4) iron oxide stains when moist; poorly sorted and matrix-supported; slightly hard and fragic when dry, friable when moist, slightly sticky and slightly plastic to plastic when wet; ±50% fine-gravel-sized clasts up to 1-inch in diameter of predominantly subrounded slightly weathered Santa Monica slate; no reaction to hydrochloric acid; common iron oxide stains on clast parting surfaces; clasts are broken due to drilling; abrupt erosional lower contact.

@30.8' to 31.3': Locally clast-supported GRAVEL; dark grayish brown (2.5Y-10YR 4/2) with strong brown (7.5YR 4/6) iron oxide stains when dry, very dark grayish brown (2.5Y-10YR 3/2) with brown (7.5YR 4/4) iron oxide stains when moist; poorly sorted and locally clast-supported; ±75% medium-gravel-sized clasts, up to 1-inch in diameter, of subrounded weathered siltstone, shale, and Santa Monica slate locally in a medium sand matrix; no reaction to hydrochloric acid; slight iron oxide stains on clasts; clasts are commonly broken due to drilling; abrupt erosional lower contact.

@31.3': to 31.9': Gravelly SILT LOAM to SILTY CLAY LOAM; light olive brown to brown (2.5Y-10YR 5/3) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; slightly hard and slightly fragic when dry, friable when moist, slightly sticky and slightly plastic when wet; 25-50% fine-gravel-sized clasts, up to 1-inch in diameter, of predominantly subrounded to rounded siltstone, shale, and Santa Monica slate; no reaction to hydrochloric acid; common pinhole-sized pores; clasts are commonly broken due to drilling; matrix-supported and slightly fines downward; abrupt erosional lower contact. [Debris flow deposit]

@33' to 38': Clast-supported GRAVEL; olive brown to brown (2.5Y-10YR 4/3) with brown (7.5YR 4/4) iron oxide stains when dry, very dark grayish brown (2.5Y-10YR 3/2) with dark brown (7.5YR 3/3) iron oxide stains when moist; poorly sorted and clast-supported; >75% fine-gravel-sized clasts, with few clasts up to 2 inches in diameter, of predominantly subrounded slightly weathered siltstone, shale, and Santa Monica slate and few weathered to

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

Leighton

CORE BORING REPORT

BORING NO. **CB-3**

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		35-40	4	4.9	98		grussified granitics and volcanics; no reaction to hydrochloric acid; common iron oxide stains and very few jarosite stains on fracture surfaces; clasts are broken due to drilling; gravelly coarse sand lens at 37.9'; clear lower contact. @31.9' to 33': Clast-supported GRAVEL; dark grayish brown (2.5Y-10YR 4/2) when dry, very dark grayish brown (2.5Y-10YR 3/2) when moist; moderately sorted and clast-supported; >75% fine- to coarse-gravel-sized clasts, with few clasts up to ¾-inch in diameter, of subrounded to rounded weathered siltstone, shale, volcanics, and Santa Monica slate; no reaction to hydrochloric acid; clasts are broken due to drilling; abrupt to clear lower contact. @38' to 39.5': Clast-supported GRAVEL; dark grayish brown (2.5Y-10YR 4/2) when dry, very dark grayish brown (2.5Y-10YR 3/2) when moist; moderately sorted and clast-supported; >75% fine- to coarse-gravel-sized clasts, with few clasts up to ¾-inch in diameter, of subrounded to rounded weathered siltstone, shale, volcanics, and Santa Monica slate; no reaction to hydrochloric acid; clasts are broken due to drilling; abrupt to clear lower contact. **Quaternary Slopewash and/or Mudflow Deposits, unaltered (Qal_{fg})** @39.5' to 39.9': SILTY CLAY LOAM; light olive brown to brown (2.5Y-10YR 5/3) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; massive breaking to single-grained; slightly hard and slightly fragic when dry, friable when moist, slightly sticky and slightly plastic to plastic when wet; ±10% coarse-sand- to fine-gravel-sized clasts of subangular to rounded shale, siltstone, volcanics, and Santa Monica slate; no reaction to hydrochloric acid; few pinhole-sized pores; abrupt lower contact. @39.9' to 40': NO RECOVERY
40							@40' to 40.2': SILTY CLAY LOAM; light olive brown to brown (2.5Y-10YR 5/3) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; massive breaking to single-grained; slightly hard and slightly fragic when dry, friable when moist, slightly sticky and slightly plastic to plastic when wet; ±10% coarse-sand- to fine-gravel-sized clasts of subangular to rounded shale, siltstone, volcanics, and Santa Monica slate; no reaction to hydrochloric acid; few pinhole-sized pores; abrupt lower contact. @40.2' to 40.9': SANDY CLAY; light olive brown to brown (2.5Y-10YR 5/3)

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

CORE BORING REPORT

BORING NO.	CB-3
PAGE 8 OF 9	

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
45		40-45	5	5	100		see below

when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; thin wispy silt and clay laminations; weak to moderate medium to coarse subangular blocky breaking to weak fine subangular blocky structure; slightly hard to hard and slightly fragic when dry, firm when moist, sticky to very sticky and plastic when wet; <10% coarse-sand- to medium-gravel-sized clasts of subrounded siltstone, shale, and Santa Monica slate; no reaction to hydrochloric acid; slightly gleyed; abrupt lower contact.

@40.9' to 41.3': GRAVEL in a SILT LOAM matrix; olive brown to brown (2.5Y-10YR 4/3) when dry, dark olive brown to dark brown (2.5Y-10YR 3/3) when moist; slightly hard and fragic when dry, friable when moist, slightly sticky and slightly plastic when wet; ±75% fine-gravel-sized clasts, up to 1-inch in diameter, of subrounded to rounded shale, siltstone, and Santa Monica slate; matrix supported; no reaction to hydrochloric acid; few pinhole-sized pores; abrupt lower contact.

@41.3' to 42': SANDY CLAY to CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) with reddish brown (5YR 5/3) burned layers when dry, olive brown to brown (2.5Y-10YR 4/3) with reddish brown (5YR 4/3) burned layers when moist; thinly laminated clay-rich and sand-rich layers; moderate medium subangular blocky breaking to weak to moderate fine subangular blocky structure; slightly hard to hard when dry, firm when moist, very sticky and plastic to very plastic when wet; ±5% coarse-sand- to fine-gravel-sized clasts of predominantly subrounded Santa Monica slate and few weathered volcanics; no reaction to hydrochloric acid; very few pinhole-sized pores; prominent burned layer at 41.75'; abrupt lower contact.

@42' to 42.5': SILTY CLAY LOAM; light yellowish brown to pale brown (2.5Y-10YR 6/3) when dry, light olive brown to brown (2.5Y-10YR 5/3) when moist; thinly laminated; weak fine subangular blocky structure breaking to single-grained; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; 0% gravel; scattered fine- to medium-sand; micaceous; no reaction to hydrochloric acid; abrupt lower contact.

@42.5' to 43': CLAY; light olive brown to brown (2.5Y-10YR 5/3) with light yellowish brown (10YR 6/4) burned layers when dry, olive brown to brown (2.5Y-10YR 4/3) with dark yellowish brown (10YR 4/4) burned layers when moist; many thin wavy clay laminations; entire layer is a baked zone with interlaminated burned layers; moderate medium subangular blocky breaking to moderate fine subangular blocky structure; slightly hard when dry, firm when moist, very sticky and very plastic when wet; <5% fine-gravel-sized clasts of subrounded siltstone; micaceous and scattered coarse sand; no reaction to hydrochloric acid; few pinhole-sized pores; possibly gleyed(?); abrupt lower contact.

@43' to 43.3': SANDY CLAY LOAM; light olive brown to brown (2.5Y-10YR 5/3) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; common thin wavy clay laminations; weak to moderate medium subangular breaking to weak fine subangular blocky structure and single-grained; soft to slightly hard when dry, friable when moist, slightly sticky and plastic when wet; <10% coarse-sand- to fine-gravel-sized clasts of subrounded to subangular shale and Santa Monica slate; micaceous; no reaction to hydrochloric acid; abrupt lower contact.

@43.3' to 43.8': CLAY; light yellowish brown to pale brown (10YR 6/3.5) with yellowish brown (10YR 5/6) oxidized zones and light olive brown (2.5Y 5/3) reduced zones when dry, yellowish brown (10YR 5/4) with dark yellowish brown (10YR 4/4) oxidized zones and olive brown (2.5Y 4/3) reduced zones when moist; many thin wavy clay laminations; strong medium angular blocky breaking to strong fine angular blocky structure; hard when dry, firm when moist, very sticky and very plastic when wet; <5% gravel with scattered fine sand; no reaction to hydrochloric acid; common pinhole-sized pores; slightly gleyed; few oxidized zones; abrupt lower contact.

@43.8' to 44.1': SANDY LOAM; light olive brown to brown (2.5Y-10YR 5/3) when dry, dark olive brown to dark brown (2.5Y-10YR 3/3) when moist; thinly laminated with alternating silt and coarse sand layers; weak medium subangular blocky structure breaking to single-grained; soft to slightly hard

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

CORE BORING REPORT

BORING NO. **CB-3**

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	BOX NUMBER	RECOVERY FT	RECOVERY %	GRAPHIC LOG	FIELD CLASSIFICATION AND REMARKS
		45-50	5	5	100		and fragic when dry, very friable when moist, very slightly sticky and slightly plastic when wet; ±10% coarse-sand- to medium-gravel-sized clasts, few clasts up to ¼-inch in diameter, of subangular to subrounded weathered shale, siltstone, Santa Monica slate, and volcanics; no reaction to hydrochloric acid; abrupt to clear lower contact. @44.1' to 45': SILTY CLAY LOAM; light olive brown to brown (2.5Y-10YR 5/3) when dry, olive brown to brown (2.5Y-10YR 4/3) when moist; common to many thin faint wavy clay laminations; few interlaminated burned layers; moderate coarse subangular blocky breaking to weak to moderate medium subangular blocky structure; slightly hard when dry, firm when moist, slightly sticky and plastic when wet; <5% gravel with scattered fine sand; micaceous; no reaction to hydrochloric acid; lower contact not observed. @46.6' to 49.2': CLAY; light olive brown to brown (2.5Y-10YR 5/3) with reddish brown (5YR 5/4) burned layers when dry, olive brown to brown (2.5Y-10YR 4/3) with reddish brown (5YR 4/4) burned layers when moist; many thin wavy clay laminations; prominent burned layer at 47.25' and common interlaminated burned layers throughout; moderate medium subangular blocky breaking to weak fine subangular blocky structure; hard to very hard when dry, firm when moist, very sticky and very plastic when wet; <10% coarse-sand- to coarse-gravel-sized clasts of subrounded to rounded siltstone and Santa Monica slate; no reaction to hydrochloric acid; few to common root filaments; common pinhole-sized pores; gradual lower contact. @45' to 46.6': CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) with brown (7.5YR 5/4) burned layers when dry, light olive brown to brown (2.5Y-10YR 5/3) with brown (7.5YR 4/4) burned layers when moist; common to many thin wavy clay laminations; common burned layers throughout; moderate medium angular blocky breaking to weak fine angular blocky structure; very hard when dry, firm when moist, very sticky and very plastic when wet; <5% gravel with scattered fine sand; micaceous; no reaction to hydrochloric acid; few pinhole-sized pores; clear to gradual lower contact. @49.2' to 50': SANDY CLAY to SILTY CLAY; light yellowish brown to pale brown (2.5Y-10YR 6/3) with light olive brown to brown (2.5Y-10YR 5/3) sand-rich layers when dry, olive brown to brown (2.5Y-10YR 4/3) with olive brown to brown (2.5Y-10YR 4/3) sand-rich layers when moist; few interlaminated coarse sand and burned layers; lower moderate coarse angular blocky breaking to moderate fine angular blocky structure; hard when dry, firm when moist, sticky to very sticky and very plastic when wet; <5% coarse-sand- to medium-gravel-sized clasts of subrounded shale and siltstone; no reaction to hydrochloric acid; many thin wavy clay laminations; contact not observed.
50							TD: 50' bgs No groundwater encountered during drilling. Backfilled with bentonite-cement grout.

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CAN'T SCRATCH	V. THIN	<2"	HORIZONTAL (0-5°)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULT	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35°)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55°)	MOD. CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85°)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90°)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

GEOTECHNICAL BORING LOG LB-1

Project No.	11428.035	**Date Drilled**	9-16-21
Project	Franklin ES	**Logged By**	EMH
Drilling Co.	Martini Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	260'
Location	See Figure 2 - *Exploration Location Map*	**Sampled By**	EMH

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
260	0			BB-1				CL	**Artificial fill, undocumented: (Afu)** @0': 3-inches Asphalt Concrete (AC) over subgrade Sandy CLAY with Gravel (CL), dark brown to reddish brown, fine to medium sand, fine gravel	
									Quaternary alluvial fan deposits: (QAL) Pedogenically altered sediments	
255	5			R-1	4 12 22			ML	@5': Clayey SILT (ML), very stiff, reddish brown, slightly moist, with few fine sand and occasional fine gravel, PP = 4.00	
				R-2	11 13 22			CL	@7.5': Silty CLAY with Gravel (CL), very stiff, reddish brown, slightly moist, low to medium plasticity, fine slate gravels, with few fine to medium sand, trace coarse sand, PP = 4.00	
250	10			R-3	9 23 29				@10':**Alluvial fan and or mudflow deposits (QALmf)** consisting of layers of gravel, sand , clay and silt Silty CLAY (CL), hard, reddish brown, slightly moist, little fine sand, with occasional fine slate gravel, grades coarser with increase in fine gravels, PP = 4.00	
245	15			S-1	5 3 4			SM-SC	@15':**Fluvial Deposits QALf)** Interbedded Silty SAND with Gravel (SM) and Sandy CLAY (CL), loose, reddish brown, slightly moist, fine to medium sand, fine slate gravel, low to medium plasticity clay	
240	20			R-4	3 18 24			SM	@20': Silty SAND with Gravel (SM), dense, reddish brown to dark brown, slightly moist, fine sand, fine slate gravel, grades to clayey gravel, fine slate and siltstone gravels, PP = 4.00	
235	25			S-2	14 16 11			GP	@25': Gravel with Sand (GP), medium dense, olive brown to reddish brown, predominantly fine slate gravels, with fine to coarse sand, grades to clay, reddish brown, moist, with some fine slate gravels	
230	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-1

Project No.	11428.035	**Date Drilled**	9-16-21
Project	Franklin ES	**Logged By**	EMH
Drilling Co.	Martini Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	260'
Location	See Figure 2 - *Exploration Location Map*	**Sampled By**	EMH

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
230	30			R-5	9 20 25			CL	@30': Sandy CLAY with Gravel (CL), hard, reddish brown, slightly moist, fine to medium sand, trace coarse sand, fine slate gravel, low to medium plasticity, chaotic assemblage, PP = 4.00	
									Total Depth of Boring: 31.5 Feet No groundwater encountered during drilling Boring backfilled with soil cuttings, tamped, and capped with approximately 6-inches of Asphalt Cold Patch Mix on 9-16-2021	
225	35									
220	40									
215	45									
210	50									
205	55									
200	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
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- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-2

Project No.	11428.035	**Date Drilled**	9-16-21
Project	Franklin ES	**Logged By**	EMH
Drilling Co.	Martini Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	260'
Location	See Figure 2 - *Exploration Location Map*	**Sampled By**	EMH

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
260	0			BB-1				CL	**Artificial fill, undocumented: (Afu)** @0': 4.5-inches Asphalt Concrete (AC) over 12-inches Aggregate Base (AB) @1.3': Silty CLAY (CL), reddish brown, moist, little fine sand, medium plasticity	CN, CR, DS, EI MD, RV
									Quaternary alluvial fan deposits: (QAL) Pedogenically altered sediments >	
255	5			R-1	2 2 10			CL	@5': Silty CLAY (CL), stiff, reddish brown, moist, little fine sand, trace fine slate gravel, slightly micaceous, low to medium plasticity, PP = 4.00	CN, DS
				R-2	13 16 21				@7.5': Silty CLAY (CL), very stiff, reddish brown, moist, little fine to medium sand, occasional fine slate gravels, trace sand sized slate fragments, low plasticity, PP > 4.50	CN, DS
250	10			R-3	5 10 24				@10': Sandy CLAY (CL) with Gravel, very stiff, brown to reddish brown, some fine to medium sand, little coarse sand, little fine to medium sub-rounded gravels, grades to clayey gravel, fine slate gravels	CN
									@12': **Alluvial fan and or mudflow deposits (QALmf)** consisting of layers of gravel, sand , clay and silt	
245	15			R-4	21 33 44			GP	@15': **Fluvial Deposits QALf)** GRAVEL (GP), very dense, predominantly fine slate gravels with silty sand matrix, grades coarser to cobble-sized clasts, predominantly fine gray slate gravels	
240	20			S-1	8 11 15			SP	@20': SAND with Gravel (SPg), medium dense, medium brown, moist, predominantly fine to medium sand, some coarse sand, little fine slate gravel	
235	25			R-5	15 23 45			GP	@25': GRAVEL with Sand (GP), dense, predominantly fine to coarse gray slate gravels, some fine to medium sand, little coarse sand, grades coarse to cobble sized clasts, PP = 4.00	
230	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
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- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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* * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * *

GEOTECHNICAL BORING LOG LB-2

Project No.	11428.035	**Date Drilled**	9-16-21
Project	Franklin ES	**Logged By**	EMH
Drilling Co.	Martini Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	260'
Location	See Figure 2 - *Exploration Location Map*	**Sampled By**	EMH

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
230	30			S-2	10 15 18			SP	@30': SAND with Gravel (SPg), dense, reddish brown, moist, fine to coarse sand, fine subrounded gravels and fine slatey gravels, with clayey laminations	
225	35			R-6	24 50/6"			SM	@35': Silty SAND with Gravel (SMg), very dense, grayish brown, moist, mostly fine sand, few medium to coarse sand, little fine slatey gravels, PP = 4.00, becoming fine grained silty clayey sand with depth	
									@37.5':**Fine grained deposits (QALfg)**	
220	40			S-3	2 3 6			CL-SM	@40': Interbedded CLAY, Sandy CLAY, and Silty SAND (CL-SM), stiff, medium olive brown to reddish brown, moist, fine sand, low to medium plasticity, PP = 3.75	
215	45			R-7	4 11 15			CL	@45': CLAY (CL), very stiff, reddish brown, moist, medium plasticity, few silt, sporatic MnO spotting, minor carbonate spotting	
210	50			S-4	2 3 4				@50': CLAY (CL), firm, olive brown to reddish brown, moist, low to medium plasticity, slightly micaceous	
									Total Depth of Boring: 51.5 Feet No groundwater encountered during drilling Boring backfilled with soil cuttings, tamped, and capped with approximately 6-inches of Asphalt Cold Patch Mix on 9-16-2021	
205	55									
200	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
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- RV R VALUE
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- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

SUMMARY

OF

CONE PENETRATION TEST DATA

Project:

Franklin Elementary School
Santa Monica, CA
September 16, 2021

Prepared for:

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Leighton Consulting
17781 Cowan
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Prepared by:

KEHOE TESTING & ENGINEERING
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www.kehoetesting.com

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3. **FIELD EQUIPMENT & PROCEDURES**
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- CPT Classification/Soil Behavior Chart
- Summary of Shear Wave Velocities
- CPT Data Files (sent via email)

SUMMARY

OF

CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the Franklin Elementary School project located in Santa Monica, California. The work was performed by Kehoe Testing & Engineering (KTE) on September 16, 2021. The scope of work was performed as directed by Leighton Consulting personnel.

2. SUMMARY OF FIELD WORK

The fieldwork consisted of performing CPT soundings at five locations to determine the soil lithology. A summary is provided in **TABLE 2.1**.

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-1	50	
CPT-2	50	
CPT-3	50	
CPT-4	50	
CPT-5	50	

TABLE 2.1 - Summary of CPT Soundings

3. FIELD EQUIPMENT & PROCEDURES

The CPT soundings were carried out by **KTE** using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig. The cone used during the program was a 15 cm^2 cone with a cone net area ratio of 0.83. The following parameters were recorded at approximately 2.5 cm depth intervals:

- Cone Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (u)
- Inclination
- Penetration Speed

At location CPT-4, shear wave measurements were obtained at approximately 5-foot intervals. The shear wave is generated using an air-actuated hammer, which is located inside the front jack of the CPT rig. The cone has a triaxial geophone, which recorded the shear wave signal generated by the air hammer.

The above parameters were recorded and viewed in real time using a laptop computer. Data is stored at the KTE office for up to 2 years for future analysis and reference. A complete set of baseline readings was taken prior to each sounding to determine temperature shifts and any zero load offsets. Monitoring base line readings ensures that the cone electronics are operating properly.

4. CONE PENETRATION TEST DATA & INTERPRETATION

The Cone Penetration Test data is presented in graphical form in the attached Appendix. These plots were generated using the CPeT-IT program. Penetration depths are referenced to ground surface. The soil behavior type on the CPT plots is derived from the attached CPT SBT plot (Robertson, “Interpretation of Cone Penetration Test…”, 2009) and presents major soil lithologic changes. The stratigraphic interpretation is based on relationships between cone resistance (qc), sleeve friction (fs), and penetration pore pressure (u). The friction ratio (Rf), which is sleeve friction divided by cone resistance, is a calculated parameter that is used along with cone resistance to infer soil behavior type. Generally, cohesive soils (clays) have high friction ratios, low cone resistance and generate excess pore water pressures. Cohesionless soils (sands) have lower friction ratios, high cone bearing and generate little (or negative) excess pore water pressures.

The CPT data files have also been provided. These files can be imported in CPeT-IT (software by GeoLogismiki) and other programs to calculate various geotechnical parameters.

It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and u. In these situations, experience, judgement and an assessment of the pore pressure data should be used to infer the soil behavior type.

If you have any questions regarding this information, please do not hesitate to call our office at (714) 901-7270.

Sincerely,

KEHOE TESTING & ENGINEERING

Steven P. Kehoe
President

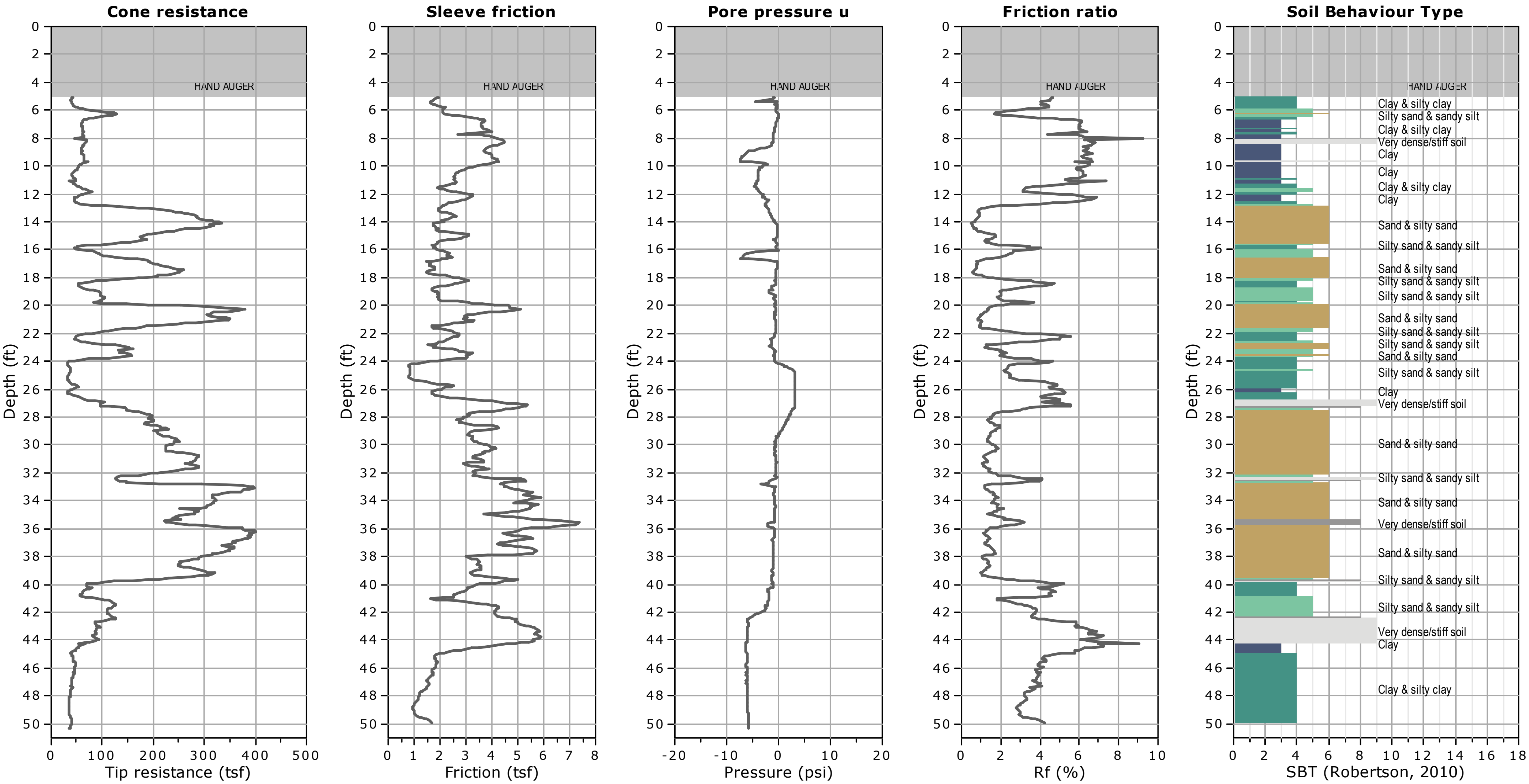
09/22/21-hh-3194

APPENDIX

Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: Leighton Consulting / Franklin Elementary School **CPT-1**

Location: Santa Monica, CA Total depth: 50.33 ft, Date: 9/16/2021



Kehoe Testing and Engineering
714-901-7270
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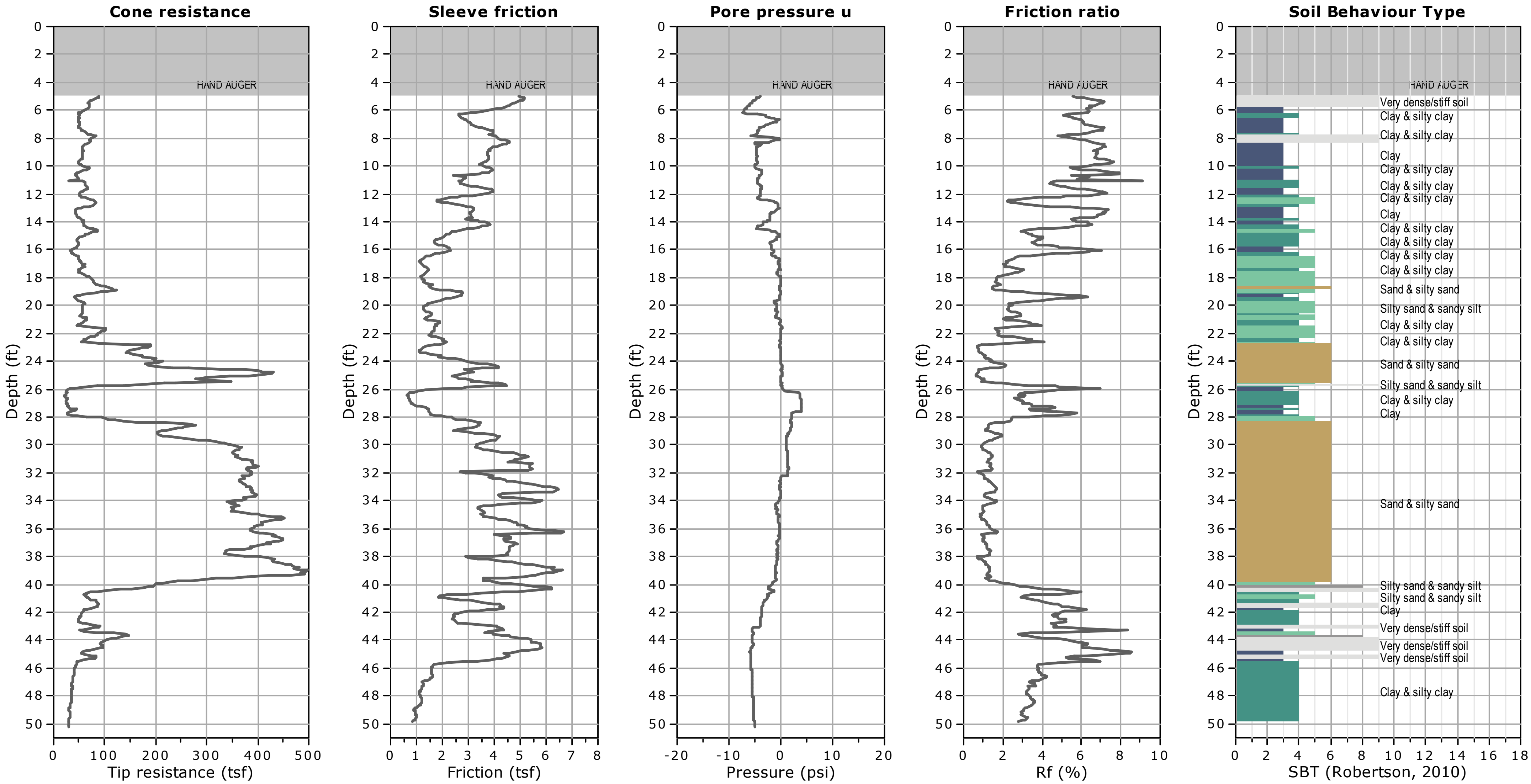
www.kehoetesting.com

Project: **Leighton Consulting / Franklin Elementary School**
Location: **Santa Monica, CA**

CPT-2
Total depth: 50.20 ft, Date: 9/16/2021



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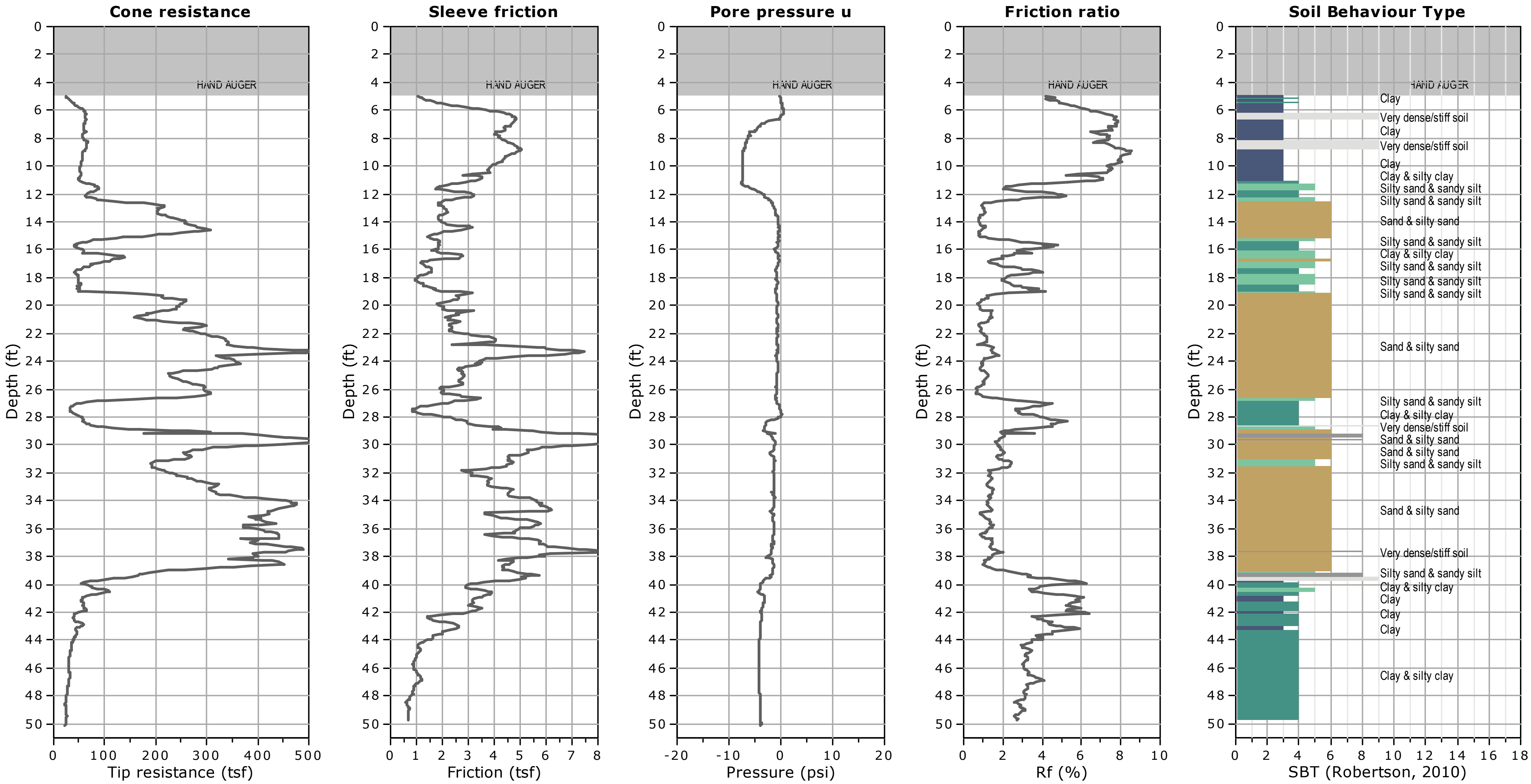
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **Leighton Consulting / Franklin Elementary School**
Location: **Santa Monica, CA**

CPT-3
Total depth: 50.16 ft, Date: 9/16/2021



Kehoe Testing and Engineering
714-901-7270
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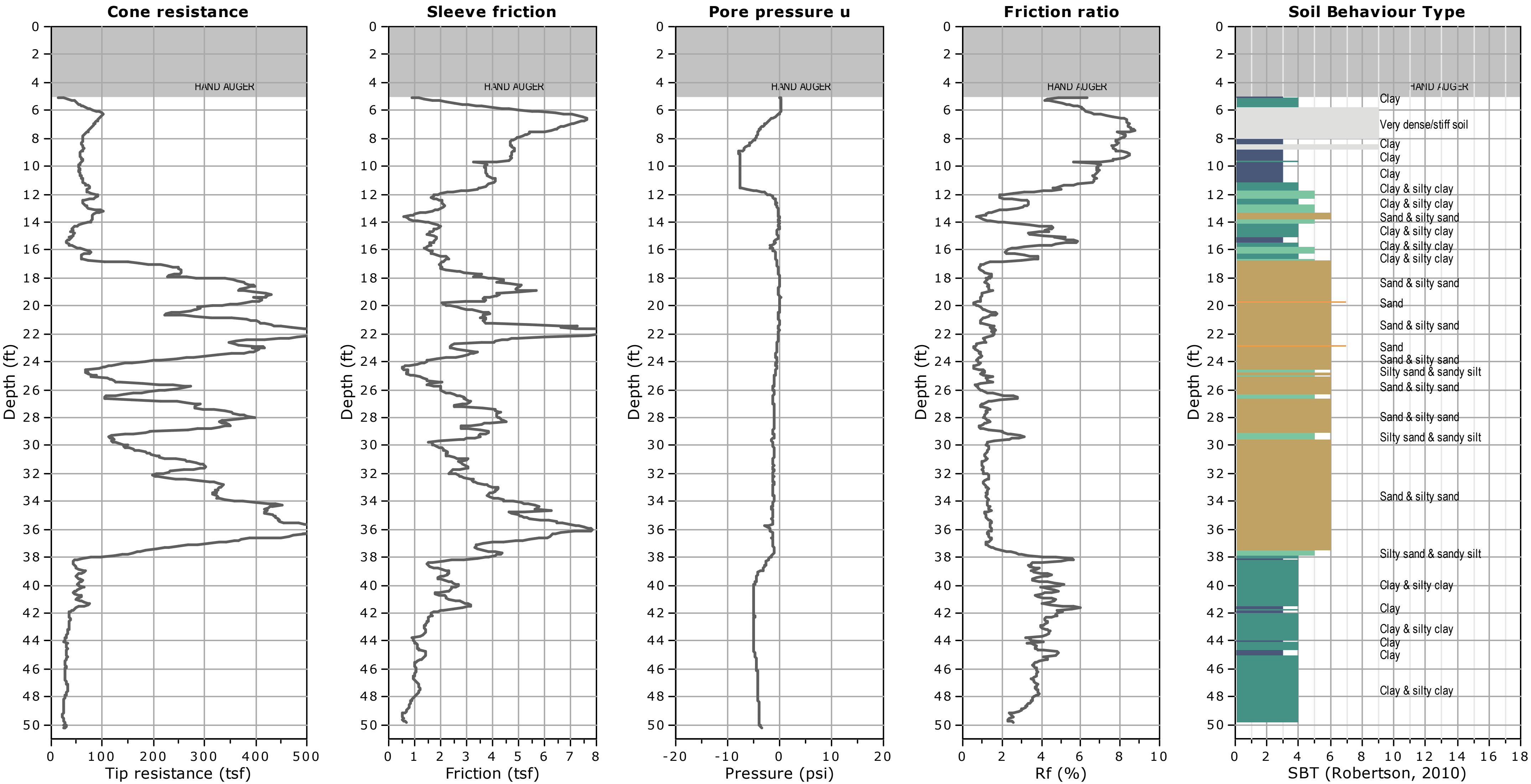
Project: **Leighton Consulting / Franklin Elementary School**
Location: **Santa Monica, CA**

CPT-4
Total depth: 50.26 ft, Date: 9/16/2021



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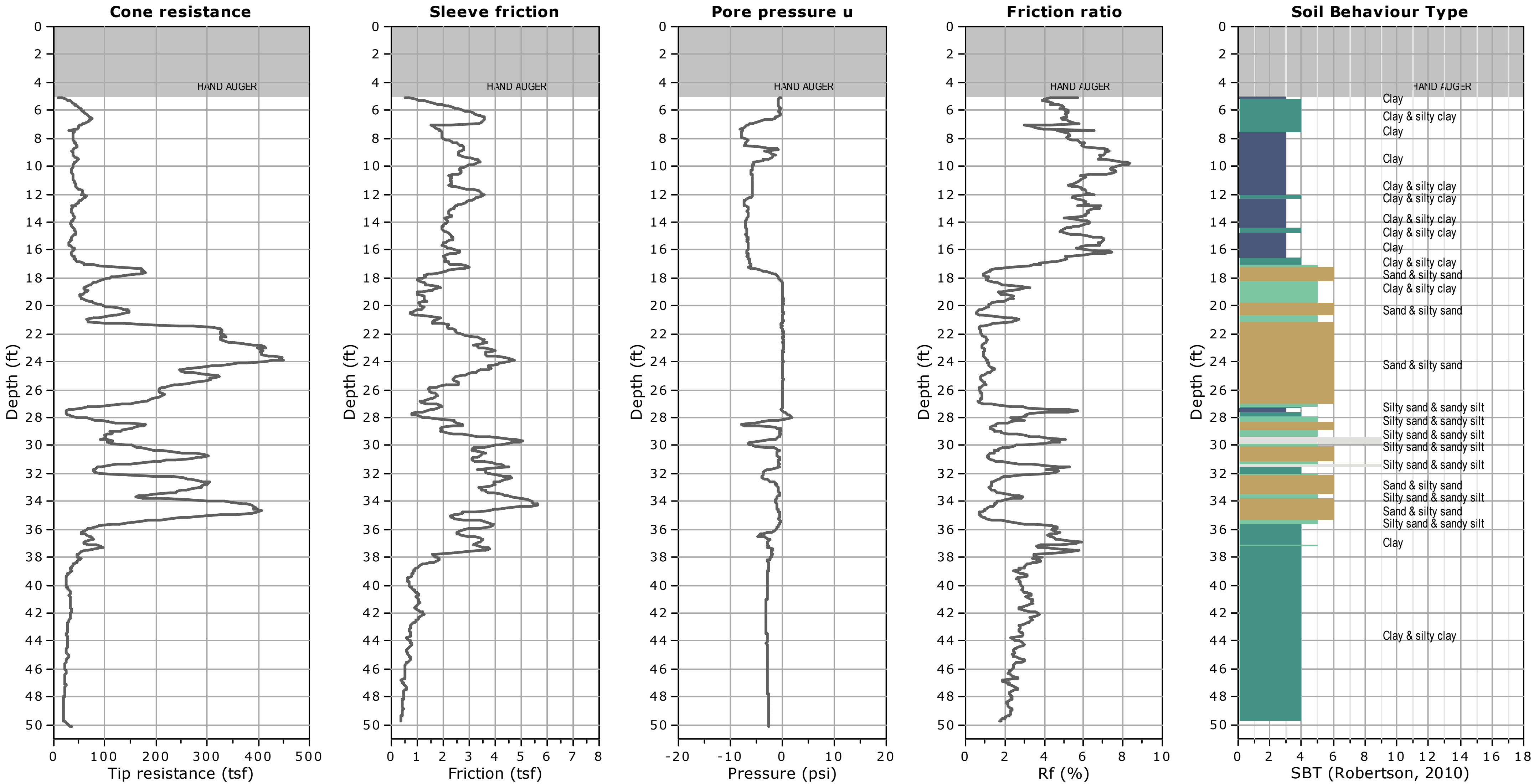
Project: Leighton Consulting / Franklin Elementary School **CPT-5**
Location: Santa Monica, CA Total depth: 50.15 ft, Date: 9/16/2021



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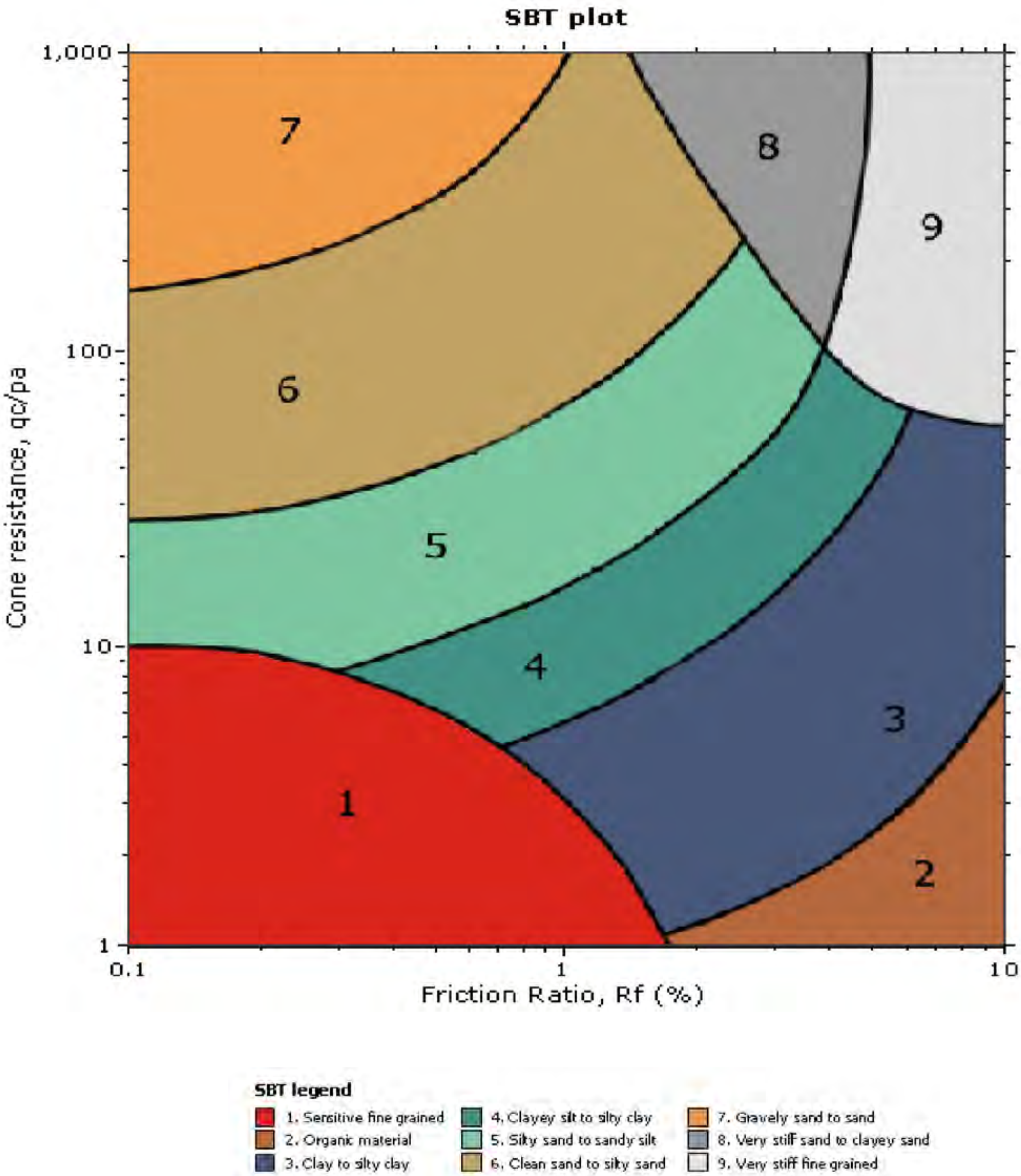


Leighton Consulting
Franklin Elementary School
Santa Monica, CA

CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
CPT-4	5.05	4.05	4.52	4.92	918	
	10.04	9.04	9.26	10.04	922	926
	15.03	14.03	14.17	14.12	1004	1204
	20.05	19.05	19.15	17.64	1086	1416
	25.03	24.03	24.11	21.40	1127	1319
	30.02	29.02	29.09	24.20	1202	1777
	35.04	34.04	34.10	27.20	1254	1670
	40.03	39.03	39.08	30.28	1291	1618
	45.05	44.05	44.10	34.80	1267	1109
	50.00	49.00	49.04	39.60	1238	1030

Shear Wave Source Offset - 2 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

APPENDIX B

Laboratory Test Results

APPENDIX B - GEOTECHNICAL LABORATORY TESTING

Our geotechnical laboratory testing program was directed toward a quantitative and qualitative evaluation of physical and mechanical properties of soils underlying this campus at proposed improvements, and to aid in verifying soil classification. This geotechnical testing was performed at our Irvine laboratory (DSA LEA 63).

Modified Proctor Compaction Curve: Laboratory modified Proctor compaction curves (ASTM D 1557) were established for bulk soil-samples to determine sample-specific modified Proctor laboratory maximum dry density and optimum moisture content. Results of these tests are presented on the following "*Modified Proctor Compaction Test*" sheets in this appendix.

Direct Shear Tests: Direct shear tests were performed, in general accordance with ASTM Test Method D 3080, on remolded soil samples remolded to 90% of the ASTM D 1557 laboratory maximum density. Remolded specimens were soaked for a minimum of 24 hours under a surcharge equal to the applied normal force during testing. After transfer of the sample to the shear box, and reloading the sample, pore pressures set up in the sample due to the transfer were allowed to dissipate for a period of approximately 1 hour prior to application of shearing force. These specimens were tested under various normal loads with a motor-driven, strain-controlled, direct-shear testing apparatus at a strain rate of 0.05 inches per minute (depending upon the soil type). Test results are presented on the *Direct Shear Test Results* sheets which follow in this appendix.

Consolidation: Consolidation tests on relatively undisturbed drive samples from our borings were performed in accordance with ASTM D 2435. Results are included in this appendix on the *One-Dimensional Consolidation Properties of Soils* sheets.

Corrosivity Tests: To evaluate corrosion potential of subsurface soils at the site, we tested a bulk sample collected during our subsurface exploration for pH, electrical resistivity (CTM 532/643), soluble sulfate content (CTM 417 Part II) and soluble chloride content (CTM 422) testing. Results of these tests are enclosed at the end of this appendix.

R-Value Tests: Selected samples were tested in accordance with DOT CA Test 301. The R-Value test measures the response of a compacted sample of soil or aggregate to a vertically applied pressure under specific conditions. This test is used by Caltrans for pavement design, replacing the California bearing ratio test. The R-value of a material is determined when the material is in a state of saturation such that water will be exuded from the compacted test specimen when a 16.8 kN load (2.07 MPa) is applied to test a series of specimens prepared at different moisture contents. R-Value is used in pavement design, with the thickness of each layer dependent on the R-value of the layer below and the expected level of traffic loading, expressed as a Traffic Index. Results of these tests are enclosed at the end of this appendix.

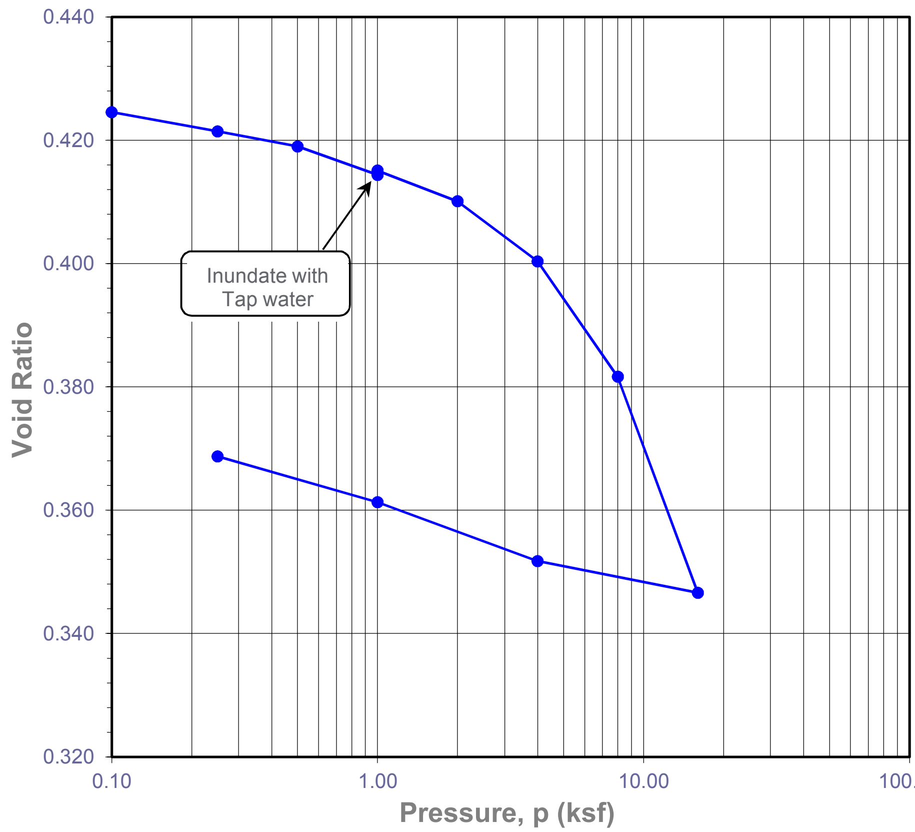
Expansion Tests: In accordance with ASTM D 4829 the specimen is compacted into a metal ring so that the degree of saturation is between 40 and 60 % and the specimen and the ring are placed in a consolidometer. A vertical confining pressure of 1 psi is applied to the specimen and then the specimen is inundated with distilled water. The deformation of the specimen is recorded for 24 hours or until the rate of deformation becomes less than 0.005 mm/hour. The Expansion Index, EI, is used to measure a basic index property of soil and therefore, the EI is comparable to other indices such as the liquid limit, plastic limit, and plasticity index of soils. Results of these tests are enclosed at the end of this appendix.

