Appendix F
Preliminary Geotechnical Investigation

GEOLABS-WESTLAKE VILLAGE
Foundation and Soils Engineering, Geology
a dba of
R&R Services
Corporation
3595 Old Conejo Road • Thousand Oaks, CA 91320
Voice: (818) 889-2562, (805) 495-2197

Preliminary Geotechnical Investigation, Proposed Multi-Family Residential Development, Lockwood Street, Parcel 1, APN 213-0-090-27, City of Oxnard, California

September 20, 2022
W.O. 9511

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SVM-LOCKWOOD, LLC.
5715 Mesmer Avenue
Los Angeles, California 90230

Attention: Mr. Mark Ross

SUBJECT: Preliminary Geotechnical Investigation,
Proposed Multi-Family Residential Development,
Lockwood Street, Parcel 1, APN 213-0-090-27,
City of Oxnard, California

Mr. Ross:

In accordance with your request, Geolabs – Westlake Village (GWV) has undertaken a study of the geotechnical conditions at the subject site (Plate 1.1). Our purpose was to evaluate the distribution and engineering characteristics of the earth materials that occur at the subject site, so that we might assess their impact upon the proposed new development.

Our scope of work for this study included the following tasks:

- review of previous work which is judged both pertinent to our purpose and readily available to our office
- logging and sampling of five exploratory borings excavated with a truck-mounted hollow-stem auger drill rig
- select laboratory testing of the retrieved samples
- soil engineering analysis of the assembled data
- and preparation of this report.

Field data and the approximate locations of exploratory excavations are shown on the enclosed Plot Map (Plate 1.2). Descriptions of the materials encountered in the exploratory excavations are provided on the enclosed logs (Appendix A). Pertinent laboratory test results are also provided herein (Appendix B). Our findings are presented in the following sections, followed by a discussion of these findings and geotechnical design criteria.

PROPOSED PROJECT

Based on the architectural site plans by Lauterbach & Associates, print date 4 May 2022, the proposed project is to construct apartments for multi-family residential housing that includes a single-story café/lounge and multi-story residential quarters on top of parking podium and tuck-under parking. The 234 residential apartments extend to as tall as five stories overall. It is anticipated that the structure will be constructed with conventional light-weight wood or steel construction with conventional shallow foundations and a slab-on-grade. We anticipate that the development of the site will include grading to prepare building pads, parking areas, and provide adequate site drainage.

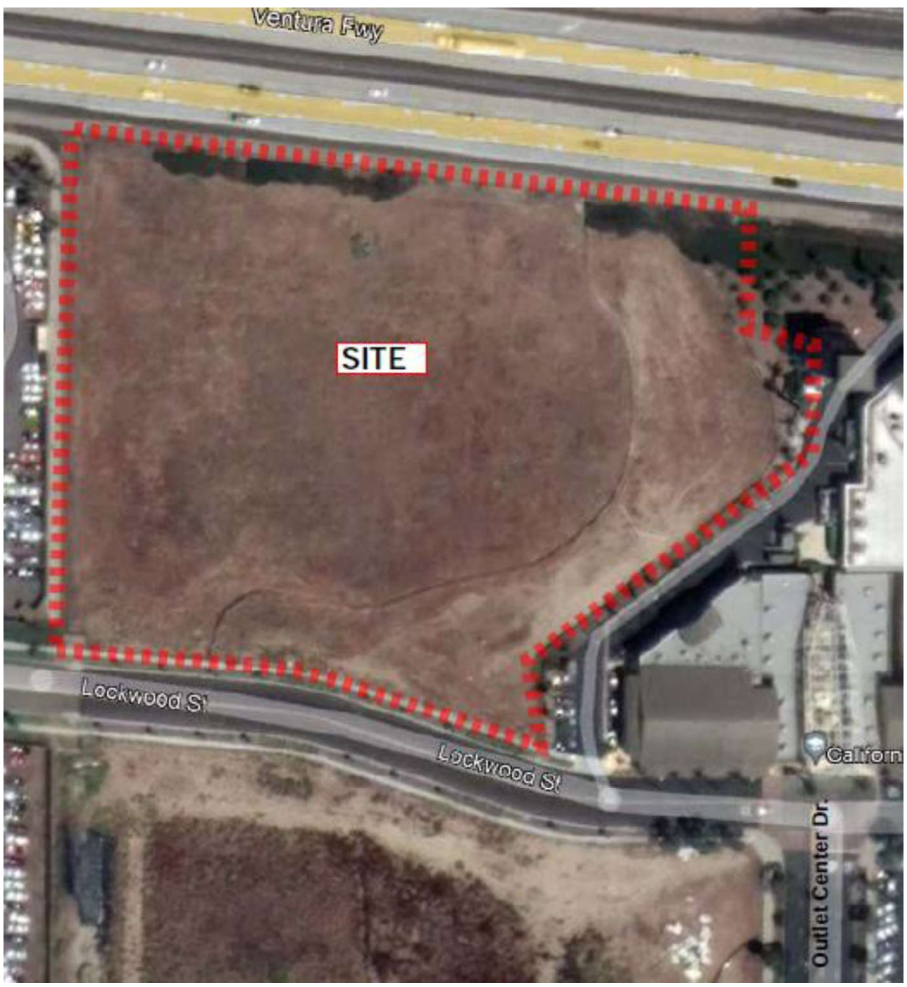

Figure 1 Approximate location of subject site. (Google Earth).

SITE DESCRIPTION & HISTORY

The site is an irregular rectangular shape, consisting of approximately 5.17 acres, located northwest of the intersection of Outlet Center