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Leighton

Project Name:	Franklin ES	Tested By: GB/YN	Date: 09/23/21
Project No.:	11428.035	Checked By: A. Santos	Date: 10/11/21
Boring No.:	LB-2	Depth (ft.): 0-5	
Sample No.:	BB-1	Sample Type:	90% Remold
Soil Identification:	Dark brown silty, clayey sand (SC-SM)		

Sample Diameter (in.)	2.415
Sample Thickness (in.)	1.000
Wt. of Sample + Ring (g)	200.13
Weight of Ring (g)	45.47
Height after consol. (in.)	0.9607
Before Test	
Wt.Wet Sample+Cont. (g)	204.08
Wt.of Dry Sample+Cont. (g)	193.09
Weight of Container (g)	67.00
Initial Moisture Content (%)	8.7
Initial Dry Density (pcf)	118.3
Initial Saturation (%)	55
Initial Vertical Reading (in.)	0.3310
After Test	
Wt.of Wet Sample+Cont. (g)	275.60
Wt. of Dry Sample+Cont. (g)	257.51
Weight of Container (g)	69.88
Final Moisture Content (%)	12.73
Final Dry Density (pcf)	123.1
Final Saturation (%)	93
Final Vertical Reading (in.)	0.2884
Specific Gravity (assumed)	2.70
Water Density (pcf)	62.43

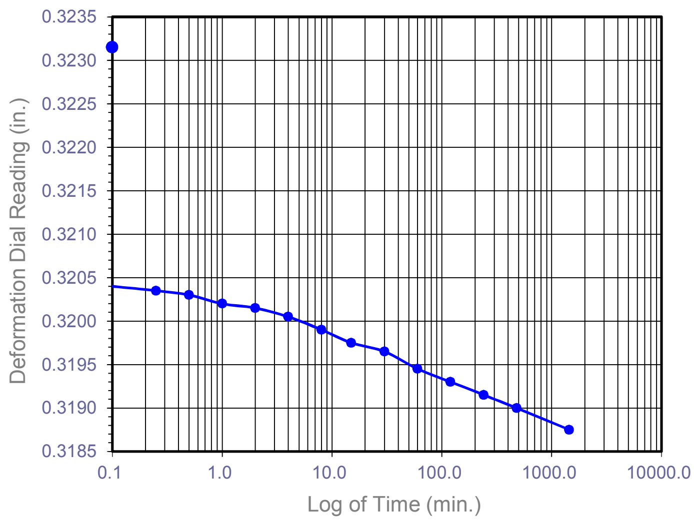


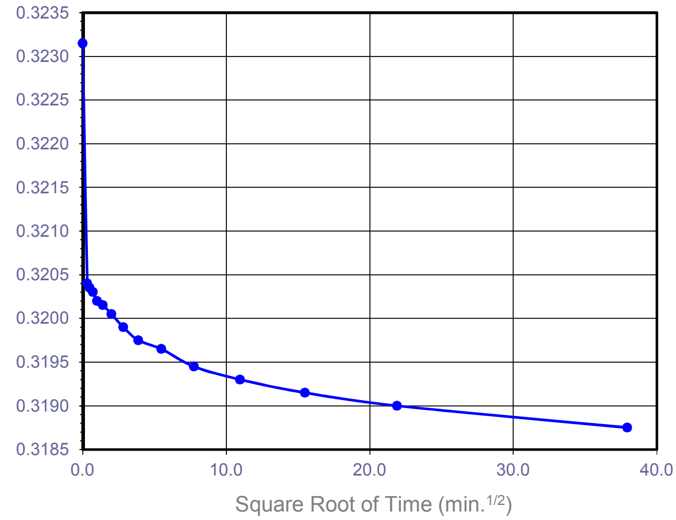
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deforma-tion (%)
0.10	0.3309	0.9999	0.00	0.01	0.425	0.01
0.25	0.3284	0.9974	0.03	0.26	0.421	0.23
0.50	0.3264	0.9954	0.06	0.46	0.419	0.40
1.00	0.3227	0.9917	0.11	0.84	0.414	0.73
1.00	0.3232	0.9922	0.11	0.79	0.415	0.68
2.00	0.3188	0.9878	0.20	1.23	0.410	1.03
4.00	0.3106	0.9796	0.33	2.04	0.400	1.71
8.00	0.2960	0.9650	0.48	3.50	0.382	3.02
16.00	0.2695	0.9385	0.67	6.15	0.347	5.48
4.00	0.2748	0.9438	0.50	5.62	0.352	5.12
1.00	0.2826	0.9516	0.39	4.84	0.361	4.45
0.25	0.2884	0.9574	0.33	4.26	0.369	3.93

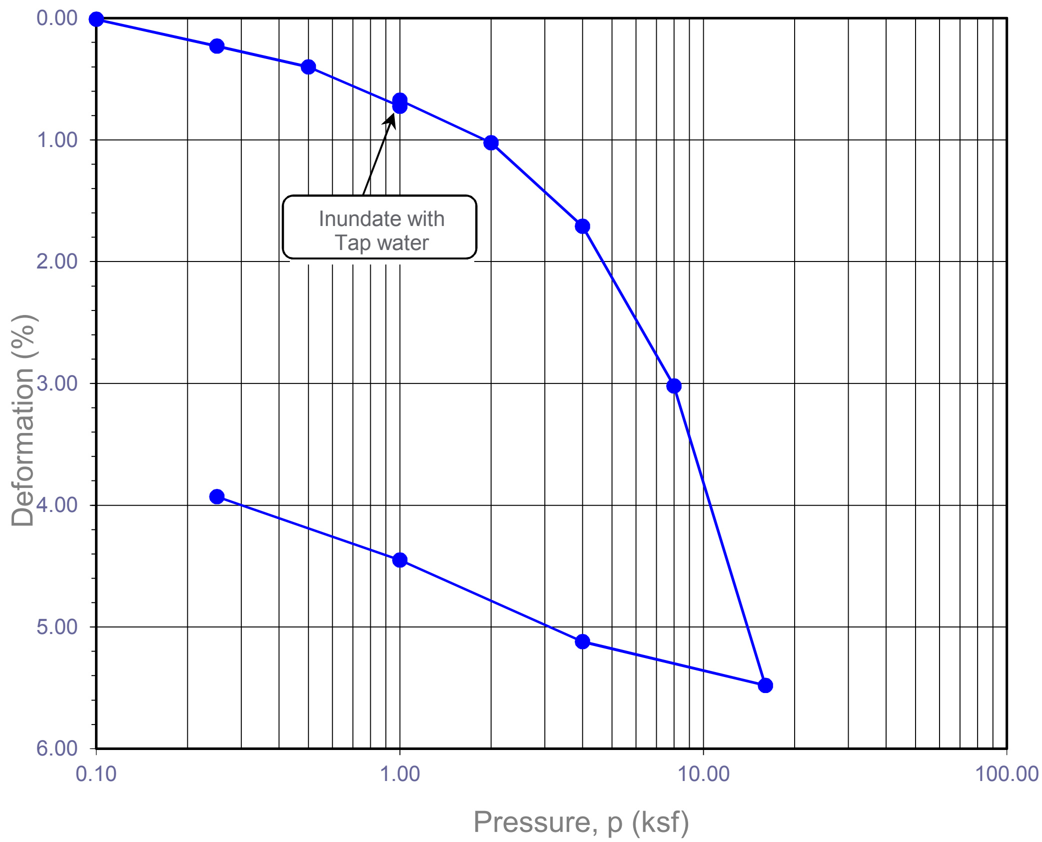
Time Readings @ 2 ksf

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)
9/27/21	11:15:00	0.0	0.0	0.3232
9/27/21	11:15:06	0.1	0.3	0.3204
9/27/21	11:15:15	0.2	0.5	0.3204
9/27/21	11:15:30	0.5	0.7	0.3203
9/27/21	11:16:00	1.0	1.0	0.3202
9/27/21	11:17:00	2.0	1.4	0.3202
9/27/21	11:19:00	4.0	2.0	0.3201
9/27/21	11:23:00	8.0	2.8	0.3199
9/27/21	11:30:00	15.0	3.9	0.3198
9/27/21	11:45:00	30.0	5.5	0.3197
9/27/21	12:15:00	60.0	7.7	0.3195
9/27/21	13:15:00	120.0	11.0	0.3193
9/27/21	15:15:00	240.0	15.5	0.3192
9/27/21	19:15:00	480.0	21.9	0.3190
9/28/21	11:15:00	1440.0	37.9	0.3188

Time Readings @ 2 ksf







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-2	**BB-1**	**0-5**	**8.7**	**12.7**	**118.3**	**123.1**	**0.425**	**0.369**	**55**	**93**

Soil Identification: Dark brown silty, clayey sand (SC-SM)

Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 11428.035

Franklin ES

10-21

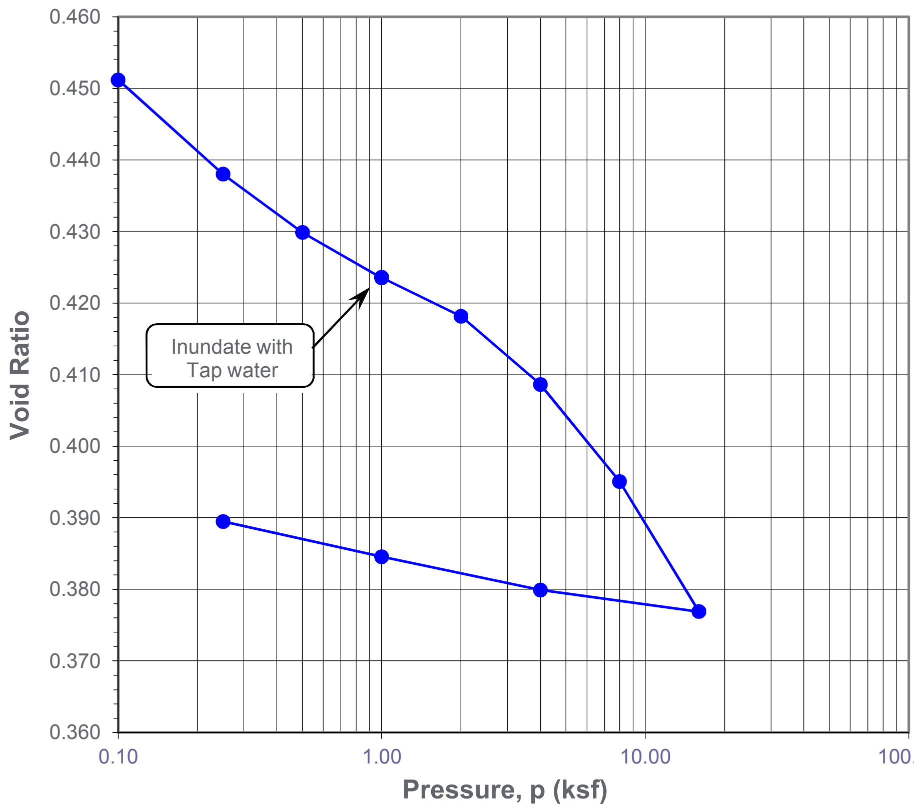
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Leighton

Project Name:	Franklin ES	Tested By: GB/YN	Date:	09/21/21
Project No.:	11428.035	Checked By: A. Santos	Date:	10/07/21
Boring No.:	LB-2	Depth (ft.): 5.0		
Sample No.:	R-1	Sample Type:	Ring	
Soil Identification:	Dark brown lean clay (CL)			

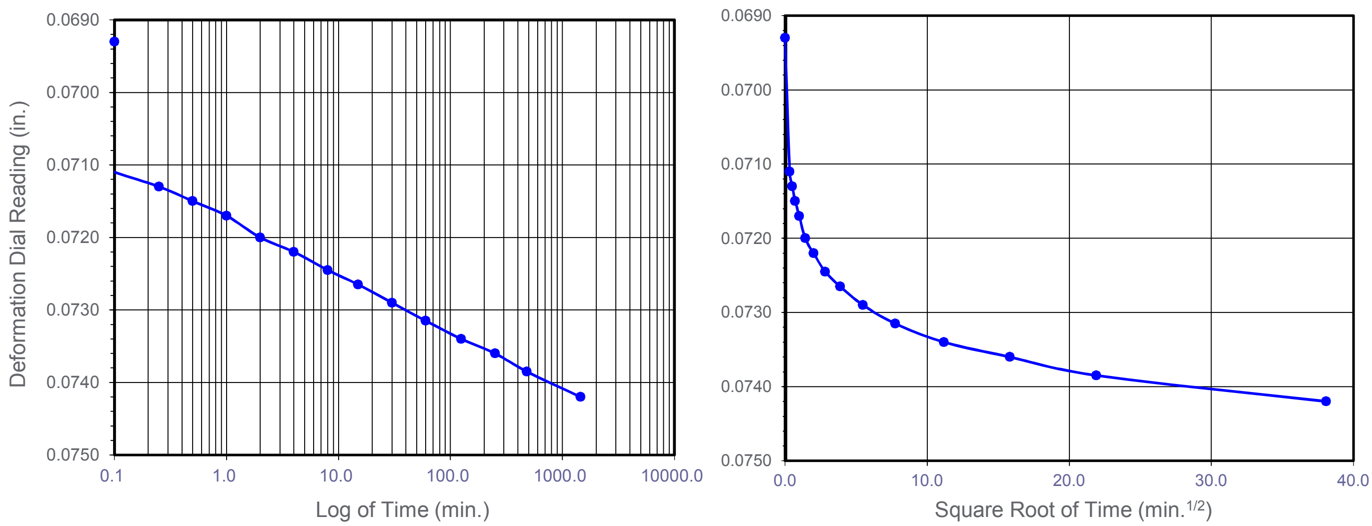
Sample Diameter (in.):	2.415
Sample Thickness (in.):	1.000
Weight of Sample + ring (g):	206.95
Weight of Ring (g):	45.74
Height after consol. (in.):	0.9551
Before Test	
Wt. of Wet Sample+Cont. (g):	177.55
Wt. of Dry Sample+Cont. (g):	161.52
Weight of Container (g):	56.66
Initial Moisture Content (%)	15.3
Initial Dry Density (pcf)	116.3
Initial Saturation (%):	91
Initial Vertical Reading (in.)	0.0455
After Test	
Wt. of Wet Sample+Cont. (g):	271.01
Wt. of Dry Sample+Cont. (g):	251.76
Weight of Container (g):	66.38
Final Moisture Content (%)	13.79
Final Dry Density (pcf):	121.6
Final Saturation (%):	95
Final Vertical Reading (in.)	0.0937
Specific Gravity (assumed):	2.71
Water Density (pcf):	62.43

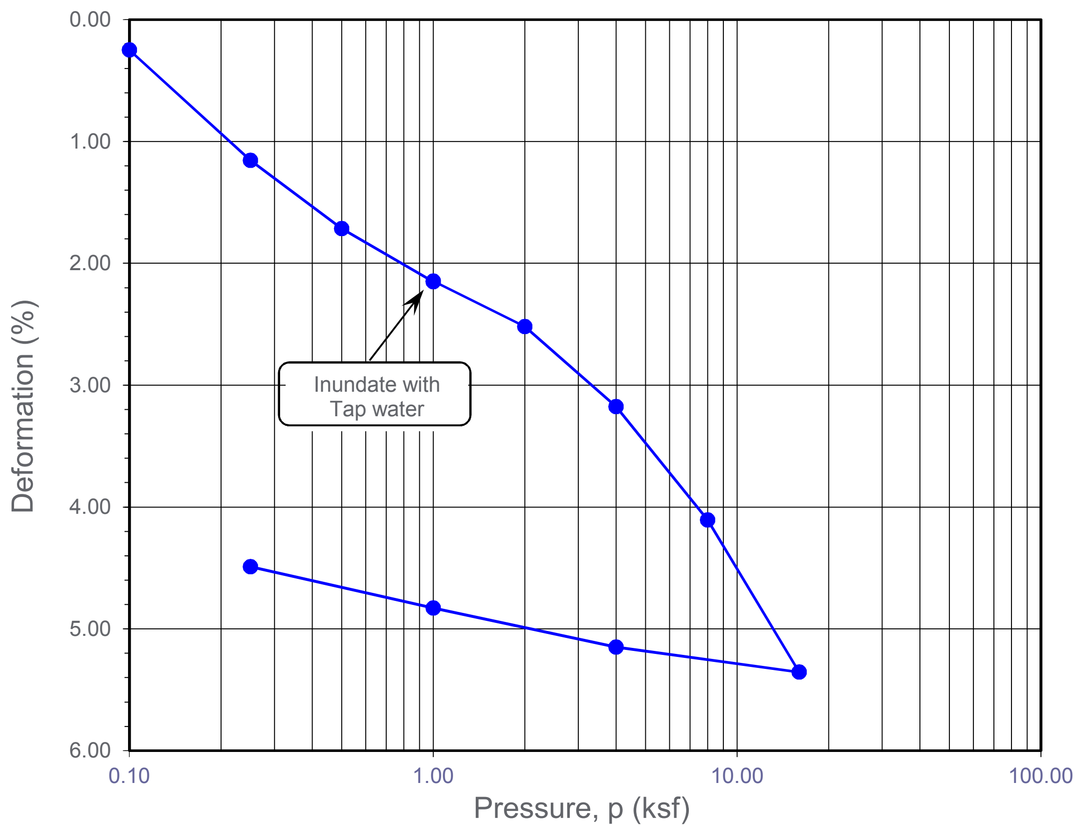


Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deforma-tion (%)
0.10	0.0480	0.9975	0.00	0.25	0.451	0.25
0.25	0.0577	0.9879	0.06	1.22	0.438	1.16
0.50	0.0640	0.9816	0.13	1.85	0.430	1.72
1.00	0.0693	0.9762	0.23	2.38	0.424	2.15
1.00	0.0693	0.9763	0.23	2.38	0.424	2.15
2.00	0.0742	0.9713	0.35	2.87	0.418	2.52
4.00	0.0821	0.9635	0.48	3.66	0.409	3.18
8.00	0.0928	0.9528	0.62	4.73	0.395	4.11
16.00	0.1067	0.9389	0.76	6.12	0.377	5.36
4.00	0.1031	0.9424	0.61	5.76	0.380	5.15
1.00	0.0983	0.9472	0.45	5.28	0.385	4.83
0.25	0.0937	0.9518	0.33	4.82	0.389	4.49

Time Readings @ 2.0 ksf				
Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)
9/23/21	10:35:00	0.0	0.0	0.0693
9/23/21	10:35:06	0.1	0.3	0.0711
9/23/21	10:35:15	0.2	0.5	0.0713
9/23/21	10:35:30	0.5	0.7	0.0715
9/23/21	10:36:00	1.0	1.0	0.0717
9/23/21	10:37:00	2.0	1.4	0.0720
9/23/21	10:39:00	4.0	2.0	0.0722
9/23/21	10:43:00	8.0	2.8	0.0725
9/23/21	10:50:00	15.0	3.9	0.0727
9/23/21	11:05:00	30.0	5.5	0.0729
9/23/21	11:35:00	60.0	7.7	0.0732
9/23/21	12:40:00	125.0	11.2	0.0734
9/23/21	14:45:00	250.0	15.8	0.0736
9/23/21	18:35:00	480.0	21.9	0.0739
9/24/21	10:45:00	1450.0	38.1	0.0742

Time Readings @ 2.0 ksf





Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-2	**R-1**	**5**	**15.3**	**13.8**	**116.3**	**121.6**	**0.455**	**0.389**	**91**	**95**

Soil Identification: Dark brown lean clay (CL)

Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 11428.035

Franklin ES

10-21

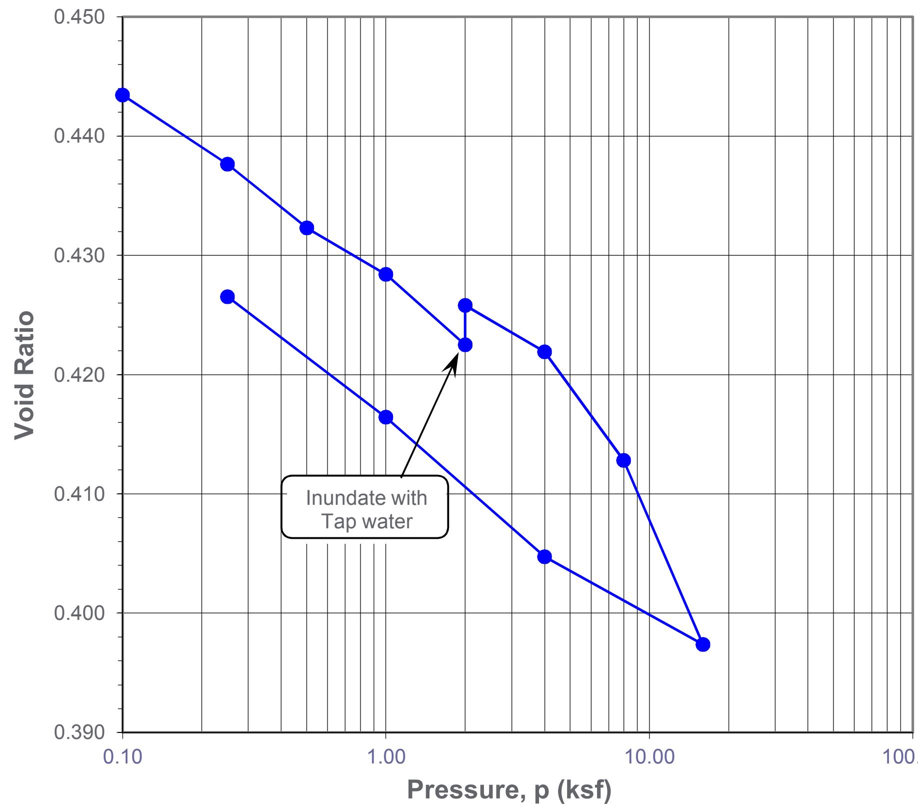
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Leighton

Project Name:	Franklin ES	Tested By: GB/YN	Date: 09/23/21
Project No.:	11428.035	Checked By: A. Santos	Date: 10/07/21
Boring No.:	LB-2	Depth (ft.): 7.5	
Sample No.:	R-2	Sample Type:	Ring
Soil Identification:	Light olive brown lean clay (CL)		

Sample Diameter (in.):	2.415
Sample Thickness (in.):	1.000
Weight of Sample + ring (g):	207.54
Weight of Ring (g):	45.84
Height after consol. (in.):	0.9879
Before Test	
Wt. of Wet Sample+Cont. (g):	219.35
Wt. of Dry Sample+Cont. (g):	201.12
Weight of Container (g):	77.77
Initial Moisture Content (%)	14.8
Initial Dry Density (pcf)	117.2
Initial Saturation (%):	90
Initial Vertical Reading (in.)	0.1104
After Test	
Wt. of Wet Sample+Cont. (g):	265.68
Wt. of Dry Sample+Cont. (g):	243.22
Weight of Container (g):	57.23
Final Moisture Content (%)	16.03
Final Dry Density (pcf):	118.0
Final Saturation (%):	100
Final Vertical Reading (in.)	0.1236
Specific Gravity (assumed):	2.71
Water Density (pcf):	62.43

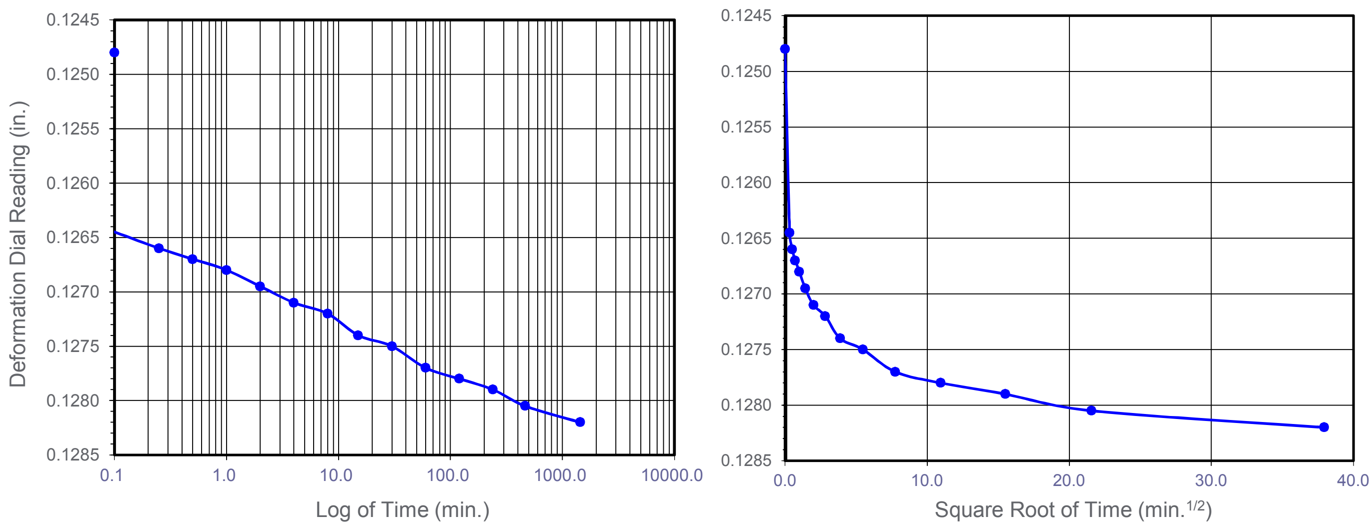


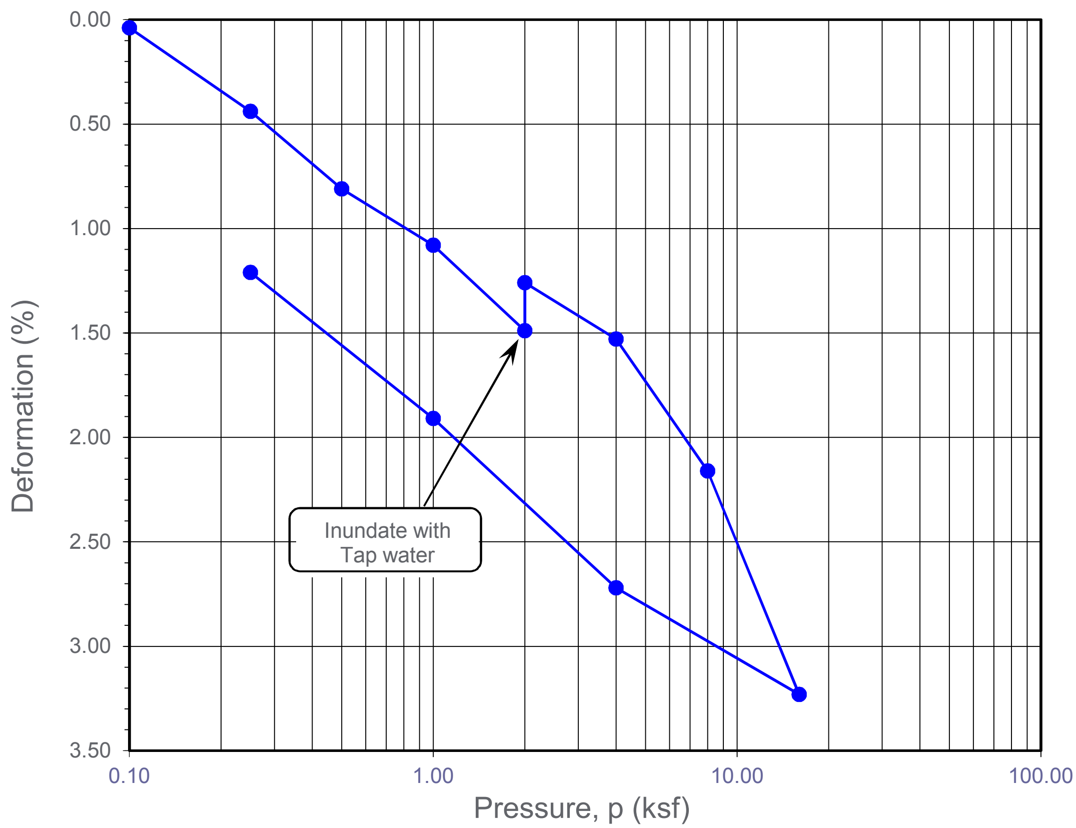
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.1108	0.9996	0.00	0.04	0.443	0.04
0.25	0.1151	0.9953	0.03	0.47	0.438	0.44
0.50	0.1192	0.9912	0.07	0.88	0.432	0.81
1.00	0.1224	0.9880	0.12	1.20	0.428	1.08
2.00	0.1271	0.9833	0.18	1.67	0.422	1.49
2.00	0.1248	0.9856	0.18	1.44	0.426	1.26
4.00	0.1282	0.9822	0.25	1.78	0.422	1.53
8.00	0.1354	0.9750	0.34	2.50	0.413	2.16
16.00	0.1474	0.9630	0.47	3.70	0.397	3.23
4.00	0.1409	0.9695	0.33	3.05	0.405	2.72
1.00	0.1317	0.9787	0.22	2.13	0.416	1.91
0.25	0.1236	0.9868	0.11	1.32	0.427	1.21

Time Readings @ 4.0 ksf

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)
9/27/21	11:30:00	0.0	0.0	0.1248
9/27/21	11:30:06	0.1	0.3	0.1265
9/27/21	11:30:15	0.2	0.5	0.1266
9/27/21	11:30:30	0.5	0.7	0.1267
9/27/21	11:31:00	1.0	1.0	0.1268
9/27/21	11:32:00	2.0	1.4	0.1270
9/27/21	11:34:00	4.0	2.0	0.1271
9/27/21	11:38:00	8.0	2.8	0.1272
9/27/21	11:45:00	15.0	3.9	0.1274
9/27/21	12:00:00	30.0	5.5	0.1275
9/27/21	12:30:00	60.0	7.7	0.1277
9/27/21	13:30:00	120.0	11.0	0.1278
9/27/21	15:30:00	240.0	15.5	0.1279
9/27/21	19:15:00	465.0	21.6	0.1281
9/28/21	11:30:00	1440.0	37.9	0.1282

Time Readings @ 4.0 ksf





Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-2	**R-2**	**7.5**	**14.8**	**16.0**	**117.2**	**118.0**	**0.444**	**0.427**	**90**	**100**

Soil Identification: Light olive brown lean clay (CL)

Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 11428.035

Franklin ES

10-21

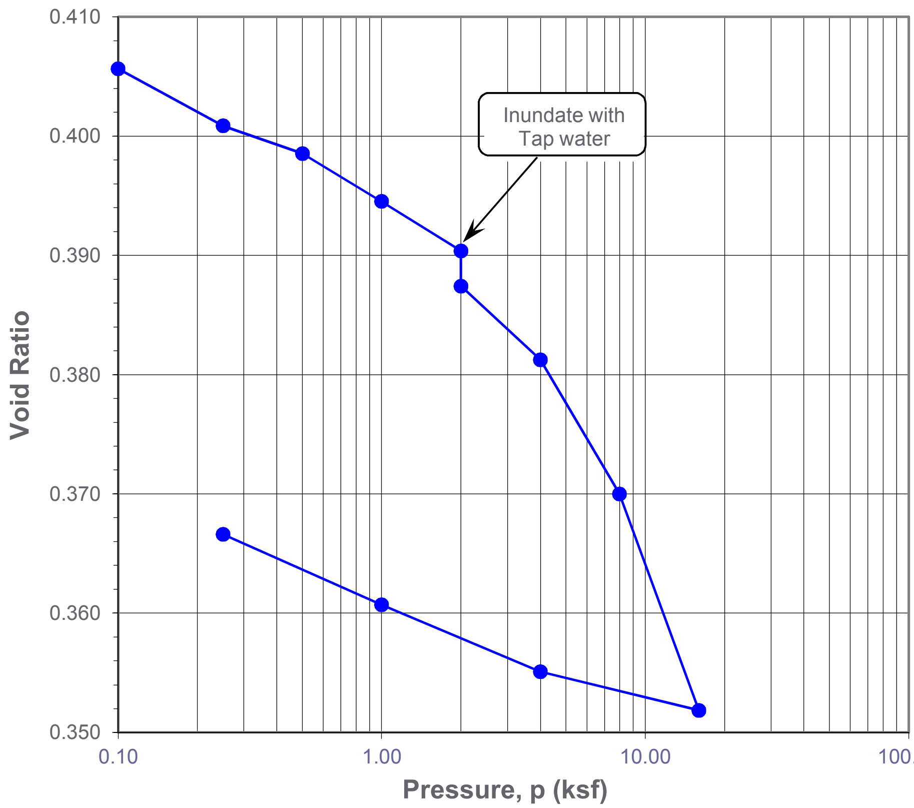
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Leighton

Project Name:	Franklin ES	Tested By: GB/YN	Date: 09/21/21
Project No.:	11428.035	Checked By: A. Santos	Date: 10/07/21
Boring No.:	LB-2	Depth (ft.): 10.0	
Sample No.:	R-3	Sample Type:	Ring
Soil Identification:	Dark yellowish brown clayey sand with gravel (SC)g		

Sample Diameter (in.):	2.415
Sample Thickness (in.):	1.000
Weight of Sample + ring (g):	204.98
Weight of Ring (g):	45.14
Height after consol. (in.):	0.9720
Before Test	
Wt. of Wet Sample+Cont. (g):	180.82
Wt. of Dry Sample+Cont. (g):	169.13
Weight of Container (g):	57.49
Initial Moisture Content (%)	10.5
Initial Dry Density (pcf)	120.3
Initial Saturation (%):	70
Initial Vertical Reading (in.)	0.0934
After Test	
Wt. of Wet Sample+Cont. (g):	274.98
Wt. of Dry Sample+Cont. (g):	256.63
Weight of Container (g):	68.15
Final Moisture Content (%)	12.80
Final Dry Density (pcf):	122.6
Final Saturation (%):	91
Final Vertical Reading (in.)	0.1232
Specific Gravity (assumed):	2.71
Water Density (pcf):	62.43

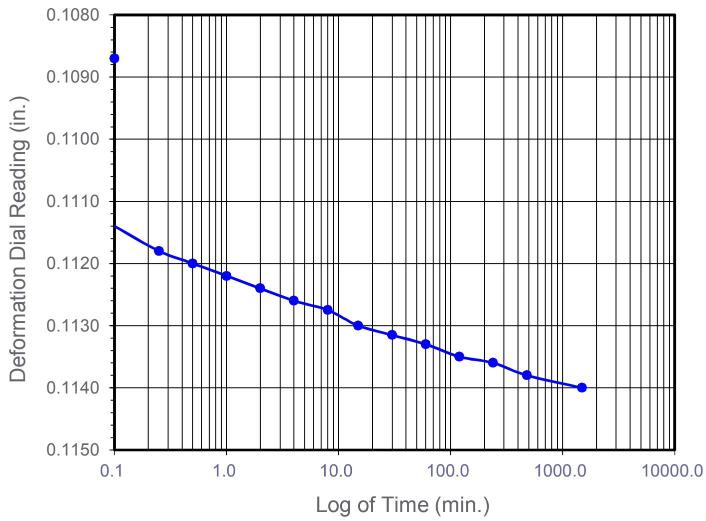


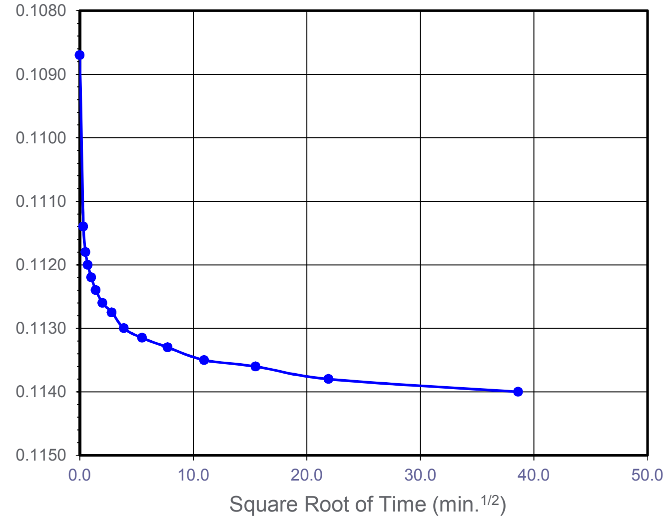
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.0937	0.9998	0.00	0.02	0.406	0.02
0.25	0.0974	0.9961	0.03	0.40	0.401	0.37
0.50	0.0995	0.9939	0.08	0.61	0.399	0.53
1.00	0.1031	0.9904	0.15	0.97	0.395	0.82
2.00	0.1066	0.9868	0.21	1.32	0.390	1.11
2.00	0.1087	0.9847	0.21	1.53	0.387	1.32
4.00	0.1140	0.9794	0.30	2.06	0.381	1.76
8.00	0.1230	0.9704	0.40	2.96	0.370	2.56
16.00	0.1372	0.9562	0.53	4.38	0.352	3.85
4.00	0.1335	0.9599	0.39	4.01	0.355	3.62
1.00	0.1284	0.9650	0.28	3.50	0.361	3.22
0.25	0.1232	0.9702	0.18	2.98	0.367	2.80

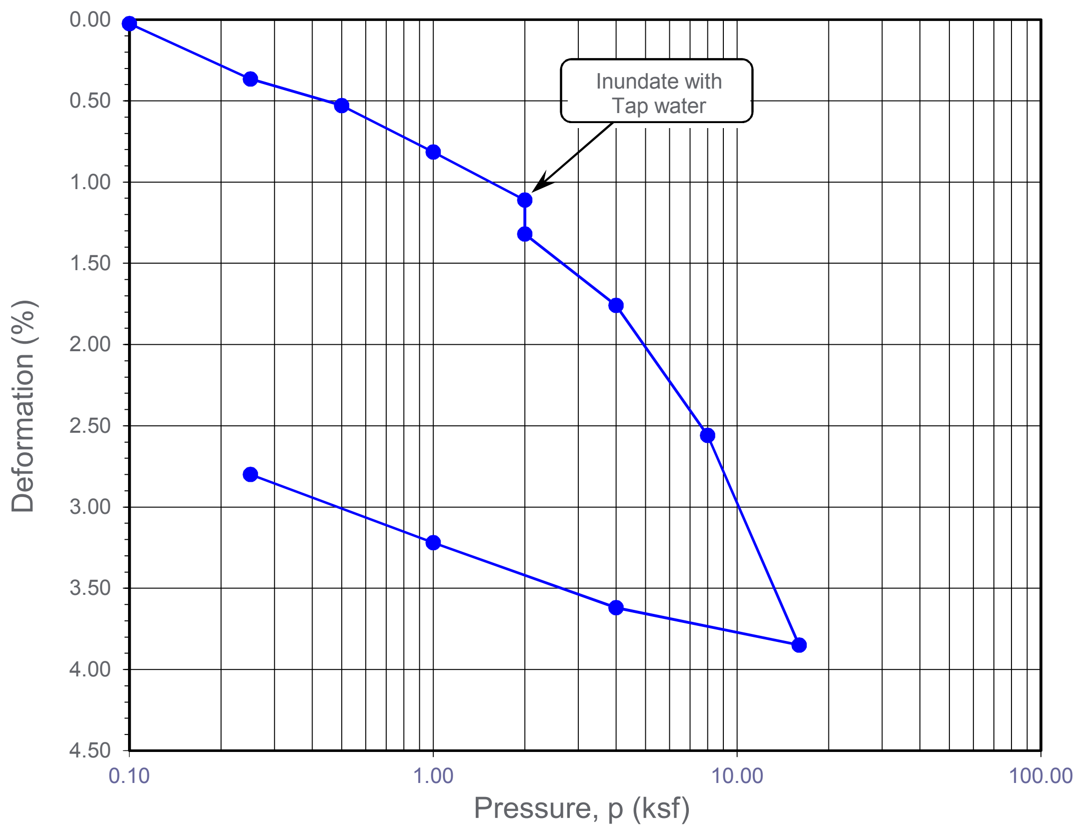
Time Readings @ 4.0 ksf

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)
9/24/21	7:50:00	0.0	0.0	0.1087
9/24/21	7:50:06	0.1	0.3	0.1114
9/24/21	7:50:15	0.2	0.5	0.1118
9/24/21	7:50:30	0.5	0.7	0.1120
9/24/21	7:51:00	1.0	1.0	0.1122
9/24/21	7:52:00	2.0	1.4	0.1124
9/24/21	7:54:00	4.0	2.0	0.1126
9/24/21	7:58:00	8.0	2.8	0.1128
9/24/21	8:05:00	15.0	3.9	0.1130
9/24/21	8:20:00	30.0	5.5	0.1132
9/24/21	8:50:00	60.0	7.7	0.1133
9/24/21	9:50:00	120.0	11.0	0.1135
9/24/21	11:50:00	240.0	15.5	0.1136
9/24/21	15:50:00	480.0	21.9	0.1138
9/25/21	8:40:00	1490.0	38.6	0.1140

Time Readings @ 4.0 ksf







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-2	**R-3**	**10**	**10.5**	**12.8**	**120.3**	**122.6**	**0.406**	**0.367**	**70**	**91**

Soil Identification: Dark yellowish brown clayey sand with gravel (SC)g

Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 11428.035

Franklin ES

10-21

Leighton

TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: Franklin ES   Tested By : O. Figueroa   Date: 09/23/21

Project No. : 11428.035   Checked By: A. Santos   Date: 10/11/21

Boring No.	LB-2			
Sample No.	BB-1			
Sample Depth (ft)	0-5			
Soil Identification:	Dark brown (SC-SM)			
Wet Weight of Soil + Container (g)	0.00			
Dry Weight of Soil + Container (g)	0.00			
Weight of Container (g)	1.00			
Moisture Content (%)	0.00			
Weight of Soaked Soil (g)	100.40			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	0			
Crucible No.	12			
Furnace Temperature (°C)	860			
Time In / Time Out	9:45/10:30			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	20.7528			
Wt. of Crucible (g)	20.7485			
Wt. of Residue (g) (A)	0.0043			
PPM of Sulfate (A) x 41150	176.95			
PPM of Sulfate, Dry Weight Basis	**177**			

CHLORIDE CONTENT, DOT California Test 422

ml of Extract For Titration (B)	30			
ml of AgNO3 Soln. Used in Titration (C)	0.8			
PPM of Chloride (C -0.2) * 100 * 30 / B	60			
PPM of Chloride, Dry Wt. Basis	**60**			

pH TEST, DOT California Test 643

pH Value	**8.04**			
Temperature °C	20.8			

SOIL RESISTIVITY TEST
DOT CA TEST 643

Project Name:	Franklin ES	Tested By :	A. Willoughby Date: 09/27/21
Project No. :	11428.035	Checked By:	A. Santos Date: 10/11/21
Boring No.:	LB-2	Depth (ft.) :	0-5
Sample No. :	BB-1		

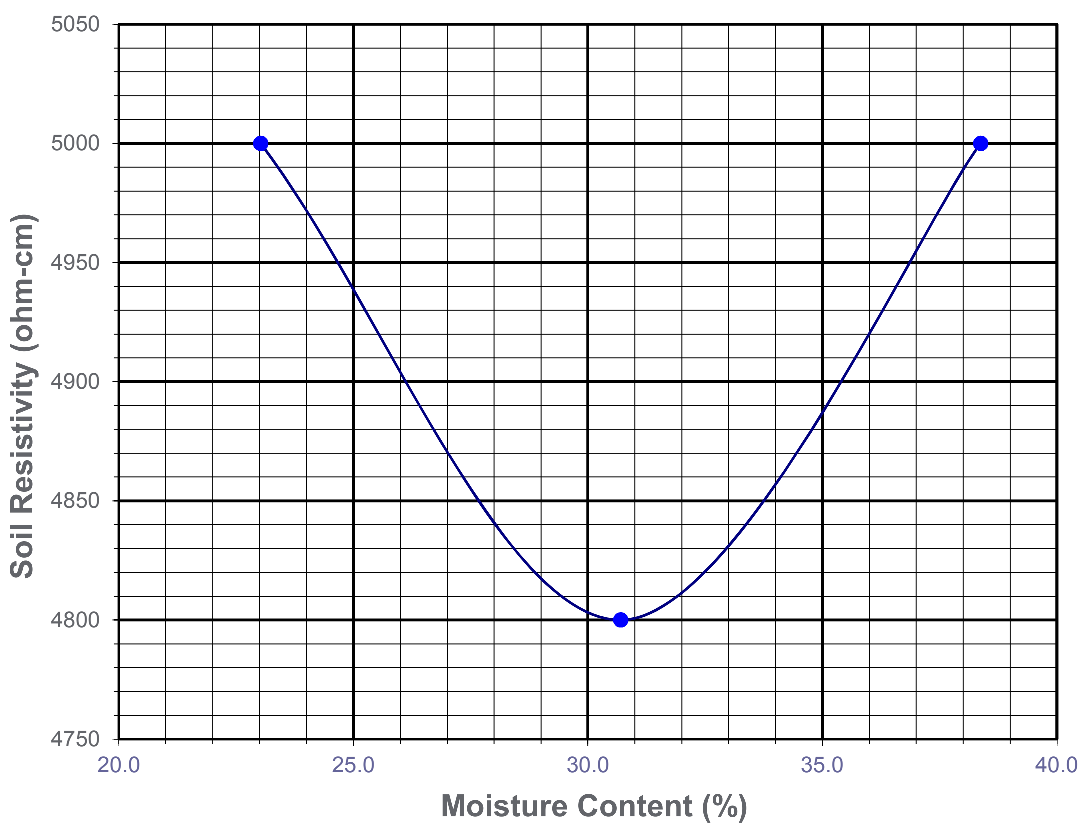
Soil Identification:* Dark brown (SC-SM)

*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	30	23.02	5000	5000
2	40	30.70	4800	4800
3	50	38.37	5000	5000
4				
5				

Moisture Content (%) (MCi)	0.00
Wet Wt. of Soil + Cont. (g)	0.00
Dry Wt. of Soil + Cont. (g)	0.00
Wt. of Container (g)	1.00
Container No.	
Initial Soil Wt. (g) (Wt)	130.30
Box Constant	1.000
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 643	
4800	**30.7**	**177**	**60**	**8.04**	**20.8**



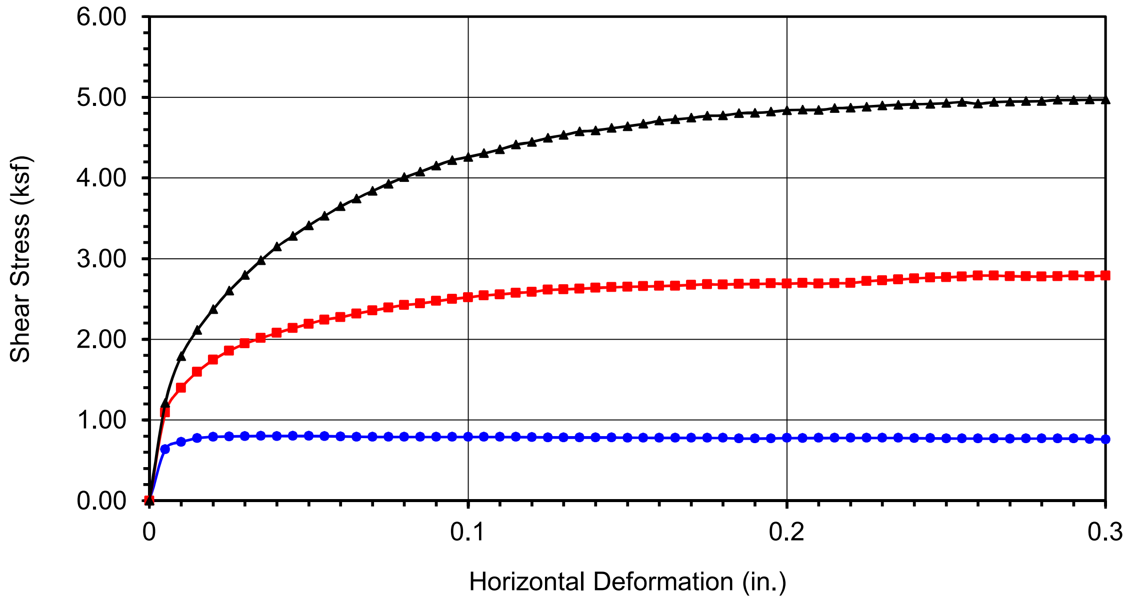
Leighton

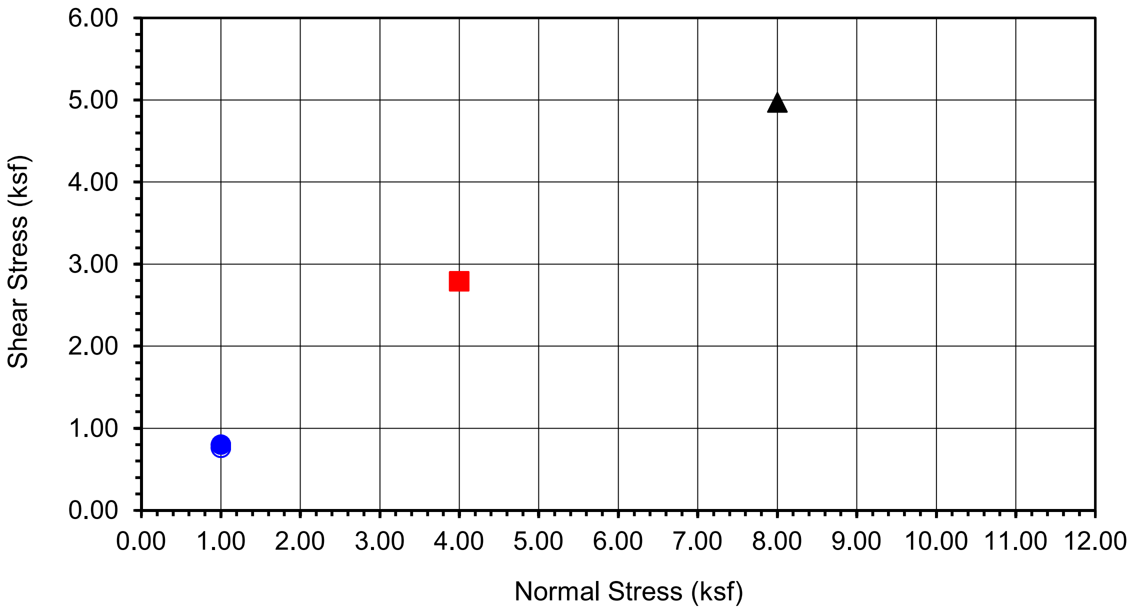
DIRECT SHEAR TEST

Consolidated Drained - ASTM D 3080

Project Name: Franklin ES
Tested By: G. Bathala
Date: 10/04/21
Project No.: 11428.035
Checked By: A. Santos
Date: 10/11/21
Boring No.: LB-2
Sample Type: 90% Remold
Sample No.: BB-1
Depth (ft.): 0-5
Soil Identification: Dark brown silty, clayey sand (SC-SM)

Sample Diameter(in):	2.415	2.415	2.415
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	200.44	199.89	200.77
Weight of Ring(gm):	45.61	44.90	45.37
Before Shearing			
Weight of Wet Sample+Cont.(gm):	204.08	204.08	204.08
Weight of Dry Sample+Cont.(gm):	193.09	193.09	193.09
Weight of Container(gm):	67.00	67.00	67.00
Vertical Rdg.(in): Initial	0.2658	0.2500	0.0000
Vertical Rdg.(in): Final	0.2719	0.2686	-0.0317
After Shearing			
Weight of Wet Sample+Cont.(gm):	217.40	214.87	234.96
Weight of Dry Sample+Cont.(gm):	198.38	197.44	218.37
Weight of Container(gm):	57.76	57.24	77.77
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43





Boring No.	**LB-2**
Sample No.	**BB-1**
Depth (ft)	**0-5**

Sample Type:

90% Remold

Soil Identification:
Dark brown silty, clayey sand (SC-SM)

Normal Stress (kip/ft²)	1.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 0.802	■ 2.789	▲ 4.970
Shear Stress @ End of Test (ksf)	○ 0.761	□ 2.789	△ 4.970
Deformation Rate (in./min.)	0.0025	0.0025	0.0025
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	8.72	8.72	8.72
Dry Density (pcf)	118.4	118.6	118.9
Saturation (%)	55.6	55.8	56.3
Soil Height Before Shearing (in.)	0.9939	0.9814	0.9683
Final Moisture Content (%)	13.5	12.4	11.8

Leighton

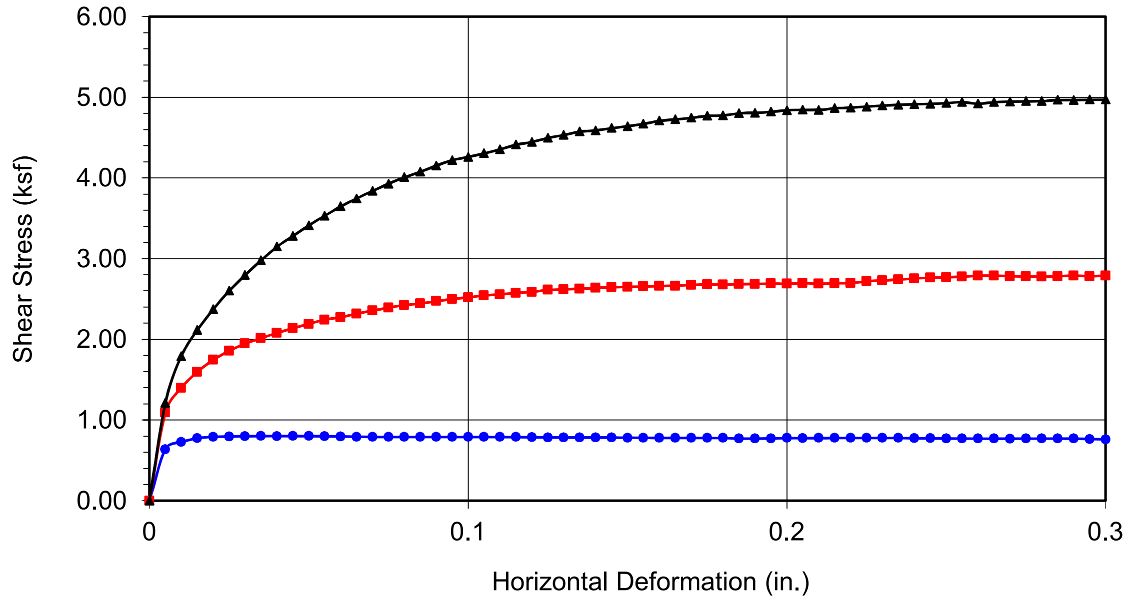
DIRECT SHEAR TEST RESULTS

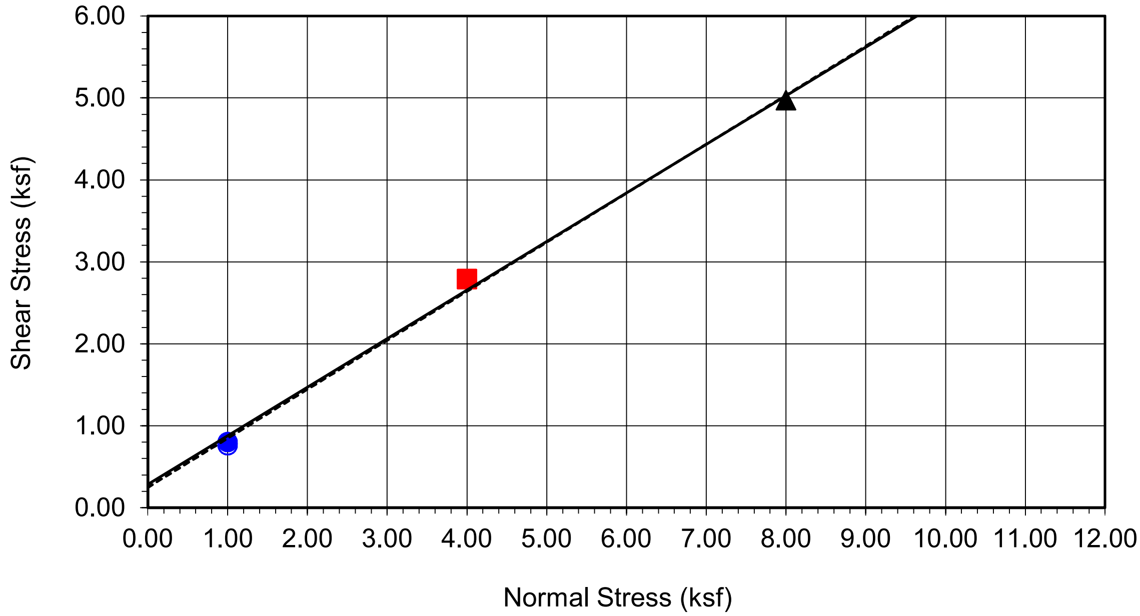
Consolidated Drained - ASTM D 3080

Project No.: 11428.035

Franklin ES

10-21





Boring No.	**LB-2**
Sample No.	**BB-1**
Depth (ft)	**0-5**
Sample Type:	90% Remold

Soil Identification:
Dark brown silty, clayey sand (SC-SM)

Strength Parameters

	C (psf)	ϕ (°)
Peak	285	31
Ultimate	248	31

Normal Stress (kip/ft²)	1.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 0.802	■ 2.789	▲ 4.970
Shear Stress @ End of Test (ksf)	○ 0.761	□ 2.789	△ 4.970
Deformation Rate (in./min.)	0.0025	0.0025	0.0025
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	8.72	8.72	8.72
Dry Density (pcf)	118.4	118.6	118.9
Saturation (%)	55.6	55.8	56.3
Soil Height Before Shearing (in.)	0.9939	0.9814	0.9683
Final Moisture Content (%)	13.5	12.4	11.8

Leighton

DIRECT SHEAR TEST RESULTS
Consolidated Drained - ASTM D 3080

Project No.: 11428.035

Franklin ES

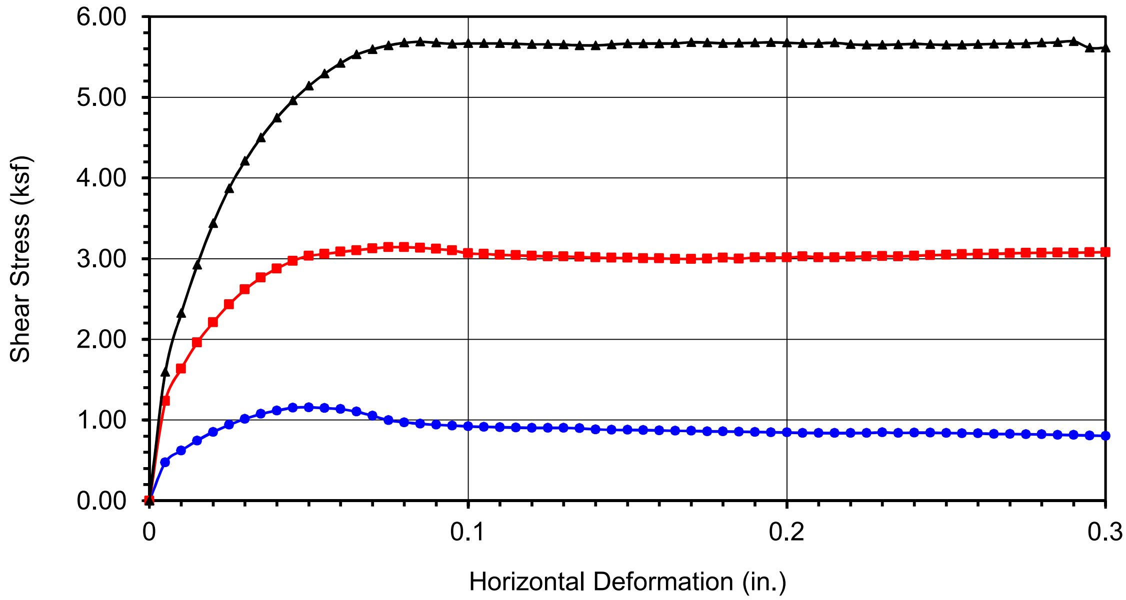
10-21

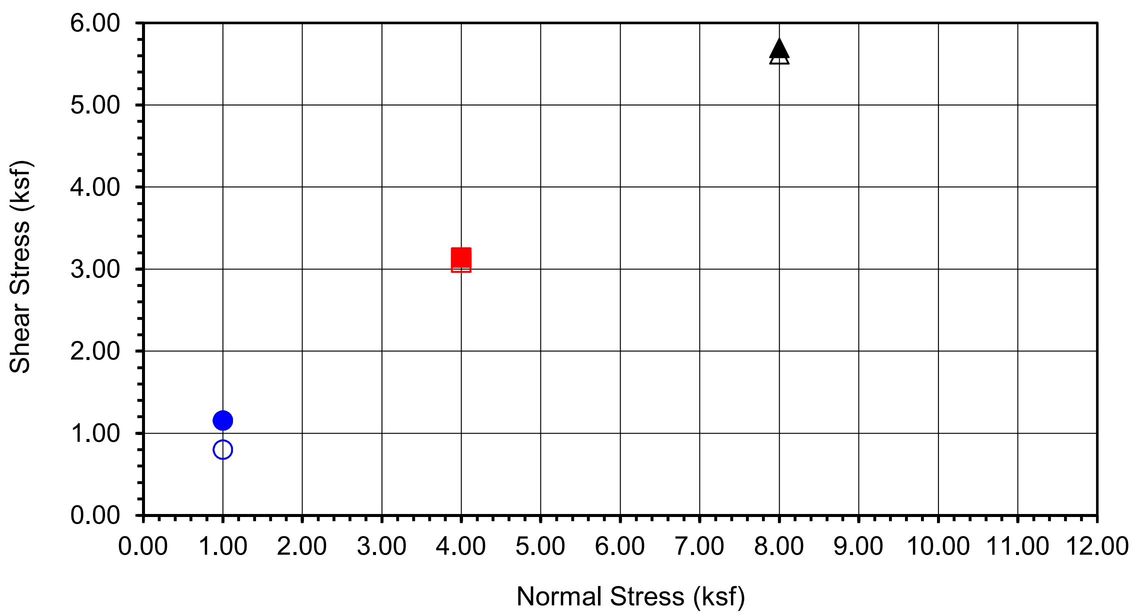
DIRECT SHEAR TEST

Consolidated Drained - ASTM D 3080

Project Name:	Franklin ES	Tested By:	G. Bathala	Date:	09/28/21
Project No.:	11428.035	Checked By:	A. Santos	Date:	10/11/21
Boring No.:	LB-2	Sample Type:	Ring		
Sample No.:	R-1	Depth (ft.):	5.0		
Soil Identification:	Dark brown lean clay (CL)				

Sample Diameter(in):	2.415	2.415	2.415
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	208.27	207.96	208.82
Weight of Ring(gm):	43.65	43.20	43.96
Before Shearing			
Weight of Wet Sample+Cont.(gm):	177.55	177.55	177.55
Weight of Dry Sample+Cont.(gm):	161.52	161.52	161.52
Weight of Container(gm):	56.66	56.66	56.66
Vertical Rdg.(in): Initial	0.2676	0.2807	0.0000
Vertical Rdg.(in): Final	0.2788	0.3170	-0.0440
After Shearing			
Weight of Wet Sample+Cont.(gm):	227.49	226.82	215.07
Weight of Dry Sample+Cont.(gm):	206.69	207.35	196.11
Weight of Container(gm):	64.60	65.21	55.15
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43





Boring No.	**LB-2**
Sample No.	**R-1**
Depth (ft)	**5**
Sample Type: Ring	
Soil Identification: Dark brown lean clay (CL)	

Normal Stress (kip/ft²)	1.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 1.157	■ 3.141	▲ 5.693
Shear Stress @ End of Test (ksf)	○ 0.802	□ 3.078	△ 5.615
Deformation Rate (in./min.)	0.0017	0.0017	0.0017
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	15.29	15.29	15.29
Dry Density (pcf)	118.8	118.9	118.9
Saturation (%)	98.4	98.7	98.9
Soil Height Before Shearing (in.)	0.9888	0.9637	0.9560
Final Moisture Content (%)	14.6	13.7	13.5

Leighton

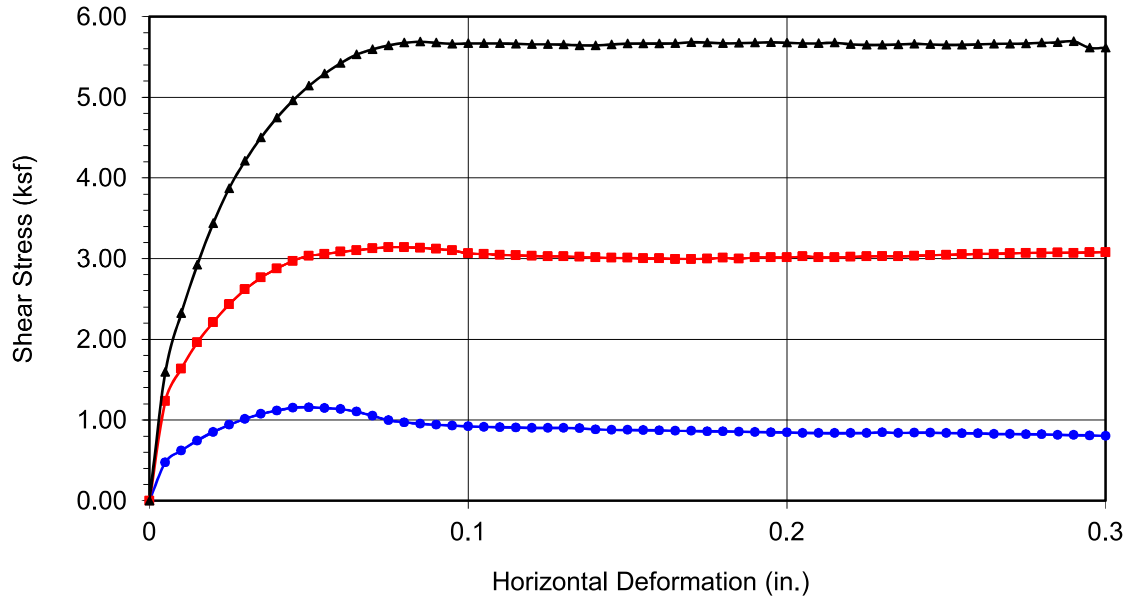
DIRECT SHEAR TEST RESULTS

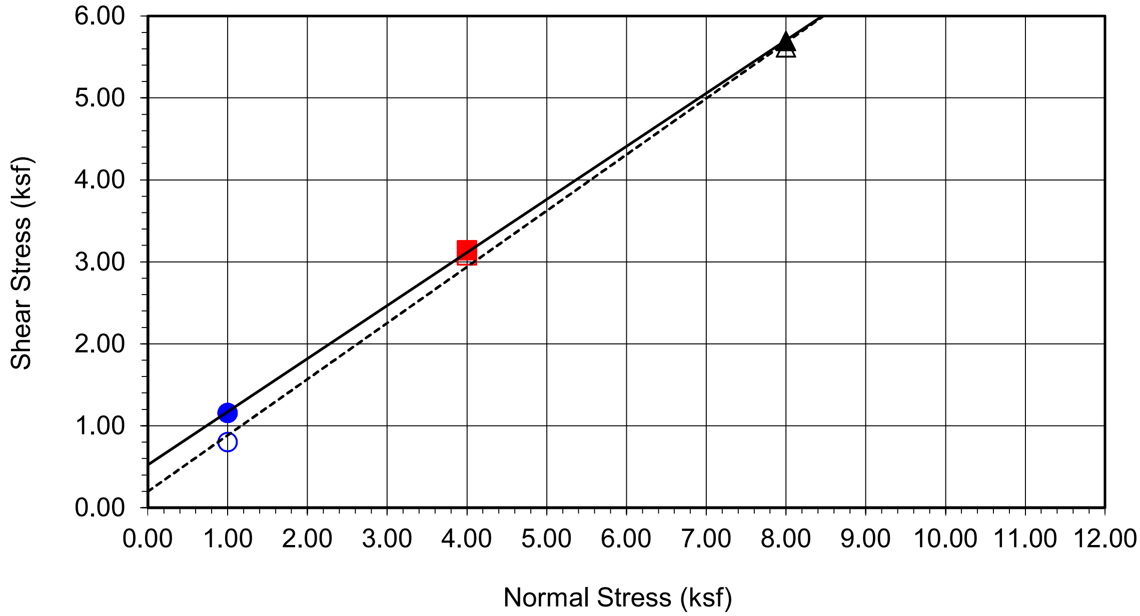
Consolidated Drained - ASTM D 3080

Project No.: 11428.035

Franklin ES

09-21





Boring No.	**LB-2**
Sample No.	**R-1**
Depth (ft)	**5**
Sample Type:	Ring
Soil Identification: Dark brown lean clay (CL)	

Strength Parameters

	C (psf)	ϕ (°)
Peak	525	33
Ultimate	198	34

Normal Stress (kip/ft²)	1.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 1.157	■ 3.141	▲ 5.693
Shear Stress @ End of Test (ksf)	○ 0.802	□ 3.078	△ 5.615
Deformation Rate (in./min.)	0.0017	0.0017	0.0017
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	15.29	15.29	15.29
Dry Density (pcf)	118.8	118.9	118.9
Saturation (%)	98.4	98.7	98.9
Soil Height Before Shearing (in.)	0.9888	0.9637	0.9560
Final Moisture Content (%)	14.6	13.7	13.5

Leighton

DIRECT SHEAR TEST RESULTS

Consolidated Drained - ASTM D 3080

Project No.: 11428.035

Franklin ES

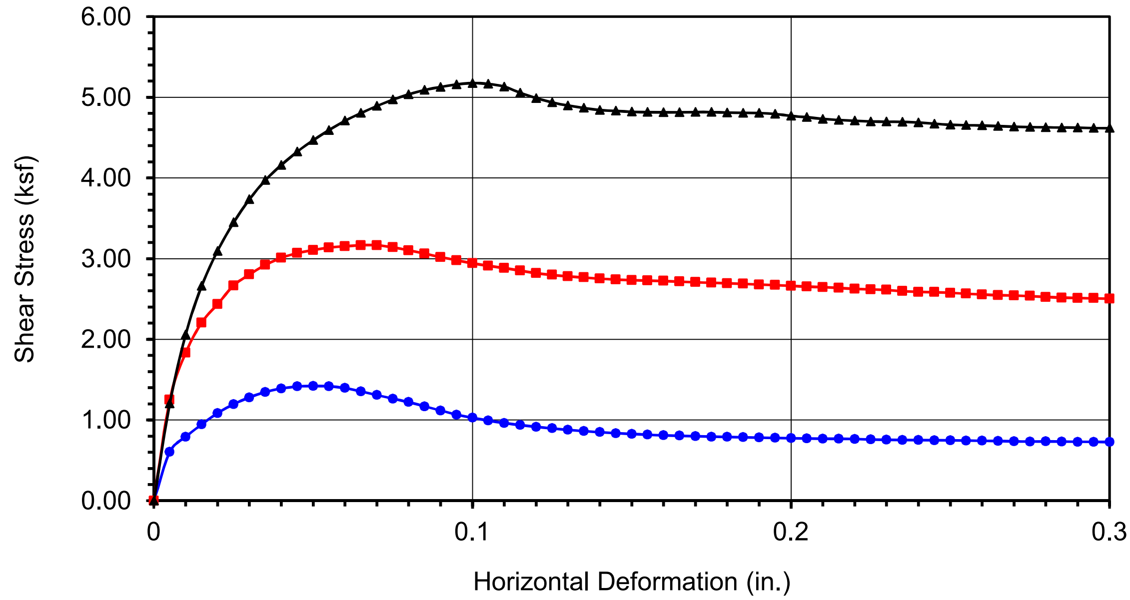
09-21

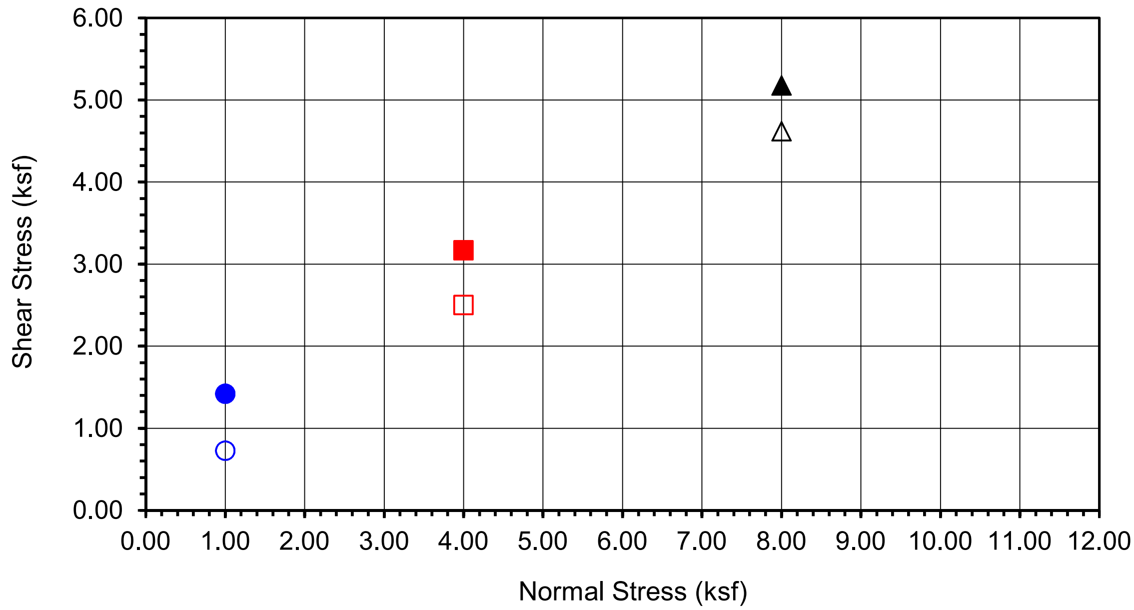
DIRECT SHEAR TEST

Consolidated Drained - ASTM D 3080

Project Name:	Franklin ES	Tested By:	G. Bathala	Date:	09/29/21
Project No.:	11428.035	Checked By:	A. Santos	Date:	10/11/21
Boring No.:	LB-2	Sample Type:	Ring		
Sample No.:	R-2	Depth (ft.):	7.5		
Soil Identification:	Light olive brown lean clay (CL)				

Sample Diameter(in):	2.415	2.415	2.415
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	206.10	207.82	207.92
Weight of Ring(gm):	43.90	44.18	44.17
Before Shearing			
Weight of Wet Sample+Cont.(gm):	219.35	219.35	219.35
Weight of Dry Sample+Cont.(gm):	201.12	201.12	201.12
Weight of Container(gm):	77.77	77.77	77.77
Vertical Rdg.(in): Initial	0.2253	0.2386	0.0000
Vertical Rdg.(in): Final	0.2310	0.2528	-0.0202
After Shearing			
Weight of Wet Sample+Cont.(gm):	228.89	222.94	229.85
Weight of Dry Sample+Cont.(gm):	204.96	199.74	207.53
Weight of Container(gm):	65.21	59.15	66.94
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43





Boring No.	**LB-2**
Sample No.	**R-2**
Depth (ft)	**7.5**

Sample Type:

Ring

Soil Identification:
Light olive brown lean clay (CL)

Normal Stress (kip/ft²)	1.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 1.421	■ 3.166	▲ 5.175
Shear Stress @ End of Test (ksf)	○ 0.726	□ 2.502	△ 4.618
Deformation Rate (in./min.)	0.0017	0.0017	0.0017
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	14.78	14.78	14.78
Dry Density (pcf)	117.5	118.6	118.6
Saturation (%)	91.9	94.6	94.9
Soil Height Before Shearing (in.)	0.9943	0.9858	0.9798
Final Moisture Content (%)	17.1	16.5	15.9

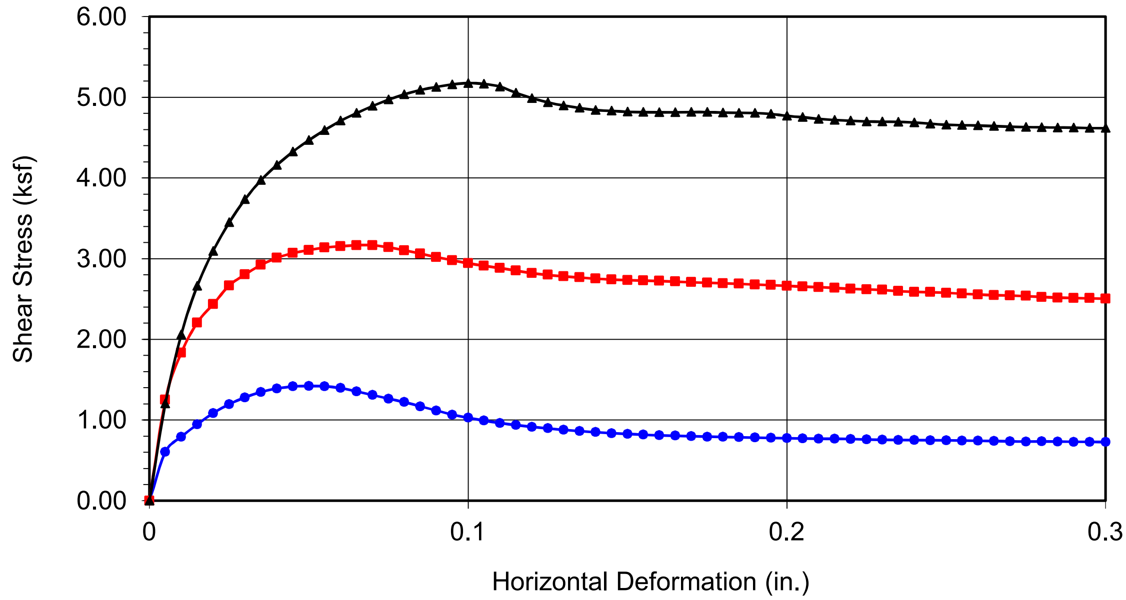
Leighton

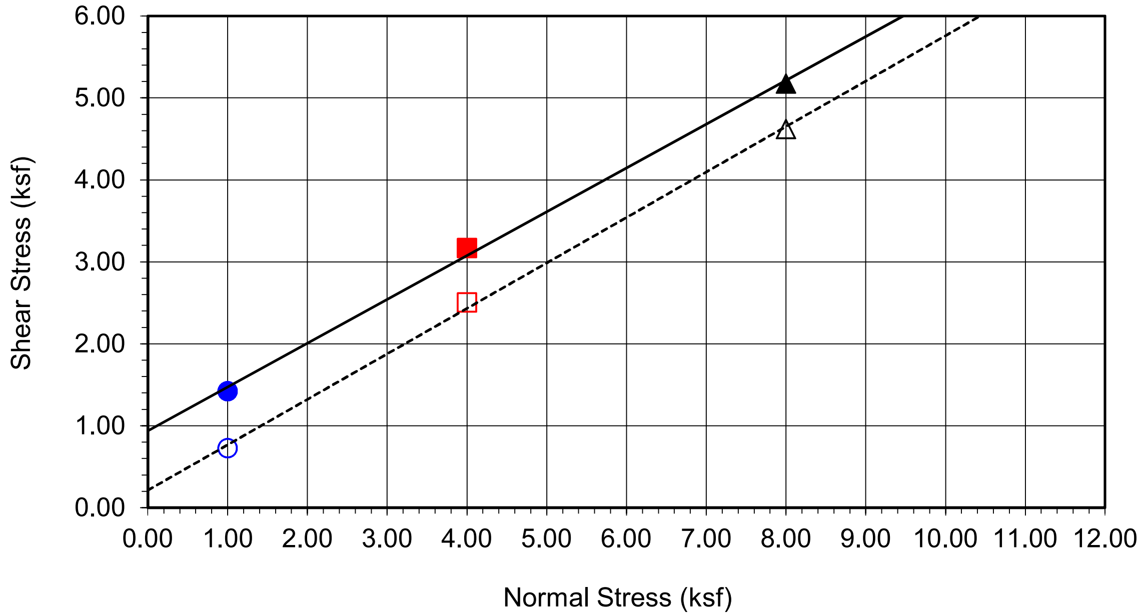
DIRECT SHEAR TEST RESULTS
Consolidated Drained - ASTM D 3080

Project No.: 11428.035

Franklin ES

09-21





Boring No.	**LB-2**
Sample No.	**R-2**
Depth (ft)	**7.5**
Sample Type:	Ring
Soil Identification: Light olive brown lean clay (CL)	

Strength Parameters

	C (psf)	ϕ (°)
Peak	938	28
Ultimate	212	29

Normal Stress (kip/ft²)	1.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 1.421	■ 3.166	▲ 5.175
Shear Stress @ End of Test (ksf)	○ 0.726	□ 2.502	△ 4.618
Deformation Rate (in./min.)	0.0017	0.0017	0.0017
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	14.78	14.78	14.78
Dry Density (pcf)	117.5	118.6	118.6
Saturation (%)	91.9	94.6	94.9
Soil Height Before Shearing (in.)	0.9943	0.9858	0.9798
Final Moisture Content (%)	17.1	16.5	15.9

Leighton

DIRECT SHEAR TEST RESULTS

Consolidated Drained - ASTM D 3080

Project No.: 11428.035

Franklin ES

09-21

EXPANSION INDEX of SOILS
ASTM D 4829

Project Name:	Franklin ES	Tested By:	GEB/OHF	Date:	10/04/21
Project No.:	11428.035	Checked By:	A. Santos	Date:	10/11/21
Boring No.:	LB-2	Depth (ft.):	0-5		
Sample No.:	BB-1				
Soil Identification:	Dark brown silty, clayey sand (SC-SM)				

Dry Wt. of Soil + Cont. (g)	1000.00
Wt. of Container No. (g)	0.00
Dry Wt. of Soil (g)	1000.00
Weight Soil Retained on #4 Sieve	0.00
Percent Passing # 4	100.00

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0100
Wt. Comp. Soil + Mold (g)	619.20	454.30
Wt. of Mold (g)	190.10	0.00
Specific Gravity (Assumed)	2.70	2.70
Container No.	O	O
Wet Wt. of Soil + Cont. (g)	854.90	644.40
Dry Wt. of Soil + Cont. (g)	795.20	589.26
Wt. of Container (g)	0.00	190.10
Moisture Content (%)	7.51	13.81
Wet Density (pcf)	129.4	135.7
Dry Density (pcf)	120.4	119.2
Void Ratio	0.400	0.414
Total Porosity	0.286	0.293
Pore Volume (cc)	59.2	61.2
Degree of Saturation (%) [S_{meas}]	**50.6**	90.1

SPECIMEN INUNDATION in distilled water for the period of 24 h or expansion rate < 0.0002 in./h

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
10/04/21	7:55	1.0	0	0.5755
10/04/21	8:05	1.0	10	0.5750
Add Distilled Water to the Specimen				
10/04/21	8:20	1.0	15	0.5820
10/05/21	7:30	1.0	1405	0.5855
10/05/21	9:00	1.0	1495	0.5855

Expansion Index (EI_{meas}) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	**11**

Leighton

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Franklin ES	Tested By:	A. Willoughby	Date:	09/22/21
Project No.:	11428.035	Checked By:	A. Santos	Date:	09/23/21
Boring No.:	LB-2	Depth (ft.):	0-5		
Sample No.:	BB-1				
Soil Identification:	Dark brown silty, clayey sand (SC-SM)				

Note: Corrected dry density calculation assumes specific gravity of 2.70 and moisture content of 1.0% for oversize particles

			Scalp Fraction (%)		
Preparation Method:	X	Moist	#3/4		Rammer Weight (lb.) = 10.0
		Dry	#3/8		Height of Drop (in.) = 18.0
Compaction Method	X	Mechanical Ram	#4	8.1	Mold Volume (ft³) 0.03320
		Manual Ram			

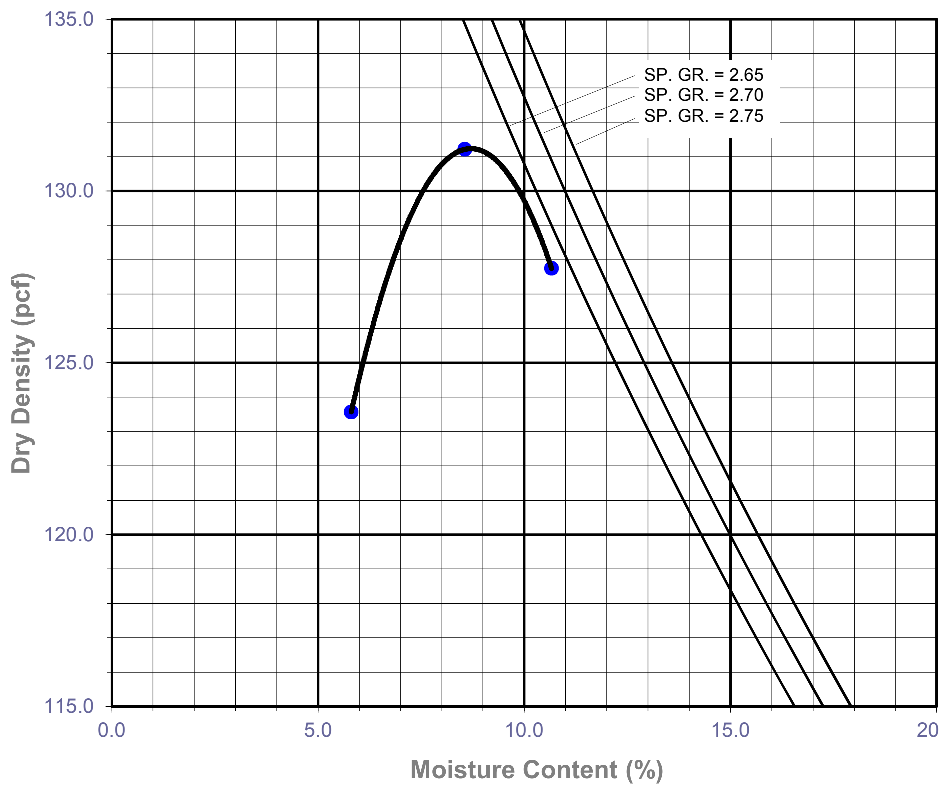
TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3831	4007	3991			
Weight of Mold (g)	1862	1862	1862			
Net Weight of Soil (g)	1969	2145	2129			
Wet Weight of Soil + Cont. (g)	365.8	357.6	388.5			
Dry Weight of Soil + Cont. (g)	347.9	332.5	354.9			
Weight of Container (g)	39.6	39.1	39.8			
Moisture Content (%)	5.81	8.55	10.66			
Wet Density (pcf)	130.7	142.4	141.4			
Dry Density (pcf)	123.6	131.2	127.8			

Maximum Dry Density (pcf)	**131.2**	**Optimum Moisture Content (%)**	**8.7**
Corrected Dry Density (pcf)	**133.6**	**Corrected Moisture Content (%)**	**8.1**

[X] **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

[ ] **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%



Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI

Project Name: Franklin ES
Project No.: 11428.035

Summary of Pocket Penetrometer Test Results

Tested by: A. Willoughby Date: 09/28/21
Prepared by: G. Bathala Date: 10/05/21

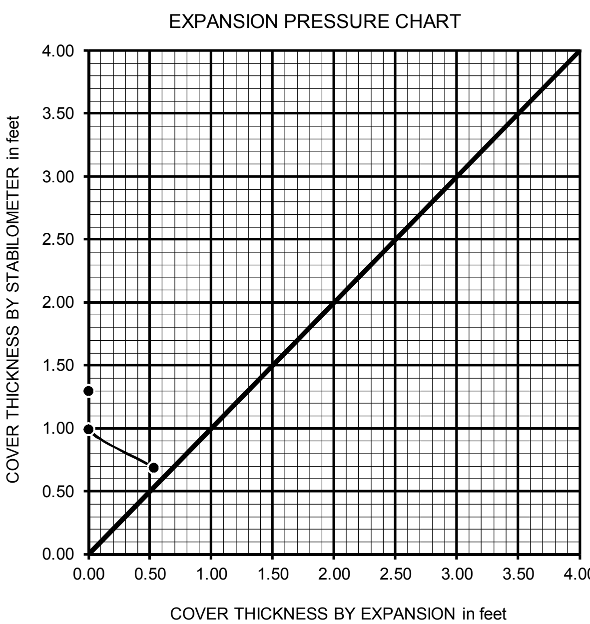
Boring No.	Sample No.	Depth (ft.)	Readings	Remarks
LB-1	R-1	5	4.00	
	R-2	7.5	4.00	
	R-3	10	4.00	
	R-4	20	4.00	
	R-5	30	4.00	
LB-2	R-2	7.5	>4.50	
	R-4	15	N/A	
	R-5	25	4.00	
	R-6	35	4.00	
	R-7	45	3.75	

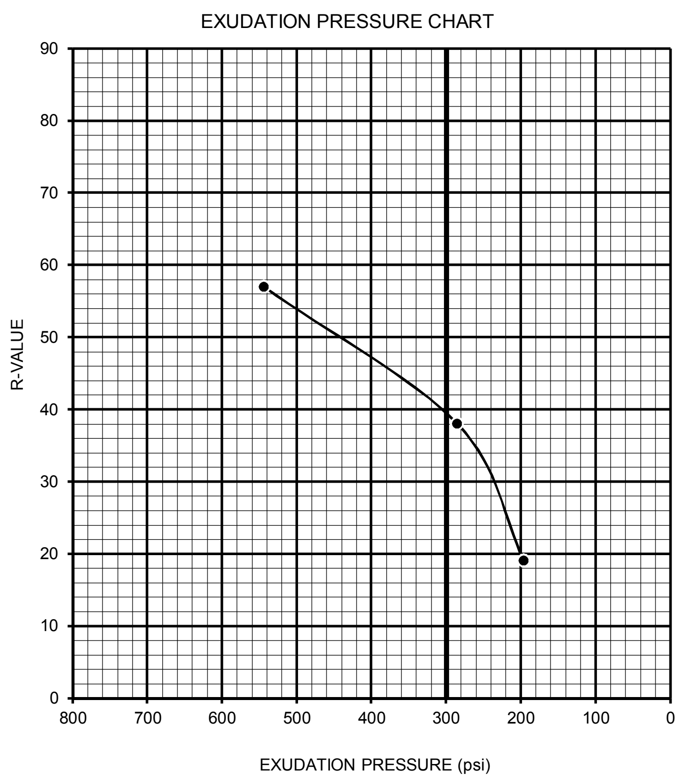
R-VALUE TEST RESULTS
DOT CA Test 301

PROJECT NAME:	Franklin ES	PROJECT NUMBER:	11428.035
BORING NUMBER:	LB-2	DEPTH (FT.):	0-5
SAMPLE NUMBER:	BB-1	TECHNICIAN:	O. Figueroa
SAMPLE DESCRIPTION:	Dark brown silty, clayey sand (SC-SM)	DATE COMPLETED:	9/28/2021

TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION %	15.1	16.0	16.9
HEIGHT OF SAMPLE, Inches	2.38	2.46	2.46
DRY DENSITY, pcf	120.4	122.0	120.4
COMPACTOR PRESSURE, psi	150	110	70
EXUDATION PRESSURE, psi	544	285	196
EXPANSION, Inches x 10exp-4	16	0	0
STABILITY Ph 2,000 lbs (160 psi)	47	74	110
TURNS DISPLACEMENT	4.25	4.70	4.82
R-VALUE UNCORRECTED	59	38	19
R-VALUE CORRECTED	57	38	19

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.69	0.99	1.30
EXPANSION PRESSURE THICKNESS, ft.	0.53	0.00	0.00





R-VALUE BY EXPANSION:	59
R-VALUE BY EXUDATION:	39
EQUILIBRIUM R-VALUE:	39

APPENDIX C

Soil Age Data and Core Review/Core Photos (Earth Consultants International)

Leighton

ECI Project No. 4114.01
December 14, 2021

Earth Consultants International

To: **LEIGHTON CONSULTING, INC.**
17781 Cowan
Irvine, California 92614

Attention: **Mr. Joe Roe,** Principal Geologist

Subject: **Report - Stratigraphic Age Estimations in Support of a Fault Investigation at the Site of the Franklin Elementary School, 2400 Montana Avenue, in the City of Santa Monica, California**
Leighton Consulting, Inc. Project No. 11328.035

Dear Joe,

At your request, we have described the soils and sediments in cores that your team obtained from three continuously sampled borings drilled as part of a fault investigation for a portion of the above-referenced school site. We used the descriptions of the soils exposed in the borings to estimate the age of the sediments to the total depth of the subsurface exploration.

Our analysis indicates that the study area is underlain by a thick, cumulic surface soil developed in generally fine-grained sediments deposited by gravity, either by slopewash or sheetflow processes. This surface soil has a noticeable concentration of translocated clay in the form of clay films distributed throughout an argillic (Bt) soil horizon section that is between 3 and 4 feet thick. The redder colors of the matrix and clay films are in the 7.5YR hue. The soil-age regressions used suggest an age for this soil of about 26,000 years, and an estimated age for the entire 50-foot thick section captured in the cores of between about 56,000 and 164,000 years. Correlation with the world-wide Quaternary sea level curves and paleo-climate records compiled for the southern California region suggest that the stratigraphic section captured in the cores dates to between about 27,000 and 126,000 years. Thus, the entire section is Pleistocene.

Two of the three borings evaluated exposed a buried soil at a depth of approximately 27 feet. This soil was not present in the core of CB-1, but several primary stratigraphic units above and below this buried soil, in addition to the surface soil described above, were observed in all three borings at similar depths, suggesting that the area is not underlain by active faults. The interpreted cross-section prepared across the study area, which included cone penetration test (CPT) data in addition to the borehole data, also shows that several layers can be correlated across, with no vertical breaks or discontinuities to suggest faulting.

1642 E. Fourth Street Santa Ana California 92701 USA
Telephones: 714-412-2654 & 544-5321 Facsimile: 714-494-4930
www.earthconsultants.com

We trust that the information provided below provides you with the information you need to move forward with this project. Thank you for the opportunity to assist you with this project.

Respectfully submitted for
Earth Consultants International, Inc.

Tania Gonzalez, CEG 1859
Vice-President/ Senior Project Consultant

Appendix C
Stratigraphic Age Estimations in Support of a Fault Investigation for the Franklin Elementary School at 2400 Montana Avenue, in the City of Santa Monica, California

INTRODUCTION

Earth Consultants International, Inc. (ECI) was retained by Leighton Consulting, Inc. (Leighton) to assist with the description, age estimation and lateral correlation of the sediments and soils exposed in three continuously sampled borings that were drilled in the study area to a depth of 50 feet. To that end, we completed the following tasks:

1. Prepared detailed logs of three continuously sampled borings (CB-1, CB-2 and CB-3) to develop an understanding of the environments of deposition represented by the geologic materials exposed therein, and the soils that have developed in these geologic deposits. We provided our descriptions to Leighton, who prepared the boring logs included in Appendix A.
2. Identified marker beds common among the three continuously sampled borings and used these marker beds to correlate units and contacts across the borings with an emphasis on whether or not distinctive marker beds extend unbroken across the study area.
3. Reviewed the cross-section prepared by Leighton that incorporates both the borehole and cone penetration test (CPT) data obtained for this study to independently assess whether or not the area is underlain by laterally continuous stratigraphic (primary geologic) and pedogenic (secondary soil) layers. The stratigraphic correlations are presented in Leighton's cross-section for this project.
4. Used soil-stratigraphic methods to estimate the age of the soils, and thus sediments, exposed in the borings. The methodology used for this analysis is described in detail in the following sections.
5. Prepared this letter report.

METHODOLOGY

As part of our involvement on this project, ECI described the sediments and soils exposed in the cores of three continuously sampled borings (CB-1, CB-2 and CB-3) using a combination of the characteristics and nomenclature set forth by the Soil Survey Staff (1975, 1992), Birkeland (1984, 1999), and the National Soil Survey Center (2012). Colors of the geologic units and soil horizons in both their dry and wet states were based on a comparison to color chips in a Munsell Soil Color Chart.

Characteristics that we recorded include: 1) texture or grain-size distribution (sand, silt, clay and mixtures of these, in addition to presence of gravel and larger clasts), 2) structure (whether the soil mass breaks into distinctive peds, or is massive or single-grained), 3) the amount, distribution and thickness of translocated clay forming films or stains on the soil ped faces and clasts, in pores and clast pockets, and between sand grains (called bridges), 4) the looseness or induration of the soil peds when dry and moist, and 5) the stickiness and plasticity of the wet soil. For those sections that have not been modified by soil-forming processes, we observed and recorded information regarding bedding or laminations, and whether the grain size distribution in a given bed or package fines upward or downward. We tested the sediments' and soils' reaction to hydrochloric acid, which is an indicator of the presence of calcium carbonate and the pH of the materials, and, where appropriate, noted the presence of calcium carbonate stringers or nodules, and manganese oxide and/or iron oxide staining. Finally, the sharpness and relief characteristics of the contact (or boundary) between layers or soil horizons observed in the cores were also noted. Given the relatively small diameter of the cores and thus limited exposure, the relief characteristics of the boundary between layers is approximate. Similarly, the strength and size of the structure of the soils may be under-represented, as the drilling process often disrupts this characteristic. The complete descriptions of the cores, including the unaltered geologic materials, and the soils observed are provided in the boring logs in Leighton's report (Appendix A). Abbreviated descriptions of the soils observed in the cores are presented here in Table C-1. We used the soils in Table C-1 to estimate the age of the stratigraphic section to the total depth of the borings (50 feet).

To estimate the age of a geologic deposit using soil-stratigraphic techniques we compare the characteristics of the soils that have developed in the geologic unit of interest to the characteristics of other soils in the region developed in similar parent materials that have been dated using both numerical (such as radiocarbon or optically stimulated luminescence – OSL) and relative (such as age estimation, geomorphic position or level of dissection) dating methods. Because the parent material controls to a certain extent the soils that develop on it, the characteristics of the parent material are "subtracted" from the characteristics of the soil being analyzed to develop a realistic estimate of the length of time that a geologic deposit has been subjected to the effects of weathering and soil formation. Field studies have shown that all other conditions being equal, a soil developed in fine-grained sediments is better developed, with increased horizonation and illuviation, than a coarse-grained soil of similar age (Rockwell et al., 1985).

For our age-estimation analysis of the soils exposed in the cores, we used a parent material consisting of sandy clay loam with light yellowish brown (2.5Y-10YR 6/4) dry color, light olive brown to yellowish brown (2.5Y-10YR 5/4) moist color, massive soil structure, soft when dry, very friable when moist, sticky and plastic when wet, with no clay films. This texture is slightly richer in sand than the sandy clay texture of several of the soil horizons, and represents our interpretation that the parent material was poorly sorted and included coarse sand and about 10 percent gravel. Finer-grained sedimentary layers of silt and clay were observed in the cores, but these typically contain 5 percent or less gravel, indicating a better sorted deposit than the sediments described in the pedogenically altered sections. The colors, structure and consistency of the parent material that we selected are similar to the characteristics recorded for several unaltered layers referred to as C horizons in the logs.

Table C-1: Abbreviated Descriptions for the Soils Observed in Borings CB-1, CB-2 and CB-3

Profile	Thickness (cm)	Texture	Color		Structure	Consistency				Clay Films
			Dry	Moist		Dry	Moist	Wet		
Boring CB-1										
Surface Soil (Starting @2.7′)										
A1	49	SiC	10YR 5/3	10YR 3/3	2csbk -> 2f-msbk	vh	vfi	s-vs	vp	none
A2	21	SiCL-SiC	10YR 5/3, 10YR 4/2 cf	10YR 3/3, 10YR 3/2 cf	1msbk->1fsbk + sg	h	fi	s	vp	v1nclpo
AB	27	SiC	10YR 5/2, 10YR 4/3 cf	10YR 4/3, 10YR 4/4 cf	2-3c-vcsbk->2-3msbk	vh	fi-vfi	s-vs	p-vp	2n-mkpf & clpo, 2kpo
Bt1	35	SiC	7.5-10YR 5/4, 7.5-10YR 5/3 cf	7.5-10YR 4/4, 7.5YR 3/3 cf	2-3vcabk->2-3f-mabk	vh-eh	vfi	s	p	1npf
Bt2	26	SC-SiC	7.5-10YR 5/4, 7.5-10YR 5/3 cf	7.5-10YR 4/4, 10YR 4/3 cf	3cabk->3mabk	vh	vfi	s-vs	p-vp	2n-mkpf
Bt3	37	SC	7.5-10YR 5/3, 7.5-10YR 4/3 cf	7.5-10YR 4/4, 7.5-10YR 3/3 cf	2m-cabk->2fabk	h-vh	vfi	vs	vp	1-2npf, 1nclpo
B/C	67	SiC	2.5Y-10YR 5/3, 2.5Y-10YR 5/3 cf	2.5Y-10YR 4/4, 2.5Y-10YR 4/4 cf	3cabk->3mabk	vh	vfi	s-vs	vp	2n-mkpf
Boring CB-2										
Surface Soil (Starting @ 3.7′)										
A	40	SC	10YR 4/2	10YR 3/2	2msbk -> 1-2fsbk	h-vh	vfi	vs	vp	none
AB	27	SC	10YR 4/3 mtx+cf	10YR 3/2, 10YR 3/2.5cf	3csbk -> 3f-msbk	vh	vfi	vs	vp	2mkclpo
Bt1	30	SiC-C	7.5-10YR 5/4, 7.5YR 5/3 cf	7.5-10YR 4/3, 7.5-10YR 3/3 cf	3csbk -> 2fsbk	h	vfi	vs	vp	3mkpf, 2-3mkclpo
Bt2	26	SC-SiC	7.5YR 5/4, 7.5YR 4/4 cf	7.5YR 4/4, 7.5YR 3/3 cf	3cabk ->3mabk	vh	vfi	vs	vp	2-3mkpf, 3mkclpo, 2mkpo
Bt3	35	SC-C	7.5-10YR 5/4, 7.5-10YR 4/4cf	7.5YR 4/4, 7.5YR 3/3 cf	3cabk -> 2-3mabk	vh	vfi	vs	vp	2-3mkpf, 2-3kclpo
BC	24	SiC	2.5Y-10YR 5/4, 10YR 5/3 cf	2.5Y-10YR 4/4, 10YR 4/4 cf	3csbk -> 3msbk	h-vh	vfi	vs	vp	2npf, 1-2mkclpo
C	64	SC	2.5Y-10YR 5/4, 10YR 4/3 cf	2.5Y-10YR 4/3, 10YR 3/3	3mabk -> 3fabk	vh	vfi	vs	vp	2mkclpo
Buried Soil (@27.3′)										
18Btb	91	gC	10YR 5/4, 7.5YR 4/3 cf	10YR 3/4, 7.5YR 3/3 cf	3cabk	vh-eh	vfi	vs	vp	2mkpf, 3mkclpo
Boring CB-3										
Surface Soil (Starting @ 2.2′)										
A1	49	SC-SiC	2.5Y-10YR 4/3 2.5Y-10YR 4/3 cf	10YR 3/3 10YR 3/3 cf	2cabk -> 2f-mabk	vh	vfi	vs	vp	1nclpo
A2	37	SC	10YR 4.5/3 10YR 4.5/3 cf	10YR 3/2.5, 10YR 3/2.5cf	1msbk -> 1fsbk	sh-h	fi	vs	vp	1vnclpo

Profile	Thickness (cm)	Texture	Color		Structure	Consistency				Clay Films
			Dry	Moist		Dry	Moist	Wet		
AB	12	SC	10YR 4/3, 10YR 4/2 cf	10YR 3/2, 10YR 3.5/2 cf	2csbk -> 2f-msbk	h	fi	vs	vp	1nclpo
Bt1	34	SC-SiC	10YR 5/4, 10YR 5/3 cf	10YR 3/4, 10YR 4/3 cf	2-3cabk -> 2mabk	vh	vfi	s	vp	2n-mkpf, 1nclpo
Bt2	46	SC	10YR 5/3, 10-7.5YR 4/4 cf	10YR 4/4, 7.5-10YR 3/4 cf	3cabk -> 3mabk	vh	vfi	vs	vp	2mkpf, 2mk-kclpo
Bt3	46	SC	10YR 5/3.5, 10YR 4/4 & 7.5YR 4/3 cf	10YR 4/3, 7.5YR 3/4 cf	2-3cabk -> 2-3f-mabk	vh	vfi	vs	vp	1kpf, 2-3kclpo
BC	27	SiC	2.5Y-10YR 5/3, 7.5YR 4/3 cf	10YR 4/4, 7.5YR 3/3 cf	2mabk -> 2fabk	h-vh	vfi	s	vp	none
C	117	SC-SiC	2.5Y-10YR 5/3	10YR 4/3	2csbk -> 2f-msbk	h	fi	s-vs	vp	none
Buried Soil (@27')										
13Btb1	79	SC	10YR 5/3, 7.5YR 5/4 cf	10YR 3/3, 7.5YR 3/3 cf	3cabk -> 3mabk	vh-eh	vfi-efi	vs	vp	2-3mkpf, 2-3mkclpo

ABBREVIATIONS:

TEXTURE: g = gravelly; S= sand; LS = loamy sand; SL = sandy loam; L = loam; SCL = sandy clay loam; SC = sandy clay; CL = clay loam; Si = silt; SiL = silt loam; SiCL = silty clay loam; SiC = silty clay; C = clay. **STRUCTURE**: Grade: 1 = weak; 2 = moderate, 3 = strong. Class: f = fine, m = medium, c = coarse; vc = very coarse. Type: m = massive; sg = single-grained; gr = granular, cr = crumb, abk = angular blocky, sbk = subangular blocky, pr = prismatic. **CONSISTENCY**: Dry: lo = loose, so = soft, sh = slightly hard, h = hard, vh = very hard, eh = extremely hard. Moist: lo = loose, vfr = very friable, fr = friable, fi = firm, vfi = very firm, efi = extremely firm. Wet: ns = non-sticky, ss = slightly sticky, s= sticky, vs = very sticky; np = non-plastic, sp = slightly plastic, p = plastic, vp = very plastic. **CLAY FILMS**: Abundance: v1 = very few, 1 = few, 2 = common, 3 = many, 4 = continuous. Thickness: n = thin, mk = moderately thick, k = thick. Location: cl = on clasts; clop = in clast pockets, po = in pores, br = forming bridges between grains, pf = on ped faces. -> = breaking to

To conduct a quantitative comparison with other dated soils, the characteristics of the soil horizons being analyzed are assigned numerical values that are then used to calculate the soil's degree of development. We used two of these quantitative methods for this study: the Soil Development Index (SDI) developed by Harden (1982) and Harden and Taylor (1993), and the Maximum Horizon Index (MHI) developed by Ponti (1985). The SDI values were normalized to a depth of 200 cm (~6 feet) to compare the results to equally normalized SDI values presented in the published regression curves used. Both SDI and MHI values have been shown to be useful relative indicators of soil age, with older, better developed soils having higher SDI and MHI values (Harden, 1982; Harden and Taylor, 1983; Rockwell et al., 1984; Rockwell et al., 1990; Bornyasz and Rockwell, 1997). We then used soil-age regressions developed from the data presented in Dolan et al. (1997) to estimate the age of the soils. The soil age regressions used are based on the chronosequences by Rockwell (1983), Rockwell et al. (1985), Harden (1982), and McFadden and Weldon (1987). The MHI and SDI values calculated for the soil profiles analyzed for this study, and the estimated ages of the soils are provided in Table C-2.

FINDINGS

Regional Setting

The subject site is located at the confluence between an alluvial fan that emanated from Brentwood Knoll to the northeast, and a larger alluvial fan that, based on the shape of the topographic contours, emanated from the Santa Monica Mountains to the north-northwest. Olson (2018) refers to this south- to southeast-sloping surface as the "Brentwood fan." The large concentration of Santa Monica slate fragments (a rock type prevalent in the Santa Monica Mountains) in the alluvial fan sediments that form this surface indicates that the mountains to the north are the primary source of these deposits. These sediments were typically transported to and deposited in the site vicinity by gravity (as slopewash or mudflows) and/or by ancestral streams over tens of thousands of years. The Brentwood fan is now elevated above the active zone of sedimentation, and disconnected from its source by the deep ravine of Santa Monica Canyon. This canyon likely incised into the Brentwood fan surface during the last glacial maximum (at the end of the Pleistocene, approximately 18,000 years ago), when sea level was considerably lower than today. This in turn indicates that the alluvial fan deposits that underlie the site are Pleistocene, and pre-date the canyon incision. Geologists that have previously mapped these deposits (Hoots and Kew, 1937; Dibblee, 1991, 1992; Yerkes and Campbell, 2005) are all in agreement that these deposits are Pleistocene. The analysis below provides additional information on the age of these deposits.

Geologic Units and Soils Observed in the Cores

All three borings drilled onsite exposed a thick (8- to 11-foot-thick), cumulic surface soil with a generalized A/AB/Bt1/Bt2/Bt3/BC/C profile. Texture of the soil horizons identified is generally fine-grained, and described as silty clay loam, silty clay, sandy clay and clay. Fine gravel is present in some of the horizons in small amounts, typically accounting for less than 10 percent of the total mass. This small but noticeable concentration of fine gravel mixed throughout, plus the thickness of the section, suggest that the parent material for this soil was deposited by slopewash or sheetflow processes over a relatively long period of time, with thin sections of sediment added to the surface as the soil formed. The A and AB soil horizons have colors in the 10YR and 2.5Y-10YR hues, whereas the argillic (Bt) soil horizons have colors in the 10YR, 7.5-10YR and 7.5YR hues. Translocated clay is present, forming few to many moderately thin to thick clay films on ped faces and in clast pockets. The reddened colors, and presence and thickness of the clay films, suggest that this soil has been exposed to soil-forming processes at the ground surface for thousands of years.

The surface soil is underlain by alluvial fan and/or mudflow deposits consisting of layers of gravel, sand, sandy clay and silty clay loam with 2.5Y to 10YR hues. These deposits extend down to a depth of between about 18.1 and 18.7 feet, forming an abrupt, erosional contact with the underlying sediments that is fairly level across the study area. Except for few thin clay films lining clast pockets, these deposits are mostly unaltered, with little to no evidence of soil development. The underlying sediments were deposited by fluvial processes as suggested by the predominantly rounded to subrounded clasts in the beds of clast-supported gravel. Borings CB-2 and CB-3 contain fining-upward sequences and thin layers of fine-grained overbank deposits, whereas the core of CB-1 consists predominantly of gravel, suggesting that it is closer to the thalweg of the paleo-channel. In cores CB-2 and CB-3, these fluvial deposits extend to a depth of approximately 27 feet, where they overlie a truncated buried soil. In the area of boring CB-1, this buried soil was not observed, and appears to have been either eroded, or never formed because that area was subject to more active, consistent deposition.

The buried argillic (Bt) soil observed in CB-2 and CB-3 is described as sandy clay to gravelly clay in texture, with 10YR colors in the matrix and 7.5YR colors in the clay films, strong coarse angular blocky soil structure, and common to many moderately thick clay films on ped faces and lining clast pockets. The mixed (poorly sorted) grain size distribution suggests that this soil developed in a debris flow deposit. The 7.5YR hue and abundance and thickness of the clay films suggests that this deposit was exposed to the ground surface, prior to burial, for several thousands of years. The section preserved is between 2.6 and 3 feet thick; we assume that the upper part of this now-buried soil was eroded off before the overlying fluvial sediments were deposited.

This buried soil is underlain by predominantly coarse-grained sediments (clast- and matrix-supported gravel beds) deposited either by fluvial processes or mudflows. This section extends to depths of between 37.2 (CB-1) and 39.5 (CB-2 and CB-3) feet. Below that, to the total depth of the borings (50 feet), is a section of predominantly fine-grained deposits consisting of beds of clay, sandy clay, silty clay, clay loam, silty clay loam, and silty clay. These are primary sedimentary deposits with no soil-formation, as indicated by the bedding and the laminations observed within some of these beds. These deposits typically have 2.5Y to 10YR hues, but display common distinctive layers or lenses with 5YR hues that we interpret represent burned surfaces (in place) or burnt soils that were eroded from the hillsides and re-deposited in the lowlands by precipitation events following wildfires. These red beds were observed at depths between about 40.7 and 50 feet in borings CB-2 and CB-3, and between 40.8 and 44.2 feet in boring CB-1.

Age of the Soils Exposed in the Cores

The surface soil exposed in all three cores has SDI values (normalized to a 200-cm depth) between 66.2 and 78.6, non-normalized SDI values between 83.0 and 95.7, and MHI values between 0.40 and 0.48. The non-normalized SDI values are higher than the normalized values because this soil is more than 2 meters (6 feet) thick. Using these values, the soil-age regressions return an average minimum age for this surface soil of about 8,400 years, an average median age of about 25,700 years, and an average maximum age of 78,100 years (see Table C-2). The minimum age estimate of 8,400 years is inconsistent with the topographic position of these sediments on a surface that is elevated tens of feet above the drainages that were cut during the most recent lowest sea level stand, and no longer within the active zone of sedimentation. The 7.5YR colors and accumulation of illuviated clay in the argillic soil horizons, plus the thickness of the overall soil, support an older age estimate. Our preferred age for the surface soil is represented by the median estimate of about 26,000 years (rounded to the nearest 1,000). Thus, the surface soil and the sediments that this soil developed in are Pleistocene, and the entire section exposed by the borings is Pleistocene.

The buried soil observed at a depth of about 27 feet in borings CB-2 and CB-3 has characteristics that result in normalized SDI values between 84.1 and 91.0, and MHI values between 0.42 and 0.46. These values in turn yield estimates of the length of time these sediments were exposed at the surface, prior to burial by the overlying fluvial sediments, of 9,250 years (minimum, based on the average between the two cores), 28,200 years (median), and 84,900 years (maximum). The amount and thickness of the clay films that developed in this coarse-grained unit indicate a much longer time period for soil formation than the minimum average value of 9,250 years. Thus, these deposits were likely exposed at the surface, prior to burial, for at least about 26,100 to 30,200 years. As shown on Table C-2, the age of this buried soil is calculated by adding the estimate of how long it took for this soil to form to the age of the surface soil. The average of the sum of the two soils in cores CB-2 and CB-3 indicates a minimum age of 56,000 years for the section down to a depth of about 30 feet. This is a minimum value because the length of time it took to deposit (and erode sections of) the alluvial fan sequence that overlies the buried soil is not captured in that age estimate. Given the lack of soil formation in the bottom 20 feet, estimating the age of the entire section is difficult. We use the sum of the maximum age estimates for the two soils as the upper end estimate of the age of the 50-foot section, but the true age of the section is likely in between the minimum and maximum values given.

Recognizing that significant periods of erosion and channel incision occur in response to sea level drops during glacial events and that channel infilling and soil development occur during interglacials, we can also attempt to correlate these soil age estimates to the Quaternary sea level curve to better place these age estimates in geomorphic context (Muhs et al., 2003). Furthermore, the depth and degree of soil development are often indicators of the climate typical of when the soils formed, and the sediments that these soils developed in can also be correlated to studies of Quaternary climate variability.

Thus, and assuming that lengthy periods of soil formation were not removed from the record by channel incision or erosion, we can use these generalized observations to place the sediments and soils within chronostratigraphic context. We suggest that the surface soil and the underlying sediments above the buried soil were deposited during the time period captured by the interglacial that correlates with Marine Isotope Stage (MIS) 3, which dates to between about 27,000 and 61,000 years ago. According to DeVecchio et al. (2012), in the southern California region the end of MIS 3 was generally wet. This is consistent with the thick, cumulic section of sediment that forms the parent material for the surface soil, and the thickness of the soil itself, with translocated clay disseminated across argillic horizons with a combined thickness of 3 to 4 feet.

The mudflow deposits below the surface soil were likely deposited during MIS 3a, a period of extreme wet-dry cycles, whereas the fluvial deposits below were likely deposited during a period of significant precipitation (wet period) consistent with MIS 3b-4. DeVecchio et al. (2012) date these sub-stages to between about 36,000 and 48,000 years ago for MIS 3a, and between 48,000 and 70,000 for MIS 3b-4.

The parent material for the underlying buried soil would have been deposited during a previous interglacial, with the soil itself forming at the end of the interglacial and into the next glacial period. The alluvial deposits below the buried soil are consistent with a high-energy environment characteristic of a wet (high precipitation) time period such as MIS 5b (dated to between about 83,000 and 100,000 years ago), with formation of the buried soil occurring during the drier period between MIS 5a and the end of MIS 4 (83,000 to 70,000 years ago). The finer-grained sediments at the bottom of the cores, with the burnt layers, suggest a dry period of deposition. Assuming that the cores do not extend across a significant erosional period that pushes the age of these deposits further back, the fine-grained sediments in the lower approximately 10 feet of the 50-foot section were possibly deposited during MIS 5c (about 100,000 to 109,000 years ago), or MIS 5c-5a (100,000 to 126,000 years ago based on the time scale presented in DeVecchio et al. [2012]).

Table B-2: Length of Time (LofT) it Took for the Soils to Form at the Ground Surface
(rounded to the nearest 100 years)
and Preferred Age of the Surface Soil and 50-ft Section (rounded to nearest 1,000 years)

Soil	SDI (NN)	SDI (N- 200)	MHI	Average LofT (years)	Minimum LofT (years)	Maximum LofT (years)
Boring CB-1						
Surface Soil	91.18	69.89	0.3981	**21,700**	7,100	**66,500**
Buried Soil	Not present; presumed to have been scoured out					
Approximate Age of Section				**>21,700**		
Boring CB-2						
Surface Soil	95.69	78.60	0.4782	**30,900**	10,200	93,000
Buried Soil	38.30	84.16	0.4208	**26,100**	8,500	78,900
Approximate Age of Section				**>57,000** – 162,000 years		
Boring CB-3						
Surface Soil	83.09	66.17	0.4208	**24,500**	8,000	74,900
Buried Soil	35.96	91.04	0.4552	**30,200**	10,000	90,800
Approximate Age of Section				**>55,000** – 166,000 years		
Preferred Age of Surface Soil (rounded to nearest 1,000 years)					**~26,000** years	
Preferred Age of Section Exposed in the Borings, to 50 ft. (rounded to nearest 1,000 years)					**>56,000** – 164,000 years	

Abbreviations: MHI = Mean Horizon Index; SDI = Soil Development Index; NN = not normalized;
N-200 = Normalized to 200 cm in thickness
Age estimates in **bold** are our preferred values for the minimum age of these soils.

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APPENDIX D

Seismicity Data

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                    *                      *
                    *     E Q S E A R C H  *
                    *                      *
                    *     Version 3.00     *
                    *                      *
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ESTIMATION OF
PEAK ACCELERATION FROM
CALIFORNIA EARTHQUAKE CATALOGS

JOB NUMBER: 11428.035

DATE: 12-02-2021

JOB NAME: Franklin ES

EARTHQUAKE-CATALOG-FILE NAME: ALLQUAKE.DAT

MAGNITUDE RANGE:
   MINIMUM MAGNITUDE: 4.00
   MAXIMUM MAGNITUDE: 9.00

SITE COORDINATES:
   SITE LATITUDE: 34.0391
   SITE LONGITUDE: 118.4851

SEARCH DATES:
   START DATE: 1800
   END DATE: 2016

SEARCH RADIUS:
   100.0 mi
   160.9 km

ATTENUATION RELATION: 14) Campbell & Bozorgnia (1997 Rev.) - Alluvium
   UNCERTAINTY (M=Median, S=Sigma): M   Number of Sigmas: 0.0
   ASSUMED SOURCE TYPE: DS [SS=Strike-slip, DS=Reverse-slip, BT=Blind-thrust]
   SCOND: 0 Depth Source: A
   Basement Depth: 5.00 km   Campbell SSR: 0   Campbell SHR: 0
   COMPUTE PEAK HORIZONTAL ACCELERATION

MINIMUM DEPTH VALUE (km): 3.0

EARTHQUAKE SEARCH RESULTS

Page 1

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	34.0000	118.5000	06/22/1920	248 0.0	0.0	4.90	0.196	VIII	2.8(4.5)
DMG	34.0000	118.5000	08/04/1927	1224 0.0	0.0	5.00	0.210	VIII	2.8(4.5)
MGI	34.0000	118.5000	06/23/1920	1220 0.0	0.0	4.00	0.102	VII	2.8(4.5)
DMG	34.0000	118.5000	03/06/1918	1820 0.0	0.0	4.00	0.102	VII	2.8(4.5)
MGI	34.0000	118.5000	03/08/1918	1230 0.0	0.0	4.00	0.102	VII	2.8(4.5)
MGI	34.0000	118.5000	11/19/1918	2018 0.0	0.0	5.00	0.210	VIII	2.8(4.5)
DMG	34.0000	118.5000	11/08/1914	1140 0.0	0.0	4.50	0.148	VIII	2.8(4.5)
GSP	34.0958	118.4912	06/02/2014	023643.9	4.3	4.16	0.098	VII	3.9(6.3)
DMG	34.0000	118.4170	12/07/1938	338 0.0	0.0	4.00	0.077	VII	4.7(7.6)
MGI	34.0000	118.4000	02/07/1927	429 0.0	0.0	4.60	0.107	VII	5.6(9.0)
MGI	34.0000	118.4000	10/01/1930	040 0.0	0.0	4.60	0.107	VII	5.6(9.0)
MGI	34.0000	118.4000	01/29/1927	2324 0.0	0.0	4.00	0.067	VI	5.6(9.0)
MGI	34.0000	118.4000	02/22/1920	1610 0.0	0.0	4.60	0.107	VII	5.6(9.0)
GSP	34.0590	118.3870	09/09/2001	235918.0	4.0	4.20	0.076	VII	5.8(9.3)
GSP	34.1340	118.4862	03/17/2014	132536.9	9.2	4.39	0.079	VII	6.5(10.5)
DMG	33.9030	118.4310	11/29/1938	192115.8	10.0	4.00	0.037	V	9.9(15.9)
DMG	33.9500	118.6320	08/31/1930	04036.0	0.0	5.20	0.092	VII	10.4(16.8)

MGI	34.0000	118.3000	06/30/1920	350 0.0	0.0	4.00	0.033	V	10.9(17.6)
MGI	34.0000	118.3000	09/03/1905	540 0.0	0.0	5.30	0.094	VII	10.9(17.6)
MGI	34.0000	118.3000	06/22/1920	2035 0.0	0.0	4.00	0.033	V	10.9(17.6)
GSP	33.9380	118.3360	05/18/2009	033936.3	13.0	4.70	0.057	VI	11.0(17.7)
DMG	33.9830	118.3000	02/11/1940	192410.0	0.0	4.00	0.032	V	11.3(18.1)
MGI	34.1000	118.3000	07/16/1920	2130 0.0	0.0	4.60	0.051	VI	11.4(18.3)
MGI	34.1000	118.3000	07/16/1920	2022 0.0	0.0	4.60	0.051	VI	11.4(18.3)
MGI	34.1000	118.3000	07/16/1920	2127 0.0	0.0	4.60	0.051	VI	11.4(18.3)
MGI	34.1000	118.3000	07/26/1920	1215 0.0	0.0	4.00	0.032	V	11.4(18.3)
PAS	33.9190	118.6270	01/19/1989	65328.8	11.9	5.00	0.068	VI	11.6(18.7)
GSP	34.2150	118.5100	01/19/1994	140914.8	17.0	4.50	0.043	VI	12.2(19.7)
GSP	34.2130	118.5370	01/17/1994	123055.4	18.0	6.70	0.228	IX	12.4(19.9)
PAS	33.9330	118.6690	10/17/1979	205237.3	5.5	4.20	0.032	V	12.8(20.6)
PAS	33.9440	118.6810	01/01/1979	231438.9	11.3	5.00	0.059	VI	13.0(20.9)
MGI	34.0800	118.2600	07/16/1920	18 8 0.0	0.0	5.00	0.058	VI	13.2(21.2)
GSP	34.2310	118.4750	03/20/1994	212012.3	13.0	5.30	0.074	VII	13.3(21.3)
T-A	34.0000	118.2500	03/26/1860	0 0 0.0	0.0	5.00	0.055	VI	13.7(22.1)
T-A	34.0000	118.2500	05/02/1856	810 0.0	0.0	4.30	0.032	V	13.7(22.1)
T-A	34.0000	118.2500	09/23/1827	0 0 0.0	0.0	5.00	0.055	VI	13.7(22.1)
T-A	34.0000	118.2500	05/04/1857	6 0 0.0	0.0	4.30	0.032	V	13.7(22.1)
T-A	34.0000	118.2500	01/17/1857	1 0 0.0	0.0	4.30	0.032	V	13.7(22.1)
T-A	34.0000	118.2500	01/10/1856	0 0 0.0	0.0	5.00	0.055	VI	13.7(22.1)
T-A	34.0000	118.2500	03/21/1880	1425 0.0	0.0	4.30	0.032	V	13.7(22.1)
GSP	34.2280	118.5730	01/17/1994	175608.2	19.0	4.60	0.039	V	14.0(22.5)
GSP	34.2180	118.6070	01/18/1994	113509.9	12.0	4.20	0.028	V	14.2(22.8)
GSP	34.2450	118.4710	01/18/1994	155144.9	12.0	4.00	0.024	IV	14.2(22.9)
DMG	33.8830	118.3170	03/11/1933	1457 0.0	0.0	4.90	0.048	VI	14.4(23.2)
GSP	33.9220	118.2700	10/28/2001	162745.6	21.0	4.00	0.023	IV	14.7(23.7)
GSP	34.2540	118.5450	01/17/1994	130627.9	0.0	4.60	0.035	V	15.2(24.5)
GSP	34.2610	118.5340	01/17/1994	123939.8	14.0	4.50	0.032	V	15.6(25.1)
DMG	34.2680	118.4450	08/30/1964	225737.1	15.4	4.00	0.020	IV	16.0(25.7)
DMG	34.2730	118.5320	06/21/1971	16 1 8.5	4.1	4.00	0.020	IV	16.4(26.3)
DMG	34.2650	118.5770	04/15/1971	111432.0	4.2	4.20	0.023	IV	16.5(26.5)
MGI	33.8000	118.5000	06/18/1915	15 5 0.0	0.0	4.00	0.020	IV	16.5(26.6)
MGI	34.0000	118.2000	06/26/1917	2120 0.0	0.0	4.60	0.032	V	16.5(26.6)
MGI	34.0000	118.2000	06/26/1917	2115 0.0	0.0	4.60	0.032	V	16.5(26.6)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]

MGI	34.0000	118.2000	06/26/1917	424 0.0	0.0	4.00	0.020	IV	16.5(26.6)
MGI	34.0000	118.2000	06/26/1917	2130 0.0	0.0	4.60	0.032	V	16.5(26.6)
MGI	34.0000	118.2000	02/13/1917	13 5 0.0	0.0	4.60	0.032	V	16.5(26.6)
GSP	34.2690	118.5760	01/17/1994	125546.8	16.0	4.10	0.021	IV	16.7(26.9)
GSP	34.2740	118.5630	01/27/1994	171958.8	14.0	4.60	0.031	V	16.8(27.1)
MGI	34.1000	118.2000	04/21/1921	1538 0.0	0.0	4.00	0.019	IV	16.8(27.1)
MGI	34.1000	118.2000	01/27/1860	830 0.0	0.0	4.30	0.024	V	16.8(27.1)
MGI	34.1000	118.2000	05/02/1916	1432 0.0	0.0	4.00	0.019	IV	16.8(27.1)
DMG	34.2840	118.5280	04/02/1971	54025.0	3.0	4.00	0.019	IV	17.1(27.5)
DMG	34.2860	118.5150	03/31/1971	145222.5	2.1	4.60	0.030	V	17.1(27.6)
GSP	34.2870	118.4660	01/19/1994	071406.2	11.0	4.00	0.019	IV	17.1(27.6)
GSP	34.2910	118.4760	02/06/1994	131926.9	11.0	4.10	0.020	IV	17.4(28.0)
DMG	33.9390	118.2050	01/11/1950	214135.0	0.4	4.10	0.020	IV	17.5(28.1)
GSP	34.0300	118.1800	06/12/1989	165718.4	16.0	4.40	0.025	V	17.5(28.1)
GSP	34.2920	118.4660	01/19/1994	144635.2	6.0	4.00	0.018	IV	17.5(28.1)
GSP	34.0200	118.1800	06/12/1989	172225.5	16.0	4.10	0.020	IV	17.5(28.2)
GSP	34.2840	118.4040	01/14/2001	022614.1	8.0	4.30	0.023	IV	17.5(28.2)
DMG	34.2960	118.4640	03/30/1971	85443.3	2.6	4.10	0.019	IV	17.8(28.6)
GSP	34.2970	118.4580	01/21/1994	185344.6	7.0	4.30	0.022	IV	17.9(28.8)
GSP	34.2890	118.4030	01/14/2001	025053.7	8.0	4.00	0.018	IV	17.9(28.8)
GSP	34.2780	118.6110	01/29/1994	121656.4	2.0	4.30	0.022	IV	18.0(29.0)
GSB	34.3000	118.4660	01/21/1994	183915.3	10.0	4.70	0.031	V	18.0(29.0)
DMG	33.8500	118.2670	03/11/1933	629 0.0	0.0	4.40	0.024	V	18.1(29.1)
DMG	33.8500	118.2670	03/11/1933	1425 0.0	0.0	5.00	0.039	V	18.1(29.1)
DMG	33.7830	118.4170	11/02/1940	25826.0	0.0	4.00	0.017	IV	18.1(29.1)
DMG	33.7830	118.4170	10/12/1940	024 0.0	0.0	4.00	0.017	IV	18.1(29.1)
DMG	33.7830	118.4170	10/14/1940	205111.0	0.0	4.00	0.017	IV	18.1(29.1)
DMG	33.7830	118.4170	11/01/1940	725 3.0	0.0	4.00	0.017	IV	18.1(29.1)
GSP	34.2990	118.4390	02/03/1994	162335.4	8.0	4.20	0.020	IV	18.1(29.2)
GSP	34.3010	118.4520	01/21/1994	185244.2	7.0	4.30	0.022	IV	18.2(29.3)
GSB	34.2990	118.4280	01/23/1994	085508.7	6.0	4.20	0.020	IV	18.2(29.3)
GSP	34.3040	118.4730	01/17/1994	150703.2	2.0	4.20	0.020	IV	18.3(29.4)
GSP	34.2930	118.3890	12/06/1994	034834.5	9.0	4.50	0.025	V	18.4(29.6)
DMG	34.1000	118.8000	05/10/1911	1340 0.0	0.0	4.00	0.017	IV	18.5(29.8)
DMG	33.7700	118.4800	04/24/1931	182754.8	0.0	4.40	0.023	IV	18.6(29.9)
GSB	34.3010	118.5650	01/17/1994	204602.4	9.0	5.20	0.044	VI	18.6(30.0)
DMG	34.3080	118.4540	02/09/1971	144346.7	6.2	5.20	0.044	VI	18.6(30.0)
GSB	34.3100	118.4740	01/21/1994	184228.8	7.0	4.20	0.019	IV	18.7(30.1)
GSB	34.2850	118.6240	01/17/1994	135602.4	19.0	4.70	0.029	V	18.7(30.2)
GSP	34.3110	118.4560	01/17/1994	193534.3	2.0	4.00	0.016	IV	18.8(30.3)
DMG	33.7670	118.4500	10/11/1940	55712.3	0.0	4.70	0.029	V	18.9(30.4)
MGI	33.9000	118.2000	10/08/1927	1914 0.0	0.0	4.60	0.026	V	18.9(30.5)
GSP	34.3050	118.5790	01/29/1994	112036.0	1.0	5.10	0.039	V	19.1(30.8)
DMG	34.3000	118.6000	04/04/1893	1940 0.0	0.0	6.00	0.081	VII	19.2(30.8)
GSP	34.3170	118.4550	01/17/1994	132644.7	2.0	4.70	0.028	V	19.3(31.0)
DMG	33.8670	118.2170	06/19/1944	3 6 7.0	0.0	4.40	0.022	IV	19.4(31.2)
DMG	33.8670	118.2170	06/19/1944	0 333.0	0.0	4.50	0.024	IV	19.4(31.2)
GSP	34.3110	118.3980	06/15/1994	055948.6	7.0	4.20	0.018	IV	19.4(31.2)
GSP	34.3120	118.3930	05/25/1994	125657.1	7.0	4.40	0.022	IV	19.6(31.5)
GSP	34.3000	118.6200	08/09/2007	075849.0	4.0	4.40	0.021	IV	19.6(31.5)

DMG	33.8000	118.3000	11/03/1931	16 5 0.0	0.0	4.00	0.016	IV	19.6(31.6)
MGI	33.8000	118.3000	12/31/1928	1045 0.0	0.0	4.00	0.016	IV	19.6(31.6)
GSB	34.3190	118.5580	01/18/1994	132444.1	1.0	4.50	0.023	IV	19.8(31.8)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
T-A	34.1700	118.1700	03/07/1888	1554 0.0	0.0	4.30	0.019	IV	20.1(32.4)
DMG	33.8670	118.2000	11/13/1933	2128 0.0	0.0	4.00	0.015	IV	20.2(32.5)
GSP	34.3310	118.4420	01/17/1994	141430.3	1.0	4.50	0.022	IV	20.3(32.7)
GSG	34.3340	118.4840	01/17/1994	223152.1	10.0	4.20	0.017	IV	20.4(32.8)
GSP	34.3390	118.4750	09/01/2011	204708.0	7.0	4.20	0.017	IV	20.7(33.3)
DMG	33.9500	118.1330	10/25/1933	7 046.0	0.0	4.30	0.018	IV	21.1(33.9)
PAS	34.1490	118.1350	12/03/1988	113826.4	13.3	4.90	0.028	V	21.4(34.4)
GSB	34.3450	118.5520	01/24/1994	041518.8	6.0	4.80	0.026	V	21.5(34.5)
DMG	33.8170	118.2170	10/22/1941	65718.5	0.0	4.90	0.028	V	21.7(34.9)
DMG	34.3530	118.4560	03/07/1971	13340.5	3.3	4.50	0.020	IV	21.7(35.0)
GSB	34.3330	118.6230	01/18/1994	072356.0	14.0	4.30	0.017	IV	21.8(35.0)
DMG	34.3560	118.4740	03/25/1971	2254 9.9	4.6	4.20	0.016	IV	21.9(35.2)
GSP	34.3570	118.4800	02/25/1994	125912.6	1.0	4.10	0.014	IV	21.9(35.3)
PAS	34.0490	118.1010	10/01/1987	144541.5	13.6	4.70	0.023	IV	22.0(35.4)
PAS	34.0600	118.1000	10/01/1987	1449 5.9	11.7	4.70	0.023	IV	22.1(35.5)
DMG	34.3610	118.4870	02/10/1971	143526.7	4.4	4.20	0.015	IV	22.2(35.8)
DMG	33.7830	118.2500	11/14/1941	84136.3	0.0	5.40	0.041	V	22.2(35.8)
DMG	34.3350	118.3310	02/09/1971	155820.7	14.2	4.80	0.025	V	22.2(35.8)
PAS	34.0730	118.0980	10/04/1987	105938.2	8.2	5.30	0.037	V	22.3(35.8)
DMG	34.3570	118.4060	02/09/1971	141950.2	11.8	4.00	0.013	III	22.4(36.1)
MGI	34.1000	118.1000	07/11/1855	415 0.0	0.0	6.30	0.082	VII	22.4(36.1)
DMG	34.3390	118.3320	02/09/1971	141612.9	11.1	4.10	0.014	IV	22.5(36.2)
PAS	34.0520	118.0900	10/01/1987	151231.8	10.8	4.70	0.022	IV	22.6(36.4)
GSB	34.3600	118.5710	01/19/1994	044048.0	2.0	4.50	0.019	IV	22.7(36.5)
PAS	34.0760	118.0900	10/01/1987	1448 3.1	11.7	4.10	0.014	III	22.7(36.6)
DMG	34.3440	118.6360	02/09/1971	143436.1	-2.0	4.90	0.026	V	22.7(36.6)
GSG	34.3040	118.7220	01/17/1994	221922.3	10.0	4.00	0.013	III	22.7(36.6)
PAS	34.0500	118.0870	10/01/1987	155953.5	10.4	4.00	0.013	III	22.8(36.7)
GSP	34.0690	118.8820	05/02/2009	011113.7	14.0	4.40	0.017	IV	22.8(36.7)
GSP	34.3740	118.4950	01/28/1994	200953.4	0.0	4.20	0.015	IV	23.1(37.2)
GSP	34.3260	118.6980	01/17/1994	233330.7	9.0	5.60	0.045	VI	23.2(37.4)
GSP	34.3040	118.7370	01/19/1994	091310.9	13.0	4.10	0.013	III	23.3(37.4)
PAS	34.0610	118.0790	10/01/1987	144220.0	9.5	5.90	0.057	VI	23.3(37.5)

GSP	33.9920	118.0820	03/16/2010	110400.2	18.0	4.40	0.017	IV	23.3(37.5)
GSB	34.3580	118.6220	01/18/1994	040126.8	1.0	4.50	0.018	IV	23.4(37.6)
GSB	34.3430	118.6660	01/17/1994	234925.4	8.0	4.30	0.016	IV	23.4(37.6)
PAS	34.3470	118.6560	04/08/1976	152138.1	14.5	4.60	0.020	IV	23.4(37.6)
DMG	33.7590	118.2530	08/31/1938	31814.2	10.0	4.50	0.018	IV	23.5(37.8)
GSP	34.3620	118.6150	03/20/1996	073759.8	13.0	4.10	0.013	III	23.5(37.8)
GSP	34.3590	118.6290	01/24/1994	055024.3	12.0	4.30	0.015	IV	23.6(37.9)
PAS	34.3800	118.4590	08/12/1977	21926.1	9.5	4.50	0.018	IV	23.6(37.9)
GSP	34.3630	118.6270	01/24/1994	055421.1	10.0	4.20	0.014	IV	23.8(38.3)
GSP	34.3790	118.5610	01/18/1994	152346.9	7.0	4.80	0.023	IV	23.9(38.4)
DMG	34.3840	118.4550	02/10/1971	113134.6	6.0	4.20	0.014	IV	23.9(38.4)
GSP	34.3790	118.5630	01/18/1994	003935.0	7.0	4.40	0.016	IV	23.9(38.4)
DMG	33.9000	118.1000	07/08/1929	1646 6.7	13.0	4.70	0.021	IV	24.0(38.7)
DMG	33.7830	118.2000	12/27/1939	192849.0	0.0	4.70	0.021	IV	24.1(38.7)
GSP	34.3610	118.6570	01/29/2002	055328.9	14.0	4.20	0.014	III	24.3(39.1)
GSP	34.3680	118.6370	01/17/1994	194353.4	13.0	4.10	0.013	III	24.3(39.1)
GSP	34.3740	118.6220	01/17/1994	155410.8	12.0	4.80	0.022	IV	24.4(39.3)
DMG	34.3610	118.3060	02/09/1971	141021.5	5.0	4.70	0.020	IV	24.5(39.4)
DMG	34.3920	118.4270	02/21/1971	71511.7	7.2	4.50	0.017	IV	24.6(39.6)
GSP	34.3780	118.6180	01/19/1994	211144.9	11.0	5.10	0.028	V	24.6(39.6)

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FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
GSP	34.0490	118.9150	02/19/1995	212418.1	15.0	4.30	0.014	IV	24.6(39.6)
DMG	34.3680	118.3140	04/25/1971	1448 6.5	-2.0	4.00	0.011	III	24.7(39.8)
DMG	34.3800	118.6230	10/29/1936	223536.1	10.0	4.00	0.011	III	24.8(39.9)
DMG	34.3970	118.4390	02/21/1971	55052.6	6.9	4.70	0.020	IV	24.8(40.0)
DMG	34.3990	118.4730	03/09/1974	05431.9	24.4	4.70	0.020	IV	24.9(40.0)
DMG	34.3870	118.3640	02/09/1971	143917.8	-1.6	4.00	0.011	III	25.0(40.2)
GSP	34.3540	118.7040	05/01/1996	194956.4	14.0	4.10	0.012	III	25.1(40.4)
DMG	34.3700	118.3020	02/10/1971	31212.0	0.8	4.00	0.011	III	25.1(40.4)
DMG	34.3990	118.4190	02/10/1971	134953.7	9.7	4.30	0.014	IV	25.1(40.4)
GSP	34.3770	118.6490	04/27/1997	110928.4	15.0	4.80	0.021	IV	25.1(40.4)
GSP	34.3690	118.6720	04/26/1997	103730.7	16.0	5.10	0.027	V	25.1(40.5)
PAS	34.0770	118.0470	02/11/1988	152555.7	12.5	4.70	0.019	IV	25.2(40.5)
DMG	33.9670	118.0500	01/30/1941	13446.9	0.0	4.10	0.012	III	25.4(40.9)
DMG	34.3960	118.3660	02/10/1971	173855.1	6.2	4.20	0.013	III	25.6(41.1)
GSP	34.3970	118.6090	07/22/1999	095724.0	11.0	4.00	0.011	III	25.7(41.4)
GSG	34.4080	118.5590	01/17/1994	200205.4	0.0	4.00	0.011	III	25.8(41.5)

GSP	34.3650	118.7080	01/19/1994	044314.5	12.0	4.10	0.012	III	25.8(41.6)
DMG	34.4110	118.4010	02/09/1971	141028.0	8.0	5.30	0.030	V	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 325.0	8.0	4.40	0.014	IV	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 444.0	8.0	4.10	0.011	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 853.0	8.0	4.60	0.017	IV	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 446.0	8.0	4.20	0.012	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 8 7.0	8.0	4.20	0.012	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 244.0	8.0	5.80	0.045	VI	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 1 8.0	8.0	5.80	0.045	VI	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 4 7.0	8.0	4.10	0.011	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 346.0	8.0	4.10	0.011	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 154.0	8.0	4.20	0.012	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 745.0	8.0	4.50	0.016	IV	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 2 3.0	8.0	4.10	0.011	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 159.0	8.0	4.10	0.011	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 230.0	8.0	4.30	0.013	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 231.0	8.0	4.70	0.018	IV	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 041.8	8.4	6.40	0.072	VI	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 710.0	8.0	4.00	0.010	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 8 4.0	8.0	4.00	0.010	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 133.0	8.0	4.20	0.012	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 439.0	8.0	4.10	0.011	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 434.0	8.0	4.20	0.012	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 140.0	8.0	4.10	0.011	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 541.0	8.0	4.10	0.011	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 838.0	8.0	4.50	0.016	IV	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 150.0	8.0	4.50	0.016	IV	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 730.0	8.0	4.00	0.010	III	26.1(42.0)
DMG	34.4110	118.4010	02/09/1971	14 550.0	8.0	4.10	0.011	III	26.1(42.0)
DMG	33.6630	118.4130	01/08/1967	738 5.3	17.7	4.00	0.010	III	26.3(42.3)
GSP	34.3770	118.6980	01/18/1994	004308.9	11.0	5.20	0.027	V	26.3(42.3)
DMG	33.7500	118.1830	08/04/1933	41748.0	0.0	4.00	0.010	III	26.4(42.5)
GSP	34.3940	118.6690	06/26/1995	084028.9	13.0	5.00	0.023	IV	26.7(42.9)
GSB	34.3790	118.7110	01/19/1994	210928.6	14.0	5.50	0.034	V	26.8(43.1)
DMG	33.7830	118.1330	01/13/1940	749 7.0	0.0	4.00	0.010	III	26.8(43.2)
DMG	33.7830	118.1330	11/20/1933	1032 0.0	0.0	4.00	0.010	III	26.8(43.2)
DMG	33.7830	118.1330	10/02/1933	91017.6	0.0	5.40	0.031	V	26.8(43.2)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]

DMG	34.4260	118.4140	02/10/1971	518 7.2	5.8	4.50	0.015	IV	27.0(43.5)
DMG	33.7500	118.1670	05/16/1933	205855.0	0.0	4.00	0.010	III	27.0(43.5)
GSP	33.6583	118.3722	05/15/2013	200006.2	1.1	4.08	0.011	III	27.1(43.6)
DMG	34.4280	118.4130	04/01/1971	15 3 3.6	8.0	4.10	0.011	III	27.2(43.7)
DMG	34.4110	118.3290	02/10/1971	5 636.0	4.7	4.30	0.013	III	27.2(43.7)
PAS	34.0540	118.9640	04/13/1982	11 212.2	16.6	4.00	0.010	III	27.4(44.1)
DMG	34.0170	118.9670	04/16/1948	222624.0	0.0	4.70	0.017	IV	27.6(44.4)
DMG	34.4330	118.3980	02/09/1971	144017.4	-2.0	4.10	0.010	III	27.6(44.5)
DMG	34.4310	118.3690	08/14/1974	144555.2	8.2	4.20	0.011	III	27.9(44.8)
MGI	34.0000	118.0000	12/25/1903	1745 0.0	0.0	5.00	0.021	IV	27.9(44.9)
MGI	34.0000	118.0000	05/05/1929	735 0.0	0.0	4.00	0.010	III	27.9(44.9)
MGI	34.0000	118.0000	05/05/1929	1 7 0.0	0.0	4.60	0.015	IV	27.9(44.9)
MGI	34.1000	118.0000	01/27/1930	2026 0.0	0.0	4.60	0.015	IV	28.1(45.2)
DMG	33.6320	118.4670	01/08/1967	73730.4	11.4	4.00	0.009	III	28.1(45.3)
DMG	34.4460	118.4360	02/10/1971	185441.7	8.1	4.20	0.011	III	28.2(45.4)
DMG	33.7670	118.1170	11/04/1939	2141 0.0	0.0	4.00	0.009	III	28.2(45.5)
DMG	33.7500	118.1330	03/11/1933	11 4 0.0	0.0	4.60	0.015	IV	28.4(45.7)
DMG	33.6330	118.4000	10/17/1934	938 0.0	0.0	4.00	0.009	III	28.5(45.8)
PAS	34.0160	118.9880	10/26/1984	172043.5	13.3	4.60	0.015	IV	28.8(46.4)
DMG	34.4570	118.4270	02/09/1971	161926.5	-1.0	4.20	0.011	III	29.0(46.7)
DMG	33.9960	117.9750	06/15/1967	458 5.5	10.0	4.10	0.010	III	29.3(47.2)
PAS	34.4630	118.4090	09/24/1977	212824.3	5.0	4.20	0.010	III	29.6(47.6)
DMG	34.0000	119.0000	09/24/1827	4 0 0.0	0.0	7.00	0.096	VII	29.6(47.6)
MGI	34.0000	119.0000	12/14/1912	0 0 0.0	0.0	5.70	0.035	V	29.6(47.6)
MGI	34.2000	118.0000	01/09/1921	530 0.0	0.0	4.60	0.014	IV	29.9(48.1)
DMG	33.7500	118.0830	03/11/1933	2231 0.0	0.0	4.40	0.012	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	1956 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	521 0.0	0.0	4.40	0.012	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	258 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	440 0.0	0.0	4.70	0.015	IV	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	910 0.0	0.0	5.10	0.020	IV	30.5(49.1)
DMG	33.7500	118.0830	03/15/1933	2 8 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	926 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	211 0.0	0.0	4.40	0.012	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	1944 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	553 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	555 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	3 9 0.0	0.0	4.40	0.012	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	22 0 0.0	0.0	4.40	0.012	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	230 0.0	0.0	5.10	0.020	IV	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	257 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	1653 0.0	0.0	4.80	0.016	IV	30.5(49.1)
DMG	33.7500	118.0830	03/12/1933	034 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	259 0.0	0.0	4.60	0.014	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	216 0.0	0.0	4.80	0.016	IV	30.5(49.1)
DMG	33.7500	118.0830	03/14/1933	036 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/14/1933	1219 0.0	0.0	4.50	0.013	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	227 0.0	0.0	4.60	0.014	III	30.5(49.1)
DMG	33.7500	118.0830	03/12/1933	740 0.0	0.0	4.20	0.010	III	30.5(49.1)

DMG	33.7500	118.0830	03/11/1933	252 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/12/1933	15 2 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	347 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	3 5 0.0	0.0	4.20	0.010	III	30.5(49.1)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	33.7500	118.0830	03/11/1933	1045 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/16/1933	1456 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/16/1933	1530 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	513 0.0	0.0	4.70	0.015	IV	30.5(49.1)
DMG	33.7500	118.0830	04/01/1933	642 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	515 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/15/1933	540 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	524 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	436 0.0	0.0	4.60	0.014	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	8 8 0.0	0.0	4.50	0.013	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	439 0.0	0.0	4.90	0.017	IV	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	832 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/31/1933	1049 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	210 0.0	0.0	4.60	0.014	III	30.5(49.1)
DMG	33.7500	118.0830	04/02/1933	1536 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/21/1933	326 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/13/1933	1532 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/12/1933	1651 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	11 0 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	311 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	2 4 0.0	0.0	4.90	0.017	IV	30.5(49.1)
DMG	33.7500	118.0830	03/12/1933	616 0.0	0.0	4.60	0.014	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	23 5 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	911 0.0	0.0	4.40	0.012	III	30.5(49.1)
DMG	33.7500	118.0830	03/15/1933	432 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/13/1933	1929 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/12/1933	448 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	1357 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/12/1933	6 1 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/14/1933	2242 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	2240 0.0	0.0	4.40	0.012	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	1547 0.0	0.0	4.00	0.008	III	30.5(49.1)

DMG	33.7500	118.0830	03/11/1933	2 9 0.0	0.0	5.00	0.019	IV	30.5(49.1)
DMG	33.7500	118.0830	03/12/1933	027 0.0	0.0	4.40	0.012	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	1025 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/12/1933	1738 0.0	0.0	4.50	0.013	III	30.5(49.1)
DMG	33.7500	118.0830	03/16/1933	1529 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	2232 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	837 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/19/1933	2123 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/12/1933	835 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	04/02/1933	8 0 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	1147 0.0	0.0	4.40	0.012	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	759 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	222 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/25/1933	1346 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/17/1933	1651 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/18/1933	2052 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	2 5 0.0	0.0	4.30	0.011	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	1141 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	339 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/20/1933	1358 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/23/1933	840 0.0	0.0	4.10	0.009	III	30.5(49.1)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	33.7500	118.0830	03/12/1933	1825 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/12/1933	546 0.0	0.0	4.40	0.012	III	30.5(49.1)
DMG	33.7500	118.0830	03/12/1933	2128 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	611 0.0	0.0	4.40	0.012	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	618 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	336 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/13/1933	432 0.0	0.0	4.70	0.015	IV	30.5(49.1)
DMG	33.7500	118.0830	03/13/1933	131828.0	0.0	5.30	0.024	V	30.5(49.1)
DMG	33.7500	118.0830	03/30/1933	1225 0.0	0.0	4.40	0.012	III	30.5(49.1)
DMG	33.7500	118.0830	03/13/1933	617 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/23/1933	1831 0.0	0.0	4.10	0.009	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	1138 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	323 0.0	0.0	5.00	0.019	IV	30.5(49.1)
DMG	33.7500	118.0830	03/12/1933	2354 0.0	0.0	4.50	0.013	III	30.5(49.1)
DMG	33.7500	118.0830	03/13/1933	343 0.0	0.0	4.10	0.009	III	30.5(49.1)

DMG	33.7500	118.0830	03/11/1933	751 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	1129 0.0	0.0	4.00	0.008	III	30.5(49.1)
DMG	33.7500	118.0830	03/11/1933	635 0.0	0.0	4.20	0.010	III	30.5(49.1)
DMG	33.7330	118.1000	03/11/1933	15 9 0.0	0.0	4.40	0.012	III	30.6(49.2)
DMG	33.7330	118.1000	03/11/1933	1350 0.0	0.0	4.40	0.012	III	30.6(49.2)
DMG	33.7330	118.1000	03/11/1933	1447 0.0	0.0	4.40	0.012	III	30.6(49.2)
DMG	34.4850	118.5210	07/16/1965	74622.4	15.1	4.00	0.008	III	30.9(49.6)
DMG	34.0650	119.0350	02/21/1973	144557.3	8.0	5.90	0.037	V	31.5(50.7)
GSP	34.2620	118.0020	06/28/1991	144354.5	11.0	5.40	0.025	V	31.6(50.9)
GSP	34.2500	117.9900	06/28/1991	170055.5	9.0	4.30	0.010	III	31.8(51.2)
GSP	34.5000	118.5600	07/05/1991	174157.1	11.0	4.10	0.008	III	32.1(51.7)
DMG	33.8000	118.0000	10/21/1913	938 0.0	0.0	4.00	0.008	II	32.3(52.0)
DMG	33.6330	118.2000	11/01/1940	20 046.0	0.0	4.00	0.008	II	32.5(52.2)
DMG	33.6300	118.2000	09/13/1929	132338.2	0.0	4.00	0.008	II	32.6(52.5)
DMG	34.4170	118.8330	06/01/1946	11 631.0	0.0	4.10	0.008	III	32.8(52.8)
DMG	33.9900	119.0580	05/29/1955	164335.4	17.4	4.10	0.008	III	33.0(53.0)
GSP	33.9325	117.9158	03/29/2014	040942.2	5.1	5.10	0.018	IV	33.4(53.8)
DMG	33.7000	118.0670	03/11/1933	85457.0	0.0	5.10	0.018	IV	33.5(53.9)
DMG	33.7000	118.0670	07/20/1940	4 113.0	0.0	4.00	0.007	II	33.5(53.9)
DMG	33.7000	118.0670	02/08/1940	165617.0	0.0	4.00	0.007	II	33.5(53.9)
DMG	33.7000	118.0670	03/11/1933	51022.0	0.0	5.10	0.018	IV	33.5(53.9)
DMG	33.7500	118.0000	11/16/1934	2126 0.0	0.0	4.00	0.007	II	34.2(55.1)
GSP	33.9613	117.8923	03/29/2014	213245.9	9.3	4.14	0.008	III	34.4(55.3)
PAS	33.9650	117.8860	01/01/1976	172012.9	6.2	4.20	0.008	III	34.7(55.8)
DMG	34.5290	118.6440	02/07/1956	21656.5	16.0	4.20	0.008	III	35.0(56.3)
DMG	33.6830	118.0500	03/11/1933	1250 0.0	0.0	4.40	0.010	III	35.0(56.4)
DMG	33.6830	118.0500	03/11/1933	658 3.0	0.0	5.50	0.023	IV	35.0(56.4)
DMG	34.2000	117.9000	07/13/1935	105416.5	0.0	4.70	0.012	III	35.2(56.7)
DMG	34.2000	117.9000	08/28/1889	215 0.0	0.0	5.50	0.023	IV	35.2(56.7)
DMG	33.5430	118.3400	09/14/1963	35116.2	2.2	4.20	0.008	III	35.2(56.7)
DMG	33.6170	118.1170	01/20/1934	2117 0.0	0.0	4.50	0.010	III	36.0(57.9)
T-A	34.4200	118.9200	03/29/1917	8 6 0.0	0.0	4.30	0.008	III	36.2(58.2)
DMG	34.5190	118.1980	08/23/1952	10 9 7.1	13.1	5.00	0.014	IV	37.0(59.5)
DMG	33.6710	118.0120	10/20/1961	223534.2	5.6	4.10	0.007	II	37.2(59.8)
MGI	33.8000	117.9000	05/22/1902	740 0.0	0.0	4.30	0.008	III	37.4(60.1)
DMG	33.6800	117.9930	11/20/1961	85334.7	4.4	4.00	0.006	II	37.6(60.4)
PAS	33.5380	118.2070	05/25/1982	134430.3	13.7	4.10	0.007	II	38.1(61.3)
DMG	34.5860	118.6130	02/07/1956	31638.6	2.6	4.60	0.010	III	38.5(61.9)

EARTHQUAKE SEARCH RESULTS

FILE	LAT.	LONG.	DATE	TIME (UTC)	DEPTH	QUAKE	SITE ACC.	SITE MM	APPROX. DISTANCE

CODE	NORTH	WEST		H M Sec	(km)	MAG.	g	INT.	mi [km]
DMG	33.6540	117.9940	10/20/1961	194950.5	4.6	4.30	0.008	II	38.7(62.3)
DMG	33.6650	117.9790	10/20/1961	214240.7	7.2	4.00	0.006	II	38.8(62.5)
DMG	33.6170	118.0330	05/21/1938	944 0.0	0.0	4.00	0.006	II	39.0(62.8)
DMG	33.6590	117.9810	10/20/1961	20 714.5	6.1	4.00	0.006	II	39.0(62.8)
PAS	34.3780	119.0350	04/03/1985	4 449.8	27.9	4.00	0.006	II	39.2(63.0)
DMG	34.1000	117.8000	03/31/1931	2033 0.0	0.0	4.00	0.006	II	39.4(63.4)
DMG	33.5000	118.2500	06/18/1920	10 8 0.0	0.0	4.50	0.009	III	39.6(63.7)
DMG	33.6170	118.0170	03/15/1933	111332.0	0.0	4.90	0.012	III	39.6(63.8)
DMG	33.6170	118.0170	03/14/1933	19 150.0	0.0	5.10	0.014	IV	39.6(63.8)
DMG	33.6170	118.0170	10/02/1933	1326 1.0	0.0	4.00	0.006	II	39.6(63.8)
PAS	33.9060	119.1660	05/23/1978	91650.8	6.0	4.00	0.006	II	40.1(64.5)
DMG	33.6000	118.0170	12/25/1935	1715 0.0	0.0	4.50	0.008	III	40.5(65.2)
GSP	33.6920	119.0580	05/30/2012	051400.8	16.0	4.00	0.006	II	40.7(65.4)
GSP	33.9090	117.7920	06/14/2012	031715.7	9.0	4.00	0.006	II	40.7(65.5)
GSP	33.9050	117.7920	08/08/2012	062334.1	10.0	4.50	0.008	III	40.7(65.6)
GSP	34.6173	118.6302	01/04/2015	031809.5	8.8	4.25	0.007	II	40.8(65.6)
GSP	33.9040	117.7910	08/08/2012	163322.1	10.0	4.50	0.008	III	40.8(65.7)
MGI	33.7000	117.9000	07/08/1902	945 0.0	0.0	4.00	0.006	II	40.9(65.8)
GSP	33.9070	117.7880	08/29/2012	203100.3	9.0	4.10	0.006	II	40.9(65.9)
DMG	33.5610	118.0580	01/15/1937	183547.0	10.0	4.00	0.006	II	41.1(66.2)
DMG	33.6000	118.0000	03/11/1933	217 0.0	0.0	4.50	0.008	III	41.1(66.2)
DMG	33.6000	118.0000	03/11/1933	231 0.0	0.0	4.40	0.008	II	41.1(66.2)
GSP	33.9170	117.7760	09/03/2002	070851.9	12.0	4.80	0.010	III	41.5(66.7)
DMG	33.6170	117.9670	03/11/1933	154 7.8	0.0	6.30	0.035	V	41.6(67.0)
PAS	33.6300	119.0200	10/23/1981	172816.9	12.0	4.60	0.009	III	41.7(67.1)
DMG	34.4830	118.9830	09/03/1942	14 6 1.0	0.0	4.50	0.008	III	41.8(67.2)
DMG	34.4830	118.9830	09/04/1942	63433.0	0.0	4.50	0.008	III	41.8(67.2)
GSG	33.9530	117.7610	07/29/2008	184215.7	14.0	5.30	0.015	IV	41.9(67.4)
DMG	34.5650	118.1130	02/28/1969	45612.4	5.3	4.30	0.007	II	42.1(67.7)
DMG	33.5170	118.1000	03/22/1941	82240.0	0.0	4.00	0.005	II	42.3(68.0)
MGI	34.2000	119.2000	06/16/1914	1052 0.0	0.0	4.60	0.009	III	42.3(68.1)
DMG	34.1180	119.2200	03/18/1957	185628.0	13.8	4.70	0.009	III	42.4(68.2)
MGI	33.8000	117.8000	11/10/1926	1723 0.0	0.0	4.60	0.009	III	42.6(68.5)
MGI	33.8000	117.8000	05/19/1917	635 0.0	0.0	4.00	0.005	II	42.6(68.5)
MGI	33.8000	117.8000	11/09/1926	1535 0.0	0.0	4.60	0.009	III	42.6(68.5)
MGI	33.8000	117.8000	11/07/1926	1948 0.0	0.0	4.60	0.009	III	42.6(68.5)
MGI	33.8000	117.8000	11/04/1926	2238 0.0	0.0	4.60	0.009	III	42.6(68.5)
MGI	33.8000	117.8000	05/20/1917	945 0.0	0.0	4.00	0.005	II	42.6(68.5)
MGI	33.8000	117.8000	05/19/1917	719 0.0	0.0	4.00	0.005	II	42.6(68.5)
DMG	33.7670	117.8170	08/22/1936	521 0.0	0.0	4.00	0.005	II	42.6(68.6)
GSP	33.9550	117.7460	12/14/2001	120135.5	13.0	4.00	0.005	II	42.7(68.7)
PAS	34.0060	117.7390	02/18/1989	717 4.8	3.3	4.30	0.007	II	42.8(68.8)
PAS	33.6370	119.0560	10/23/1981	191552.5	6.3	4.60	0.008	III	42.9(69.1)
DMG	33.5750	117.9830	03/11/1933	518 4.0	0.0	5.20	0.014	III	43.1(69.3)
DMG	33.5670	117.9830	04/17/1934	1833 0.0	0.0	4.00	0.005	II	43.5(70.0)
DMG	33.5670	117.9830	07/07/1937	1112 0.0	0.0	4.00	0.005	II	43.5(70.0)
PAS	33.5080	118.0710	11/20/1988	53928.7	6.0	4.50	0.008	II	43.7(70.3)
DMG	33.8540	117.7520	10/04/1961	22131.6	4.3	4.10	0.005	II	43.9(70.6)

PAS	33.6710	119.1110	09/04/1981	155050.3	5.0	5.30	0.014	IV	44.0(70.8)
GSP	34.1100	117.7200	04/17/1990	223227.2	4.0	4.60	0.008	III	44.0(70.8)
GSP	33.6200	117.9000	04/07/1989	200730.2	13.0	4.50	0.007	II	44.3(71.3)
GSP	34.1500	117.7200	03/01/1990	032303.0	11.0	4.70	0.009	III	44.4(71.5)
GSP	33.9510	117.7090	01/05/1998	181406.5	11.0	4.30	0.006	II	44.8(72.2)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
PAS	34.1360	117.7090	06/26/1988	15 458.5	7.9	4.60	0.008	II	44.9(72.2)
MGI	34.0000	117.7000	12/03/1929	9 5 0.0	0.0	4.00	0.005	II	45.0(72.4)
PAS	34.5410	118.9890	06/12/1984	02752.4	11.7	4.10	0.005	II	45.0(72.4)
GSP	34.1300	117.7000	03/01/1990	003457.1	4.0	4.00	0.005	II	45.3(72.9)
DMG	34.6000	118.9000	05/18/1940	91512.0	0.0	4.00	0.005	II	45.4(73.0)
GSP	34.1400	117.7000	02/28/1990	234336.6	5.0	5.20	0.013	III	45.4(73.1)
GSP	34.1400	117.6900	03/02/1990	172625.4	6.0	4.60	0.008	II	46.0(74.0)
DMG	34.1000	117.6830	01/18/1934	214 0.0	0.0	4.00	0.005	II	46.1(74.1)
DMG	34.1000	117.6830	01/09/1934	1410 0.0	0.0	4.50	0.007	II	46.1(74.1)
PAS	33.4710	118.0610	02/27/1984	101815.0	6.0	4.00	0.005	II	46.2(74.3)
DMG	34.4000	117.8000	02/24/1946	6 752.0	0.0	4.10	0.005	II	46.4(74.6)
DMG	33.6040	119.1050	03/25/1956	332 2.3	8.2	4.20	0.005	II	46.5(74.9)
GSP	33.8060	117.7150	03/07/2000	002028.2	11.0	4.00	0.005	II	47.0(75.6)
GSP	34.5217	119.0748	03/12/2016	084240.3	19.3	4.13	0.005	II	47.3(76.2)
DMG	34.6670	118.8330	01/24/1950	215659.0	0.0	4.00	0.004	I	47.7(76.7)
GSP	33.5150	119.0330	08/24/2010	054216.9	16.0	4.00	0.004	I	47.9(77.1)
DMG	34.5000	119.1170	11/17/1954	23 351.0	0.0	4.40	0.006	II	48.1(77.4)
GSP	34.4400	119.1830	05/08/2009	202714.0	7.0	4.10	0.005	II	48.5(78.1)
MGI	34.3000	119.3000	09/28/1926	1749 0.0	0.0	4.00	0.004	I	49.9(80.3)
MGI	34.3000	119.3000	05/15/1927	1120 0.0	0.0	4.00	0.004	I	49.9(80.3)
MGI	34.3000	119.3000	05/01/1904	1830 0.0	0.0	4.60	0.007	II	49.9(80.3)
DMG	34.1500	119.3500	08/22/1950	224758.0	0.0	4.20	0.005	II	50.0(80.5)
DMG	33.3670	118.1500	04/16/1942	72833.0	0.0	4.00	0.004	I	50.2(80.8)
DMG	33.5830	119.1830	02/10/1952	135055.0	0.0	4.00	0.004	I	50.9(82.0)
DMG	33.5450	117.8070	10/27/1969	1316 2.3	6.5	4.50	0.006	II	51.7(83.3)
DMG	33.9500	117.5830	04/11/1941	12024.0	0.0	4.00	0.004	I	52.0(83.7)
DMG	34.6170	119.0830	02/26/1950	0 622.0	0.0	4.70	0.007	II	52.5(84.5)
DMG	34.1000	119.4000	05/19/1893	035 0.0	0.0	5.50	0.013	III	52.5(84.5)
DMG	34.1830	117.5830	10/03/1948	24628.0	0.0	4.00	0.004	I	52.5(84.5)
MGI	34.4000	119.3000	08/12/1925	1845 0.0	0.0	4.00	0.004	I	52.8(84.9)
DMG	34.3700	117.6500	12/08/1812	15 0 0.0	0.0	7.00	0.043	VI	52.9(85.1)

GSP	34.3740	117.6490	08/20/1998	234958.4	9.0	4.40	0.005	II	53.0(85.4)
DMG	34.6830	119.0000	04/06/1943	223624.0	0.0	4.00	0.004	I	53.3(85.7)
DMG	33.8000	117.6000	09/16/1903	1210 0.0	0.0	4.00	0.004	I	53.3(85.8)
MGI	33.8000	117.6000	04/22/1918	2115 0.0	0.0	5.00	0.009	III	53.3(85.8)
DMG	34.3000	117.6000	07/30/1894	512 0.0	0.0	6.00	0.019	IV	53.7(86.4)
GSP	34.3850	117.6350	10/16/2007	085344.1	8.0	4.20	0.004	I	54.1(87.0)
DMG	34.7000	119.0000	10/23/1916	254 0.0	0.0	5.50	0.012	III	54.2(87.3)
DMG	34.7170	118.9670	06/11/1935	1810 0.0	0.0	4.00	0.004	I	54.3(87.3)
DMG	34.1830	117.5480	09/01/1937	163533.5	10.0	4.50	0.006	II	54.5(87.7)
DMG	33.4300	119.0960	10/31/1969	103929.0	7.3	4.80	0.007	II	54.8(88.1)
GSP	33.6660	119.3300	03/16/2002	213323.8	7.0	4.60	0.006	II	54.9(88.3)
DMG	34.1670	117.5330	03/01/1948	81213.0	0.0	4.70	0.006	II	55.1(88.7)
DMG	34.3040	117.5700	05/05/1969	16 2 9.6	8.8	4.40	0.005	II	55.4(89.1)
DMG	34.1270	117.5210	12/27/1938	10 928.6	10.0	4.00	0.004	I	55.5(89.3)
DMG	34.2110	117.5300	09/01/1937	1348 8.2	10.0	4.50	0.005	II	55.9(89.9)
PAS	34.2110	117.5300	10/19/1979	122237.8	4.9	4.10	0.004	I	55.9(89.9)
DMG	34.2810	117.5520	09/13/1970	44748.6	8.0	4.40	0.005	II	55.9(89.9)
DMG	34.1400	117.5150	01/01/1965	8 418.0	5.9	4.40	0.005	II	55.9(90.0)
DMG	34.2700	117.5400	09/12/1970	143053.0	8.0	5.40	0.011	III	56.3(90.6)
DMG	34.0000	117.5000	07/03/1908	1255 0.0	0.0	4.00	0.004	I	56.4(90.8)
MGI	34.0000	117.5000	12/16/1858	10 0 0.0	0.0	7.00	0.039	V	56.4(90.8)
DMG	34.7840	118.9020	07/27/1972	03117.4	8.0	4.40	0.005	II	56.6(91.2)

EARTHQUAKE SEARCH RESULTS

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FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
T-A	34.8300	118.7500	11/27/1852	0 0 0.0	0.0	7.00	0.039	V	56.6(91.2)
DMG	33.9860	119.4750	08/06/1973	232917.0	16.9	5.00	0.008	II	56.8(91.4)
DMG	34.2000	117.5000	06/14/1892	1325 0.0	0.0	4.90	0.007	II	57.4(92.4)
DMG	34.2670	117.5180	09/12/1970	141011.2	8.0	4.10	0.004	I	57.5(92.5)
DMG	34.1240	117.4800	05/15/1955	17 326.0	7.6	4.00	0.003	I	57.8(93.0)
DMG	34.1160	117.4750	06/28/1960	20 048.0	12.0	4.10	0.004	I	58.0(93.3)
DMG	34.0000	119.5000	03/19/1905	440 0.0	0.0	4.00	0.003	I	58.1(93.6)
MGI	34.0000	119.5000	05/03/1926	1353 0.0	0.0	4.30	0.004	I	58.1(93.6)
DMG	34.0000	119.5000	02/18/1926	1818 0.0	0.0	5.00	0.008	II	58.1(93.6)
GSP	34.4810	119.3530	10/23/1996	220929.4	14.0	4.20	0.004	I	58.2(93.6)
DMG	33.9170	119.5000	08/26/1954	1348 3.0	0.0	4.80	0.006	II	58.7(94.5)
GSP	34.1390	117.4650	03/09/2008	092232.1	3.0	4.00	0.003	I	58.7(94.5)
DMG	33.6820	117.5530	07/05/1938	18 655.7	10.0	4.50	0.005	II	58.9(94.7)
DMG	34.3000	117.5000	07/22/1899	2032 0.0	0.0	6.50	0.025	V	59.1(95.1)

GSP	34.3810	119.4350	07/24/2004	125519.9	3.0	4.30	0.004	I	59.1(95.2)
DMG	34.2170	117.4670	03/25/1941	234341.0	0.0	4.00	0.003	I	59.5(95.7)
PAS	34.1350	117.4480	01/08/1983	71930.4	4.6	4.10	0.004	I	59.7(96.0)
DMG	33.7170	117.5170	06/19/1935	1117 0.0	0.0	4.00	0.003	I	59.8(96.2)
DMG	34.2500	119.5000	04/21/1917	659 0.0	0.0	4.00	0.003	I	59.8(96.2)
DMG	34.2500	119.5000	04/13/1917	359 0.0	0.0	4.50	0.005	II	59.8(96.2)
DMG	33.3390	119.1040	10/24/1969	202642.5	-1.8	4.70	0.006	II	60.0(96.6)
GSP	34.1430	117.4425	01/15/2014	093518.9	2.9	4.43	0.005	I	60.0(96.6)
GSP	34.1250	117.4380	01/06/2005	143527.7	4.0	4.40	0.004	I	60.2(96.8)
DMG	33.7170	117.5070	08/06/1938	22 056.0	10.0	4.00	0.003	I	60.3(97.1)
DMG	33.6990	117.5110	05/31/1938	83455.4	10.0	5.50	0.011	III	60.6(97.5)
DMG	33.7250	117.4980	01/03/1956	02548.9	13.7	4.70	0.006	II	60.6(97.5)
DMG	34.1120	117.4260	03/19/1937	12338.4	10.0	4.00	0.003	I	60.8(97.8)
DMG	34.1320	117.4260	04/15/1965	20 833.3	5.5	4.50	0.005	II	60.9(98.0)
T-A	34.0000	117.4200	09/10/1920	1415 0.0	0.0	4.30	0.004	I	61.0(98.2)
T-A	34.0000	117.4200	04/12/1888	1315 0.0	0.0	4.30	0.004	I	61.0(98.2)
DMG	34.2670	119.5170	04/12/1944	153310.0	0.0	4.00	0.003	I	61.0(98.2)
DMG	33.7480	117.4790	06/22/1971	104119.0	8.0	4.20	0.004	I	61.1(98.3)
DMG	34.8670	118.8670	07/22/1952	74455.0	0.0	4.10	0.003	I	61.2(98.4)
DMG	34.3490	119.4920	07/14/1958	52555.3	16.0	4.70	0.005	II	61.4(98.7)
USG	34.4180	119.4680	09/07/1984	11 345.2	9.5	4.00	0.003	I	61.9(99.6)
DMG	34.8350	118.9880	11/29/1936	55445.3	10.0	4.00	0.003	I	62.0(99.7)
DMG	33.7330	117.4670	10/26/1954	162226.0	0.0	4.10	0.003	I	62.1(99.9)
GSP	33.7330	117.4660	09/02/2007	172914.0	2.0	4.70	0.005	II	62.1(100.0)
MGI	34.0000	117.4000	05/22/1907	652 0.0	0.0	4.60	0.005	II	62.2(100.0)
GSP	34.1910	117.4132	12/30/2015	014857.3	7.0	4.40	0.004	I	62.2(100.0)
DMG	34.8670	118.9330	09/21/1941	1953 7.2	0.0	5.20	0.008	III	62.6(100.7)
DMG	34.2000	117.4000	07/22/1899	046 0.0	0.0	5.50	0.010	III	63.0(101.4)
DMG	34.8000	119.1000	09/05/1883	1230 0.0	0.0	6.00	0.015	IV	63.1(101.6)
USG	34.1390	117.3860	02/21/1987	231530.1	2.6	4.07	0.003	I	63.2(101.7)
GSP	34.1900	117.3900	12/28/1989	094108.1	15.0	4.50	0.004	I	63.5(102.1)
DMG	34.8430	119.0260	03/07/1939	195331.8	10.0	4.00	0.003	I	63.5(102.1)
DMG	33.6670	119.5000	11/30/1939	64251.0	0.0	4.00	0.003	I	63.6(102.4)
DMG	33.8330	117.4000	06/05/1940	82727.0	0.0	4.00	0.003	I	63.8(102.6)
DMG	34.2670	119.5670	06/29/1968	191357.0	10.0	4.40	0.004	I	63.8(102.6)
DMG	34.9000	118.9000	10/23/1916	244 0.0	0.0	6.00	0.015	IV	64.0(102.9)
PAS	34.9430	118.7430	06/10/1988	23 643.0	6.8	5.40	0.009	III	64.1(103.2)
DMG	33.9330	117.3670	10/24/1943	02921.0	0.0	4.00	0.003	I	64.4(103.7)
DMG	34.2450	119.5880	06/29/1968	203633.6	1.8	4.00	0.003	I	64.6(104.0)

EARTHQUAKE SEARCH RESULTS

				TIME			SITE	SITE	APPROX.

FILE CODE	LAT. NORTH	LONG. WEST	DATE	(UTC) H M Sec	DEPTH (km)	QUAKE MAG.	ACC. g	MM INT.	DISTANCE mi [km]
DMG	34.8670	119.0170	07/21/1952	2153 9.0	0.0	4.30	0.004	I	64.7(104.1)
DMG	34.0330	117.3500	04/18/1940	184343.9	0.0	4.40	0.004	I	64.9(104.5)
DMG	34.9000	118.9500	08/01/1952	13 430.0	0.0	5.10	0.007	II	65.1(104.7)
DMG	34.8850	119.0020	02/23/1939	91846.7	10.0	4.50	0.004	I	65.4(105.2)
DMG	34.1180	117.3410	09/22/1951	82239.1	11.9	4.30	0.004	I	65.7(105.7)
T-A	34.9200	118.9200	01/20/1857	0 0 0.0	0.0	5.00	0.006	II	65.7(105.7)
T-A	34.9200	118.9200	05/23/1857	0 0 0.0	0.0	5.00	0.006	II	65.7(105.7)
T-A	34.9200	118.9200	08/29/1857	0 0 0.0	0.0	4.30	0.004	I	65.7(105.7)
DMG	33.2910	119.1930	10/24/1969	82912.1	10.0	5.10	0.007	II	65.7(105.8)
DMG	34.1270	117.3380	02/23/1936	222042.7	10.0	4.50	0.004	I	65.9(106.0)
DMG	34.1400	117.3390	02/26/1936	93327.6	10.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	09/08/1941	31423.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	09/14/1941	14518.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	07/01/1941	830 0.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	07/03/1941	1926 0.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	11/18/1941	18 810.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	07/02/1941	2219 0.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	07/01/1941	821 0.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	09/25/1941	51256.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	09/08/1941	31245.0	0.0	4.50	0.004	I	65.9(106.1)
DMG	34.3330	119.5830	07/12/1941	1618 0.0	0.0	4.50	0.004	I	65.9(106.1)
DMG	34.3330	119.5830	07/01/1941	2354 0.0	0.0	4.50	0.004	I	65.9(106.1)
DMG	34.3330	119.5830	07/01/1941	1820 0.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	07/01/1941	9 5 0.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	07/01/1941	848 0.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	09/15/1941	137 2.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	07/01/1941	945 0.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	07/01/1941	1025 0.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	07/01/1941	819 0.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	10/02/1938	1845 0.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	07/01/1941	858 0.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.3330	119.5830	11/21/1941	1656 3.0	0.0	4.00	0.003	I	65.9(106.1)
DMG	34.5000	119.5000	08/05/1930	1125 0.0	0.0	5.00	0.006	II	66.1(106.3)
DMG	34.5000	119.5000	06/29/1926	2321 0.0	0.0	5.50	0.009	III	66.1(106.3)
DMG	34.5000	119.5000	12/05/1920	1158 0.0	0.0	4.50	0.004	I	66.1(106.3)
DMG	34.8830	119.0330	08/20/1952	84747.0	0.0	4.20	0.003	I	66.1(106.4)
DMG	34.2550	119.6140	07/31/1968	224445.3	15.0	4.00	0.003	I	66.2(106.5)
GSP	34.1680	117.3370	06/28/1997	214525.1	9.0	4.20	0.003	I	66.2(106.6)
DMG	34.9110	118.9730	02/23/1939	84551.7	10.0	4.50	0.004	I	66.3(106.7)
DMG	33.7000	117.4000	05/15/1910	1547 0.0	0.0	6.00	0.014	IV	66.5(107.0)
DMG	33.7000	117.4000	05/13/1910	620 0.0	0.0	5.00	0.006	II	66.5(107.0)
DMG	33.7000	117.4000	04/11/1910	757 0.0	0.0	5.00	0.006	II	66.5(107.0)
DMG	34.9500	118.8670	07/21/1952	121936.0	0.0	5.30	0.008	III	66.5(107.1)
PAS	34.2510	119.6220	03/23/1988	84247.0	16.4	4.00	0.003	I	66.6(107.2)
DMG	34.3670	119.5830	07/01/1941	75054.8	0.0	5.90	0.013	III	66.7(107.3)
DMG	34.0330	117.3170	09/03/1935	647 0.0	0.0	4.50	0.004	I	66.8(107.6)
DMG	34.2540	119.6280	07/08/1968	91837.2	15.7	4.00	0.003	I	67.0(107.8)

DMG	34.1830	119.6460	06/29/1968	63320.9	8.4	4.00	0.003	I	67.1(108.0)
T-A	34.1700	117.3200	12/02/1859	2210 0.0	0.0	4.30	0.003	I	67.2(108.2)
DMG	34.9280	118.9700	01/15/1955	1 3 6.7	9.1	4.30	0.003	I	67.3(108.3)
DMG	34.9030	119.0380	05/08/1939	248 5.3	10.0	4.50	0.004	I	67.4(108.5)
DMG	34.9000	119.0500	07/22/1952	143018.0	0.0	4.30	0.003	I	67.6(108.7)
DMG	34.9320	118.9760	03/01/1963	02557.9	13.9	5.00	0.006	II	67.7(108.9)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
GSP	34.1070	117.3040	01/09/2009	034946.3	14.0	4.50	0.004	I	67.7(109.0)
DMG	35.0000	118.7330	04/29/1953	124745.0	0.0	4.70	0.005	II	67.8(109.1)
DMG	35.0000	118.7330	08/23/1952	6 3 3.0	0.0	4.30	0.003	I	67.8(109.1)
GSP	34.9180	119.0200	12/24/2000	010421.9	14.0	4.40	0.004	I	67.9(109.3)
MGI	34.1000	117.3000	12/27/1901	11 0 0.0	0.0	4.60	0.004	I	67.9(109.3)
DMG	34.1000	117.3000	02/16/1931	1327 0.0	0.0	4.00	0.003	I	67.9(109.3)
MGI	34.1000	117.3000	07/15/1905	2041 0.0	0.0	5.30	0.008	II	67.9(109.3)
MGI	34.1000	117.3000	11/22/1911	257 0.0	0.0	4.00	0.003	I	67.9(109.3)
DMG	34.9500	118.9500	10/16/1952	1222 7.0	0.0	4.30	0.003	I	68.2(109.8)
DMG	34.9450	118.9680	03/04/1963	201042.3	8.5	4.00	0.003	I	68.3(109.9)
DMG	34.2500	119.6540	06/29/1968	153242.8	14.6	4.10	0.003	I	68.4(110.0)
DMG	34.9410	118.9870	11/15/1961	53855.5	10.7	5.00	0.006	II	68.5(110.2)
DMG	33.4000	119.4000	07/24/1947	1654 2.0	0.0	4.30	0.003	I	68.6(110.4)
MGI	34.2000	117.3000	04/13/1913	1045 0.0	0.0	4.00	0.003	I	68.6(110.5)
DMG	34.0000	117.2830	11/07/1939	1852 8.4	0.0	4.70	0.005	II	68.8(110.8)
DMG	35.0000	118.8330	07/23/1952	75319.0	0.0	5.40	0.008	III	69.2(111.4)
DMG	35.0000	118.8330	12/01/1952	52610.0	0.0	4.40	0.004	I	69.2(111.4)
DMG	35.0000	118.8330	07/23/1952	181351.0	0.0	5.20	0.007	II	69.2(111.4)
DMG	34.9670	118.9500	11/27/1952	153641.0	0.0	4.00	0.003	-	69.3(111.5)
DMG	34.9670	118.9500	07/30/1952	11 255.0	0.0	4.10	0.003	I	69.3(111.5)
DMG	34.9830	118.9000	07/24/1952	95032.0	0.0	4.30	0.003	I	69.3(111.5)
DMG	34.9830	118.9000	03/23/1953	17 637.0	0.0	4.00	0.003	-	69.3(111.5)
DMG	33.9960	117.2700	02/17/1952	123658.3	16.0	4.50	0.004	I	69.6(112.0)
DMG	34.9500	119.0170	11/11/1952	181225.0	0.0	4.10	0.003	I	69.8(112.3)
DMG	34.1180	119.7020	07/05/1968	04517.2	5.9	5.20	0.007	II	69.8(112.3)
DMG	34.2120	119.6910	06/26/1968	181111.2	13.9	4.00	0.003	-	69.9(112.6)
DMG	34.9330	119.0670	02/10/1954	235838.0	0.0	4.50	0.004	I	70.0(112.7)
DMG	34.8410	119.2400	01/11/1958	23 847.4	10.8	4.00	0.003	-	70.1(112.8)
DMG	34.9220	119.1030	01/09/1963	6 4 3.8	8.7	4.00	0.003	-	70.4(113.2)
GSP	34.0470	117.2550	02/21/2000	134943.1	15.0	4.50	0.004	I	70.4(113.3)

DMG	34.9670	119.0000	09/02/1952	204556.0	0.0	4.70	0.005	I	70.4(113.4)
DMG	33.0380	118.7340	09/13/1937	221439.5	10.0	4.00	0.003	-	70.6(113.6)
T-A	34.0800	117.2500	10/07/1869	0 0 0.0	0.0	4.30	0.003	I	70.7(113.8)
DMG	34.0000	117.2500	07/23/1923	73026.0	0.0	6.25	0.016	IV	70.7(113.8)
DMG	34.0000	117.2500	11/01/1932	445 0.0	0.0	4.00	0.003	-	70.7(113.8)
DMG	35.0630	118.4230	08/26/1952	205640.6	-0.8	4.40	0.004	I	70.8(113.9)
DMG	34.0720	119.7230	07/05/1968	23614.1	4.3	4.00	0.003	-	70.8(114.0)
DMG	34.2530	119.6980	06/29/1968	191221.3	9.5	4.20	0.003	I	70.9(114.0)
PAS	34.0230	117.2450	10/02/1985	234412.4	15.2	4.80	0.005	II	71.0(114.2)
DMG	34.9830	118.9830	05/23/1954	235243.0	0.0	5.10	0.006	II	71.1(114.4)
DMG	35.0670	118.6170	07/23/1952	235136.0	0.0	4.00	0.003	-	71.4(114.8)
DMG	35.0330	118.8500	10/07/1953	145921.0	0.0	4.90	0.005	II	71.7(115.4)
GSP	34.0240	117.2300	03/11/1998	121851.8	14.0	4.50	0.004	I	71.8(115.6)
DMG	34.0430	117.2280	04/03/1939	25044.7	10.0	4.00	0.002	-	71.9(115.7)
DMG	34.3170	119.7000	10/21/1953	16 238.0	0.0	4.00	0.002	-	72.0(115.9)
DMG	34.1920	119.7330	07/05/1968	036 6.4	15.6	4.00	0.002	-	72.1(116.0)
DMG	34.9830	119.0330	07/21/1952	235328.0	0.0	4.50	0.004	I	72.2(116.3)
DMG	35.0830	118.5830	08/04/1952	535 0.0	0.0	4.00	0.002	-	72.3(116.3)
DMG	35.0830	118.5830	07/22/1952	81624.0	0.0	4.40	0.003	I	72.3(116.3)
PAS	34.3470	119.6960	08/13/1978	225453.4	12.8	5.10	0.006	II	72.3(116.4)
DMG	35.0000	119.0000	07/21/1952	132512.0	0.0	4.50	0.004	I	72.5(116.7)
DMG	35.0000	119.0000	03/13/1929	228 0.0	0.0	4.50	0.004	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1210 0.0	0.0	4.50	0.004	I	72.5(116.7)

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FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	35.0000	119.0000	07/22/1952	175236.0	0.0	4.10	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/22/1952	191024.0	0.0	4.10	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	12 7 0.0	0.0	4.70	0.004	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	12 6 0.0	0.0	4.80	0.005	II	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1336 0.0	0.0	4.10	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1317 0.0	0.0	4.00	0.002	-	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1451 0.0	0.0	4.20	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1212 0.0	0.0	4.60	0.004	I	72.5(116.7)
DMG	35.0000	119.0000	07/23/1952	043 8.0	0.0	4.40	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1359 0.0	0.0	4.60	0.004	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1259 0.0	0.0	4.20	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	01/25/1919	2229 0.0	0.0	4.00	0.002	-	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1222 0.0	0.0	4.90	0.005	II	72.5(116.7)

DMG	35.0000	119.0000	07/25/1952	0 3 0.0	0.0	4.00	0.002	-	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	12 531.0	0.0	6.40	0.017	IV	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	18 0 0.0	0.0	4.50	0.004	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1313 0.0	0.0	4.50	0.004	I	72.5(116.7)
DMG	35.0000	119.0000	07/22/1952	133143.0	0.0	4.80	0.005	II	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1442 0.0	0.0	4.20	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	02/16/1919	1557 0.0	0.0	5.00	0.006	II	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1638 0.0	0.0	4.50	0.004	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1617 0.0	0.0	4.10	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	13 8 0.0	0.0	4.50	0.004	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1225 0.0	0.0	4.70	0.004	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1417 0.0	0.0	4.10	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1415 0.0	0.0	4.40	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/22/1952	82122.0	0.0	4.10	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1542 0.0	0.0	4.20	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	08/10/1952	194424.0	0.0	4.10	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1228 0.0	0.0	4.20	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1218 0.0	0.0	4.40	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	14 6 0.0	0.0	4.20	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1239 0.0	0.0	4.20	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1553 0.0	0.0	4.50	0.004	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1311 0.0	0.0	4.10	0.003	I	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1240 0.0	0.0	4.90	0.005	II	72.5(116.7)
DMG	35.0000	119.0000	07/21/1952	1536 0.0	0.0	4.20	0.003	I	72.5(116.7)
DMG	35.0670	118.7670	07/22/1952	21 211.0	0.0	4.20	0.003	I	72.8(117.1)
DMG	35.0330	118.9170	07/23/1952	211658.0	0.0	4.10	0.003	I	72.9(117.3)
DMG	35.0000	119.0170	01/12/1954	233349.0	0.0	5.90	0.011	III	72.9(117.3)
DMG	35.0000	119.0170	05/25/1953	324 1.0	0.0	4.80	0.005	II	72.9(117.3)
DMG	35.0000	119.0170	07/21/1952	115214.0	0.0	7.70	0.047	VI	72.9(117.3)
PAS	35.0950	118.5190	06/22/1981	45747.3	5.0	4.00	0.002	-	72.9(117.4)
DMG	34.1760	119.7540	07/07/1968	143330.8	12.8	4.50	0.004	I	73.2(117.7)
DMG	35.0330	118.9330	07/22/1952	223133.0	0.0	4.70	0.004	I	73.2(117.8)
DMG	35.0170	118.9830	08/17/1952	9 9 7.0	0.0	4.10	0.003	I	73.2(117.8)
DMG	35.0000	119.0330	07/21/1952	1158 0.0	0.0	4.60	0.004	I	73.3(118.0)
DMG	35.0000	119.0330	07/21/1952	1155 0.0	0.0	4.50	0.004	I	73.3(118.0)
DMG	35.0000	119.0330	07/21/1952	12 2 0.0	0.0	5.60	0.009	III	73.3(118.0)
DMG	35.0000	119.0330	07/21/1952	1157 0.0	0.0	4.50	0.004	I	73.3(118.0)
DMG	35.0000	119.0330	07/21/1952	1159 0.0	0.0	4.50	0.004	I	73.3(118.0)
DMG	35.0000	119.0330	07/21/1952	1154 0.0	0.0	4.50	0.004	I	73.3(118.0)
MGI	34.1000	117.2000	04/23/1923	2113 0.0	0.0	4.00	0.002	-	73.6(118.5)

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	35.1000	118.6170	09/26/1952	202120.0	0.0	4.00	0.002	-	73.6(118.5)
DMG	35.0830	118.7500	07/22/1952	84734.0	0.0	4.70	0.004	I	73.6(118.5)
DMG	35.0830	118.7500	07/26/1952	15 831.0	0.0	4.40	0.003	I	73.6(118.5)
DMG	35.0830	118.7500	07/26/1952	18 244.0	0.0	4.00	0.002	-	73.6(118.5)
DMG	35.0500	118.9000	09/25/1952	162136.0	0.0	4.10	0.003	-	73.7(118.6)
MGI	34.4000	119.7000	06/24/1926	1530 0.0	0.0	4.00	0.002	-	73.7(118.6)
MGI	34.4000	119.7000	07/06/1926	1745 0.0	0.0	4.00	0.002	-	73.7(118.6)
MGI	34.4000	119.7000	08/26/1927	1240 0.0	0.0	4.00	0.002	-	73.7(118.6)
MGI	34.4000	119.7000	08/09/1926	412 0.0	0.0	4.00	0.002	-	73.7(118.6)
MGI	34.4000	119.7000	03/25/1806	8 0 0.0	0.0	5.00	0.005	II	73.7(118.6)
DMG	35.0000	119.0500	09/12/1952	103525.0	0.0	4.50	0.004	I	73.7(118.6)
GSP	35.0980	118.3060	12/31/1995	214823.1	7.0	4.00	0.002	-	73.8(118.8)
DMG	33.9000	117.2000	12/19/1880	0 0 0.0	0.0	6.00	0.012	III	74.2(119.4)
DMG	35.1170	118.4810	05/01/1953	64820.9	2.4	4.10	0.003	-	74.4(119.8)
DMG	35.0670	118.8830	08/17/1952	21 442.0	0.0	4.30	0.003	I	74.5(119.9)
DMG	35.0670	118.8830	08/14/1952	114146.0	0.0	4.20	0.003	I	74.5(119.9)
DMG	35.0000	119.0830	11/07/1952	85535.0	0.0	4.60	0.004	I	74.6(120.0)
DMG	35.0330	119.0000	07/22/1952	101939.0	0.0	4.10	0.003	-	74.6(120.1)
DMG	35.0500	118.9500	11/14/1952	2334 1.4	0.0	4.00	0.002	-	74.6(120.1)
DMG	35.0500	118.9500	08/17/1952	614 4.0	0.0	4.00	0.002	-	74.6(120.1)
GSP	34.0050	117.1800	02/13/2010	213906.6	8.0	4.10	0.003	-	74.7(120.2)
T-A	34.5000	119.6700	02/09/1902	15 0 0.0	0.0	4.30	0.003	I	74.7(120.2)
T-A	34.5000	119.6700	03/14/1857	23 0 0.0	0.0	4.30	0.003	I	74.7(120.2)
T-A	34.5000	119.6700	05/31/1854	1250 0.0	0.0	4.30	0.003	I	74.7(120.2)
T-A	34.5000	119.6700	06/25/1855	22 0 0.0	0.0	4.30	0.003	I	74.7(120.2)
T-A	34.5000	119.6700	06/01/1893	12 0 0.0	0.0	5.00	0.005	II	74.7(120.2)
T-A	34.5000	119.6700	07/09/1885	0 0 0.0	0.0	4.30	0.003	I	74.7(120.2)
DMG	35.0170	119.0500	08/05/1953	122059.0	0.0	4.30	0.003	I	74.8(120.3)
PAS	35.0000	119.1030	05/13/1975	02135.6	19.1	4.50	0.003	I	75.1(120.8)
DMG	35.0670	118.9330	07/23/1952	223220.0	0.0	4.10	0.003	-	75.4(121.3)
PAS	35.0460	119.0010	06/05/1975	144645.3	9.0	4.10	0.003	-	75.5(121.4)
DMG	35.0450	119.0040	03/23/1956	212327.1	12.1	4.30	0.003	I	75.5(121.4)
DMG	34.3250	119.7610	08/09/1956	0 849.2	4.0	4.00	0.002	-	75.5(121.5)
DMG	34.4900	119.6910	09/16/1962	181235.2	13.3	4.00	0.002	-	75.5(121.5)
GSP	35.0430	119.0130	09/22/2005	202448.6	11.0	4.70	0.004	I	75.5(121.6)
DMG	35.1330	118.5170	07/22/1952	141 2.0	0.0	4.50	0.003	I	75.5(121.6)
DMG	35.1330	118.5170	08/14/1952	72822.0	0.0	4.10	0.003	-	75.5(121.6)
DMG	35.1330	118.5170	07/28/1952	54554.0	0.0	4.20	0.003	I	75.5(121.6)
DMG	35.1330	118.5170	07/23/1952	152524.0	0.0	4.00	0.002	-	75.5(121.6)
GSP	32.9750	118.7910	03/04/1992	190627.0	6.0	4.20	0.003	I	75.5(121.6)
DMG	35.0330	119.0500	08/18/1952	44010.0	0.0	4.70	0.004	I	75.8(121.9)
DMG	35.0330	119.0500	08/07/1952	163151.0	0.0	4.90	0.005	II	75.8(121.9)
DMG	35.0330	119.0500	07/27/1952	71611.0	0.0	4.10	0.002	-	75.8(121.9)
DMG	34.2000	119.8000	12/21/1812	19 0 0.0	0.0	7.00	0.026	V	76.0(122.3)
PAS	33.0330	117.9440	02/22/1983	21830.4	10.0	4.30	0.003	I	76.1(122.5)
MGI	34.5000	119.7000	08/26/1919	1212 0.0	0.0	4.00	0.002	-	76.3(122.7)

MGI	34.5000	119.7000	07/29/1925	14 0 0.0	0.0	4.00	0.002	-	76.3(122.7)
MGI	34.5000	119.7000	08/26/1919	1457 0.0	0.0	4.00	0.002	-	76.3(122.7)
DMG	34.3500	119.7670	11/10/1940	102510.0	0.0	4.00	0.002	-	76.3(122.8)
DMG	35.0670	118.9830	08/04/1952	194750.0	0.0	4.00	0.002	-	76.4(123.0)
GSP	33.1660	119.3020	11/15/2009	224527.1	6.0	4.30	0.003	I	76.4(123.0)
DMG	35.1330	118.7000	09/02/1952	124132.0	0.0	4.60	0.004	I	76.5(123.1)
DMG	33.2670	119.4500	11/18/1947	2159 3.0	0.0	5.00	0.005	II	76.9(123.8)

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FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	35.0330	119.1000	09/02/1953	152756.0	0.0	4.00	0.002	-	77.0(123.9)
DMG	35.0330	119.1000	01/13/1954	14531.0	0.0	4.40	0.003	I	77.0(123.9)
DMG	35.0330	119.1000	02/07/1954	0 953.0	0.0	4.40	0.003	I	77.0(123.9)
DMG	35.0330	119.1000	01/12/1954	234037.0	0.0	4.10	0.002	-	77.0(123.9)
DMG	35.1500	118.6330	01/27/1954	141948.0	0.0	5.00	0.005	II	77.2(124.2)
PAS	35.0180	119.1410	11/10/1981	223435.5	3.1	4.50	0.003	I	77.2(124.2)
DMG	35.1330	118.7670	07/21/1952	194122.0	0.0	5.50	0.008	II	77.2(124.2)
DMG	35.1330	118.7670	07/25/1952	143442.0	0.0	4.40	0.003	I	77.2(124.2)
DMG	34.3000	119.8000	06/29/1925	144216.0	0.0	6.25	0.014	IV	77.2(124.3)
MGI	34.3000	119.8000	07/03/1925	1638 0.0	0.0	5.30	0.006	II	77.2(124.3)
MGI	34.3000	119.8000	07/03/1925	1821 0.0	0.0	5.30	0.006	II	77.2(124.3)
DMG	33.7380	117.1870	04/27/1962	91232.1	5.7	4.10	0.002	-	77.2(124.3)
GSP	33.6740	119.7600	07/24/2005	125942.9	6.0	4.10	0.002	-	77.3(124.4)
DMG	35.0670	119.0330	07/23/1952	175329.0	0.0	4.10	0.002	-	77.5(124.7)
DMG	35.0670	119.0330	07/27/1952	113438.0	0.0	4.10	0.002	-	77.5(124.7)
DMG	35.1500	118.6830	08/13/1952	173925.0	0.0	4.70	0.004	I	77.5(124.7)
DMG	35.0660	119.0490	01/24/1974	5 2 0.8	6.4	4.30	0.003	I	77.8(125.2)
PAS	35.0120	119.1790	11/10/1981	2237 5.0	9.4	4.20	0.003	-	77.9(125.4)
GSB	35.0380	119.1300	02/14/2004	124311.4	12.0	4.60	0.004	I	78.1(125.7)
PAS	35.0350	119.1370	06/16/1978	42131.6	1.8	4.30	0.003	I	78.1(125.7)
DMG	35.1000	118.9670	08/25/1952	62026.0	0.0	4.70	0.004	I	78.2(125.8)
DMG	35.0670	119.0670	02/24/1954	223022.0	0.0	4.50	0.003	I	78.3(126.0)
DMG	34.4710	119.7570	11/16/1958	934 6.1	15.2	4.00	0.002	-	78.5(126.3)
GSB	35.0270	119.1780	04/16/2005	191813.0	10.0	4.60	0.004	I	78.8(126.8)
DMG	35.1000	119.0000	07/24/1952	311 7.0	0.0	4.10	0.002	-	78.9(126.9)
DMG	35.1000	119.0000	07/22/1952	14 511.0	0.0	4.30	0.003	I	78.9(126.9)
DMG	35.0500	119.1330	08/06/1953	1120 4.0	0.0	4.40	0.003	I	78.9(127.0)
DMG	35.0500	119.1330	05/23/1953	75255.0	0.0	4.20	0.003	-	78.9(127.0)
GSP	35.0310	119.1800	05/06/2005	022909.5	11.0	4.10	0.002	-	79.1(127.2)

MGI	34.4000	119.8000	09/09/1929	515 0.0	0.0	4.60	0.004	I	79.1(127.3)
PAS	34.4020	119.8020	03/10/1986	153316.3	18.0	4.10	0.002	-	79.2(127.5)
DMG	35.1830	118.6000	07/26/1952	63850.0	0.0	4.00	0.002	-	79.2(127.5)
DMG	35.1830	118.6000	07/26/1952	2241 3.0	0.0	4.60	0.004	I	79.2(127.5)
DMG	35.1830	118.6000	07/29/1952	154950.0	0.0	4.90	0.004	I	79.2(127.5)
DMG	35.1830	118.6500	07/21/1952	151358.0	0.0	5.10	0.005	II	79.5(128.0)
DMG	34.3330	119.8330	06/26/1933	62752.0	0.0	4.30	0.003	I	79.6(128.1)
DMG	34.3330	119.8330	06/26/1933	62542.0	0.0	4.30	0.003	I	79.6(128.1)
DMG	35.1940	118.4650	07/22/1952	19 858.2	3.7	4.30	0.003	I	79.7(128.3)
DMG	35.0500	119.1670	12/14/1950	135623.0	0.0	4.40	0.003	I	79.8(128.5)
DMG	34.2000	117.1000	09/20/1907	154 0.0	0.0	6.00	0.011	III	79.9(128.7)
DMG	35.1990	118.5310	09/01/1961	165148.9	4.5	4.00	0.002	-	80.1(128.9)
GSP	34.1920	117.0950	04/06/1994	190104.1	7.0	4.80	0.004	I	80.2(129.0)
USG	33.0170	117.8170	07/16/1986	1247 3.7	10.0	4.11	0.002	-	80.4(129.3)
USG	33.0170	117.8170	07/14/1986	11112.6	10.0	4.12	0.002	-	80.4(129.3)
GSP	33.1950	119.4490	01/03/2012	141856.1	18.0	4.10	0.002	-	80.4(129.4)
DMG	35.2000	118.6330	07/22/1952	321 5.0	0.0	4.40	0.003	I	80.6(129.7)
T-A	34.4200	119.8200	00/00/1862	0 0 0.0	0.0	5.70	0.008	III	80.6(129.7)
GSP	35.0220	119.2530	05/08/2010	192306.6	15.0	4.30	0.003	I	80.7(129.9)
DMG	35.1000	119.0830	07/24/1946	019 8.0	0.0	4.00	0.002	-	80.7(129.9)
DMG	35.1000	119.0830	12/06/1934	743 0.0	0.0	4.00	0.002	-	80.7(129.9)
GSP	33.9530	117.0760	09/14/2011	144451.0	16.0	4.10	0.002	-	80.9(130.2)
PAS	32.9900	117.8490	07/13/1986	14 133.0	12.0	4.60	0.003	I	81.2(130.6)
GSP	32.8667	118.6535	11/10/2014	084242.9	5.1	4.11	0.002	-	81.5(131.2)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
PAS	32.9860	117.8440	10/01/1986	201218.6	6.0	4.00	0.002	-	81.5(131.2)
DMG	35.0500	119.2330	08/19/1952	191226.0	0.0	4.50	0.003	I	81.7(131.5)
PAS	32.9710	117.8700	07/13/1986	1347 8.2	6.0	5.30	0.006	II	81.8(131.6)
DMG	35.2170	118.6670	09/14/1952	204324.0	0.0	4.10	0.002	-	82.0(131.9)
DMG	32.8670	118.2500	02/13/1952	151337.0	0.0	4.70	0.004	I	82.0(132.0)
DMG	34.0170	117.0500	02/19/1940	12 655.7	0.0	4.60	0.003	I	82.1(132.2)
DMG	35.2290	118.5130	06/28/1957	1132 0.8	1.6	4.10	0.002	-	82.2(132.2)
GSP	32.9850	117.8180	06/21/1995	211736.2	6.0	4.30	0.003	-	82.3(132.4)
DMG	35.2330	118.5330	07/22/1952	15 314.0	0.0	4.20	0.002	-	82.5(132.7)
DMG	35.2330	118.5330	07/29/1952	173643.0	0.0	4.40	0.003	I	82.5(132.7)
DMG	35.2330	118.5330	07/24/1952	1735 6.0	0.0	4.20	0.002	-	82.5(132.7)
DMG	35.2330	118.5330	03/17/1953	161517.0	0.0	4.00	0.002	-	82.5(132.7)

DMG	35.2330	118.5330	07/30/1952	144650.0	0.0	4.10	0.002	-	82.5(132.7)
DMG	35.2330	118.5330	07/21/1952	174244.0	0.0	5.10	0.005	II	82.5(132.7)
DMG	35.2350	118.5480	03/03/1973	181449.5	8.0	4.00	0.002	-	82.6(133.0)
DMG	35.2330	118.6000	01/10/1953	221738.0	0.0	4.00	0.002	-	82.7(133.1)
DMG	35.2330	118.6000	07/22/1952	91025.0	0.0	4.50	0.003	I	82.7(133.1)
DMG	33.1500	119.4500	01/05/1940	62052.0	0.0	4.00	0.002	-	82.7(133.2)
DMG	33.1500	119.4500	06/17/1934	243 0.0	0.0	4.00	0.002	-	82.7(133.2)
DMG	33.7000	117.1000	06/11/1902	245 0.0	0.0	4.50	0.003	I	82.8(133.2)
DMG	35.2390	118.5180	07/21/1952	2021 5.1	-2.0	4.20	0.002	-	82.9(133.4)
DMG	35.2410	118.5600	07/21/1952	1912 7.4	5.8	4.30	0.003	-	83.1(133.7)
DMG	35.1500	119.0500	11/11/1952	1722 8.0	0.0	4.20	0.002	-	83.1(133.8)
GSP	34.0540	117.0300	06/27/2005	221733.6	12.0	4.00	0.002	-	83.2(134.0)
GSP	32.9000	118.0070	06/20/2009	010030.6	14.0	4.10	0.002	-	83.3(134.1)
GSP	32.9700	117.8100	04/04/1990	085439.3	6.0	4.00	0.002	-	83.4(134.2)
DMG	35.2170	118.8170	12/15/1953	124436.0	0.0	4.60	0.003	I	83.5(134.3)
DMG	35.2170	118.8170	07/23/1952	1317 5.0	0.0	5.70	0.008	III	83.5(134.3)
DMG	35.2500	118.4830	07/23/1952	1330 4.0	0.0	4.40	0.003	I	83.6(134.5)
DMG	35.2500	118.4830	07/23/1952	93842.0	0.0	4.20	0.002	-	83.6(134.5)
PAS	32.9700	117.8030	07/14/1986	03246.2	10.0	4.00	0.002	-	83.6(134.5)
DMG	35.0830	119.2330	03/03/1956	62412.0	0.0	4.20	0.002	-	83.7(134.7)
GSP	33.9320	117.0230	01/16/2010	120325.7	13.0	4.30	0.003	-	84.0(135.2)
GSP	35.2100	118.0660	07/11/1992	181416.2	10.0	5.70	0.008	II	84.3(135.6)
GSP	34.1800	117.0200	12/04/1991	081703.5	11.0	4.00	0.002	-	84.3(135.7)
GSP	35.1490	119.1040	05/28/1993	044740.6	21.0	5.20	0.005	II	84.3(135.7)
GSP	34.0580	117.0100	06/16/2005	205326.0	11.0	4.90	0.004	I	84.4(135.8)
PAS	32.9450	117.8310	07/29/1986	81741.8	10.0	4.10	0.002	-	84.4(135.8)
DMG	32.8170	118.3500	12/26/1951	04654.0	0.0	5.90	0.009	III	84.7(136.4)
DMG	35.2670	118.4500	07/21/1952	191619.0	0.0	4.30	0.002	-	84.8(136.5)
PAS	32.9330	117.8410	07/29/1986	81741.6	10.0	4.30	0.002	-	84.9(136.6)
GSP	34.2823	117.0267	07/05/2014	165934.1	7.3	4.58	0.003	I	85.0(136.8)
DMG	34.0000	117.0000	06/30/1923	022 0.0	0.0	4.50	0.003	I	85.0(136.8)
PAS	32.9450	117.8060	09/07/1984	11 313.4	6.0	4.30	0.002	-	85.1(136.9)
GSP	34.1200	116.9980	06/29/1992	144126.0	4.0	4.40	0.003	I	85.2(137.1)
GSP	34.0970	116.9960	12/05/1997	170438.9	4.0	4.10	0.002	-	85.3(137.2)
GSP	34.0850	116.9890	06/30/1992	214900.3	3.0	4.40	0.003	I	85.6(137.8)
GSP	34.4062	119.9198	05/29/2013	143803.4	7.1	4.80	0.004	I	85.7(138.0)
DMG	35.2830	118.5500	07/26/1952	922 6.0	0.0	4.30	0.002	-	86.0(138.3)
DMG	35.2830	118.5500	07/22/1952	15151.0	0.0	4.40	0.003	I	86.0(138.3)
DMG	35.2830	118.5500	07/31/1952	41022.0	0.0	4.20	0.002	-	86.0(138.3)
DMG	35.2830	118.5500	07/23/1952	34928.0	0.0	4.70	0.003	I	86.0(138.3)
DMG	35.2830	118.5500	08/01/1952	31611.6	0.0	4.50	0.003	I	86.0(138.3)

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	35.2830	118.5500	07/23/1952	737 0.0	0.0	4.80	0.004	I	86.0(138.3)
DMG	35.2830	118.5830	07/31/1952	1719 8.0	0.0	4.50	0.003	I	86.1(138.5)
DMG	35.2890	118.4600	07/26/1952	1 221.3	10.8	4.20	0.002	-	86.3(138.9)
DMG	34.1670	116.9830	10/16/1951	1241 5.0	0.0	4.00	0.002	-	86.3(138.9)
DMG	35.2900	118.4700	07/24/1952	12 757.6	14.1	4.10	0.002	-	86.4(139.0)
DMG	35.2890	118.4110	08/10/1952	122318.0	4.0	4.60	0.003	I	86.4(139.0)
DMG	35.1840	119.0990	07/01/1959	234923.4	9.0	4.70	0.003	I	86.4(139.0)
GSP	34.1570	116.9760	12/19/2007	121409.0	7.0	4.00	0.002	-	86.7(139.5)
DMG	33.8000	117.0000	12/25/1899	1225 0.0	0.0	6.40	0.013	III	86.7(139.5)
DMG	35.2940	118.4010	08/13/1952	42940.6	14.5	4.60	0.003	I	86.8(139.6)
GSP	34.0840	116.9680	10/02/2008	094149.3	12.0	4.10	0.002	-	86.8(139.7)
PAS	34.1510	116.9720	11/20/1978	655 9.5	6.1	4.30	0.002	-	86.9(139.8)
PAS	32.9470	117.7360	01/15/1989	153955.2	6.0	4.20	0.002	-	86.9(139.8)
DMG	35.2990	118.4350	07/25/1952	20 6 6.1	-1.4	4.80	0.004	I	87.0(140.1)
DMG	35.3000	118.5000	02/19/1953	812 6.0	0.0	4.40	0.003	-	87.1(140.1)
DMG	35.3000	118.5330	07/21/1952	182628.0	0.0	4.10	0.002	-	87.1(140.2)
DMG	35.3000	118.5330	09/02/1952	1638 9.0	0.0	4.00	0.002	-	87.1(140.2)
DMG	35.3000	118.5330	07/30/1952	95929.0	0.0	4.00	0.002	-	87.1(140.2)
DMG	35.3000	118.5330	07/21/1952	182338.0	0.0	4.50	0.003	I	87.1(140.2)
DMG	35.3000	118.4320	07/23/1952	61045.9	14.5	4.20	0.002	-	87.1(140.2)
DMG	34.3330	117.0000	02/27/1942	1 853.0	0.0	4.00	0.002	-	87.2(140.3)
DMG	35.3030	118.4810	09/04/1952	18 649.1	5.8	4.40	0.003	-	87.3(140.4)
DMG	35.3030	118.4730	08/01/1952	213522.4	4.2	4.00	0.002	-	87.3(140.4)
DMG	35.3050	118.5070	08/09/1952	10 732.1	-2.0	4.20	0.002	-	87.4(140.7)
DMG	33.7500	117.0000	04/21/1918	223225.0	0.0	6.80	0.018	IV	87.4(140.7)
DMG	33.7500	117.0000	06/06/1918	2232 0.0	0.0	5.00	0.004	I	87.4(140.7)
DMG	35.3080	118.5160	07/31/1952	19 515.4	7.3	4.00	0.002	-	87.6(141.0)
DMG	35.3000	118.6670	08/13/1952	212548.0	0.0	4.10	0.002	-	87.7(141.1)
DMG	34.0000	120.0170	04/01/1945	234342.0	0.0	5.40	0.006	II	87.7(141.1)
DMG	35.3110	118.4990	07/25/1952	1313 8.2	2.8	5.00	0.004	I	87.8(141.3)
PAS	34.1980	116.9590	04/01/1978	105227.4	8.0	4.00	0.002	-	87.9(141.5)
DMG	35.3130	118.4890	10/20/1952	181443.6	14.0	4.30	0.002	-	88.0(141.5)
DMG	34.1330	116.9500	06/10/1938	1440 0.0	0.0	4.00	0.002	-	88.0(141.6)
DMG	35.3140	118.4820	08/30/1952	45559.8	5.5	4.70	0.003	I	88.0(141.7)
USG	32.7700	118.3340	06/16/1985	1027 0.7	5.0	4.14	0.002	-	88.1(141.7)
DMG	35.3140	118.5300	07/26/1952	225856.1	6.8	4.30	0.002	-	88.1(141.7)
DMG	35.3150	118.5160	07/25/1952	194323.7	11.2	5.70	0.007	II	88.1(141.8)
DMG	35.1830	119.1740	06/04/1956	83319.3	14.3	4.00	0.002	-	88.1(141.9)
DMG	34.2670	116.9670	08/29/1943	35754.0	0.0	4.00	0.002	-	88.2(141.9)
DMG	34.2670	116.9670	08/29/1943	51630.0	0.0	4.00	0.002	-	88.2(141.9)
DMG	34.2670	116.9670	08/29/1943	34513.0	0.0	5.50	0.006	II	88.2(141.9)
DMG	35.3160	118.4870	09/15/1952	44013.2	4.2	4.90	0.004	I	88.2(141.9)
DMG	35.3160	118.5140	07/24/1952	14 525.9	5.4	4.30	0.002	-	88.2(141.9)
DMG	35.3170	118.4940	07/25/1952	19 944.6	5.5	5.70	0.007	II	88.2(142.0)
DMG	35.3200	118.5180	07/27/1952	0 915.6	6.5	4.20	0.002	-	88.5(142.3)

DMG	35.3210	118.4940	02/11/1955	194431.5	14.7	4.50	0.003	I	88.5(142.4)
DMG	35.3210	118.5400	07/24/1952	141012.2	9.5	4.00	0.002	-	88.6(142.5)
DMG	35.3240	118.4860	01/20/1953	81322.8	7.2	4.00	0.002	-	88.7(142.8)
GSP	35.3180	118.6540	01/25/2003	091610.2	5.0	4.50	0.003	I	88.8(142.9)
DMG	35.3000	118.8000	12/23/1905	2223 0.0	0.0	5.00	0.004	I	88.9(143.0)
GSP	32.7600	118.2880	08/16/2001	180433.8	6.0	4.40	0.003	-	89.0(143.3)
DMG	35.3300	118.5070	05/29/1968	22938.7	3.1	4.00	0.002	-	89.1(143.4)
GSP	34.1210	116.9280	08/16/1998	133440.2	6.0	4.70	0.003	I	89.2(143.6)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
T-A	33.5000	117.0700	12/29/1880	7 0 0.0	0.0	4.30	0.002	-	89.3(143.8)
DMG	35.3330	118.5330	08/01/1952	103556.0	0.0	4.00	0.002	-	89.4(143.8)
DMG	35.3330	118.5670	08/08/1952	51718.0	0.0	4.00	0.002	-	89.5(144.0)
DMG	35.3350	118.4740	07/23/1952	172224.0	6.6	4.50	0.003	I	89.5(144.0)
DMG	35.3360	118.4720	07/23/1952	105413.5	19.7	4.10	0.002	-	89.5(144.1)
DMG	35.3330	118.6000	09/16/1952	142454.0	0.0	4.00	0.002	-	89.6(144.1)
DMG	35.3330	118.6000	07/31/1952	12 9 9.0	0.0	5.80	0.008	II	89.6(144.1)
DMG	35.3330	118.6000	07/23/1952	164853.0	0.0	4.50	0.003	I	89.6(144.1)
DMG	35.3330	118.6000	07/23/1952	161838.0	0.0	4.50	0.003	I	89.6(144.1)
DMG	35.3330	118.6000	08/10/1952	6 118.0	0.0	4.00	0.002	-	89.6(144.1)
GSP	34.2900	116.9460	02/10/2001	210505.8	9.0	5.10	0.004	I	89.6(144.2)
GSP	34.1120	116.9200	10/01/1998	181816.0	4.0	4.70	0.003	I	89.6(144.3)
DMG	35.3370	118.5370	08/30/1952	45954.8	3.5	4.00	0.002	-	89.7(144.3)
DMG	35.3380	118.5230	08/06/1952	34624.2	12.6	4.30	0.002	-	89.7(144.4)
GSP	34.2870	116.9420	02/11/2001	003916.0	8.0	4.20	0.002	-	89.8(144.5)
DMG	35.3400	118.4730	07/24/1952	5 249.6	2.1	4.50	0.003	I	89.8(144.5)
GSP	34.1780	116.9220	06/28/1992	170131.9	13.0	4.70	0.003	I	89.9(144.6)
DMG	34.4330	116.9830	04/18/1945	458 2.0	0.0	4.30	0.002	-	89.9(144.7)
DMG	34.1800	116.9200	01/16/1930	034 3.6	0.0	5.10	0.004	I	90.0(144.8)
DMG	34.1800	116.9200	01/16/1930	02433.9	0.0	5.20	0.005	II	90.0(144.8)
DMG	35.3450	118.5070	07/23/1952	18 328.3	10.4	4.00	0.002	-	90.2(145.1)
DMG	35.3460	118.4650	12/25/1952	55633.0	4.6	4.10	0.002	-	90.2(145.2)
DMG	35.3330	118.7330	08/05/1952	65010.0	0.0	4.40	0.002	-	90.4(145.5)
DMG	32.7500	118.2000	06/25/1939	149 0.0	0.0	4.50	0.003	I	90.5(145.7)
GSP	32.7340	118.3340	08/16/2001	220628.1	25.0	4.20	0.002	-	90.5(145.7)
DMG	35.3510	118.5270	08/11/1952	132149.2	-2.0	4.40	0.002	-	90.6(145.8)
DMG	35.3560	118.5380	07/19/1955	2 425.5	6.4	4.10	0.002	-	91.0(146.4)
GSP	34.3950	120.0220	05/09/2004	085717.3	4.0	4.40	0.002	-	91.1(146.6)

GSP	34.2560	116.9120	06/28/1992	170557.5	8.0	4.60	0.003	I	91.1(146.6)
DMG	34.3200	116.9250	04/18/1968	174213.4	4.7	4.00	0.002	-	91.2(146.8)
DMG	35.3600	118.4380	08/03/1952	15156.1	7.0	4.10	0.002	-	91.2(146.8)
MGI	34.2000	116.9000	10/10/1915	5 6 0.0	0.0	4.00	0.002	-	91.3(146.9)
DMG	35.3580	118.6160	08/24/1955	17 540.9	7.2	4.00	0.002	-	91.4(147.0)
GSP	33.9585	116.8883	01/06/2016	144234.9	16.7	4.39	0.002	-	91.6(147.4)
PAS	34.2460	116.9010	06/29/1979	55320.5	5.7	4.60	0.003	I	91.6(147.5)
DMG	35.3670	118.5000	06/20/1953	231852.0	0.0	4.40	0.002	-	91.7(147.5)
DMG	35.3670	118.5330	07/23/1952	195134.0	0.0	4.20	0.002	-	91.7(147.6)
DMG	34.1000	116.8830	10/24/1935	1527 0.0	0.0	4.00	0.002	-	91.7(147.6)
DMG	34.1000	116.8830	10/24/1935	1451 0.0	0.0	4.50	0.003	I	91.7(147.6)
DMG	34.1000	116.8830	10/24/1935	1452 0.0	0.0	4.50	0.003	I	91.7(147.6)
PAS	34.2490	116.9000	06/30/1979	7 353.0	5.6	4.50	0.003	I	91.7(147.6)
GSP	32.7280	118.2230	01/29/2009	084159.0	0.0	4.20	0.002	-	91.8(147.7)
MGI	35.3000	119.0000	09/04/1908	0 0 0.0	0.0	4.60	0.003	I	91.8(147.8)
MGI	35.3000	119.0000	01/08/1903	030 0.0	0.0	4.60	0.003	I	91.8(147.8)
DMG	35.3670	118.5830	07/23/1952	31923.0	0.0	5.00	0.004	I	91.9(147.8)
DMG	35.3670	118.5830	07/23/1952	65342.0	0.0	4.20	0.002	-	91.9(147.8)
DMG	35.3670	118.5830	07/27/1952	73539.0	0.0	4.20	0.002	-	91.9(147.8)
DMG	35.3670	118.5830	07/28/1952	154120.0	0.0	4.00	0.002	-	91.9(147.8)
DMG	35.3670	118.5830	07/23/1952	62628.0	0.0	4.00	0.002	-	91.9(147.8)
DMG	35.3670	118.5830	07/23/1952	03832.0	0.0	6.10	0.010	III	91.9(147.8)
DMG	35.3670	118.5830	07/23/1952	4 140.0	0.0	4.70	0.003	I	91.9(147.8)
DMG	35.3670	118.5830	07/23/1952	04738.0	0.0	4.60	0.003	I	91.9(147.8)
DMG	35.3670	118.5830	09/16/1952	1521 8.0	0.0	4.30	0.002	-	91.9(147.8)

EARTHQUAKE SEARCH RESULTS

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FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	33.9680	116.8820	06/27/1959	162211.1	13.8	4.00	0.002	-	91.9(147.9)
PAS	34.2430	116.8960	06/30/1979	03411.6	5.8	4.90	0.004	I	91.9(147.9)
GSP	34.3620	116.9230	12/07/1992	033331.5	1.0	4.00	0.002	-	91.9(148.0)
DMG	35.3170	118.9500	09/01/1952	1039 0.0	0.0	4.10	0.002	-	92.1(148.2)
GSP	33.9660	116.8760	01/12/2010	023608.4	10.0	4.30	0.002	-	92.2(148.4)
DMG	33.7100	116.9250	09/23/1963	144152.6	16.5	5.00	0.004	I	92.3(148.5)
MGI	33.8000	116.9000	12/18/1920	1726 0.0	0.0	4.00	0.002	-	92.3(148.5)
MGI	33.8000	116.9000	04/23/1918	1415 0.0	0.0	4.00	0.002	-	92.3(148.5)
MGI	33.8000	116.9000	04/29/1918	2 0 0.0	0.0	4.00	0.002	-	92.3(148.5)
MGI	33.8000	116.9000	06/14/1918	1024 0.0	0.0	4.00	0.002	-	92.3(148.5)
MGI	34.3000	116.9000	12/01/1915	14 5 0.0	0.0	4.00	0.002	-	92.3(148.6)

DMG	34.3370	116.9090	11/30/1962	2351 5.5	7.0	4.30	0.002	-	92.3(148.6)
GSP	34.3770	116.9180	12/04/1992	052511.2	2.0	4.80	0.003	I	92.5(148.8)
GSP	34.3610	116.9130	12/04/1992	125942.1	0.0	4.20	0.002	-	92.5(148.8)
GSP	33.6570	120.0330	04/21/2005	063619.0	6.0	4.00	0.002	-	92.6(149.0)
DMG	35.3330	118.9170	08/22/1952	224124.0	0.0	5.80	0.007	II	92.6(149.1)
DMG	35.3330	118.9170	07/29/1952	195132.0	0.0	4.50	0.003	-	92.6(149.1)
DMG	35.3330	118.9170	07/31/1952	195314.0	0.0	4.50	0.003	-	92.6(149.1)
DMG	35.3330	118.9170	08/07/1952	1919 7.0	0.0	4.20	0.002	-	92.6(149.1)
GSP	34.3400	116.9000	11/27/1992	160057.5	1.0	5.30	0.005	II	92.9(149.5)
DMG	35.3830	118.5670	07/23/1952	546 3.0	0.0	4.70	0.003	I	92.9(149.5)
DMG	34.4000	116.9170	02/01/1942	151828.0	0.0	4.50	0.003	-	92.9(149.5)
DMG	34.4000	116.9170	02/01/1942	16 334.0	0.0	4.50	0.003	-	92.9(149.5)
DMG	34.4000	116.9170	02/01/1942	151555.0	0.0	4.00	0.002	-	92.9(149.5)
DMG	34.4000	116.9170	01/25/1942	215133.0	0.0	4.00	0.002	-	92.9(149.5)
DMG	32.7180	118.1720	04/28/1938	6 728.0	10.0	4.50	0.003	-	93.0(149.6)
DMG	33.5000	117.0000	08/08/1925	1013 0.0	0.0	4.50	0.003	-	93.0(149.7)
DMG	35.3830	118.6000	09/05/1953	192436.0	0.0	4.10	0.002	-	93.0(149.7)
GSP	34.3640	116.9040	11/27/1992	183225.0	1.0	4.10	0.002	-	93.0(149.7)
DMG	35.3790	118.6680	11/21/1955	205527.6	5.3	4.30	0.002	-	93.1(149.8)
PAS	32.7560	117.9880	01/12/1975	212214.8	15.3	4.80	0.003	I	93.1(149.8)
GSP	34.1372	116.8580	09/16/2015	161047.3	9.6	4.00	0.002	-	93.3(150.1)
GSP	34.1410	116.8570	09/19/1997	223714.5	10.0	4.10	0.002	-	93.4(150.2)
GSP	34.1950	116.8620	08/17/1992	204152.1	11.0	5.30	0.005	II	93.4(150.3)
GSP	34.1980	116.8620	08/18/1992	094640.7	12.0	4.20	0.002	-	93.4(150.3)
DMG	32.8000	117.8330	01/24/1942	214148.0	0.0	4.00	0.002	-	93.4(150.4)
PAS	35.3720	118.7740	12/15/1987	182346.1	3.2	4.10	0.002	-	93.5(150.4)
DMG	34.3240	116.8850	12/01/1962	03548.8	9.6	4.30	0.002	-	93.5(150.4)
GSP	34.3690	116.8970	12/04/1992	020857.5	3.0	5.30	0.005	II	93.5(150.5)
GSP	34.1630	116.8550	06/28/1992	144321.0	6.0	5.30	0.005	II	93.6(150.6)
GSP	35.3900	118.6230	09/29/2004	225454.2	3.0	5.00	0.004	I	93.6(150.6)
DMG	34.3120	116.8790	01/31/1972	155 4.2	8.0	4.00	0.002	-	93.7(150.7)
DMG	34.3330	116.8830	10/14/1943	142844.0	0.0	4.50	0.003	-	93.7(150.8)
DMG	35.3670	118.8330	03/17/1935	2026 0.0	0.0	4.00	0.002	-	93.8(150.9)
GSP	32.7260	118.0680	12/27/2000	002714.1	6.0	4.10	0.002	-	93.8(150.9)
T-A	35.3300	119.0000	01/04/1870	7 0 0.0	0.0	4.30	0.002	-	93.8(150.9)
DMG	33.9500	116.8500	09/28/1946	719 9.0	0.0	5.00	0.004	I	93.8(150.9)
DMG	35.3950	118.6200	08/08/1955	32150.5	4.1	4.70	0.003	I	93.9(151.2)
DMG	34.3250	116.8750	12/02/1962	04138.4	6.7	4.40	0.002	-	94.1(151.4)
DMG	35.4000	118.5830	07/24/1952	114756.0	0.0	4.40	0.002	-	94.1(151.5)
DMG	35.4000	118.5830	07/25/1952	7 351.0	0.0	4.10	0.002	-	94.1(151.5)
GSP	35.3700	118.8500	12/18/1990	165643.0	6.0	4.20	0.002	-	94.2(151.6)
DMG	35.4000	118.6330	10/02/1952	231021.0	0.0	4.20	0.002	-	94.3(151.8)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	35.3670	118.8830	09/12/1953	64116.0	0.0	4.10	0.002	-	94.4(152.0)
GSP	34.3700	116.8800	11/29/1992	142120.5	3.0	4.00	0.002	-	94.5(152.0)
PAS	32.7590	117.9060	10/18/1976	172753.1	13.8	4.20	0.002	-	94.5(152.0)
DMG	35.3500	118.9670	02/04/1954	204841.0	0.0	4.00	0.002	-	94.6(152.2)
GSP	34.2320	116.8460	07/10/1992	012940.0	0.0	4.20	0.002	-	94.6(152.3)
DMG	34.3250	116.8650	10/29/1962	24253.9	8.6	4.80	0.003	I	94.6(152.3)
GSP	34.2250	116.8440	07/09/1992	023435.0	0.0	4.10	0.002	-	94.7(152.3)
DMG	34.3500	116.8670	10/15/1943	1650 1.0	0.0	4.50	0.002	-	94.9(152.7)
GSP	34.3240	116.8580	02/22/2003	141608.4	4.0	4.10	0.002	-	95.0(152.9)
PAS	34.6610	119.9730	05/07/1984	193232.8	9.9	4.20	0.002	-	95.1(153.0)
DMG	35.3830	118.8500	10/13/1952	222035.0	0.0	4.00	0.002	-	95.1(153.0)
DMG	35.3830	118.8500	07/29/1952	7 347.0	0.0	6.10	0.009	III	95.1(153.0)
GSP	34.3260	116.8570	02/22/2003	122513.6	9.0	4.00	0.002	-	95.1(153.0)
GSP	34.1630	116.8270	06/28/1992	150451.5	12.0	4.40	0.002	-	95.2(153.2)
GSP	34.2390	116.8370	07/09/1992	014357.6	0.0	5.30	0.005	II	95.2(153.2)
GSP	34.3110	116.8510	02/22/2003	122133.1	4.0	4.30	0.002	-	95.2(153.2)
PAS	35.2250	117.6290	05/02/1975	18 323.1	10.0	4.20	0.002	-	95.2(153.3)
GSP	34.3100	116.8500	02/22/2003	193345.8	3.0	4.50	0.002	-	95.3(153.3)
GSG	34.3100	116.8480	02/22/2003	121910.6	1.0	5.20	0.004	I	95.4(153.5)
GSP	34.3200	116.8500	10/27/1998	154017.1	4.0	4.10	0.002	-	95.4(153.5)
GSP	34.3110	116.8470	02/22/2003	122015.6	4.0	4.00	0.002	-	95.4(153.6)
GSN	34.2030	116.8270	06/28/1992	150530.7	5.0	6.70	0.015	IV	95.4(153.6)
GSP	34.3040	116.8430	02/27/2003	050021.7	4.0	4.00	0.002	-	95.6(153.8)
GSP	32.6850	118.1380	06/20/1997	053855.0	6.0	4.20	0.002	-	95.6(153.9)
GSP	34.3220	116.8460	09/20/1999	070249.2	2.0	4.20	0.002	-	95.6(153.9)
GSP	34.3150	116.8440	02/25/2003	040304.8	2.0	4.60	0.003	I	95.7(153.9)
GSP	34.3230	116.8440	10/27/1998	010840.7	5.0	4.90	0.003	I	95.8(154.1)
DMG	35.4000	118.8170	07/29/1952	8 146.0	0.0	5.10	0.004	I	95.8(154.2)
DMG	34.3070	116.8350	08/28/1950	194526.4	11.7	4.20	0.002	-	96.1(154.6)
DMG	34.7000	117.0000	07/16/1916	1230 0.0	0.0	4.00	0.002	-	96.1(154.7)
DMG	34.7000	117.0000	07/16/1916	1150 0.0	0.0	4.50	0.002	-	96.1(154.7)
GSP	32.6810	118.1090	06/20/1997	043540.5	6.0	4.70	0.003	I	96.2(154.9)
PAS	33.5350	120.0490	01/12/1983	1719 0.6	5.0	4.20	0.002	-	96.3(154.9)
GSP	34.3540	116.8430	11/13/2004	173916.9	9.0	4.20	0.002	-	96.3(154.9)
DMG	34.1000	116.8000	10/24/1935	1448 7.6	0.0	5.10	0.004	I	96.5(155.2)
GSP	34.3290	116.8320	12/03/2005	074934.6	5.0	4.10	0.002	-	96.5(155.3)
DMG	33.9670	116.8000	09/07/1945	153424.0	0.0	4.30	0.002	-	96.6(155.4)
GSP	34.2370	116.8110	06/28/1992	125730.8	10.0	4.00	0.002	-	96.6(155.5)
DMG	35.4320	118.6640	09/30/1964	175125.8	7.4	4.00	0.002	-	96.7(155.6)
GSP	34.1830	116.8020	06/28/1992	192637.6	1.0	4.00	0.002	-	96.7(155.7)
DMG	32.6800	118.0770	10/28/1973	22 0 2.7	8.0	4.50	0.002	-	96.7(155.7)
DMG	34.4170	116.8500	02/11/1932	231120.0	0.0	4.00	0.002	-	96.9(156.0)
DMG	35.4330	118.7000	05/01/1954	22 439.0	0.0	4.20	0.002	-	97.0(156.1)
DMG	35.4400	118.3470	01/02/1964	194841.0	6.3	4.20	0.002	-	97.0(156.2)

DMG	34.0290	116.7870	04/30/1954	03623.9	11.1	4.20	0.002	-	97.2(156.4)
PAS	32.7140	117.9100	10/18/1976	172652.6	15.1	4.20	0.002	-	97.3(156.6)
PAS	33.7010	116.8370	08/22/1979	2 136.3	5.0	4.10	0.002	-	97.3(156.6)
PAS	34.3220	116.8150	08/29/1985	759 8.7	6.1	4.10	0.002	-	97.4(156.7)
DMG	33.5000	116.9170	11/04/1935	355 0.0	0.0	4.50	0.002	-	97.4(156.7)
DMG	34.2290	116.7950	05/11/1956	163050.5	13.3	4.70	0.003	I	97.5(156.9)
GSP	35.4530	118.4310	05/06/1997	191253.8	6.0	4.50	0.002	-	97.7(157.2)
GSP	34.2980	116.8040	07/05/1992	200303.1	3.0	4.00	0.002	-	97.7(157.2)
DMG	35.4540	118.4760	11/23/1953	2039 0.9	5.9	4.40	0.002	-	97.7(157.2)

EARTHQUAKE SEARCH RESULTS

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FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
GSP	34.0140	116.7750	10/18/2005	040841.5	16.0	4.10	0.002	-	97.9(157.5)
GSP	34.0120	116.7750	10/18/2005	073103.5	18.0	4.40	0.002	-	97.9(157.5)
DMG	35.4540	118.6050	02/07/1964	22 750.3	-2.0	4.40	0.002	-	97.9(157.6)
DMG	33.9760	116.7750	10/17/1965	94519.0	17.0	4.90	0.003	I	98.0(157.7)
DMG	35.1060	117.3460	10/11/1966	165912.9	6.5	4.40	0.002	-	98.1(157.8)
DMG	34.0140	116.7710	06/10/1944	111150.5	10.0	4.50	0.002	-	98.1(157.9)
DMG	35.3530	117.8260	07/03/1944	53823.5	-2.0	4.70	0.003	I	98.1(157.9)
DMG	34.3170	116.8000	08/12/1950	21717.0	0.0	4.30	0.002	-	98.1(157.9)
DMG	34.4360	116.8340	07/14/1973	8 020.1	8.0	4.80	0.003	I	98.1(157.9)
DMG	33.9730	116.7690	06/10/1944	111531.9	10.0	4.00	0.002	-	98.3(158.2)
GSP	35.4663	118.5210	04/19/2014	121513.0	-0.8	4.24	0.002	-	98.6(158.6)
DMG	32.7170	117.8330	11/06/1950	205546.0	0.0	4.40	0.002	-	98.7(158.9)
DMG	35.2000	119.5000	06/09/1928	822 0.0	0.0	4.00	0.002	-	98.7(158.9)
MGI	35.2000	119.5000	12/01/1920	130 0.0	0.0	4.60	0.003	-	98.7(158.9)
GSP	34.2190	116.7710	07/21/1992	211029.0	1.0	4.10	0.002	-	98.7(158.9)
DMG	34.2990	116.7840	03/18/1956	24217.3	6.3	4.40	0.002	-	98.8(159.0)
GSP	34.2670	116.7750	12/02/2000	082807.4	3.0	4.10	0.002	-	99.0(159.3)
DMG	35.4650	118.6680	02/07/1964	221052.0	-0.5	4.20	0.002	-	99.0(159.3)
DMG	33.0000	117.3000	11/22/1800	2130 0.0	0.0	6.50	0.012	III	99.0(159.3)
GSP	35.4730	118.4250	05/01/2008	081143.2	6.0	4.40	0.002	-	99.1(159.4)
DMG	34.2500	116.7700	03/16/1956	203344.3	0.8	4.00	0.002	-	99.1(159.4)
GSP	34.2730	116.7740	08/24/1992	135146.0	1.0	4.30	0.002	-	99.1(159.5)
GSP	34.2110	116.7600	06/28/1992	152429.3	6.0	4.50	0.002	-	99.3(159.8)
DMG	35.3330	119.2500	01/20/1941	135816.0	0.0	4.00	0.002	-	99.3(159.8)
DMG	34.1170	116.7500	08/22/1942	125913.0	0.0	4.00	0.002	-	99.4(159.9)
GSP	35.0170	117.2030	06/29/1992	041642.6	3.0	4.00	0.002	-	99.4(159.9)
GSP	34.2070	116.7570	06/28/1992	161719.2	3.0	4.20	0.002	-	99.4(160.0)

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GSP |32.6260|118.1510|06/20/1997|080413.6|  6.0| 4.60| 0.003 |  - | 99.4(160.0)
DMG |33.9330|116.7500|10/28/1944|183016.0|  0.0| 4.40| 0.002 |  - | 99.6(160.3)
DMG |33.9330|116.7500|08/06/1938| 228 0.0|  0.0| 4.00| 0.002 |  - | 99.6(160.3)
PAS |35.2970|119.3460|05/06/1985|231433.0| 24.4| 4.40| 0.002 |  - | 99.7(160.4)
DMG |33.4540|116.8980|07/29/1936|142252.8| 10.0| 4.00| 0.002 |  - | 99.7(160.4)
PAS |35.2700|119.4020|09/26/1980|131841.1|  5.0| 4.10| 0.002 |  - | 99.7(160.4)
DMG |33.9170|116.7500|01/25/1933|1444 0.0|  0.0| 4.00| 0.002 |  - | 99.7(160.4)
DMG |33.4560|116.8960|06/16/1938| 55916.9| 10.0| 4.00| 0.002 |  - | 99.7(160.5)
DMG |33.2670|117.0170|06/07/1935|1633 0.0|  0.0| 4.00| 0.002 |  - | 99.8(160.6)

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-END OF SEARCH-   1096 EARTHQUAKES FOUND WITHIN THE SPECIFIED SEARCH AREA.

TIME PERIOD OF SEARCH:   1800  TO  2016

LENGTH OF SEARCH TIME:   217  years

THE EARTHQUAKE CLOSEST TO THE SITE IS ABOUT 2.8 MILES (4.5 km) AWAY.

LARGEST EARTHQUAKE MAGNITUDE FOUND IN THE SEARCH RADIUS: 7.7

LARGEST EARTHQUAKE SITE ACCELERATION FROM THIS SEARCH: 0.228 g

COEFFICIENTS FOR GUTENBERG & RICHTER RECURRENCE RELATION:
  a-value=  3.953
  b-value=  0.819
  beta-value=  1.885


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TABLE OF MAGNITUDES AND EXCEEDANCES:
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Earthquake Magnitude	Number of Times Exceeded	Cumulative No. / Year
4.0	1096	5.07407
4.5	407	1.88426
5.0	145	0.67130
5.5	54	0.25000
6.0	27	0.12500
6.5	11	0.05093
7.0	6	0.02778
7.5	1	0.00463

Table 1: Site-Specific Seismic Ground Motion Analysis per ASCE 7-16

Project Name:	Franklin ES	Date:	November 2021	Seismic Design Coefficients: Per ASCE 7-16 & 2019 CBC					
Project Location:	2400 Montana Avenue, Santa Monica	Latitude:	34.0391°	S_s	1.962	**S_{MS}**	**2.212**	T_0	0.179
Project Number:	11428.035	Longitude:	-118.4851°	S_1	0.701	**S_{M1}**	**1.402**	T_s	0.893
Site Class:	D			F_a	1	**S_{DS}**	**1.474**	T_L	8
Shear Wave Velocity:	339 m/sec			F_v	2.5	**S_{D1}**	**0.935**	**PGA_M**	**0.907**
Return Period:	2475 years (2% probability of exceedance in 50 years)			C_{RS}	0.908	C_{R1}	0.904		
Percent Damping:	5%								

	Sec. 21.2.1.1 Probabilistic				Sec. 21.2.2 Deterministic			Sec. 11.4.6 General Procedure	Sec. 21.3 Design Response Spectrum				Risk Targeted Spectrum
Period (sec)	Spectral Acceleration (g)	Seismic Risk Coefficients	Maximum Response Coefficients	MCE_R Response Spectrum (g)	Spectral Acceleration (g)	Maximum Response Coefficients	MCE_R Response Spectrum (g)	Design Response Spectral Acceleration (g)	Lower Limit of General Procedure - 80% of S_a (g)	MCE_R - S_{aM} (g)	2/3 * S_{aM} (g)	Design Response Spectrum (g)	1.5 * Design Response Spectrum (g)
0.01	0.907	0.908	1.19	0.980	1.153	1.19	1.372	0.567	0.454	0.980	0.653	0.653	0.980
0.02	0.912	0.908	1.19	0.985	1.161	1.19	1.382	0.611	0.489	0.985	0.657	0.657	0.985
0.03	0.953	0.908	1.19	1.029	1.191	1.19	1.417	0.655	0.524	1.029	0.686	0.686	1.029
0.05	1.118	0.908	1.19	1.208	1.345	1.19	1.600	0.743	0.594	1.208	0.805	0.805	1.208
0.075	1.408	0.908	1.19	1.521	1.607	1.19	1.912	0.853	0.682	1.521	1.014	1.014	1.521
0.1	1.649	0.908	1.19	1.782	1.861	1.19	2.215	0.963	0.770	1.782	1.188	1.188	1.782
0.15	1.927	0.908	1.20	2.100	2.178	1.20	2.614	1.182	0.946	2.100	1.400	1.400	2.100
0.2	2.089	0.908	1.21	2.295	2.462	1.21	2.979	1.308	1.046	2.295	1.530	1.530	2.295
0.25	2.180	0.908	1.22	2.414	2.649	1.22	3.232	1.308	1.046	2.414	1.609	1.609	2.414
0.3	2.220	0.908	1.22	2.457	2.845	1.22	3.471	1.308	1.046	2.457	1.638	1.638	2.457
0.4	2.130	0.907	1.23	2.376	2.913	1.23	3.584	1.308	1.046	2.376	1.584	1.584	2.376
0.5	1.987	0.907	1.23	2.216	2.770	1.23	3.407	1.308	1.046	2.216	1.477	1.477	2.216
0.75	1.548	0.905	1.24	1.737	2.242	1.24	2.780	1.308	1.046	1.737	1.158	1.158	1.737
1	1.218	0.904	1.24	1.365	1.715	1.24	2.127	1.168	0.935	1.365	0.910	0.935	1.402
1.5	0.791	0.904	1.24	0.887	1.129	1.24	1.400	0.779	0.623	0.887	0.591	0.623	0.935
2	0.561	0.904	1.24	0.628	0.810	1.24	1.004	0.584	0.467	0.628	0.419	0.467	0.701
3	0.342	0.904	1.25	0.386	0.456	1.25	0.570	0.389	0.312	0.386	0.258	0.312	0.467
4	0.231	0.904	1.26	0.263	0.289	1.26	0.365	0.292	0.234	0.263	0.175	0.234	0.351
5	0.170	0.904	1.26	0.194	0.203	1.26	0.256	0.234	0.187	0.194	0.129	0.187	0.280
7.5	0.095	0.904	1.28	0.109	0.100	1.28	0.128	0.156	0.125	0.109	0.073	0.125	0.187
10	0.060	0.904	1.29	0.070	0.055	1.29	0.072	0.093	0.075	0.070	0.047	0.075	0.112

Latitude, Longitude: 34.0391, -118.4851

Date	11/16/2021, 9:53:38 AM
Design Code Reference Document	ASCE7-16
Risk Category	IV
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.962	MCE_R ground motion. (for 0.2 second period)
S_1	0.701	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.962	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.308	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.837	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.921	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.962	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.161	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.435	Factored deterministic acceleration value. (0.2 second)
S1RT	0.701	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.776	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.822	Factored deterministic acceleration value. (1.0 second)
PGAd	0.985	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.908	Mapped value of the risk coefficient at short periods
C_{R1}	0.904	Mapped value of the risk coefficient at a period of 1 s

DISCLAIMER

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U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (update…

Latitude

Decimal degrees

34.0391

Longitude

Decimal degrees, negative values for western longitudes

-118.4851

Site Class

259 m/s (Site class D)

Spectral Period

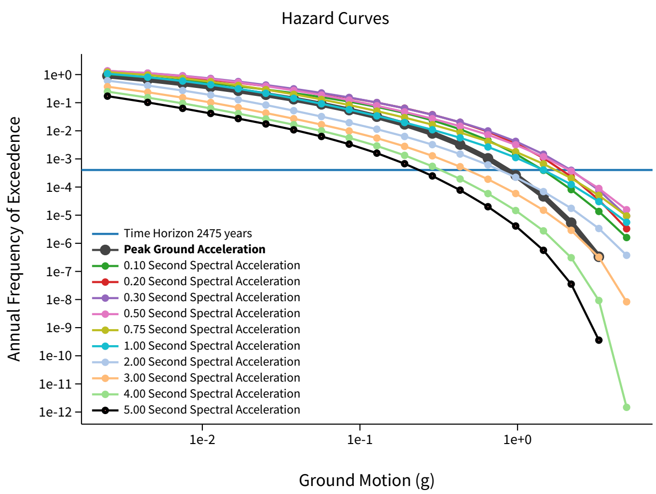
Peak Ground Acceleration

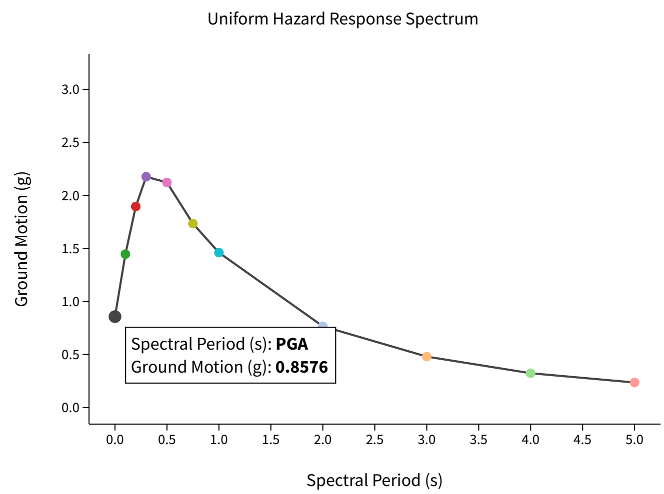
Time Horizon

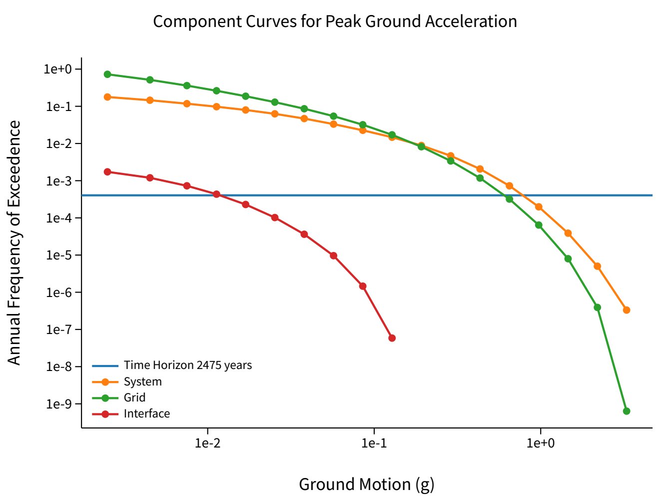
Return period in years

2475

Hazard Curve





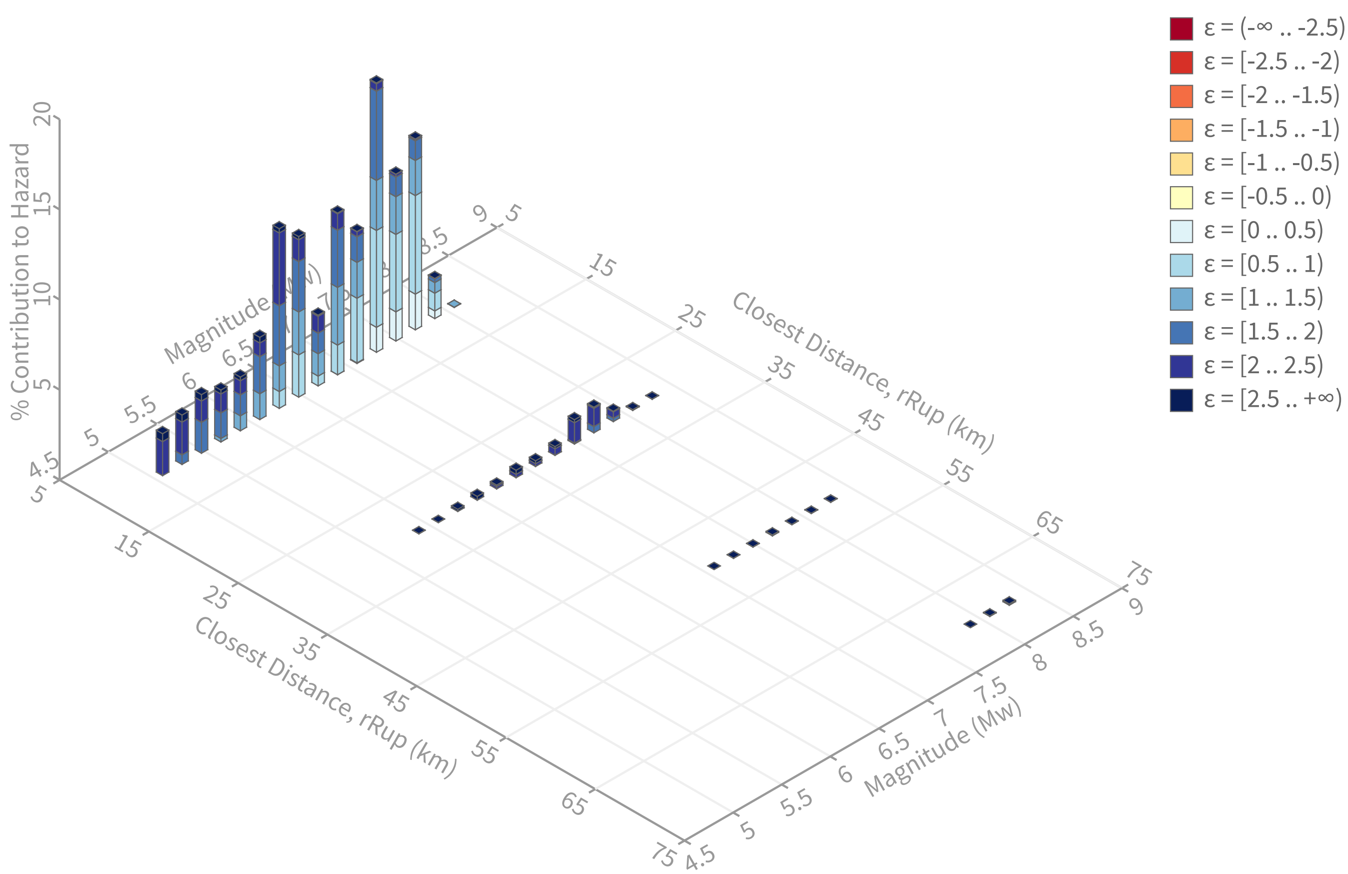


View Raw Data

^ Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.85757346 g

Recovered targets

Return period: 2963.8203 yrs
Exceedance rate: 0.00033740237 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.03 %

Mean (over all sources)

m: 6.83
r: 8.11 km
ε_0: 1.45 σ

Mode (largest m-r bin)

m: 7.31
r: 7.79 km
ε_0: 1.18 σ
Contribution: 14.93 %

Mode (largest m-r-ε_0 bin)

m: 7.69
r: 6.36 km
ε_0: 0.78 σ
Contribution: 5.46 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM31	System							37.54
Santa Monica alt 1 [1]		1.85	7.16	0.84	118.488°W	34.036°N	209.60	13.29
Compton [4]		10.04	7.39	0.91	118.595°W	33.997°N	245.35	5.64
Palos Verdes [15]		10.22	7.02	1.74	118.557°W	33.970°N	220.88	4.86
Newport-Inglewood alt 1 [8]		8.98	6.68	1.85	118.389°W	34.044°N	86.72	3.64
Malibu Coast alt 1 [0]		3.87	6.32	1.37	118.525°W	34.031°N	255.51	2.15
San Pedro Escarpment [1]		8.73	7.60	0.81	118.655°W	33.915°N	228.76	1.09
UC33brAvg_FM32	System							37.28
Santa Monica alt 2 [2]		1.48	7.14	0.85	118.486°W	34.047°N	353.07	9.54
Malibu Coast alt 2 [0]		4.07	7.46	0.88	118.525°W	34.033°N	259.44	5.37
Hollywood [2]		7.83	6.97	1.56	118.422°W	34.084°N	49.08	4.76
Palos Verdes [15]		10.22	7.02	1.80	118.557°W	33.970°N	220.88	4.51
Newport-Inglewood alt 2 [8]		8.94	6.74	1.81	118.390°W	34.043°N	86.93	2.87
Compton [4]		10.04	7.47	0.89	118.595°W	33.997°N	245.35	2.83
Compton [3]		10.89	7.26	1.06	118.533°W	33.925°N	199.24	1.44
UC33brAvg_FM31 (opt)	Grid							13.00
PointSourceFinite: -118.485, 34.080		6.61	5.75	1.71	118.485°W	34.080°N	0.00	2.86
PointSourceFinite: -118.485, 34.080		6.61	5.75	1.71	118.485°W	34.080°N	0.00	2.86
PointSourceFinite: -118.485, 34.098		7.70	5.86	1.84	118.485°W	34.098°N	0.00	1.16
PointSourceFinite: -118.485, 34.098		7.70	5.86	1.84	118.485°W	34.098°N	0.00	1.16
UC33brAvg_FM32 (opt)	Grid							12.18
PointSourceFinite: -118.485, 34.080		6.59	5.77	1.70	118.485°W	34.080°N	0.00	2.46
PointSourceFinite: -118.485, 34.080		6.59	5.77	1.70	118.485°W	34.080°N	0.00	2.46
PointSourceFinite: -118.485, 34.098		7.74	5.84	1.85	118.485°W	34.098°N	0.00	1.16
PointSourceFinite: -118.485, 34.098		7.74	5.84	1.85	118.485°W	34.098°N	0.00	1.16

OpenSHA PSHA Output

X-Axis: Period (sec)
Y-Axis: SA (g)
Number of Data Sets: 1

DATASET #1

Name:
Num Points: 21
Info:
IMR Param List:

IMR = NGAWest2 2014 Averaged No Idriss; IMR Weights = ['Abrahamson, Silva & Kamai (2014)': 0.25, 'Boore, Stewart, Seyhan & Atkinson (2014)': 0.25, 'Campbell & Bozorgnia (2014)': 0.25, 'Chiou & Youngs (2014)': 0.25]; Std Dev Type = Total; Tectonic Region = Active Shallow Crust; Additional Epistemic Uncertainty = null; Component = RotD50; Gaussian Truncation = None

Site Param List:

Longitude = -118.4851; Latitude = 34.0391; Vs30 = 339.0; Vs30 Type = Measured; Depth 2.5 km/sec = 3.25; Depth 1.0 km/sec = 350.0

IML/Prob Param List:

Map Type = IML@Prob; Probability = 0.02

Forecast Param List:

Eqk Rup Forecast = Mean UCERF3; Mean UCERF3 Presets = (POISSON ONLY) Both FM Branch Averaged; Apply Aftershock Filter = false; Aleatory Mag-Area StdDev = 0.0; Background Seismicity = Include; Treat Background Seismicity As = Point Sources; Fault Grid Spacing = 1.0; Probability Model = Poisson; Sect Upper Depth Averaging Tolerance = 100.0; Use Mean Upper Depth = true; Rup Mag Averaging Tolerance = 1.0; Rupture Rake To Use = Def. Model Mean; Fault Model(s) = Both; Ignore Cache = false

TimeSpan Param List:

Duration = 50.0

Maximum Distance = 200.0; Pt Src Dist Corr = None

X, Y Data:
0.01 0.90692085
0.02 0.9118346
0.03 0.95255804
0.05 1.11763
0.075 1.4075167
0.1 1.6489706
0.15 1.9272577
0.2 2.0890965
0.25 2.1797433
0.3 2.2196062
0.4 2.1301453

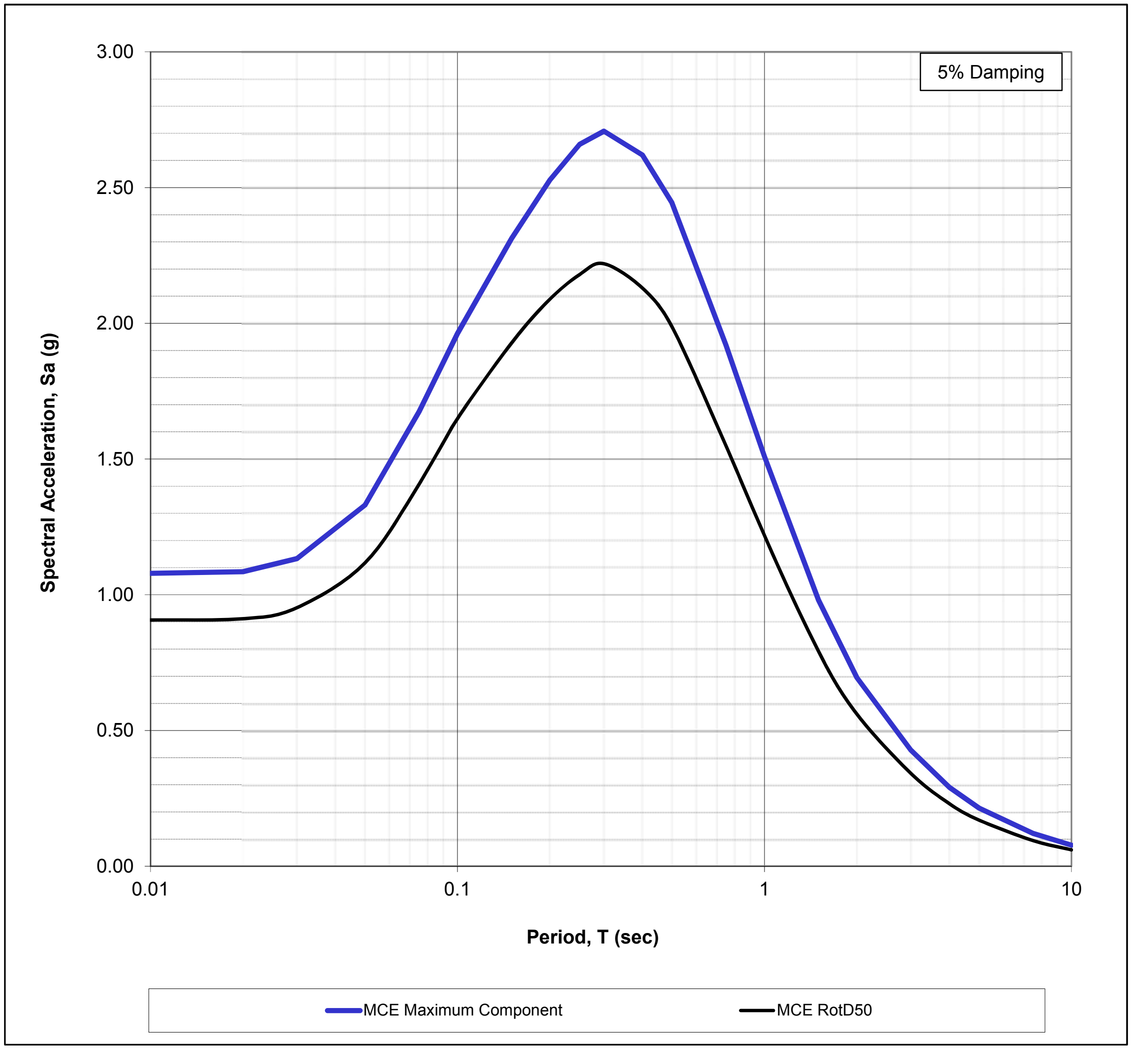
0.5	1.9872205
0.75	1.5477033
1.0	1.2179469
1.5	0.7909015
2.0	0.560597
3.0	0.34192818
4.0	0.23082952
5.0	0.17000519
7.5	0.09451725
10.0	0.06024067

MCE PROBABILISTIC SPECTRA (2,475-YEAR AVERAGE RETURN INTERVAL)

Project: Franklin ES

Project Number: 11428.035

Location: 2400 Montana Avenue, Santa Monica



Period T (s)	MCE GEOMEAN Sa (g)	Maximum Component Factor	MCE MAX COMP Site-Specific Sa (g)
0.01	0.907	1.19	1.079
0.02	0.912	1.19	1.085
0.03	0.953	1.19	1.134
0.05	1.118	1.19	1.330
0.075	1.408	1.19	1.675
0.10	1.649	1.19	1.962
0.15	1.927	1.20	2.313
0.20	2.089	1.21	2.528
0.25	2.180	1.22	2.659
0.30	2.220	1.22	2.708
0.40	2.130	1.23	2.620
0.50	1.987	1.23	2.444
0.75	1.548	1.24	1.919
1.00	1.218	1.24	1.510
1.50	0.791	1.24	0.981
2.00	0.561	1.24	0.695
3.00	0.342	1.25	0.427
4.00	0.231	1.26	0.291
5.00	0.170	1.26	0.214
7.50	0.095	1.28	0.121
10.00	0.060	1.29	0.078

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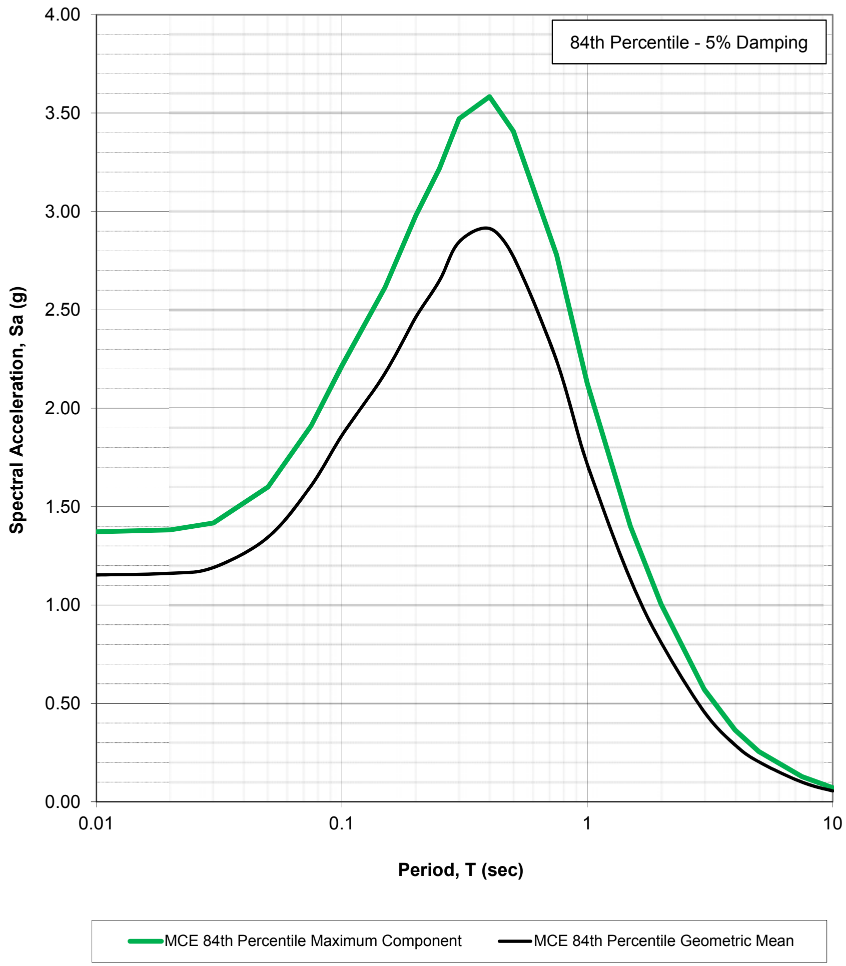
Figure C1

MCE DETERMINISTIC SPECTRA

Project: Franklin ES

Project Number: 11428.035

Location: 2400 Montana Avenue, Santa Monica



DETERMINISTIC PGA MAGNITUDE

MC FACTOR		DSHA - 84TH PERCENTILE		
Period T (s)	Maximum Component Factor	Period T (s)	MCE GEOMEAN Sa (g)	MCE MAX COMP Sa (g)
0.01	1.19	0.01	1.153	1.372
0.02	1.19	0.02	1.161	1.382
0.03	1.19	0.03	1.191	1.417
0.05	1.19	0.05	1.345	1.600
0.075	1.19	0.075	1.607	1.912
0.10	1.19	0.10	1.861	2.215
0.15	1.20	0.15	2.178	2.614
0.20	1.21	0.20	2.462	2.979
0.25	1.22	0.25	2.649	3.218
0.30	1.22	0.30	2.845	3.471
0.40	1.23	0.40	2.913	3.584
0.50	1.23	0.50	2.770	3.407
0.75	1.24	0.75	2.242	2.780
1.00	1.24	1.00	1.715	2.127
1.50	1.24	1.50	1.129	1.400
2.00	1.24	2.00	0.810	1.004
3.00	1.25	3.00	0.456	0.570
4.00	1.26	4.00	0.289	0.365
5.00	1.26	5.00	0.203	0.256
7.50	1.28	7.50	0.100	0.128
10.00	1.29	10.00	0.055	0.072

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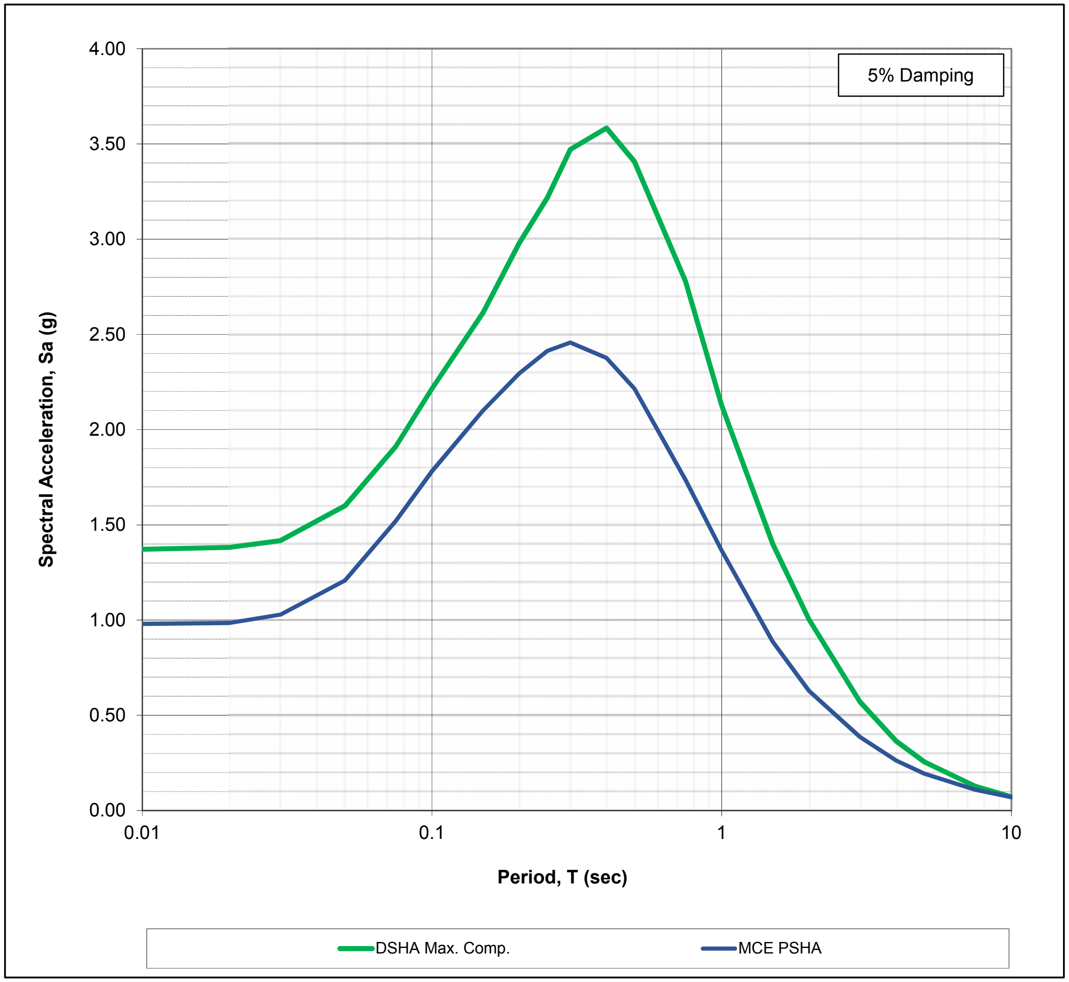
Figure C2

MCE SPECTRA COMPARISON - MAXIMUM HORIZONTAL COMPONENT

Project: Franklin ES

Project Number: 11428.035

Location: 2400 Montana Avenue, Santa Monica



DSHA		PSHA			
Period T (s)	MAX COMP. Sa (g)	Period T (s)	MCE MAX COMP. Sa (g)	Site Risk Coefficient (Cs)	MCE_R Sa (g)
0.01	1.372	0.01	1.079	0.908	0.980
0.02	1.382	0.02	1.085	0.908	0.985
0.03	1.417	0.03	1.134	0.908	1.029
0.05	1.600	0.05	1.330	0.908	1.208
0.075	1.912	0.075	1.675	0.908	1.521
0.10	2.215	0.10	1.962	0.908	1.782
0.15	2.614	0.15	2.313	0.908	2.100
0.20	2.979	0.20	2.528	0.908	2.295
0.25	3.218	0.25	2.659	0.908	2.414
0.30	3.471	0.30	2.708	0.908	2.457
0.40	3.584	0.40	2.620	0.907	2.376
0.50	3.407	0.50	2.444	0.907	2.216
0.75	2.780	0.75	1.919	0.905	1.737
1.00	2.127	1.00	1.510	0.904	1.365
1.50	1.400	1.50	0.981	0.904	0.887
2.00	1.004	2.00	0.695	0.904	0.628
3.00	0.570	3.00	0.427	0.904	0.386
4.00	0.365	4.00	0.291	0.904	0.263
5.00	0.256	5.00	0.214	0.904	0.194
7.50	0.128	7.50	0.121	0.904	0.109
10.00	0.072	10.00	0.078	0.904	0.070

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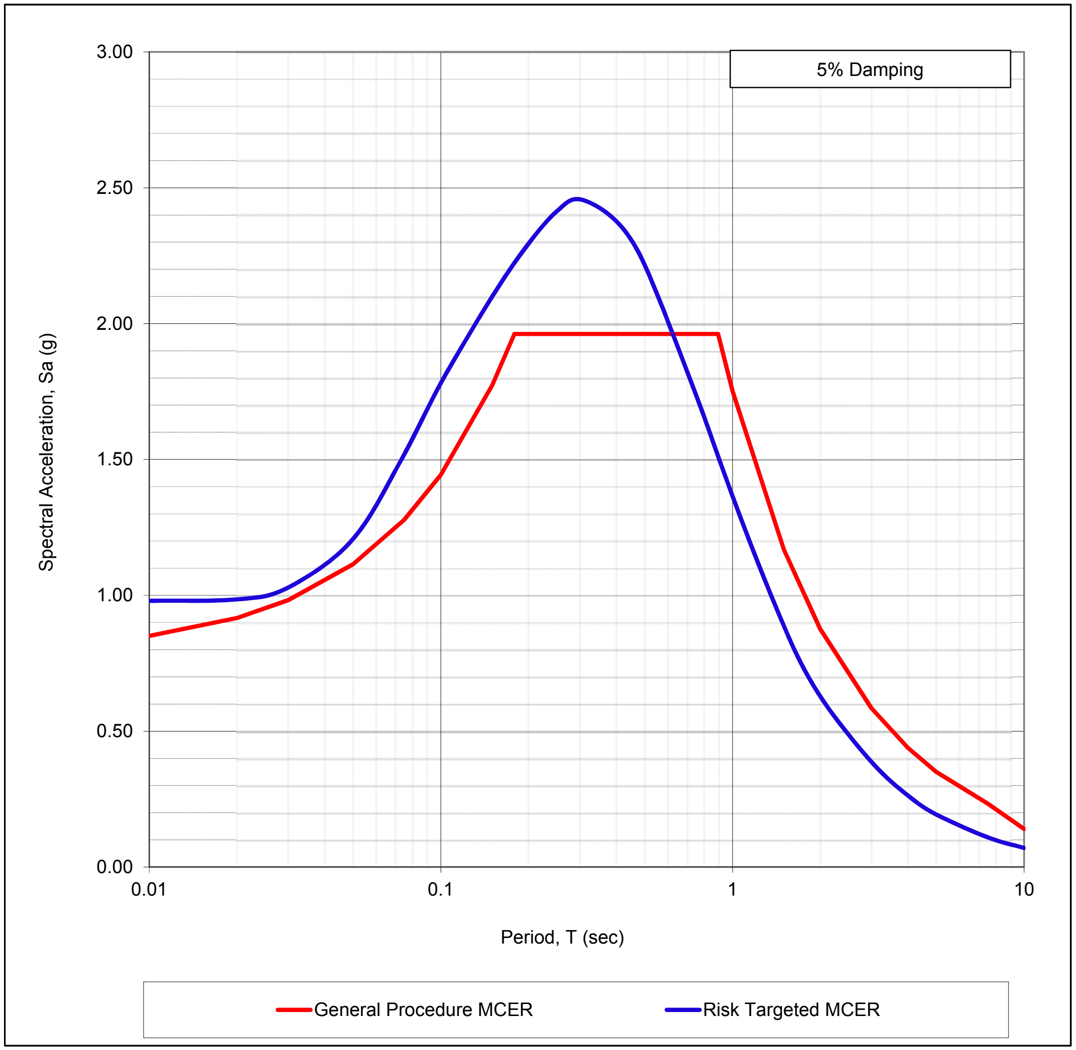
Figure C3

RISK TARGETED MAXIMUM CONSIDERED EARTHQUAKE (MCE_R) RESPONSE SPECTRUM

Project: Franklin ES
Project Number: 11428.035
Location: 2400 Montana Avenue, Santa Monica



SITE-SPECIFIC vs. GENERAL CODE-BASED SPECTRA

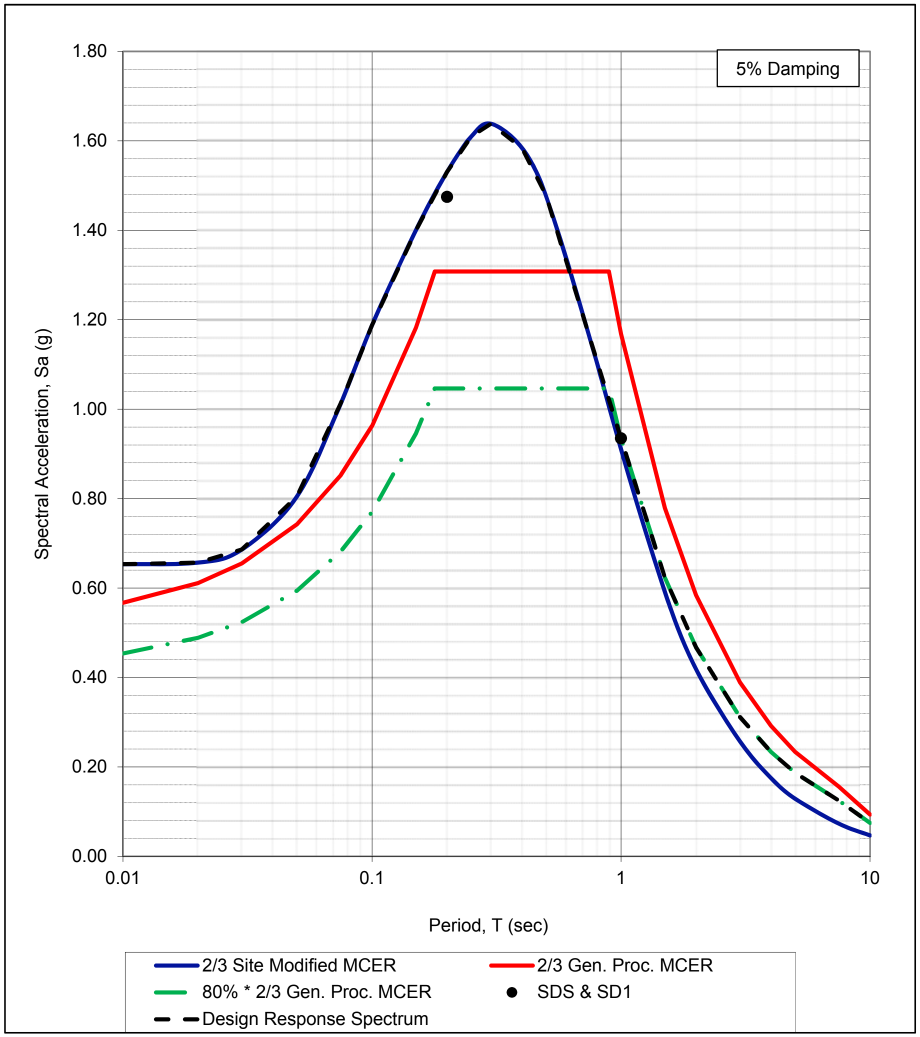
Period T (s)	DETERM. MCE_R Sa (g)	PROB. MCE_R Sa (g)	**Risk TGT MCE_R Sa (g)**	General Procedure Sa (g)
0.01	1.372	0.980	**0.980**	0.851
0.02	1.382	0.985	**0.985**	0.917
0.03	1.417	1.029	**1.029**	0.982
0.05	1.600	1.208	**1.208**	1.114
0.075	1.912	1.521	**1.521**	1.279
0.10	2.215	1.782	**1.782**	1.444
0.15	2.614	2.100	**2.100**	1.773
0.20	2.979	2.295	**2.295**	1.962
0.25	3.232	2.414	**2.414**	1.962
0.30	3.471	2.457	**2.457**	1.962
0.40	3.584	2.376	**2.376**	1.962
0.50	3.407	2.216	**2.216**	1.962
0.75	2.780	1.737	**1.737**	1.962
1.00	2.127	1.365	**1.365**	1.753
1.50	1.400	0.887	**0.887**	1.168
2.00	1.004	0.628	**0.628**	0.876
3.00	0.570	0.386	**0.386**	0.584
4.00	0.365	0.263	**0.263**	0.438
5.00	0.256	0.194	**0.194**	0.351
7.50	0.128	0.109	**0.109**	0.234
10.00	0.072	0.070	**0.070**	0.140

Leighton

Figure C4

ASCE 7-16 DESIGN RESPONSE SPECTRUM AND SITE-SPECIFIC S_{DS} AND S_{D1}

Project: Franklin ES
Project Number: 11428.035
Location: 2400 Montana Avenue, Santa Monica



	CODE BASED GENERAL PROCEDURE SPECTRUM			RISK TGT SPECTRUM	DESIGN RESPONSE SPECTRUM
Period T (s)	GENERAL PROC. MCER CURVE Sa (g)	2/3 GENERAL PROC. MCER CURVE Sa (g)	80% * 2/3 GENERAL PROC. MCER CURVE Sa (g)	2/3*MCE$_R$ CURVE Sa (g)	MAX of 2/3 MCE$_R$ and 80% * 2/3 GENERAL PROC. MCER Sa (g)
0.01	0.851	0.567	0.454	0.653	0.653
0.02	0.917	0.611	0.489	0.657	0.657
0.03	0.982	0.655	0.524	0.686	0.686
0.05	1.114	0.743	0.594	0.805	0.805
0.075	1.279	0.853	0.682	1.014	1.014
0.10	1.444	0.963	0.770	1.188	1.188
0.15	1.773	1.182	0.946	1.400	1.400
0.20	1.962	1.308	1.046	1.530	1.530
0.25	1.962	1.308	1.046	1.609	1.609
0.30	1.962	1.308	1.046	1.638	1.638
0.40	1.962	1.308	1.046	1.584	1.584
0.50	1.962	1.308	1.046	1.477	1.477
0.75	1.962	1.308	1.046	1.158	1.158
1.00	1.753	1.168	0.935	0.910	0.935
1.50	1.168	0.779	0.623	0.591	0.623
2.00	0.876	0.584	0.467	0.419	0.467
3.00	0.584	0.389	0.312	0.258	0.312
4.00	0.438	0.292	0.234	0.175	0.234
5.00	0.351	0.234	0.187	0.129	0.187
7.50	0.234	0.156	0.125	0.073	0.125
10.00	0.140	0.093	0.075	0.047	0.075

S_{DS} = 1.474 g
S_{D1} = 0.935 g

Note: Based on ASCE 7-16 Section 21.4, the parameter S_{DS} shall be taken as 90% of the maximum spectral acceleration, Sa, obtained from the site-specific spectrum, at any period within the range from 0.2 to 5 s, inclusive. The parameter S_{D1} shall be taken as the maximum value of the product, TSa, for periods from 1 to 2 s for sites with Vs_{30} > 1,200 ft/s (Vs_{30} > 365.76 m/s) and for periods from 1 to 5 s for sites with Vs_{30} ≤ 1,200 ft/s (Vs_{30} ≤ 365.76 m/s). The design Sa shall not be less than 80% of 2/3 of the general procedure (ASCE 7-16 Sec 11.4.6)

Leighton

Figure C5

Compton (3)

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

This excel file will be updated as necessary on the PEER website to fix any typos or other errors. Please check the website frequently for new versions at: http://peer.berkeley.edu/ngawest2/databases/

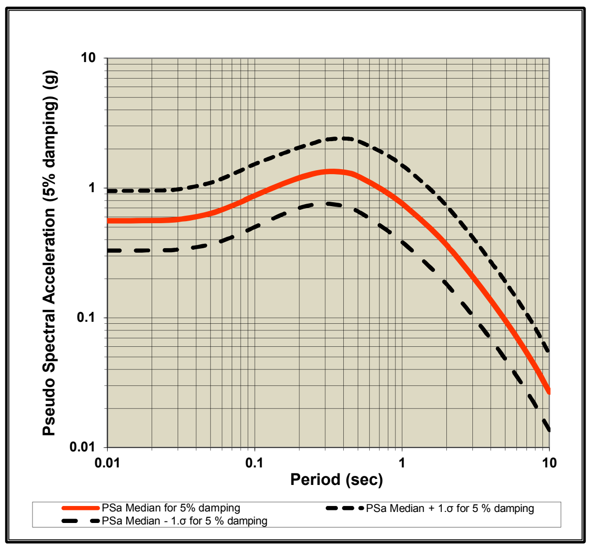
Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

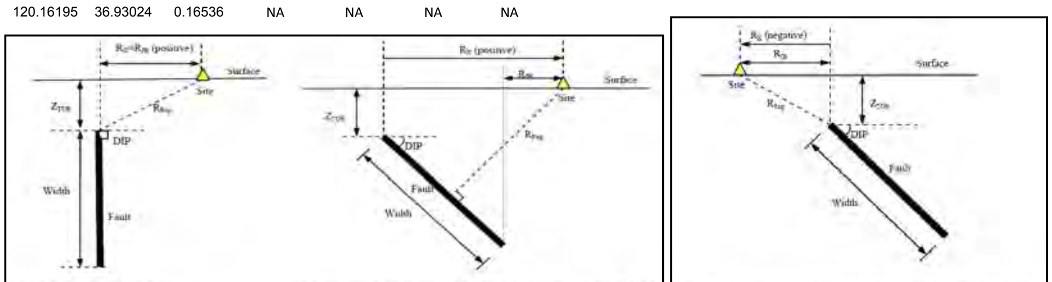
GMPE averaging	Geometric	*Weighted average of the natural logarithm of the spectral values*			
GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0.25	0.25	0.25	0.25	0
# of std. dev.	1				
Damping ratio (%)	5	*Modification factors are calculated in Sheet DSF*			

ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
CY14 Chiou & Youngs 2014 NGA West-2 Model
I14 Idriss 2014 NGA West-2 Model

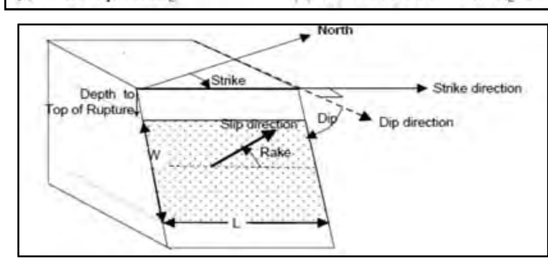
RotD50 Horizontal Component of PGA, PGV and *IMs*

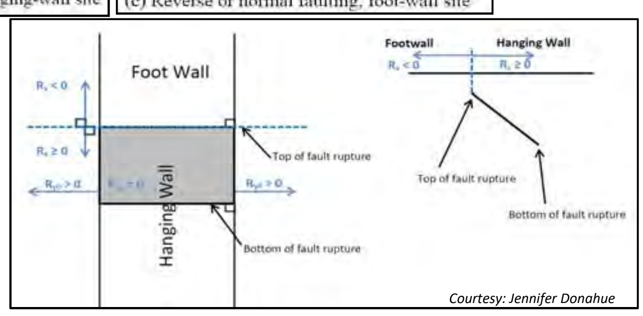
GMP	*T* (s)	Baseline: 5% Damping				User defined: 5% Damping			
		PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	PSa Median for 5% damping	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
PSa (g), S_d (cm)	0.01	0.55860	0.94857	0.32895	0.00139	0.55860	0.94857	0.32895	0.00139
	0.02	0.56116	0.95349	0.33026	0.00557	0.56116	0.95349	0.33026	0.00557
	0.03	0.57193	0.97611	0.33510	0.01278	0.57135	0.97514	0.33477	0.01276
	0.05	0.63437	1.09612	0.36714	0.03937	0.63437	1.09612	0.36714	0.03937
	0.075	0.75040	1.31257	0.42900	0.10478	0.75265	1.31651	0.43029	0.10509
	0.1	0.87122	1.52250	0.49854	0.21627	0.87384	1.52707	0.50004	0.21692
	0.15	1.05716	1.81703	0.61507	0.59046	1.05928	1.82067	0.61630	0.59164
	0.2	1.19441	2.04399	0.69796	1.18599	1.19680	2.04808	0.69935	1.18836
	0.25	1.27914	2.20703	0.74136	1.98456	1.28298	2.21365	0.74359	1.99052
	0.3	1.33216	2.34589	0.75649	2.97622	1.33482	2.35058	0.75801	2.98217
	0.4	1.31977	2.40183	0.72520	5.24186	1.32109	2.40423	0.72592	5.24711
	0.5	1.23255	2.30054	0.66035	7.64908	1.23378	2.30284	0.66101	7.65673
	0.75	0.95340	1.85064	0.49117	13.31268	0.95340	1.85064	0.49117	13.31268
	1	0.75777	1.49665	0.38367	18.81064	0.75777	1.49665	0.38367	18.81064
	1.5	0.50667	1.01211	0.25364	28.29922	0.50718	1.01312	0.25390	28.32752
	2	0.36488	0.73158	0.18198	36.23049	0.36415	0.73012	0.18162	36.15803
	3	0.20929	0.42014	0.10426	46.75898	0.20908	0.41972	0.10416	46.71222
	4	0.13589	0.27011	0.06837	53.97417	0.13576	0.26984	0.06830	53.92020
	5	0.09621	0.19163	0.04830	59.70477	0.09592	0.19105	0.04816	59.52565
	7.5	0.04781	0.09496	0.02407	66.75346	0.04766	0.09468	0.02399	66.55320
	10	0.02686	0.05285	0.01365	66.67469	0.02675	0.05264	0.01359	66.40799
PGA (g)	0	0.55581	0.94313	0.32756	0.00138	0.55581	0.94313	0.32756	0.00138
PGV (cm/s)	-1	66.61539	120.16195	36.93024	0.16536	NA	NA	NA	NA





(a) Strike slip faulting (b) Reverse or normal faulting, hanging-wall site (c) Reverse or normal faulting, foot-wall site





Courtesy: Jennifer Donahue

Input variables | **Errors and warnings**

Input variables	Errors and warnings
M_w: 7.45	
R_{RUP} (km): 10.89	
R_{JB} (km): 3.53	
R_X (km): 13.26	
Ry0 (km): 999	*If unknown use 999*
V_{S30} (m/sec): 339	
U (BSSA13): 0	*1: Unspecified fault mech.*
F_{RV}: 1	*1: reverse fault*
F_{NM}: 0	*1: normal fault*
F_{HW}: 1	*1: hanging wall side*
Dip (deg): 20	
Z_{TOR} (km): 5.2	*If unknown use 999*
Z_{HYP} (km): 999	*If unknown use 999*
$Z_{1.0}$ (km): 0.35	*If unknown use 999*
$Z_{2.5}$ (km): 3.25	*If unknown use 999*
W (km): 27.37	*If unknown use 999*
Vs30Flag: measured	*Choose options for V_{s30} from the list*
F_{AS}: no	*Aftershock effect is not applicable.*
Region: California	*Choose region from the list*

Calculated Variables/Flags

ΔDPP	0	*Always 0 for median calcs.*
PGA_r (g)	0.407	
Z_{BOT} (km) (CB14)	15	*Enter for default W calcs*
SS	0	*auto calculated*
$V_{s30Flag}$	1	*measured*
F_{AS}	0	*Aftershock effect is not applicable.*
Region	0	*California*
Option for Sa value	1	*Weighted average of the natural logarithm of the spectral values*

Definition of Parameters

Damping ratio = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
PSA = Pseudo-absolute acceleration response spectrum (g)
PGA = Peak ground acceleration (g)
PGV = Peak ground velocity (cm/s)
S_d = Relative displacement response spectrum (cm)
M_w = Moment magnitude
R_{RUP} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustration
R_{JB} = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustration
R_X = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustration
R_{y0} = The horizontal distance off the end of the rupture measured parallel to strike (km)
V_{S30} = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
U = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
F_{RV} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
F_{NM} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
F_{HW} = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
Dip = Average dip of rupture plane (degrees)
Z_{TOR} = Depth to top of coseismic rupture (km)
Z_{HYP} = Hypocentral depth from the earthquake
$Z_{1.0}$ = Depth to Vs=1 km/sec
$Z_{2.5}$ = Depth to Vs=2.5 km/sec
W = Fault rupture width (km)
$V_{s30flag}$ = 1 for measured, 0 for inferred Vs30
F_{AS} = 0 for mainshock; 1 for aftershock
Region = Specific regions considered in the models, Click on Region to see codes
ΔDPP = Directivity term, direct point parameter; uses 0 for median predictions
PGA_r (g) = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
Z_{BOT} (km) = The depth to the bottom of the seismogenic crust
Z_{BOR} (km) = The depth to the bottom of the rupture plane
SS = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	27.37			42.251		
$Z_{1.0}$ (km)	0.650	0.650			0.424	
$\delta Z_{1.0}$ (km)	0.225		**0.225**			
$Z_{2.5}$ (V_{S30}=1100)(km)	4.100			0.398		
$Z_{2.5}$ (V_{S30})(km)	4.100			1.528		
Z_{hyp} (km)	999.00			**5.000**		
Z_{tor} (km)	5.20			0.549	0.549	
Z_{BOR} (km)	-			15.000		

ACKNOWLEDGEMENTS

Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

Compton (4)

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

This excel file will be updated as necessary on the PEER website to fix any typos or other errors. Please check the website frequently for new versions at: http://peer.berkeley.edu/ngawest2/databases/

Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

GMPE averaging	Geometric

Weighted average of the natural logarithm of the spectral values

GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0.25	0.25	0.25	0.25	0

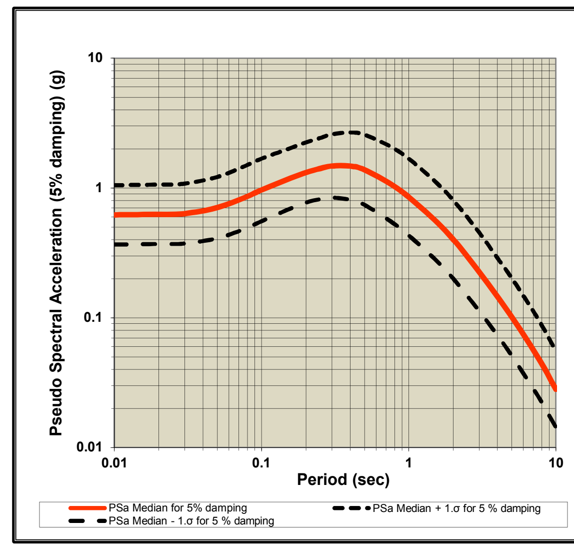
# of std. dev.	1
Damping ratio (%)	5

Modification factors are calculated in Sheet DSF

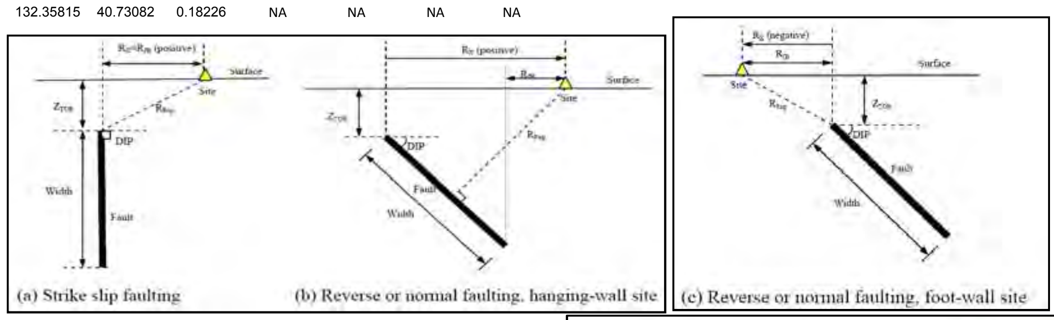
ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
CY14 Chiou & Youngs 2014 NGA West-2 Model
I14 Idriss 2014 NGA West-2 Model

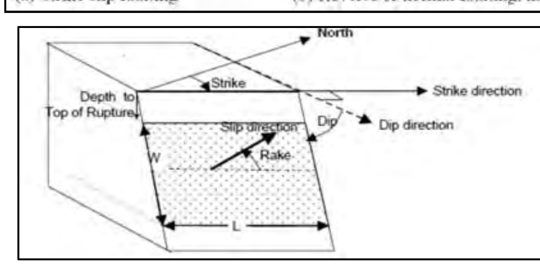
RotD50 Horizontal Component of PGA, PGV and *IMs*

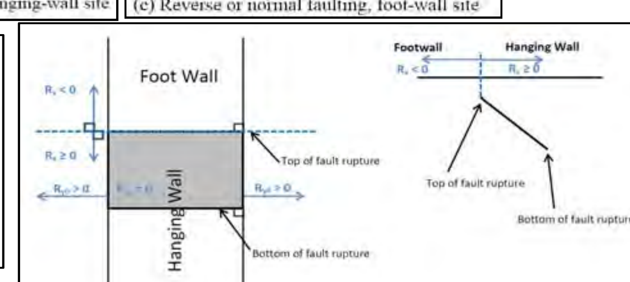
GMP	*T* (s)	Baseline: 5% Damping				User defined: 5% Damping			
		PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	PSa Median for 5% damping	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
PSa (g), S_d (cm)	**0.01**	0.61977	1.04922	0.36609	0.00154	0.61977	1.04922	0.36609	0.00154
	0.02	0.62673	1.06156	0.37001	0.00622	0.62673	1.06156	0.37001	0.00622
	0.03	0.63518	1.08059	0.37336	0.01419	0.63455	1.07951	0.37299	0.01418
	0.05	0.70529	1.21499	0.40942	0.04377	0.70529	1.21499	0.40942	0.04377
	0.075	0.83180	1.45094	0.47686	0.11615	0.83430	1.45529	0.47829	0.11650
	0.1	0.96272	1.67760	0.55248	0.23898	0.96561	1.68263	0.55414	0.23970
	0.15	1.15989	1.98700	0.67707	0.64784	1.16221	1.99097	0.67843	0.64913
	0.2	1.31273	2.23850	0.76983	1.30347	1.31535	2.24298	0.77137	1.30608
	0.25	1.40598	2.41741	0.81773	2.18136	1.41020	2.42466	0.82018	2.18790
	0.3	1.47346	2.58630	0.83945	3.29190	1.47641	2.59148	0.84113	3.29848
	0.4	1.47227	2.67339	0.81080	5.84755	1.47374	2.67606	0.81161	5.85339
	0.5	1.37972	2.57120	0.74036	8.56241	1.38110	2.57377	0.74110	8.57097
	0.75	1.07566	2.08619	0.55462	15.01979	1.07566	2.08619	0.55462	15.01979
	1	0.85157	1.68103	0.43138	21.13901	0.85071	1.67935	0.43095	21.11787
	1.5	0.56525	1.12885	0.28303	31.57087	0.56581	1.12998	0.28332	31.60244
	2	0.40379	0.80953	0.20141	40.09391	0.40298	0.80791	0.20100	40.01372
	3	0.22726	0.45620	0.11321	50.77288	0.22703	0.45574	0.11310	50.72210
	4	0.14557	0.28936	0.07324	57.81923	0.14543	0.28907	0.07316	57.76141
	5	0.10200	0.20317	0.05121	63.30058	0.10169	0.20256	0.05106	63.11068
	7.5	0.05022	0.09975	0.02528	70.11890	0.05007	0.09945	0.02520	69.90854
	10	0.02820	0.05549	0.01433	70.00638	0.02809	0.05527	0.01427	69.72636
PGA (g)	**0**	0.61660	1.04306	0.36450	0.00153	0.61660	1.04306	0.36450	0.00153
PGV (cm/s)	**-1**	73.42381	132.35815	40.73082	0.18226	NA	NA	NA	NA



Input variables	Errors and warnings
M_w	
7.45	
R_{RUP} (km)	
10.04	
R_{JB} (km)	
0	
R_X (km)	
11.17	
Ry0 (km)	*If unknown use 999*
999	
V_{S30} (m/sec)	
339	
U (BSSA13)	*1: Unspecified fault mech.*
0	
F_{RV}	*1: reverse fault*
1	
F_{NM}	*1: normal fault*
0	
F_{HW}	*1: hanging wall side*
1	
Dip (deg)	
20	
Z_{TOR} (km)	*If unknown use 999*
5.2	
Z_{HYP} (km)	*If unknown use 999*
999	
$Z_{1.0}$ (km)	*If unknown use 999*
0.35	
$Z_{2.5}$ (km)	*If unknown use 999*
3.25	
W (km)	*If unknown use 999*
27.37	
Vs30Flag	
measured	*Choose options for V_{s30} from the list*
F_{AS}	
no	*Aftershock effect is not applicable.*
Region	
California	*Choose region from the list*







Courtesy: Jennifer Donahue

Calculated Variables/Flags

ΔDPP	*Always 0 for median calcs.*
0	
PGA_r (g)	
0.471	
Z_{BOT} (km) (CB14)	*Enter for default W calcs*
15	
SS	
0	*auto calculated*
$V_{s30Flag}$	
1	*measured*
F_{AS}	
0	*Aftershock effect is not applicable.*
Region	
0	*California*
Option for Sa value	
1	*Weighted average of the natural logarithm of the spectral values*

Definition of Parameters

- ***Damping ratio*** = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
- ***PSA*** = Pseudo-absolute acceleration response spectrum (g)
- ***PGA*** = Peak ground acceleration (g)
- ***PGV*** = Peak ground velocity (cm/s)
- ***S_d*** = Relative displacement response spectrum (cm)
- ***M_w*** = Moment magnitude
- ***R_{RUP}*** = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustation
- ***R_{JB}*** = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustation
- ***R_X*** = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustation
- ***R_{y0}*** = The horizontal distance off the end of the rupture measured parallel to strike (km)
- ***V_{S30}*** = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
- ***U*** = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
- ***F_{RV}*** = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
- ***F_{NM}*** = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
- ***F_{HW}*** = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
- ***Dip*** = Average dip of rupture plane (degrees)
- ***Z_{TOR}*** = Depth to top of coseismic rupture (km)
- ***Z_{HYP}*** = Hypocentral depth from the earthquake
- ***$Z_{1.0}$*** = Depth to Vs=1 km/sec
- ***$Z_{2.5}$*** = Depth to Vs=2.5 km/sec
- ***W*** = Fault rupture width (km)
- ***$V_{s30flag}$*** = 1 for measured, 0 for inferred Vs30
- ***F_{AS}*** = 0 for mainshock; 1 for aftershock
- ***Region*** = Specific regions considered in the models, Click on Region to see codes
- ***ΔDPP*** = Directivity term, direct point parameter; uses 0 for median predictions
- ***PGA_r (g)*** = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
- ***Z_{BOT} (km)*** = The depth to the bottom of the seismogenic crust
- ***Z_{BOR} (km)*** = The depth to the bottom of the rupture plane
- ***SS*** = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	27.37			42.251		
$Z_{1.0}$ (km)	0.650	0.650			0.424	
$\delta Z_{1.0}$ (km)	0.225		**0.225**			
$Z_{2.5}$ (V_{S30}=1100)(km)	4.100			0.398		
$Z_{2.5}$ (V_{S30})(km)	4.100			1.528		
Z_{hyp} (km)	999.00			**5.000**		
Z_{tor} (km)	5.20			0.549	0.549	
Z_{BOR} (km)	-			15.000		

ACKNOWLEDGEMENTS

Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

Hollywood (2)

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

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Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

GMPE averaging	Geometric	*Weighted average of the natural logarithm of the spectral values*

GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0.25	0.25	0.25	0.25	0

# of std. dev.	1	
Damping ratio (%)	5	*Modification factors are calculated in Sheet DSF*

ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
CY14 Chiou & Youngs 2014 NGA West-2 Model
I14 Idriss 2014 NGA West-2 Model

Input variables | **Errors and warnings**

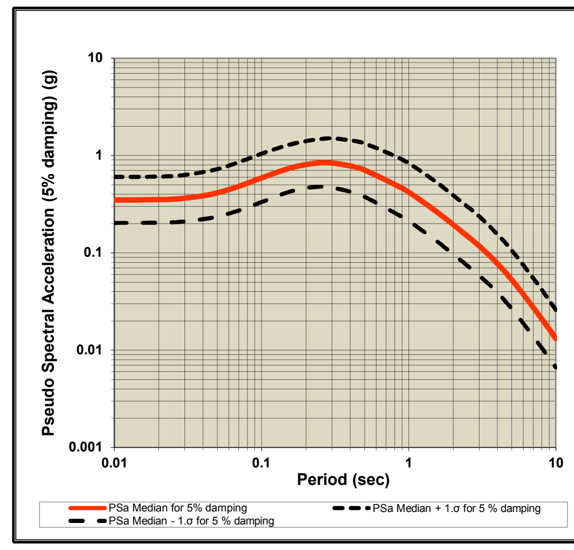
		Errors and warnings
M_w	6.7	
R_{RUP} (km)	7.83	
R_{JB} (km)	7.64	
R_X (km)	-1.78	
Ry0 (km)	999	*If unknown use 999*
V_{S30} (m/sec)	339	
U (BSSA13)	0	*1: Unspecified fault mech.*
F_{RV}	0	*1: reverse fault*
F_{NM}	0	*1: normal fault*
F_{HW}	0	*1: hanging wall side*
Dip (deg)	70	
Z_{TOR} (km)	999	*If unknown use 999*
Z_{HYP} (km)	999	*If unknown use 999*
$Z_{1.0}$ (km)	0.35	*If unknown use 999*
$Z_{2.5}$ (km)	3.25	*If unknown use 999*
W (km)	16.57	*If unknown use 999*
Vs30Flag	measured	*Choose options for V_{s30} from the list*
F_{AS}	no	*Aftershock effect is not applicable.*
Region	California	*Choose region from the list*

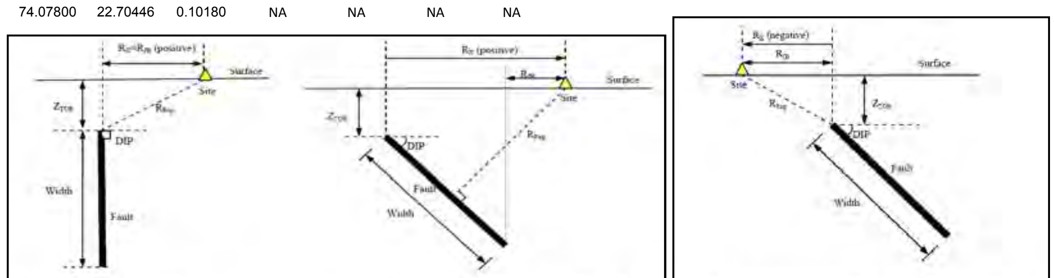
Calculated Variables/Flags

ΔDPP	0	*Always 0 for median calcs.*
PGA_r (g)	0.264	
Z_{BOT} (km) (CB14)	15	*Enter for default W calcs*
SS	1	*auto calculated*
$V_{s30Flag}$	1	*measured*
F_{AS}	0	*Aftershock effect is not applicable.*
Region	0	*California*
Option for Sa value	1	*Weighted average of the natural logarithm of the spectral values*

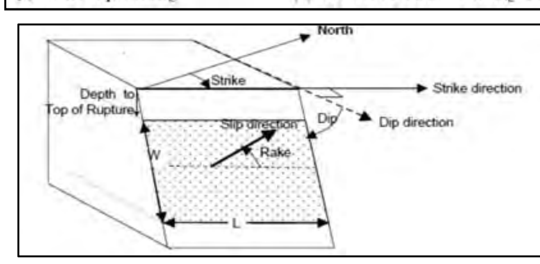
RotD50 Horizontal Component of PGA, PGV and *IMs*

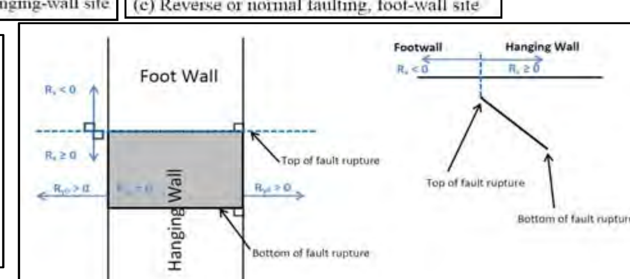
GMP	T (s)	Baseline: 5% Damping				User defined: 5% Damping			
		PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	PSa Median for 5% damping	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
PSa (g), S_d (cm)	0.01	0.34987	0.60310	0.20296	0.00087	0.34987	0.60310	0.20296	0.00087
	0.02	0.35196	0.60721	0.20400	0.00349	0.35196	0.60721	0.20400	0.00349
	0.03	0.36414	0.63139	0.21001	0.00814	0.36414	0.63139	0.21001	0.00814
	0.05	0.41216	0.72330	0.23486	0.02558	0.41216	0.72330	0.23486	0.02558
	0.075	0.49939	0.88611	0.28145	0.06973	0.50039	0.88788	0.28201	0.06987
	0.1	0.58693	1.04064	0.33104	0.14570	0.58869	1.04376	0.33203	0.14614
	0.15	0.72838	1.27271	0.41686	0.40683	0.72984	1.27526	0.41769	0.40764
	0.2	0.80557	1.40339	0.46241	0.79989	0.80638	1.40480	0.46287	0.80069
	0.25	0.83826	1.47228	0.47727	1.30054	0.83994	1.47522	0.47823	1.30314
	0.3	0.83755	1.49839	0.46816	1.87120	0.83839	1.49989	0.46863	1.87307
	0.4	0.77945	1.43267	0.42406	3.09581	0.78023	1.43410	0.42449	3.09891
	0.5	0.70849	1.33171	0.37693	4.39684	0.70920	1.33304	0.37730	4.40124
	0.75	0.53124	1.03636	0.27231	7.41783	0.53124	1.03636	0.27231	7.41783
	1	0.42030	0.83349	0.21194	10.43328	0.42030	0.83349	0.21194	10.43328
	1.5	0.27339	0.54786	0.13643	15.26967	0.27366	0.54840	0.13656	15.28494
	2	0.19533	0.39269	0.09716	19.39494	0.19494	0.39191	0.09696	19.35615
	3	0.11830	0.23803	0.05879	26.42976	0.11818	0.23779	0.05874	26.40333
	4	0.07778	0.15495	0.03904	30.89172	0.07770	0.15479	0.03900	30.86083
	5	0.05339	0.10659	0.02675	33.13651	0.05318	0.10617	0.02664	33.00396
	7.5	0.02409	0.04796	0.01210	33.64051	0.02404	0.04787	0.01208	33.57323
	10	0.01317	0.02598	0.00668	32.70111	0.01312	0.02588	0.00665	32.57031
PGA (g)	0	0.34814	0.59967	0.20212	0.00086	0.34814	0.59967	0.20212	0.00086
PGV (cm/s)	-1	41.01098	74.07800	22.70446	0.10180	NA	NA	NA	NA





(a) Strike slip faulting (b) Reverse or normal faulting, hanging-wall site (c) Reverse or normal faulting, foot-wall site





Courtesy: Jennifer Donahue

Definition of Parameters

Damping ratio = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
PSA = Pseudo-absolute acceleration response spectrum (g)
PGA = Peak ground acceleration (g)
PGV = Peak ground velocity (cm/s)
S_d = Relative displacement response spectrum (cm)
M_w = Moment magnitude
R_{RUP} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustation
R_{JB} = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustation
R_X = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustation
R_{y0} = The horizontal distance off the end of the rupture measured parallel to strike (km)
V_{S30} = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
U = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
F_{RV} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
F_{NM} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
F_{HW} = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
Dip = Average dip of rupture plane (degrees)
Z_{TOR} = Depth to top of coseismic rupture (km)
Z_{HYP} = Hypocentral depth from the earthquake
$Z_{1.0}$ = Depth to Vs=1 km/sec
$Z_{2.5}$ = Depth to Vs=2.5 km/sec
W = Fault rupture width (km)
$V_{s30flag}$ = 1 for measured, 0 for inferred Vs30
F_{AS} = 0 for mainshock; 1 for aftershock
Region = Specific regions considered in the models, Click on Region to see codes
ΔDPP = Directivity term, direct point parameter; uses 0 for median predictions
PGA_r (g) = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
Z_{BOT} (km) = The depth to the bottom of the seismogenic crust
Z_{BOR} (km) = The depth to the bottom of the rupture plane
SS = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	16.57			15.430		
$Z_{1.0}$ (km)	0.650	0.650			0.424	
$\delta Z_{1.0}$ (km)	0.225		**0.225**			
$Z_{2.5}$ (V_{S30}=1100)(km)	4.100			0.398		
$Z_{2.5}$ (V_{S30})(km)	4.100			1.528		
Z_{hyp} (km)	999.00			**10.237**		
Z_{tor} (km)	999.00			**0.501**	**0.501**	
Z_{BOR} (km)	-			15.000		

ACKNOWLEDGEMENTS

Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

Malibu Coast Alt 1 (0)

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

This excel file will be updated as necessary on the PEER website to fix any typos or other errors. Please check the website frequently for new versions at: http://peer.berkeley.edu/ngawest2/databases/

Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

GMPE averaging	Geometric	*Weighted average of the natural logarithm of the spectral values*			
GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0.25	0.25	0.25	0.25	0
# of std. dev.	1				
Damping ratio (%)	5	*Modification factors are calculated in Sheet DSF*			

ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
CY14 Chiou & Youngs 2014 NGA West-2 Model
I14 Idriss 2014 NGA West-2 Model

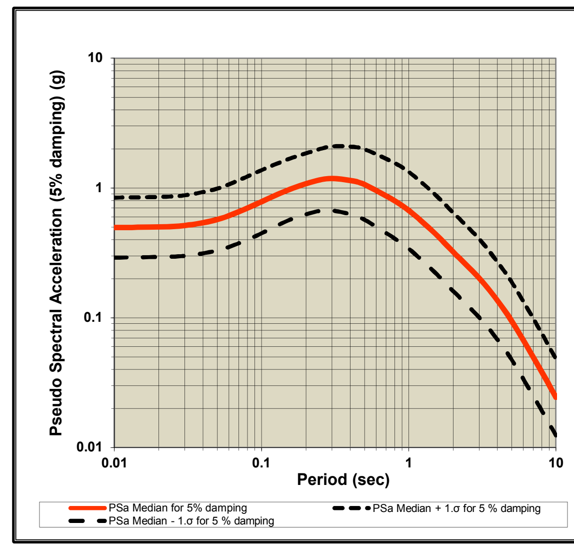
Input variables	Value	Errors and warnings
M_w	6.97	
R_{RUP} (km)	3.87	
R_{JB} (km)	3.61	
R_X (km)	1.53	
Ry0 (km)	999	*If unknown use 999*
V_{S30} (m/sec)	339	
U (BSSA13)	0	*1: Unspecified fault mech.*
F_{RV}	0	*1: reverse fault*
F_{NM}	0	*1: normal fault*
F_{HW}	1	*1: hanging wall side*
Dip (deg)	74	
Z_{TOR} (km)	0	*If unknown use 999*
Z_{HYP} (km)	999	*If unknown use 999*
$Z_{1.0}$ (km)	0.35	*If unknown use 999*
$Z_{2.5}$ (km)	3.25	*If unknown use 999*
W (km)	15.51	*If unknown use 999*
Vs30Flag	measured	*Choose options for V_{S30} from the list*
F_{AS}	no	*Aftershock effect is not applicable.*
Region	California	*Choose region from the list*

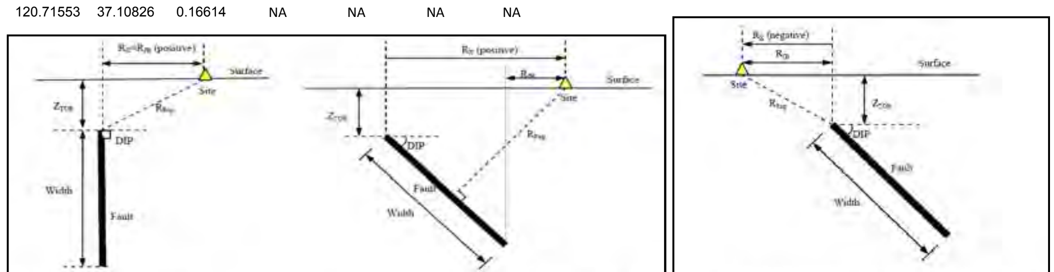
Calculated Variables/Flags

ΔDPP	0	*Always 0 for median calcs.*
PGA_r (g)	0.385	
Z_{BOT} (km) (CB14)	15	*Enter for default W calcs*
SS	1	*auto calculated*
$V_{s30Flag}$	1	*measured*
F_{AS}	0	*Aftershock effect is not applicable.*
Region	0	*California*
Option for Sa value	1	*Weighted average of the natural logarithm of the spectral values*

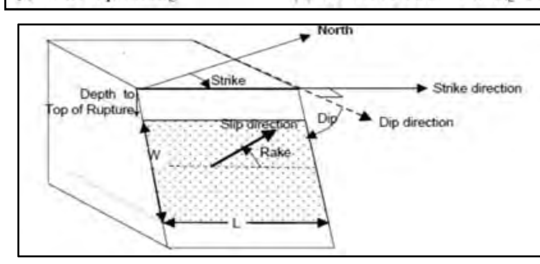
RotD50 Horizontal Component of PGA, PGV and *IMs*

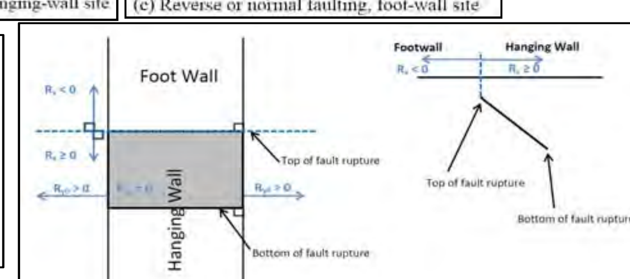
GMP	T (s)	Baseline: 5% Damping				User defined: 5% Damping			
		PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	PSa Median for 5% damping	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
PSa (g), S_d (cm)	0.01	0.49475	0.84247	0.29055	0.00123	0.49475	0.84247	0.29055	0.00123
	0.02	0.50056	0.85287	0.29379	0.00497	0.50056	0.85287	0.29379	0.00497
	0.03	0.51292	0.87778	0.29971	0.01146	0.51292	0.87778	0.29971	0.01146
	0.05	0.57059	0.98830	0.32943	0.03541	0.57059	0.98830	0.32943	0.03541
	0.075	0.67566	1.18416	0.38552	0.09434	0.67701	1.18653	0.38629	0.09453
	0.1	0.78219	1.36953	0.44674	0.19417	0.78375	1.37227	0.44763	0.19456
	0.15	0.96044	1.65468	0.55748	0.53644	0.96236	1.65798	0.55859	0.53751
	0.2	1.07362	1.84263	0.62556	1.06605	1.07470	1.84447	0.62618	1.06712
	0.25	1.14923	1.98949	0.66385	1.78301	1.15383	1.99745	0.66651	1.79014
	0.3	1.18183	2.08742	0.66911	2.64036	1.18301	2.08951	0.66978	2.64300
	0.4	1.14218	2.08177	0.62667	4.53652	1.14333	2.08385	0.62730	4.54105
	0.5	1.06221	1.98416	0.56864	6.59197	1.06327	1.98614	0.56921	6.59856
	0.75	0.83204	1.61592	0.42842	11.61811	0.83204	1.61592	0.42842	11.61811
	1	0.67307	1.32993	0.34064	16.70810	0.67240	1.32860	0.34030	16.69139
	1.5	0.44794	0.89510	0.22417	25.01914	0.44839	0.89599	0.22439	25.04416
	2	0.32272	0.64724	0.16091	32.04418	0.32207	0.64594	0.16059	31.98009
	3	0.20264	0.40688	0.10093	45.27334	0.20244	0.40647	0.10083	45.22807
	4	0.13540	0.26919	0.06810	53.77689	0.13526	0.26892	0.06803	53.72311
	5	0.09499	0.18925	0.04768	58.95246	0.09461	0.18850	0.04749	58.71665
	7.5	0.04358	0.08658	0.02193	60.84793	0.04353	0.08649	0.02191	60.78709
	10	0.02445	0.04812	0.01242	60.69095	0.02438	0.04798	0.01238	60.50888
PGA (g)	0	0.49215	0.83739	0.28924	0.00122	0.49215	0.83739	0.28924	0.00122
PGV (cm/s)	-1	66.92939	120.71553	37.10826	0.16614	NA	NA	NA	NA





(a) Strike slip faulting (b) Reverse or normal faulting, hanging-wall site (c) Reverse or normal faulting, foot-wall site





Courtesy: Jennifer Donahue

Definition of Parameters

Damping ratio = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
PSA = Pseudo-absolute acceleration response spectrum (g)
PGA = Peak ground acceleration (g)
PGV = Peak ground velocity (cm/s)
S_d = Relative displacement response spectrum (cm)
M_w = Moment magnitude
R_{RUP} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustation
R_{JB} = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustation
R_X = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustation
R_{y0} = The horizontal distance off the end of the rupture measured parallel to strike (km)
V_{S30} = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
U = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
F_{RV} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
F_{NM} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
F_{HW} = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
Dip = Average dip of rupture plane (degrees)
Z_{TOR} = Depth to top of coseismic rupture (km)
Z_{HYP} = Hypocentral depth from the earthquake
$Z_{1.0}$ = Depth to Vs=1 km/sec
$Z_{2.5}$ = Depth to Vs=2.5 km/sec
W = Fault rupture width (km)
$V_{s30flag}$ = 1 for measured, 0 for inferred Vs30
F_{AS} = 0 for mainshock; 1 for aftershock
Region = Specific regions considered in the models, Click on Region to see codes
ΔDPP = Directivity term, direct point parameter; uses 0 for median predictions
PGA_r ***(g)*** = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
Z_{BOT} ***(km)*** = The depth to the bottom of the seismogenic crust
Z_{BOR} ***(km)*** = The depth to the bottom of the rupture plane
SS = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	15.51			15.437		
$Z_{1.0}$ (km)	0.650	0.650			0.424	
$\delta Z_{1.0}$ (km)	0.225		**0.225**			
$Z_{2.5}$ (V_{S30}=1100)(km)	4.100			0.398		
$Z_{2.5}$ (V_{S30})(km)	4.100			1.528		
Z_{hyp} (km)	999.00			**10.387**		
Z_{tor} (km)	0.00			0.161	0.161	
Z_{BOR} (km)	-			15.000		

ACKNOWLEDGEMENTS

Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

Malibu Coast Alt 2 (0)

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

This excel file will be updated as necessary on the PEER website to fix any typos or other errors. Please check the website frequently for new versions at: http://peer.berkeley.edu/ngawest2/databases/

Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

GMPE averaging	Geometric	*Weighted average of the natural logarithm of the spectral values*

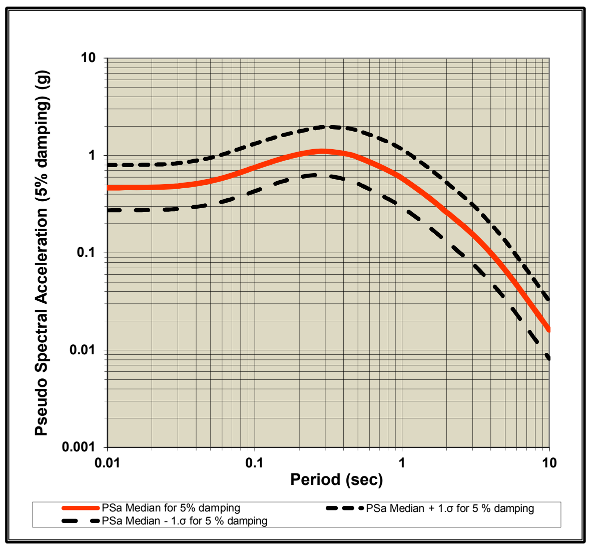
GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0.25	0.25	0.25	0.25	0

# of std. dev.	1	
Damping ratio (%)	5	*Modification factors are calculated in Sheet DSF*

ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
CY14 Chiou & Youngs 2014 NGA West-2 Model
I14 Idriss 2014 NGA West-2 Model

RotD50 Horizontal Component of PGA, PGV and *IMs*

GMP	*T* (s)	Baseline: 5% Damping				User defined: 5% Damping			
		PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	PSa Median for 5% damping	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
PSa (g), S_d (cm)	0.01	0.46690	0.79765	0.27330	0.00116	0.46690	0.79765	0.27330	0.00116
	0.02	0.47114	0.80535	0.27562	0.00468	0.47114	0.80535	0.27562	0.00468
	0.03	0.48553	0.83348	0.28283	0.01085	0.48553	0.83348	0.28283	0.01085
	0.05	0.54406	0.94500	0.31324	0.03376	0.54406	0.94500	0.31324	0.03376
	0.075	0.64792	1.13848	0.36874	0.09047	0.64922	1.14075	0.36948	0.09065
	0.1	0.75209	1.32021	0.42844	0.18670	0.75359	1.32285	0.42930	0.18707
	0.15	0.92270	1.59424	0.53403	0.51536	0.92455	1.59743	0.53510	0.51639
	0.2	1.02565	1.76623	0.59560	1.01842	1.02668	1.76799	0.59619	1.01943
	0.25	1.08787	1.89043	0.62602	1.68780	1.09222	1.89799	0.62853	1.69455
	0.3	1.10673	1.96259	0.62410	2.47258	1.10673	1.96259	0.62410	2.47258
	0.4	1.05021	1.92123	0.57409	4.17123	1.05126	1.92315	0.57466	4.17540
	0.5	0.96286	1.80468	0.51371	5.97540	0.96382	1.80648	0.51423	5.98138
	0.75	0.73739	1.43650	0.37853	10.29649	0.73739	1.43650	0.37853	10.29649
	1	0.58449	1.15822	0.29496	14.50931	0.58391	1.15706	0.29467	14.49480
	1.5	0.37495	0.75125	0.18714	20.94216	0.37532	0.75200	0.18733	20.96310
	2	0.26336	0.52955	0.13098	26.15058	0.26284	0.52849	0.13072	26.09828
	3	0.15632	0.31464	0.07766	34.92325	0.15616	0.31433	0.07758	34.88832
	4	0.09935	0.19801	0.04985	39.45954	0.09925	0.19781	0.04980	39.42008
	5	0.06728	0.13437	0.03369	41.75358	0.06701	0.13384	0.03355	41.58657
	7.5	0.02934	0.05845	0.01473	40.97432	0.02931	0.05839	0.01472	40.93334
	10	0.01614	0.03185	0.00818	40.06948	0.01609	0.03175	0.00816	39.94927
PGA (g)	0	0.46445	0.79287	0.27207	0.00115	0.46445	0.79287	0.27207	0.00115
PGV (cm/s)	-1	56.71897	102.32748	31.43869	0.14080	NA	NA	NA	NA



Input variables | **Errors and warnings**

M_w
6.64

R_{RUP} (km)
4.07

R_{JB} (km)
3.61

R_X (km)
1.26

Ry0 (km) — *If unknown use 999*
999

V_{S30} (m/sec)
339

U (BSSA13) — *1: Unspecified fault mech.*
0

F_{RV} — *1: reverse fault*
0

F_{NM} — *1: normal fault*
0

F_{HW} — *1: hanging wall side*
1

Dip (deg)
75

Z_{TOR} (km) — *If unknown use 999*
0

Z_{HYP} (km) — *If unknown use 999*
999

$Z_{1.0}$ (km) — *If unknown use 999*
0.35

$Z_{2.5}$ (km) — *If unknown use 999*
3.25

W (km) — *If unknown use 999*
7.27

Vs30Flag
measured — *Choose options for V_{S30} from the list*

F_{AS}
no — *Aftershock effect is not applicable.*

Region
California — *Choose region from the list*

Calculated Variables/Flags

ΔDPP — *Always 0 for median calcs.*
0

PGA_r (g)
0.364

Z_{BOT} (km) (CB14) — *Enter for default W calcs*
15

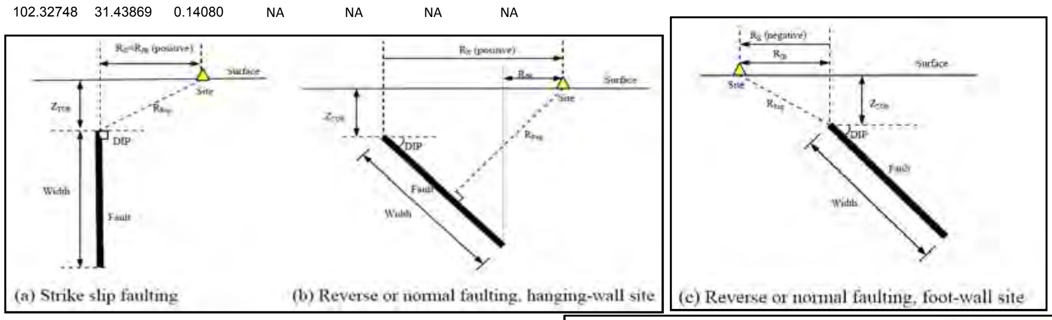
SS
1 — *auto calculated*

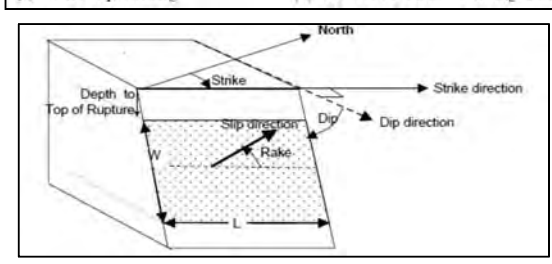
$V_{s30Flag}$
1 — *measured*

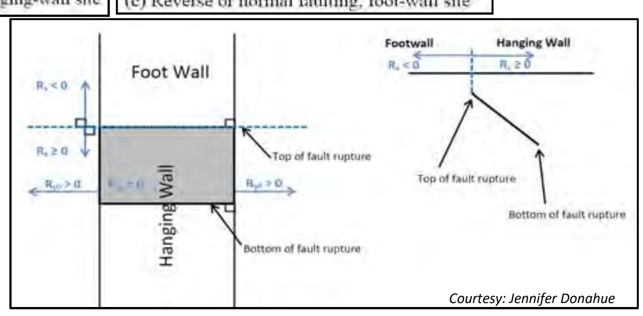
F_{AS}
0 — *Aftershock effect is not applicable.*

Region
0 — *California*

Option for Sa value
1 — *Weighted average of the natural logarithm of the spectral values*







Courtesy: Jennifer Donahue

Definition of Parameters

Damping ratio = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
PSA = Pseudo-absolute acceleration response spectrum (g)
PGA = Peak ground acceleration (g)
PGV = Peak ground velocity (cm/s)
S_d = Relative displacement response spectrum (cm)
M_w = Moment magnitude
R_{RUP} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustation
R_{JB} = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustation
R_X = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustation
R_{y0} = The horizontal distance off the end of the rupture measured parallel to strike (km)
V_{S30} = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
U = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
F_{RV} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
F_{NM} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
F_{HW} = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
Dip = Average dip of rupture plane (degrees)
Z_{TOR} = Depth to top of coseismic rupture (km)
Z_{HYP} = Hypocentral depth from the earthquake
$Z_{1.0}$ = Depth to Vs=1 km/sec
$Z_{2.5}$ = Depth to Vs=2.5 km/sec
W = Fault rupture width (km)
$V_{s30flag}$ = 1 for measured, 0 for inferred Vs30
F_{AS} = 0 for mainshock; 1 for aftershock
Region = Specific regions considered in the models, Click on Region to see codes
ΔDPP = Directivity term, direct point parameter; uses 0 for median predictions
PGA_r (g) = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
Z_{BOT} (km) = The depth to the bottom of the seismogenic crust
Z_{BOR} (km) = The depth to the bottom of the rupture plane
SS = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	7.27			14.906		
$Z_{1.0}$ (km)	0.650	0.650			0.424	
$\delta Z_{1.0}$ (km)	0.225		0.225			
$Z_{2.5}$ (V_{S30}=1100)(km)	4.100			0.398		
$Z_{2.5}$ (V_{S30})(km)	4.100			1.528		
Z_{hyp} (km)	999.00			9.780		
Z_{tor} (km)	0.00			0.602	0.602	
Z_{BOR} (km)	-			15.000		

ACKNOWLEDGEMENTS

Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

Newport-Inglewood Alt 1 (8)

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

This excel file will be updated as necessary on the PEER website to fix any typos or other errors. Please check the website frequently for new versions at: http://peer.berkeley.edu/ngawest2/databases/

Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

GMPE averaging	Geometric	*Weighted average of the natural logarithm of the spectral values*

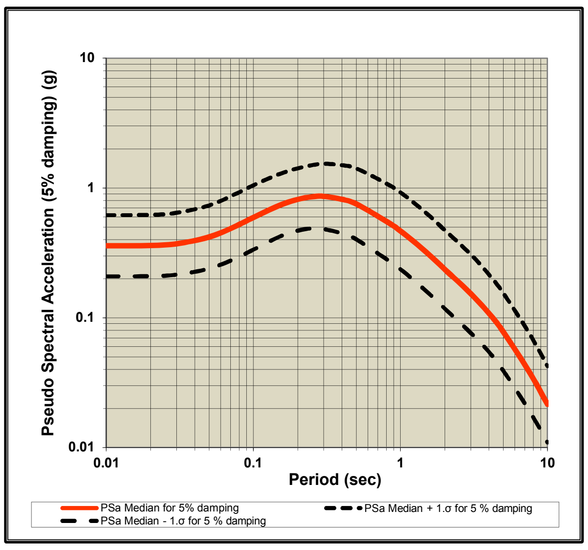
GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0.25	0.25	0.25	0.25	0

# of std. dev.	1	
Damping ratio (%)	5	*Modification factors are calculated in Sheet DSF*

ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
CY14 Chiou & Youngs 2014 NGA West-2 Model
I14 Idriss 2014 NGA West-2 Model

RotD50 Horizontal Component of PGA, PGV and *IMs*

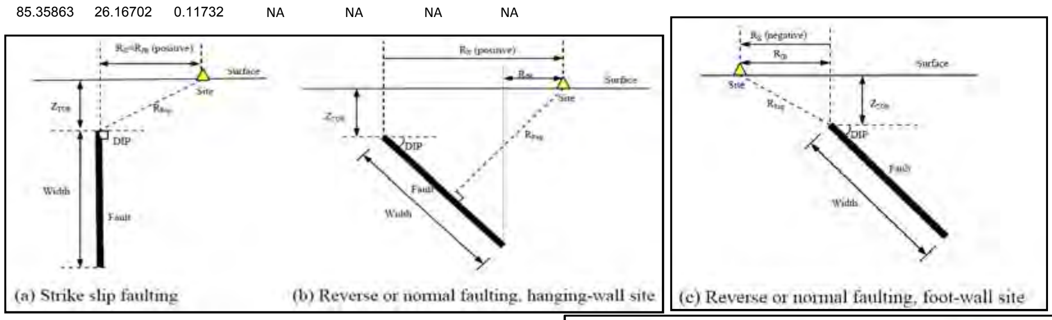
GMP	*T* (s)	Baseline: 5% Damping PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	User defined: 5% Damping PSa Median for 5% damping	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
PSa (g), S_d (cm)	0.01	0.35843	0.61670	0.20832	0.00089	0.35843	0.61670	0.20832	0.00089
	0.02	0.36009	0.62012	0.20910	0.00358	0.36009	0.62012	0.20910	0.00358
	0.03	0.37164	0.64333	0.21469	0.00830	0.37164	0.64333	0.21469	0.00830
	0.05	0.41817	0.73280	0.23863	0.02595	0.41817	0.73280	0.23863	0.02595
	0.075	0.50378	0.89273	0.28430	0.07035	0.50479	0.89451	0.28486	0.07049
	0.1	0.59011	1.04491	0.33326	0.14649	0.59188	1.04804	0.33426	0.14693
	0.15	0.73147	1.27617	0.41926	0.40855	0.73293	1.27873	0.42010	0.40937
	0.2	0.81301	1.41363	0.46758	0.80728	0.81464	1.41645	0.46852	0.80889
	0.25	0.85227	1.49337	0.48639	1.32228	0.85483	1.49785	0.48785	1.32625
	0.3	0.86010	1.53471	0.48203	1.92157	0.86096	1.53624	0.48251	1.92350
	0.4	0.81631	1.49636	0.44532	3.24220	0.81712	1.49785	0.44576	3.24544
	0.5	0.75411	1.41369	0.40226	4.67992	0.75486	1.41511	0.40266	4.68460
	0.75	0.57941	1.12743	0.29777	8.09044	0.57941	1.12743	0.29777	8.09044
	1	0.46826	0.92630	0.23671	11.62382	0.46779	0.92538	0.23647	11.61220
	1.5	0.31962	0.63898	0.15988	17.85200	0.31994	0.63962	0.16004	17.86985
	2	0.23662	0.47460	0.11797	23.49500	0.23615	0.47365	0.11773	23.44801
	3	0.15397	0.30910	0.07670	34.39933	0.15382	0.30879	0.07662	34.36493
	4	0.10823	0.21512	0.05445	42.98565	0.10812	0.21491	0.05439	42.94266
	5	0.07819	0.15574	0.03925	48.52334	0.07795	0.15527	0.03914	48.37777
	7.5	0.03848	0.07644	0.01937	53.73102	0.03836	0.07621	0.01931	53.56983
	10	0.02160	0.04251	0.01098	53.62513	0.02152	0.04234	0.01093	53.41063
PGA (g)	0	0.35668	0.61322	0.20746	0.00089	0.35668	0.61322	0.20746	0.00089
PGV (cm/s)	-1	47.26077	85.35863	26.16702	0.11732	NA	NA	NA	NA

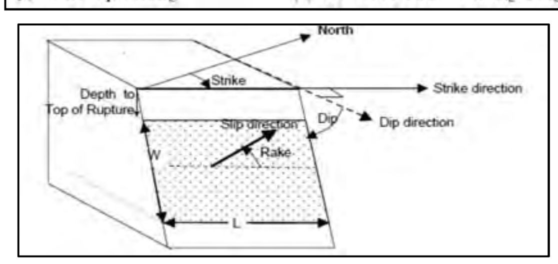


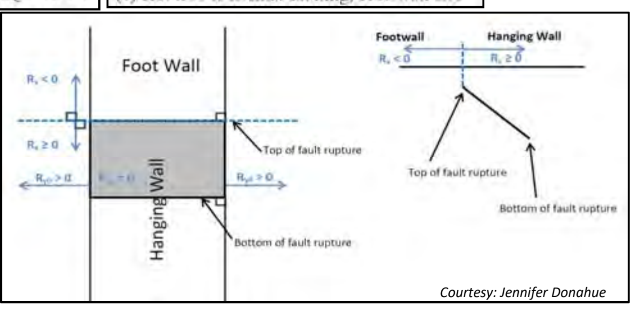
Input variables	Errors and warnings
M_w: 7.15	
R_{RUP} (km): 8.98	
R_{JB} (km): 8.66	
R_X (km): -8.03	
Ry0 (km): 999	*If unknown use 999*
V_{S30} (m/sec): 339	
U (BSSA13): 0	*1: Unspecified fault mech.*
F_{RV}: 0	*1: reverse fault*
F_{NM}: 0	*1: normal fault*
F_{HW}: 0	*1: hanging wall side*
Dip (deg): 88	
Z_{TOR} (km): 0	*If unknown use 999*
Z_{HYP} (km): 999	*If unknown use 999*
$Z_{1.0}$ (km): 0.35	*If unknown use 999*
$Z_{2.5}$ (km): 3.25	*If unknown use 999*
W (km): 13.51	*If unknown use 999*
Vs30Flag: measured	*Choose options for V_{S30} from the list*
F_{AS}: no	*Aftershock effect is not applicable.*
Region: California	*Choose region from the list*

Calculated Variables/Flags

ΔDPP: 0	*Always 0 for median calcs.*
PGA_r (g): 0.276	
Z_{BOT} (km) (CB14): 15	*Enter for default W calcs*
SS: 1	*auto calculated*
$V_{s30Flag}$: 1	*measured*
F_{AS}: 0	*Aftershock effect is not applicable.*
Region: 0	*California*
Option for Sa value: 1	*Weighted average of the natural logarithm of the spectral values*







Courtesy: Jennifer Donahue

Definition of Parameters

Damping ratio = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
PSA = Pseudo-absolute acceleration response spectrum (g)
PGA = Peak ground acceleration (g)
PGV = Peak ground velocity (cm/s)
S_d = Relative displacement response spectrum (cm)
M_w = Moment magnitude
R_{RUP} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustration
R_{JB} = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustration
R_X = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustation
R_{y0} = The horizontal distance off the end of the rupture measured parallel to strike (km)
V_{S30} = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
U = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
F_{RV} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
F_{NM} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
F_{HW} = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
Dip = Average dip of rupture plane (degrees)
Z_{TOR} = Depth to top of coseismic rupture (km)
Z_{HYP} = Hypocentral depth from the earthquake
$Z_{1.0}$ = Depth to Vs=1 km/sec
$Z_{2.5}$ = Depth to Vs=2.5 km/sec
W = Fault rupture width (km)
$V_{s30flag}$ = 1 for measured, 0 for inferred Vs30
F_{AS} = 0 for mainshock; 1 for aftershock
Region = Specific regions considered in the models, Click on Region to see codes
ΔDPP = Directivity term, direct point parameter; uses 0 for median predictions
PGA_r (g) = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
Z_{BOT} (km) = The depth to the bottom of the seismogenic crust
Z_{BOR} (km) = The depth to the bottom of the rupture plane
SS = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	13.51			14.970		
$Z_{1.0}$ (km)	0.650	0.650			0.424	
$\delta Z_{1.0}$ (km)	0.225		0.225			
$Z_{2.5}$ (V_{S30}=1100)(km)	4.100			0.398		
$Z_{2.5}$ (V_{S30})(km)	4.100			1.528		
Z_{hyp} (km)	999.00			10.265		
Z_{tor} (km)	0.00			0.039	0.039	
Z_{BOR} (km)	-			15.000		

ACKNOWLEDGEMENTS

Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

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Newport-Inglewood Alt 2 (8)

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

This excel file will be updated as necessary on the PEER website to fix any typos or other errors. Please check the website frequently for new versions at: http://peer.berkeley.edu/ngawest2/databases/

Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

GMPE averaging	Geometric	Weighted average of the natural logarithm of the spectral values

GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0.25	0.25	0.25	0.25	0

# of std. dev.	1	
Damping ratio (%)	5	Modification factors are calculated in Sheet DSF

ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
CY14 Chiou & Youngs 2014 NGA West-2 Model
I14 Idriss 2014 NGA West-2 Model

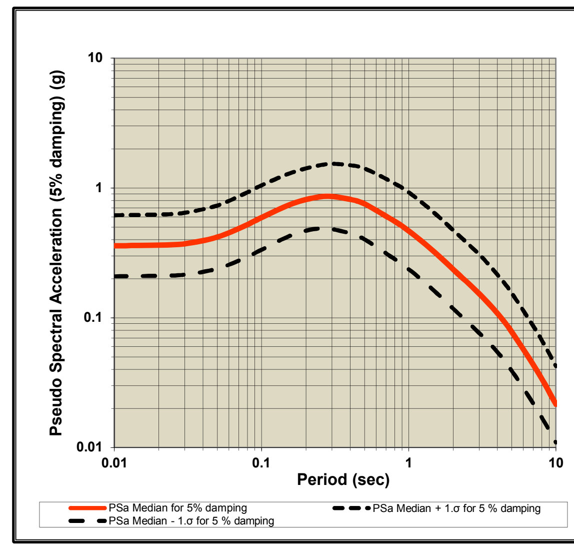
Input variables		Errors and warnings
M_w	7.15	
R_{RUP} (km)	8.94	
R_{JB} (km)	8.82	
R_X (km)	-7.58	
Ry0 (km)	999	If unknown use 999
V_{S30} (m/sec)	339	
U (BSSA13)	0	1: Unspecified fault mech.
F_{RV}	0	1: reverse fault
F_{NM}	0	1: normal fault
F_{HW}	0	1: hanging wall side
Dip (deg)	90	
Z_{TOR} (km)	0	If unknown use 999
Z_{HYP} (km)	999	If unknown use 999
$Z_{1.0}$ (km)	0.35	If unknown use 999
$Z_{2.5}$ (km)	3.25	If unknown use 999
W (km)	13.59	If unknown use 999
Vs30Flag	measured	Choose options for V_{S30} from the list
F_{AS}	no	Aftershock effect is not applicable.
Region	California	Choose region from the list

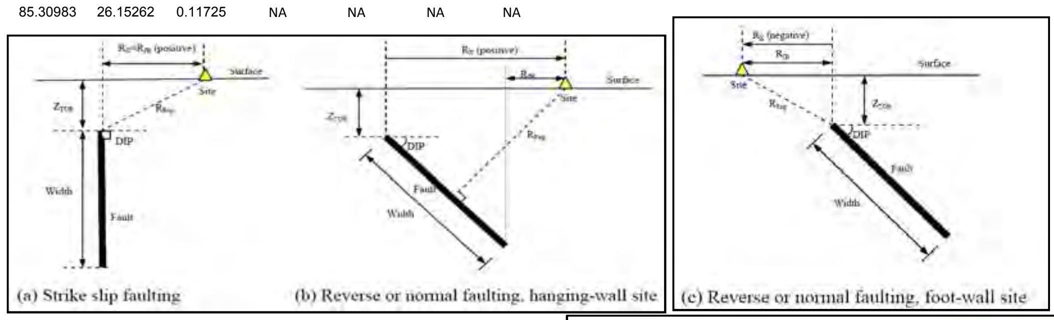
Calculated Variables/Flags

ΔDPP	0	Always 0 for median calcs.
PGA_r (g)	0.274	
Z_{BOT} (km) (CB14)	15	Enter for default W calcs
SS	1	auto calculated
$V_{s30Flag}$	1	measured
F_{AS}	0	Aftershock effect is not applicable.
Region	0	California
Option for Sa value	1	Weighted average of the natural logarithm of the spectral values

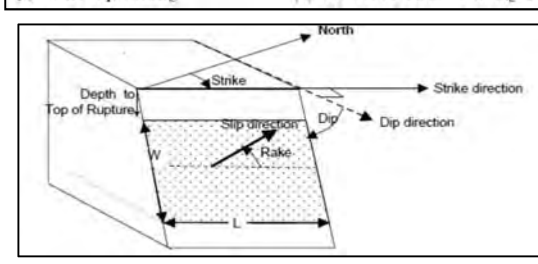
RotD50 Horizontal Component of PGA, PGV and *IMs*

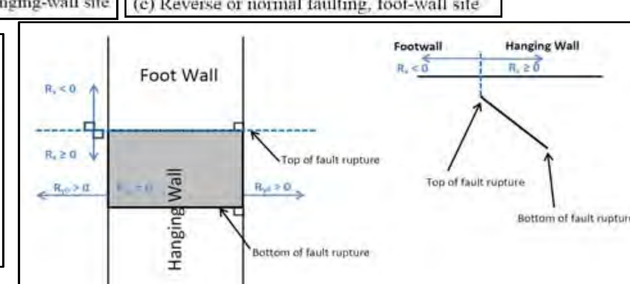
GMP: PSa (g), S_d (cm)	T (s)	Baseline: 5% Damping PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	User defined: 5% Damping PSa Median for 5% damping	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
	0.01	0.35823	0.61632	0.20821	0.00089	0.35823	0.61632	0.20821	0.00089
	0.02	0.36244	0.62413	0.21048	0.00360	0.36244	0.62413	0.21048	0.00360
	0.03	0.37141	0.64289	0.21457	0.00830	0.37141	0.64289	0.21457	0.00830
	0.05	0.41789	0.73225	0.23849	0.02593	0.41789	0.73225	0.23849	0.02593
	0.075	0.50344	0.89204	0.28412	0.07030	0.50444	0.89382	0.28469	0.07044
	0.1	0.58968	1.04405	0.33305	0.14638	0.59145	1.04718	0.33405	0.14682
	0.15	0.73091	1.27506	0.41898	0.40823	0.73237	1.27761	0.41982	0.40905
	0.2	0.81239	1.41241	0.46727	0.80666	0.81401	1.41524	0.46820	0.80827
	0.25	0.85168	1.49222	0.48610	1.32137	0.85424	1.49669	0.48756	1.32534
	0.3	0.85954	1.53360	0.48175	1.92032	0.86040	1.53513	0.48223	1.92224
	0.4	0.81579	1.49535	0.44506	3.24016	0.81661	1.49685	0.44550	3.24340
	0.5	0.75363	1.41276	0.40202	4.67696	0.75438	1.41417	0.40242	4.68164
	0.75	0.57904	1.12670	0.29759	8.08535	0.57904	1.12670	0.29759	8.08535
	1	0.46794	0.92566	0.23655	11.61591	0.46747	0.92474	0.23631	11.60429
	1.5	0.31940	0.63853	0.15977	17.83945	0.31972	0.63917	0.15993	17.85729
	2	0.23645	0.47427	0.11789	23.47873	0.23598	0.47333	0.11765	23.43177
	3	0.15388	0.30892	0.07665	34.37889	0.15373	0.30861	0.07658	34.34451
	4	0.10817	0.21502	0.05442	42.96402	0.10806	0.21480	0.05437	42.92106
	5	0.07816	0.15568	0.03924	48.50425	0.07792	0.15521	0.03912	48.35874
	7.5	0.03848	0.07643	0.01937	53.72927	0.03836	0.07621	0.01931	53.56808
	10	0.02160	0.04251	0.01098	53.62751	0.02152	0.04234	0.01093	53.41300
PGA (g)	0	0.35648	0.61284	0.20736	0.00088	0.35648	0.61284	0.20736	0.00088
PGV (cm/s)	-1	47.23426	85.30983	26.15262	0.11725	NA	NA	NA	NA





(a) Strike slip faulting (b) Reverse or normal faulting, hanging-wall site (c) Reverse or normal faulting, foot-wall site





Courtesy: Jennifer Donahue

Definition of Parameters

Damping ratio = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
PSA = Pseudo-absolute acceleration response spectrum (g)
PGA = Peak ground acceleration (g)
PGV = Peak ground velocity (cm/s)
S_d = Relative displacement response spectrum (cm)
M_w = Moment magnitude
R_{RUP} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustration
R_{JB} = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustration
R_X = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustration
R_{y0} = The horizontal distance off the end of the rupture measured parallel to strike (km)
V_{S30} = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
U = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
F_{RV} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
F_{NM} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
F_{HW} = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
Dip = Average dip of rupture plane (degrees)
Z_{TOR} = Depth to top of coseismic rupture (km)
Z_{HYP} = Hypocentral depth from the earthquake
$Z_{1.0}$ = Depth to Vs=1 km/sec
$Z_{2.5}$ = Depth to Vs=2.5 km/sec
W = Fault rupture width (km)
$V_{s30flag}$ = 1 for measured, 0 for inferred Vs30
F_{AS} = 0 for mainshock; 1 for aftershock
Region = Specific regions considered in the models, Click on Region to see codes
ΔDPP = Directivity term, direct point parameter; uses 0 for median predictions
PGA_r (g) = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
Z_{BOT} (km) = The depth to the bottom of the seismogenic crust
Z_{BOR} (km) = The depth to the bottom of the rupture plane
SS = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	13.59			14.961		
$Z_{1.0}$ (km)	0.650	0.650			0.424	
$\delta Z_{1.0}$ (km)	0.225		0.225			
$Z_{2.5}$ (V_{S30}=1100)(km)	4.100			0.398		
$Z_{2.5}$ (V_{S30})(km)	4.100			1.528		
Z_{hyp} (km)	999.00			10.265		
Z_{tor} (km)	0.00			0.039	0.039	
Z_{BOR} (km)	-			15.000		

ACKNOWLEDGEMENTS

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Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

Palos Verdes (15)

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

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Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

GMPE averaging	Geometric	*Weighted average of the natural logarithm of the spectral values*

GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0.25	0.25	0.25	0.25	0

# of std. dev.	1	
Damping ratio (%)	5	*Modification factors are calculated in Sheet DSF*

ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
CY14 Chiou & Youngs 2014 NGA West-2 Model
I14 Idriss 2014 NGA West-2 Model

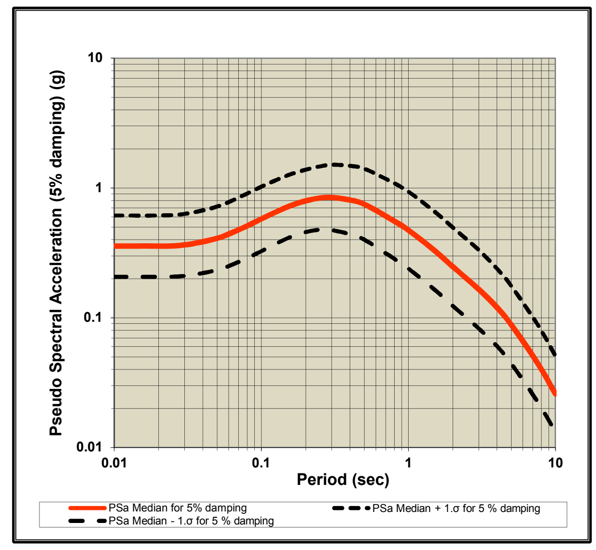
Input variables	Value	Errors and warnings
M_w	7.38	
R_{RUP} (km)	10.22	
R_{JB} (km)	10.13	
R_X (km)	9.98	
Ry0 (km)	999	*If unknown use 999*
V_{S30} (m/sec)	339	
U (BSSA13)	0	*1: Unspecified fault mech.*
F_{RV}	0	*1: reverse fault*
F_{NM}	0	*1: normal fault*
F_{HW}	1	*1: hanging wall side*
Dip (deg)	90	
Z_{TOR} (km)	0	*If unknown use 999*
Z_{HYP} (km)	999	*If unknown use 999*
$Z_{1.0}$ (km)	0.35	*If unknown use 999*
$Z_{2.5}$ (km)	3.25	*If unknown use 999*
W (km)	12.24	*If unknown use 999*
Vs30Flag	measured	*Choose options for V_{S30} from the list*
F_{AS}	no	*Aftershock effect is not applicable.*
Region	California	*Choose region from the list*

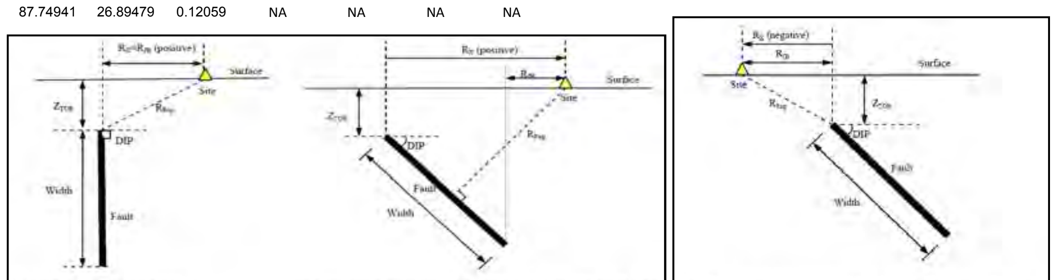
Calculated Variables/Flags

Variable	Value	Note
ΔDPP	0	*Always 0 for median calcs.*
PGA_r (g)	0.270	
Z_{BOT} (km) (CB14)	15	*Enter for default W calcs*
SS	1	*auto calculated*
$V_{s30Flag}$	1	*measured*
F_{AS}	0	*Aftershock effect is not applicable.*
Region	0	*California*
Option for Sa value	1	*Weighted average of the natural logarithm of the spectral values*

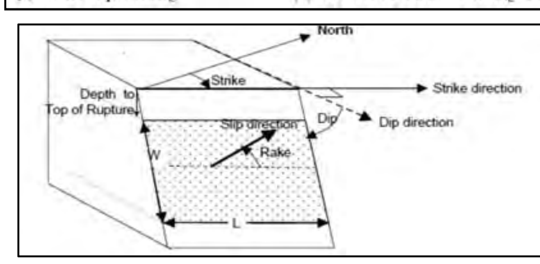
RotD50 Horizontal Component of PGA, PGV and *IMs*

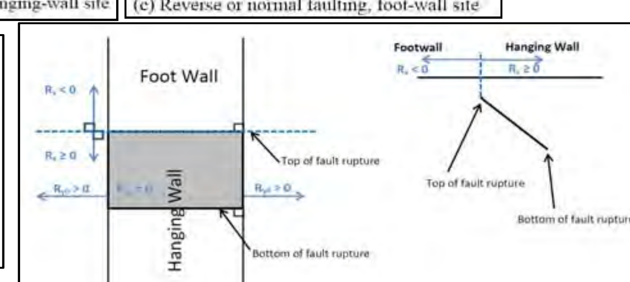
GMP	T (s)	Baseline: 5% Damping				User defined: 5% Damping			
		PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	PSa Median for 5% damping	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
PSa (g), S_d (cm)	0.01	0.35633	0.61357	0.20694	0.00088	0.35633	0.61357	0.20694	0.00088
	0.02	0.35611	0.61375	0.20662	0.00354	0.35611	0.61375	0.20662	0.00354
	0.03	0.36438	0.63131	0.21031	0.00814	0.36401	0.63068	0.21010	0.00813
	0.05	0.40913	0.71764	0.23324	0.02539	0.40913	0.71764	0.23324	0.02539
	0.075	0.49192	0.87255	0.27734	0.06869	0.49291	0.87429	0.27789	0.06883
	0.1	0.57538	1.01984	0.32462	0.14283	0.57710	1.02290	0.32559	0.14326
	0.15	0.71228	1.24394	0.40785	0.39783	0.71371	1.24643	0.40867	0.39863
	0.2	0.79291	1.37991	0.45561	0.78732	0.79450	1.38267	0.45653	0.78889
	0.25	0.83306	1.46075	0.47509	1.29247	0.83556	1.46514	0.47651	1.29635
	0.3	0.84357	1.50607	0.47250	1.88466	0.84526	1.50909	0.47344	1.88843
	0.4	0.80634	1.47861	0.43973	3.20261	0.80715	1.48009	0.44017	3.20582
	0.5	0.74965	1.40568	0.39979	4.65227	0.75040	1.40709	0.40019	4.65692
	0.75	0.58086	1.13036	0.29849	8.11074	0.58086	1.13036	0.29849	8.11074
	1	0.47301	0.93574	0.23910	11.74175	0.47301	0.93574	0.23910	11.74175
	1.5	0.33009	0.65990	0.16511	18.43645	0.33042	0.66056	0.16528	18.45489
	2	0.24829	0.49801	0.12379	24.65403	0.24779	0.49701	0.12354	24.60473
	3	0.16625	0.33375	0.08282	37.14308	0.16609	0.33342	0.08273	37.10594
	4	0.12011	0.23875	0.06043	47.70582	0.11999	0.23851	0.06037	47.65812
	5	0.08863	0.17653	0.04450	55.00143	0.08836	0.17600	0.04436	54.83642
	7.5	0.04536	0.09009	0.02283	63.33129	0.04522	0.08982	0.02276	63.14129
	10	0.02595	0.05107	0.01319	64.42432	0.02585	0.05087	0.01314	64.16663
PGA (g)	0	0.35049	0.60305	0.20371	0.00087	0.35049	0.60305	0.20371	0.00087
PGV (cm/s)	-1	48.57985	87.74941	26.89479	0.12059	NA	NA	NA	NA





(a) Strike slip faulting (b) Reverse or normal faulting, hanging-wall site (c) Reverse or normal faulting, foot-wall site





Courtesy: Jennifer Donahue

Definition of Parameters

Damping ratio = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
PSA = Pseudo-absolute acceleration response spectrum (g)
PGA = Peak ground acceleration (g)
PGV = Peak ground velocity (cm/s)
S_d = Relative displacement response spectrum (cm)
M_w = Moment magnitude
R_{RUP} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustation
R_{JB} = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustation
R_X = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustation
R_{y0} = The horizontal distance off the end of the rupture measured parallel to strike (km)
V_{S30} = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
U = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
F_{RV} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
F_{NM} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
F_{HW} = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
Dip = Average dip of rupture plane (degrees)
Z_{TOR} = Depth to top of coseismic rupture (km)
Z_{HYP} = Hypocentral depth from the earthquake
$Z_{1.0}$ = Depth to Vs=1 km/sec
$Z_{2.5}$ = Depth to Vs=2.5 km/sec
W = Fault rupture width (km)
$V_{s30flag}$ = 1 for measured, 0 for inferred Vs30
F_{AS} = 0 for mainshock; 1 for aftershock
Region = Specific regions considered in the models, Click on Region to see codes
ΔDPP = Directivity term, direct point parameter; uses 0 for median predictions
PGA_r ***(g)*** = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
Z_{BOT} ***(km)*** = The depth to the bottom of the seismogenic crust
Z_{BOR} ***(km)*** = The depth to the bottom of the rupture plane
SS = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	12.24			15.000		
$Z_{1.0}$ (km)	0.650	0.650			0.424	
$\delta Z_{1.0}$ (km)	0.225		**0.225**			
$Z_{2.5}$ (V_{S30}=1100)(km)	4.100			0.398		
$Z_{2.5}$ (V_{S30})(km)	4.100			1.528		
Z_{hyp} (km)	999.00			**10.227**		
Z_{tor} (km)	0.00			0.000	0.000	
Z_{BOR} (km)	-			15.000		

ACKNOWLEDGEMENTS

Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

San Pedro Escarpment (1)

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

This excel file will be updated as necessary on the PEER website to fix any typos or other errors. Please check the website frequently for new versions at: http://peer.berkeley.edu/ngawest2/databases/

Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

GMPE averaging	Geometric	*Weighted average of the natural logarithm of the spectral values*

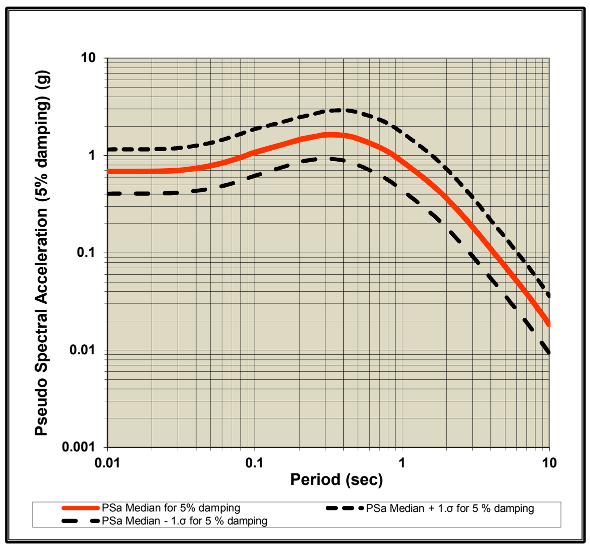
GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0.25	0.25	0.25	0.25	0

# of std. dev.	1	
Damping ratio (%)	5	*Modification factors are calculated in Sheet DSF*

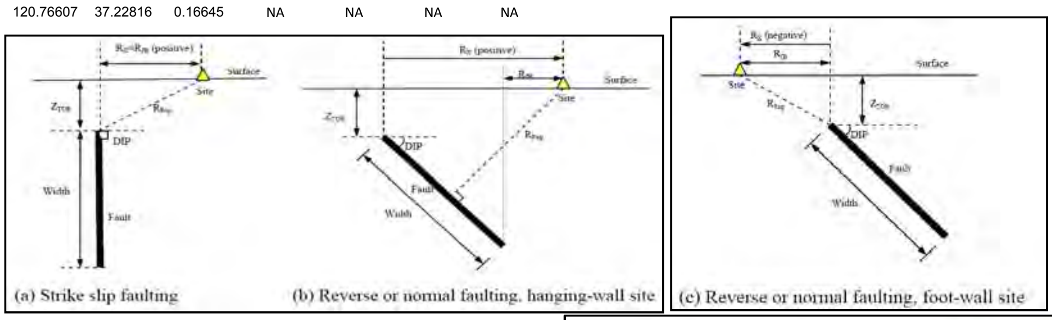
ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
CY14 Chiou & Youngs 2014 NGA West-2 Model
I14 Idriss 2014 NGA West-2 Model

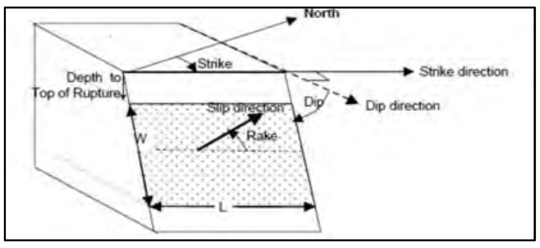
RotD50 Horizontal Component of PGA, PGV and *IMs*

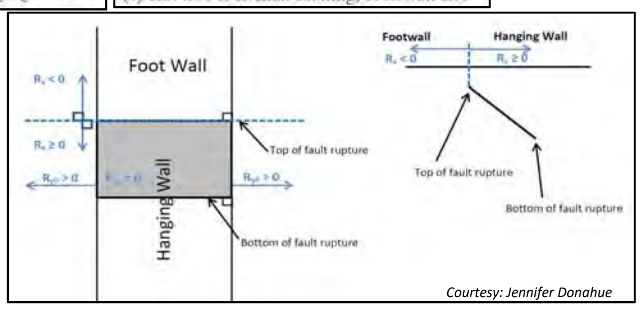
GMP	*T* (s)	Baseline: 5% Damping				User defined: 5% Damping			
		PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	PSa Median for 5% damping	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
PSa (g), S_d (cm)	0.01	0.68364	1.15303	0.40533	0.00170	0.68364	1.15303	0.40533	0.00170
	0.02	0.68829	1.16140	0.40790	0.00683	0.68829	1.16140	0.40790	0.00683
	0.03	0.70267	1.19087	0.41461	0.01570	0.70267	1.19087	0.41461	0.01570
	0.05	0.78307	1.34466	0.45603	0.04860	0.78307	1.34466	0.45603	0.04860
	0.075	0.92376	1.60676	0.53109	0.12899	0.92561	1.60997	0.53215	0.12925
	0.1	1.07144	1.86138	0.61673	0.26597	1.07465	1.86697	0.61858	0.26677
	0.15	1.27658	2.17850	0.74806	0.71301	1.27913	2.18285	0.74956	0.71444
	0.2	1.44999	2.46177	0.85404	1.43976	1.45289	2.46669	0.85575	1.44264
	0.25	1.54735	2.64878	0.90392	2.40069	1.55199	2.65672	0.90664	2.40789
	0.3	1.62759	2.84484	0.93118	3.63625	1.62922	2.84768	0.93211	3.63989
	0.4	1.60935	2.91348	0.88897	6.39199	1.61096	2.91640	0.88986	6.39838
	0.5	1.48979	2.77030	0.80117	9.24550	1.49128	2.77307	0.80197	9.25475
	0.75	1.15703	2.24158	0.59722	16.15599	1.15703	2.24158	0.59722	16.15599
	1	0.86926	1.71493	0.44061	21.57835	0.86926	1.71493	0.44061	21.57835
	1.5	0.54071	1.07964	0.27080	30.20058	0.54125	1.08072	0.27107	30.23078
	2	0.36449	0.73076	0.18180	36.19208	0.36376	0.72930	0.18144	36.11970
	3	0.18660	0.37459	0.09295	41.68869	0.18641	0.37422	0.09286	41.64700
	4	0.10917	0.21699	0.05492	43.35807	0.10906	0.21677	0.05487	43.31471
	5	0.07277	0.14494	0.03653	45.15905	0.07255	0.14451	0.03642	45.02357
	7.5	0.03347	0.06648	0.01685	46.73267	0.03340	0.06635	0.01681	46.63921
	10	0.01839	0.03618	0.00934	45.63979	0.01831	0.03603	0.00931	45.45723
PGA (g)	0	0.68020	1.14636	0.40360	0.00169	0.68020	1.14636	0.40360	0.00169
PGV (cm/s)	-1	67.05146	120.76607	37.22816	0.16645	NA	NA	NA	NA



Input variables	Errors and warnings
M_w: 7	
R_{RUP} (km): 8.73	
R_{JB} (km): 0	
R_X (km): 20.65	
Ry0 (km): 999	*If unknown use 999*
V_{S30} (m/sec): 339	
U (BSSA13): 0	*1: Unspecified fault mech.*
F_{RV}: 1	*1: reverse fault*
F_{NM}: 0	*1: normal fault*
F_{HW}: 1	*1: hanging wall side*
Dip (deg): 17	
Z_{TOR} (km): 999	*If unknown use 999*
Z_{HYP} (km): 999	*If unknown use 999*
$Z_{1.0}$ (km): 0.35	*If unknown use 999*
$Z_{2.5}$ (km): 3.25	*If unknown use 999*
W (km): 999	*If unknown use 999*
Vs30Flag: measured	*Choose options for V_{S30} from the list*
F_{AS}: no	*Aftershock effect is not applicable.*
Region: California	*Choose region from the list*







Courtesy: Jennifer Donahue

Calculated Variables/Flags

ΔDPP: 0	*Always 0 for median calcs.*
PGA_r (g): 0.446	
Z_{BOT} (km) (CB14): 15	*Enter for default W calcs*
SS: 0	*auto calculated*
$V_{s30Flag}$: 1	*measured*
F_{AS}: 0	*Aftershock effect is not applicable.*
Region: 0	*California*
Option for Sa value: 1	*Weighted average of the natural logarithm of the spectral values*

Definition of Parameters

Damping ratio = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
PSA = Pseudo-absolute acceleration response spectrum (g)
PGA = Peak ground acceleration (g)
PGV = Peak ground velocity (cm/s)
S_d = Relative displacement response spectrum (cm)
M_w = Moment magnitude
R_{RUP} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustation
R_{JB} = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustation
R_X = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustation
R_{y0} = The horizontal distance off the end of the rupture measured parallel to strike (km)
V_{S30} = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
U = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
F_{RV} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
F_{NM} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
F_{HW} = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
Dip = Average dip of rupture plane (degrees)
Z_{TOR} = Depth to top of coseismic rupture (km)
Z_{HYP} = Hypocentral depth from the earthquake
$Z_{1.0}$ = Depth to Vs=1 km/sec
$Z_{2.5}$ = Depth to Vs=2.5 km/sec
W = Fault rupture width (km)
$V_{s30flag}$ = 1 for measured, 0 for inferred Vs30
F_{AS} = 0 for mainshock; 1 for aftershock
Region = Specific regions considered in the models, Click on Region to see codes
ΔDPP = Directivity term, direct point parameter; uses 0 for median predictions
PGA_r (g) = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
Z_{BOT} (km) = The depth to the bottom of the seismogenic crust
Z_{BOR} (km) = The depth to the bottom of the rupture plane
SS = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	999.00			31.253		
$Z_{1.0}$ (km)	0.650	0.650			0.424	
$\delta Z_{1.0}$ (km)	0.225		0.225			
$Z_{2.5}$ (V_{S30}=1100)(km)	4.100			0.398		
$Z_{2.5}$ (V_{S30})(km)	4.100			1.528		
Z_{hyp} (km)	999.00			5.346		
Z_{tor} (km)	999.00			1.672	1.672	
Z_{BOR} (km)	-			10.809		

ACKNOWLEDGEMENTS

Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

Santa Monica Alt 1 (1)

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

This excel file will be updated as necessary on the PEER website to fix any typos or other errors. Please check the website frequently for new versions at: http://peer.berkeley.edu/ngawest2/databases/

Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

GMPE averaging	Geometric	*Weighted average of the natural logarithm of the spectral values*

GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0.25	0.25	0.25	0.25	0

# of std. dev.	1	
Damping ratio (%)	5	*Modification factors are calculated in Sheet DSF*

ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
CY14 Chiou & Youngs 2014 NGA West-2 Model
I14 Idriss 2014 NGA West-2 Model

Input variables | **Errors and warnings**

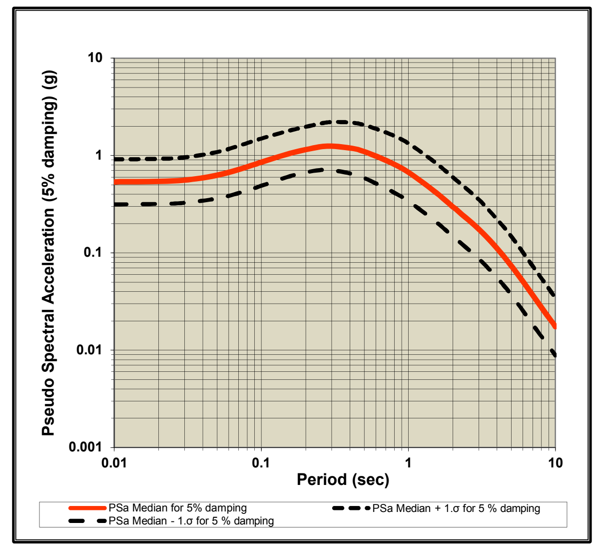
M_w	6.58	
R_{RUP} (km)	1.85	
R_{JB} (km)	0	
R_X (km)	0.29	
Ry0 (km)	999	*If unknown use 999*
V_{S30} (m/sec)	339	
U (BSSA13)	0	*1: Unspecified fault mech.*
F_{RV}	0	*1: reverse fault*
F_{NM}	0	*1: normal fault*
F_{HW}	1	*1: hanging wall side*
Dip (deg)	75	
Z_{TOR} (km)	0	*If unknown use 999*
Z_{HYP} (km)	999	*If unknown use 999*
$Z_{1.0}$ (km)	0.35	*If unknown use 999*
$Z_{2.5}$ (km)	3.25	*If unknown use 999*
W (km)	16.6	*If unknown use 999*
Vs30Flag	measured	*Choose options for V_{s30} from the list*
F_{AS}	no	*Aftershock effect is not applicable.*
Region	California	*Choose region from the list*

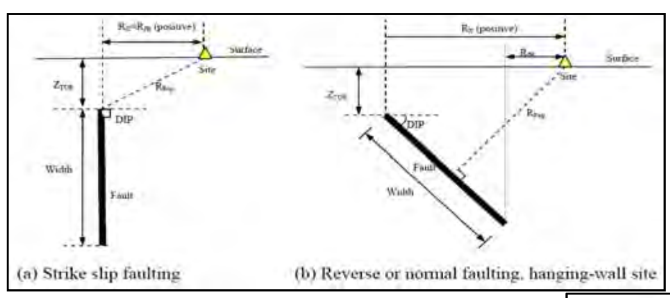
Calculated Variables/Flags

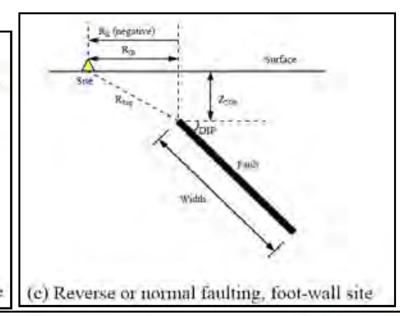
ΔDPP	0	*Always 0 for median calcs.*
PGA_r (g)	0.437	
Z_{BOT} (km) (CB14)	15	*Enter for default W calcs*
SS	1	*auto calculated*
$V_{s30Flag}$	1	*measured*
F_{AS}	0	*Aftershock effect is not applicable.*
Region	0	*California*
Option for Sa value	1	*Weighted average of the natural logarithm of the spectral values*

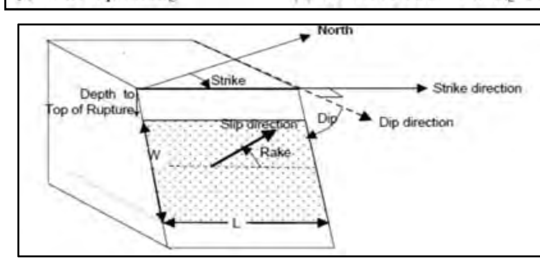
RotD50 Horizontal Component of PGA, PGV and *IMs*

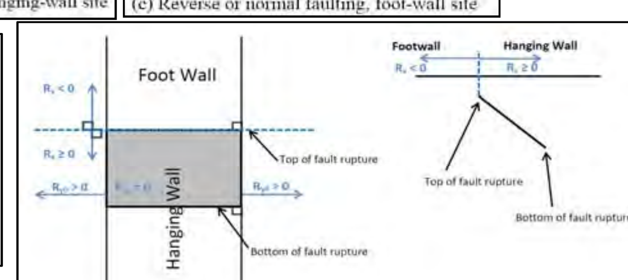
GMP	T (s)	Baseline: 5% Damping				User defined: 5% Damping			
		PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	PSa Median for 5% damping	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
PSa (g), S_d (cm)	0.01	0.53546	0.91221	0.31431	0.00133	0.53546	0.91221	0.31431	0.00133
	0.02	0.54237	0.92444	0.31821	0.00539	0.54237	0.92444	0.31821	0.00539
	0.03	0.55873	0.95624	0.32647	0.01248	0.55873	0.95624	0.32647	0.01248
	0.05	0.62618	1.08429	0.36162	0.03886	0.62618	1.08429	0.36162	0.03886
	0.075	0.73981	1.29596	0.42233	0.10330	0.74129	1.29855	0.42317	0.10351
	0.1	0.85178	1.49029	0.48684	0.21144	0.85348	1.49327	0.48781	0.21187
	0.15	1.03276	1.77756	0.60003	0.57683	1.03482	1.78112	0.60123	0.57798
	0.2	1.14568	1.96505	0.66797	1.13760	1.14683	1.96701	0.66864	1.13874
	0.25	1.22032	2.11263	0.70490	1.89331	1.22643	2.12320	0.70842	1.90278
	0.3	1.24937	2.20825	0.70687	2.79127	1.24937	2.20825	0.70687	2.79127
	0.4	1.19422	2.18000	0.65421	4.74321	1.19542	2.18218	0.65486	4.74795
	0.5	1.09906	2.05694	0.58724	6.82066	1.10016	2.05900	0.58783	6.82748
	0.75	0.85279	1.66017	0.43805	11.90773	0.85193	1.65851	0.43761	11.89583
	1	0.67420	1.33560	0.34033	16.73610	0.67285	1.33293	0.33965	16.70263
	1.5	0.42977	0.86115	0.21448	24.00400	0.42977	0.86115	0.21448	24.00400
	2	0.29914	0.60165	0.14873	29.70278	0.29854	0.60044	0.14843	29.64337
	3	0.17626	0.35493	0.08753	39.37834	0.17591	0.35422	0.08735	39.29958
	4	0.11103	0.22139	0.05568	44.09770	0.11092	0.22117	0.05562	44.05361
	5	0.07433	0.14852	0.03720	46.12783	0.07403	0.14792	0.03705	45.94332
	7.5	0.03169	0.06314	0.01590	44.24472	0.03172	0.06320	0.01592	44.28896
	10	0.01747	0.03449	0.00885	43.36972	0.01742	0.03438	0.00882	43.23961
PGA (g)	0	0.53252	0.90652	0.31282	0.00132	0.53252	0.90652	0.31282	0.00132
PGV (cm/s)	-1	66.33104	119.58373	36.79268	0.16466	NA	NA	NA	NA











Courtesy: Jennifer Donahue

Definition of Parameters

Damping ratio = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
PSA = Pseudo-absolute acceleration response spectrum (g)
PGA = Peak ground acceleration (g)
PGV = Peak ground velocity (cm/s)
S_d = Relative displacement response spectrum (cm)
M_w = Moment magnitude
R_{RUP} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustation
R_{JB} = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustation
R_X = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustation
R_{y0} = The horizontal distance off the end of the rupture measured parallel to strike (km)
V_{S30} = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
U = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
F_{RV} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
F_{NM} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
F_{HW} = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
Dip = Average dip of rupture plane (degrees)
Z_{TOR} = Depth to top of coseismic rupture (km)
Z_{HYP} = Hypocentral depth from the earthquake
$Z_{1.0}$ = Depth to Vs=1 km/sec
$Z_{2.5}$ = Depth to Vs=2.5 km/sec
W = Fault rupture width (km)
$V_{s30flag}$ = 1 for measured, 0 for inferred Vs30
F_{AS} = 0 for mainshock; 1 for aftershock
Region = Specific regions considered in the models, Click on Region to see codes
ΔDPP = Directivity term, direct point parameter; uses 0 for median predictions
PGA_r (g) = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
Z_{BOT} (km) = The depth to the bottom of the seismogenic crust
Z_{BOR} (km) = The depth to the bottom of the rupture plane
SS = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	16.60			14.792		
$Z_{1.0}$ (km)	0.650	0.650			0.424	
$\delta Z_{1.0}$ (km)	0.225		0.225			
$Z_{2.5}$ (V_{S30}=1100)(km)	4.100			0.398		
$Z_{2.5}$ (V_{S30})(km)	4.100			1.528		
Z_{hyp} (km)	999.00			9.364		
Z_{tor} (km)	0.00			0.712	0.712	
Z_{BOR} (km)	-			15.000		

ACKNOWLEDGEMENTS

Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

Santa Monica Alt 2 (2)

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

This excel file will be updated as necessary on the PEER website to fix any typos or other errors. Please check the website frequently for new versions at: http://peer.berkeley.edu/ngawest2/databases/

Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

GMPE averaging	Geometric

Weighted average of the natural logarithm of the spectral values

GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0.25	0.25	0.25	0.25	0

- ***ASK14*** Abrahamson & Silva & Kamai 2014 NGA West-2 Model
- ***BSSA14*** Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
- ***CB14*** Campbell & Bozorgnia 2014 NGA West-2 Model
- ***CY14*** Chiou & Youngs 2014 NGA West-2 Model
- ***I14*** Idriss 2014 NGA West-2 Model

# of std. dev.	1	
Damping ratio (%)	5	*Modification factors are calculated in Sheet DSF*

Input variables | **Errors and warnings**

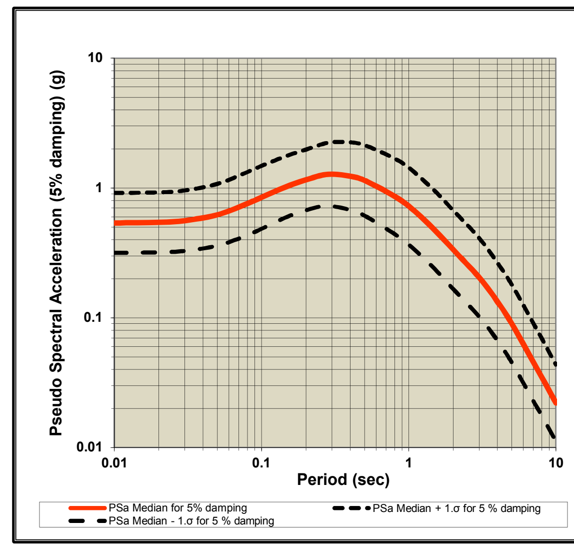
Input variable	Value	Errors and warnings
M_w	6.78	
R_{RUP} (km)	1.48	
R_{JB} (km)	0.92	
R_X (km)	-0.91	
Ry0 (km)	999	*If unknown use 999*
V_{S30} (m/sec)	339	
U (BSSA13)	1	*1: Unspecified fault mech.*
F_{RV}	0	*1: reverse fault*
F_{NM}	0	*1: normal fault*
F_{HW}	0	*1: hanging wall side*
Dip (deg)	50	
Z_{TOR} (km)	0	*If unknown use 999*
Z_{HYP} (km)	999	*If unknown use 999*
$Z_{1.0}$ (km)	0.35	*If unknown use 999*
$Z_{2.5}$ (km)	3.25	*If unknown use 999*
W (km)	13.63	*If unknown use 999*
Vs30Flag	measured	*Choose options for V_{s30} from the list*
F_{AS}	no	*Aftershock effect is not applicable.*
Region	California	*Choose region from the list*

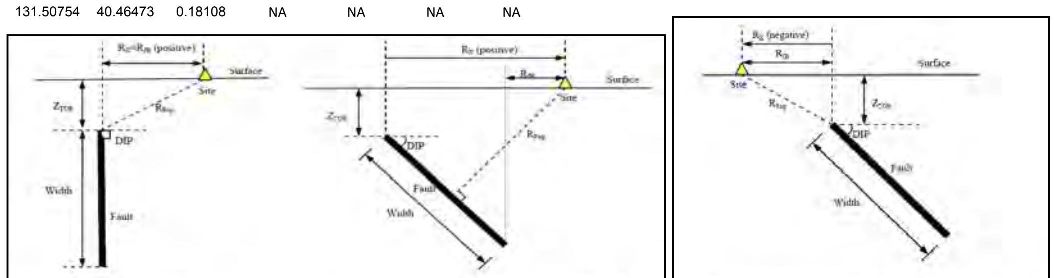
Calculated Variables/Flags

Variable	Value	Note
ΔDPP	0	*Always 0 for median calcs.*
PGA_r (g)	0.424	
Z_{BOT} (km) (CB14)	15	*Enter for default W calcs*
SS	0	*auto calculated*
$V_{s30Flag}$	1	*measured*
F_{AS}	0	*Aftershock effect is not applicable.*
Region	0	*California*
Option for Sa value	1	*Weighted average of the natural logarithm of the spectral values*

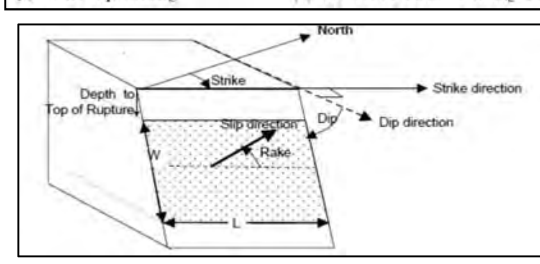
RotD50 Horizontal Component of PGA, PGV and *IMs*

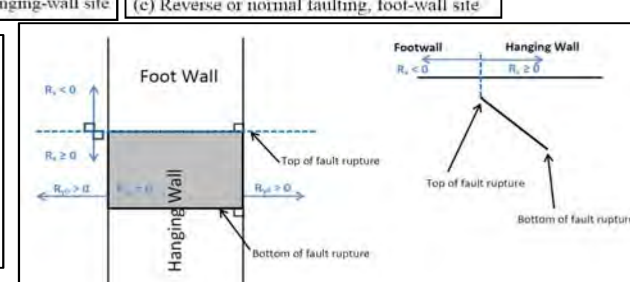
GMP	*T* (s)	Baseline: 5% Damping – PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	User defined: 5% Damping – PSa Median for 5% damping	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
PSa (g), S_d (cm)	0.01	0.53717	0.91399	0.31570	0.00133	0.53717	0.91399	0.31570	0.00133
	0.02	0.54328	0.92489	0.31913	0.00539	0.54328	0.92489	0.31913	0.00539
	0.03	0.55894	0.95558	0.32694	0.01249	0.55894	0.95558	0.32694	0.01249
	0.05	0.62156	1.07530	0.35928	0.03857	0.62093	1.07423	0.35892	0.03853
	0.075	0.73293	1.28287	0.41874	0.10234	0.73440	1.28544	0.41958	0.10255
	0.1	0.84465	1.47666	0.48314	0.20967	0.84634	1.47962	0.48410	0.21009
	0.15	1.03058	1.77228	0.59928	0.57561	1.03264	1.77582	0.60048	0.57676
	0.2	1.14990	1.97010	0.67117	1.14179	1.15105	1.97207	0.67184	1.14293
	0.25	1.23773	2.13972	0.71597	1.92031	1.24392	2.15042	0.71955	1.92992
	0.3	1.27722	2.25375	0.72381	2.85348	1.27722	2.25375	0.72381	2.85348
	0.4	1.23181	2.24464	0.67599	4.89250	1.23304	2.24688	0.67667	4.89740
	0.5	1.14290	2.13528	0.61173	7.09276	1.14405	2.13742	0.61235	7.09986
	0.75	0.90131	1.75165	0.46377	12.58532	0.90041	1.74990	0.46331	12.57273
	1	0.72676	1.43734	0.36747	18.04081	0.72530	1.43447	0.36673	18.00473
	1.5	0.47510	0.95045	0.23749	26.53581	0.47510	0.95045	0.23749	26.53581
	2	0.33585	0.67443	0.16725	33.34806	0.33484	0.67240	0.16674	33.24801
	3	0.20610	0.41438	0.10251	46.04497	0.20569	0.41355	0.10230	45.95288
	4	0.13338	0.26556	0.06699	52.97625	0.13325	0.26529	0.06693	52.92328
	5	0.09079	0.18114	0.04551	56.34652	0.09043	0.18042	0.04533	56.12114
	7.5	0.03975	0.07908	0.01998	55.49733	0.03978	0.07916	0.02000	55.55282
	10	0.02211	0.04358	0.01122	54.89006	0.02205	0.04345	0.01119	54.72539
PGA (g)	0	0.53422	0.90830	0.31421	0.00133	0.53422	0.90830	0.31421	0.00133
PGV (cm/s)	-1	72.94804	131.50754	40.46473	0.18108	NA	NA	NA	NA





(a) Strike slip faulting (b) Reverse or normal faulting, hanging-wall site (c) Reverse or normal faulting, foot-wall site





Courtesy: Jennifer Donahue

Definition of Parameters

- ***Damping ratio*** = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
- ***PSA*** = Pseudo-absolute acceleration response spectrum (g)
- ***PGA*** = Peak ground acceleration (g)
- ***PGV*** = Peak ground velocity (cm/s)
- ***S_d*** = Relative displacement response spectrum (cm)
- ***M_w*** = Moment magnitude
- ***R_{RUP}*** = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustration
- ***R_{JB}*** = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustation
- ***R_X*** = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustation
- ***R_{y0}*** = The horizontal distance off the end of the rupture measured parallel to strike (km)
- ***V_{S30}*** = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
- ***U*** = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
- ***F_{RV}*** = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
- ***F_{NM}*** = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
- ***F_{HW}*** = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
- ***Dip*** = Average dip of rupture plane (degrees)
- ***Z_{TOR}*** = Depth to top of coseismic rupture (km)
- ***Z_{HYP}*** = Hypocentral depth from the earthquake
- ***$Z_{1.0}$*** = Depth to Vs=1 km/sec
- ***$Z_{2.5}$*** = Depth to Vs=2.5 km/sec
- ***W*** = Fault rupture width (km)
- ***$V_{s30flag}$*** = 1 for measured, 0 for inferred Vs30
- ***F_{AS}*** = 0 for mainshock; 1 for aftershock
- ***Region*** = Specific regions considered in the models, Click on Region to see codes
- ***ΔDPP*** = Directivity term, direct point parameter; uses 0 for median predictions
- ***PGA_r (g)*** = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
- ***Z_{BOT} (km)*** = The depth to the bottom of the seismogenic crust
- ***Z_{BOR} (km)*** = The depth to the bottom of the rupture plane
- ***SS*** = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	13.63			19.084		
$Z_{1.0}$ (km)	0.650	0.650			0.424	
$\delta Z_{1.0}$ (km)	0.225		0.225			
$Z_{2.5}$ (V_{S30}=1100)(km)	4.100			0.398		
$Z_{2.5}$ (V_{S30})(km)	4.100			1.528		
Z_{hyp} (km)	999.00			10.607		
Z_{tor} (km)	0.00			0.380	0.380	
Z_{BOR} (km)	-			15.000		

ACKNOWLEDGEMENTS

Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

APPENDIX E

General Earthwork and Grading Guidelines

APPENDIX E

LEIGHTON CONSULTING, INC.
EARTHWORK AND GRADING GUIDE SPECIFICATIONS

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E-1.0 GENERAL

E-1.1 Intent

These Earthwork and Grading Guide Specifications are for grading and earthwork shown on the current, approved grading plan(s) and/or indicated in the Leighton Consulting, Inc. geotechnical report(s). These Guide Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the project-specific recommendations in the geotechnical report shall supersede these Guide Specifications. Leighton Consulting, Inc. shall provide geotechnical observation and testing during earthwork and grading. Based on these observations and tests, Leighton Consulting, Inc. may provide new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

E-1.2 Role of Leighton Consulting, Inc.

Prior to commencement of earthwork and grading, Leighton Consulting, Inc. shall meet with the earthwork contractor to review the earthwork contractor's work plan, to schedule sufficient personnel to perform the appropriate level of observation, mapping and compaction testing. During earthwork and grading, Leighton Consulting, Inc. shall observe, map, and document subsurface exposures to verify geotechnical design assumptions. If observed conditions are found to be significantly different than the interpreted assumptions during the design phase, Leighton Consulting, Inc. shall inform the owner, recommend appropriate changes in design to accommodate these observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include (1) natural ground after clearing to receiving fill but before fill is placed, (2) bottoms of all "remedial removal" areas, (3) all key bottoms, and (4) benches made on sloping ground to receive fill.

Leighton Consulting, Inc. shall observe moisture-conditioning and processing of the subgrade and fill materials, and perform relative compaction testing of fill to determine the attained relative compaction. Leighton Consulting, Inc. shall provide *Daily Field Reports* to the owner and the Contractor on a routine and frequent basis.

E-1.3 The Earthwork Contractor

The earthwork contractor (Contractor) shall be qualified, experienced and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Guide

Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing grading and backfilling in accordance with the current, approved plans and specifications.

The Contractor shall inform the owner and Leighton Consulting, Inc. of changes in work schedules at least one working day in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that Leighton Consulting, Inc. is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish earthwork and grading in accordance with the applicable grading codes and agency ordinances, these Guide Specifications, and recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of Leighton Consulting, Inc., unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, adverse weather, etc., are resulting in a quality of work less than required in these specifications, Leighton Consulting, Inc. shall reject the work and may recommend to the owner that earthwork and grading be stopped until unsatisfactory condition(s) are rectified.

E-2.0 PREPARATION OF AREAS TO BE FILLED

E-2.1 Clearing and Grubbing

Vegetation, such as brush, grass, roots and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies and Leighton Consulting, Inc.. Care should be taken not to encroach upon or otherwise damage native and/or historic trees designated by the Owner or appropriate agencies to remain. Pavements, flatwork or other construction should not extend under the “drip line” of designated trees to remain.

Leighton Consulting, Inc. shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 3 percent of organic materials (by dry weight: ASTM D 2974). Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area. As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

E-2.2 Processing

Existing ground that has been declared satisfactory for support of fill, by Leighton Consulting, Inc., shall be scarified to a minimum depth of 6 inches (15 cm). Existing ground that is not satisfactory shall be over-excavated as specified in the following Section E-2.3. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

E-2.3 Overexcavation

In addition to removals and over-excavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be over-excavated to competent ground as evaluated by Leighton Consulting, Inc. during grading. All undocumented fill soils under proposed structure footprints should be excavated

E-2.4 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), (>20 percent grade) the ground shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet (4.5 m) wide and at least 2 feet (0.6 m) deep, into competent material as evaluated by Leighton Consulting, Inc.. Other benches shall be excavated a minimum height of 4 feet (1.2 m) into competent material or as otherwise recommended by Leighton Consulting, Inc.. Fill placed on ground sloping flatter than 5:1 (horizontal to vertical units), (<20 percent grade) shall also be benched or otherwise over-excavated to provide a flat subgrade for the fill.

E-2.5 Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by Leighton Consulting, Inc. as suitable to receive fill. The Contractor shall obtain a written acceptance (*Daily Field Report*) from Leighton Consulting, Inc. prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys and benches.

E-3.0 FILL MATERIAL

E-3.1 Fill Quality

Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by Leighton Consulting, Inc. prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to Leighton Consulting, Inc. or mixed with other soils to achieve satisfactory fill material.

E-3.2 Oversize

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 6 inches (15 cm), shall not be buried or placed in fill unless location, materials and placement methods are specifically accepted by Leighton Consulting, Inc.. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 feet (3 m) measured vertically from finish grade, or within 2 feet (0.61 m) of future utilities or underground construction.

E-3.3 Import

If importing of fill material is required for grading, proposed import material shall meet the requirements of Section E-3.1, and be free of hazardous materials ("contaminants") and rock larger than 3-inches (8 cm) in largest dimension. All import soils shall have an Expansion Index (EI) of 20 or less and a sulfate content no greater than (≤) 500 parts-per-million (ppm). A representative sample of a potential import source shall be given to Leighton Consulting, Inc. at least four full working days before importing begins, so that suitability of this import material can be determined and appropriate tests performed.

E-4.0 FILL PLACEMENT AND COMPACTION

E-4.1 Fill Layers

Approved fill material shall be placed in areas prepared to receive fill, as described in Section E-2.0, above, in near-horizontal layers not exceeding 8 inches (20 cm) in loose thickness. Leighton Consulting, Inc. may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers, and only if the building officials with the appropriate jurisdiction approve. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

E-4.2 Fill Moisture Conditioning

Fill soils shall be watered, dried back, blended and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM) Test Method D 1557.

E-4.3 Compaction of Fill

After each layer has been moisture-conditioned, mixed, and evenly spread, each layer shall be uniformly compacted to not-less-than (≥) 90 percent of the maximum dry density as determined by ASTM Test Method D 1557. In some cases, structural fill may be specified (see project-specific geotechnical report) to be uniformly compacted to at-least (≥) 95 percent of the ASTM D 1557 modified Proctor laboratory maximum dry density. For fills thicker than (>) 15 feet (4.5 m), the portion of fill deeper than 15 feet below proposed finish grade shall be compacted to 95 percent of the ASTM D 1557 laboratory maximum density. Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

E-4.4 Compaction of Fill Slopes

In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by back rolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet (1 to 1.2 m) in fill elevation, or by other methods producing satisfactory results acceptable to Leighton Consulting, Inc.. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of the ASTM D 1557 laboratory maximum density.

E-4.5 Compaction Testing

Field-tests for moisture content and relative compaction of the fill soils shall be performed by Leighton Consulting, Inc.. Location and frequency of tests shall be at our field representative(s) discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

E-4.6 Compaction Test Locations

Leighton Consulting, Inc. shall document the approximate elevation and horizontal coordinates of each density test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that Leighton

Consulting, Inc. can determine the test locations with sufficient accuracy. Adequate grade stakes shall be provided.

E-5.0 EXCAVATION

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by Leighton Consulting, Inc. during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by Leighton Consulting, Inc. based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, then observed and reviewed by Leighton Consulting, Inc. prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by Leighton Consulting, Inc..

E-6.0 TRENCH BACKFILLS

E-6.1 Safety

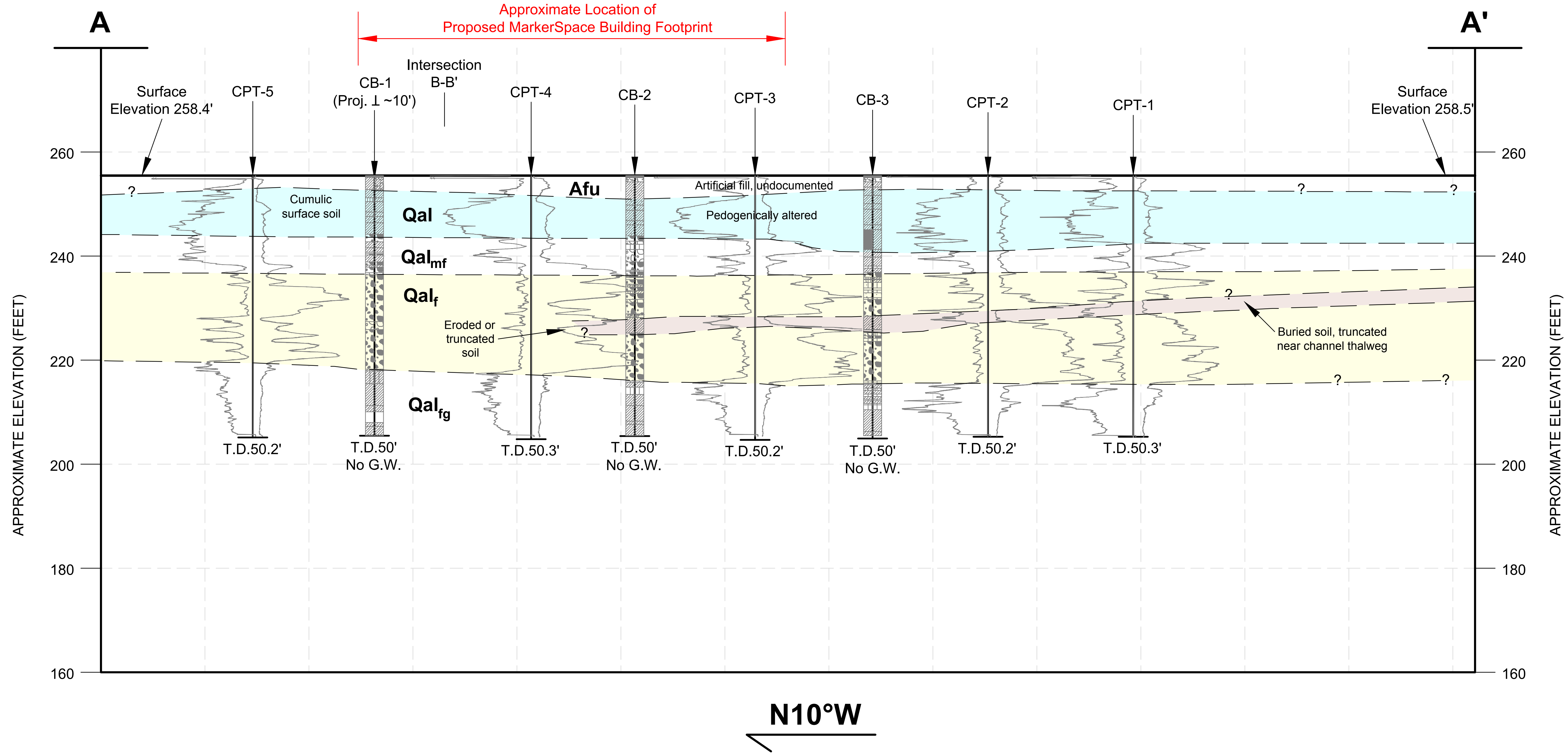
The Contractor shall follow all OSHA and Cal/OSHA requirements for safety of trench excavations. Work should be performed in accordance with Article 6 of the *California Construction Safety Orders*, 2009 Edition or more current (see also: http://www.dir.ca.gov/title8/sb4a6.html).

E-6.2 Bedding and Backfill

All utility trench bedding and backfill shall be performed in accordance with applicable provisions of the 2015 Edition of the *Standard Specifications for Public Works Construction* (Green Book). Bedding material shall have a Sand Equivalent greater than 30 (SE>30). Bedding shall be placed to 1-foot (0.3 m) over the top of the conduit, and densified by jetting in areas of granular soils, if allowed by the permitting agency. Otherwise, the pipe-bedding zone should be backfilled with Controlled Low Strength Material (CLSM) consisting of at least one sack of Portland cement per cubic-yard of sand, and conforming to Section 201-6 of the 2015 Edition of the *Standard Specifications for Public Works Construction* (Green Book). Backfill over the bedding zone shall be placed and densified mechanically to a minimum of 90 percent of relative compaction (ASTM D 1557) from 1 foot (0.3 m) above the top of the conduit to the surface. Backfill above the pipe zone shall **not** be jetted. Jetting of the bedding around the conduits shall be observed by Leighton Consulting, Inc. and backfill above the pipe zone (bedding) shall be observed and tested by Leighton Consulting, Inc..

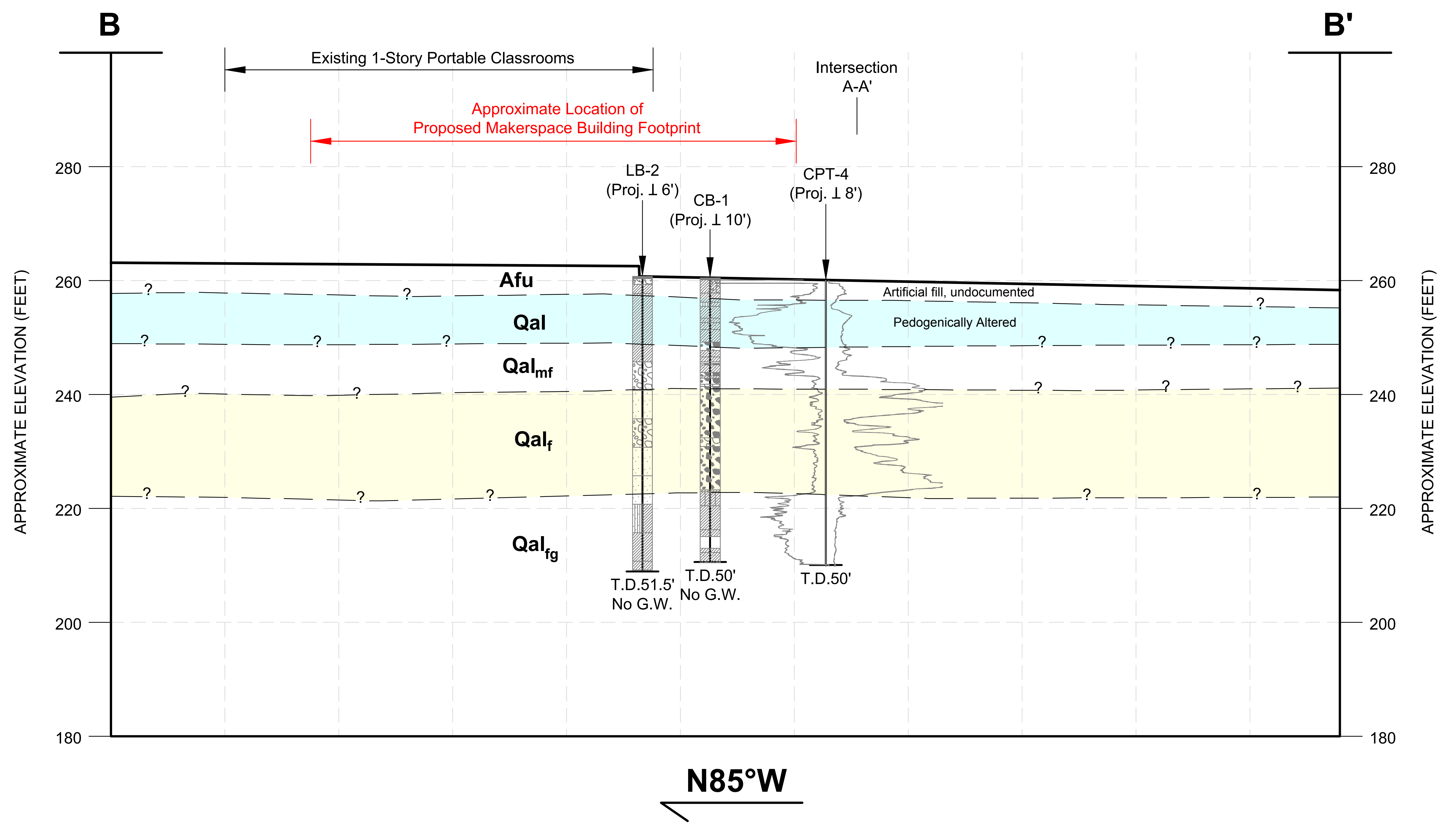
E-6.3 <u>Lift Thickness</u>

Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to Leighton Consulting, Inc. that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method, and only if the building officials with the appropriate jurisdiction approve.



UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) GRAPHIC

- SAND (SP)
- CLAYEY SAND (SC)
- CLAY (CL), SILTY CLAY AND CLAY LOAM
- SILTY SAND (SM)
- SAND WITH GRAVEL TO SANDY GRAVEL (SPg -GP)
- SANDY SILT (ML), CLAYEY SILT



PLEISTOCENE SOILS-SEE APPENDIX C FOR AGE OF SOILS

Qal Pedogenically altered Quaternary Alluvial Fan deposits characterized as Sandy Clay (CL), Silty Clay to Clay (CL) displaying moderate to strong blocky structure with subrounded to rounded Santa Monica slate rock clasts.

Qal_{mf} Alluvial fan and or mudflow deposits consisting of layers of Gravel (GP), Sand (SP), Sandy Clay (CL) and Clay Loam. Unit forms an abrupt erosional contact with underlying sediments.

Qal_f Fluvial deposits with rounded to subrounded slate clasts in beds of clast supported gravel. Fining upward Sequences and thin layers of overbank deposits in CB-2 and CB-3. Core of CB-1 contains primarily gravel suggesting close proximity to thalweg of channel in area of active depsoition.

Qal_{fg} Predominately fine grained deposits consisting of clay (CL), Sandy Clay (CL), Silty Clay (CL-ML) Clay Loam and Silty Clay Loam (CL).

Surface elevations approximate:
Alta Survey SMMUSD Franklin Elementary School
2400 Montana Avenue, Santa Monica, CA
Psomas Sheets 5 and 6, dated August 16, 2021

GEOTECHNICAL CROSS SECTION A-A' AND B-B' SMMUSD - Franklin Elementary School 2400 Montana Avenue Santa Monica, California	**PLATE 1** Scale: 1"=20' Date: January 2022
Leighton	Proj: 11428.035 Eng/Geol: CCK/EMH

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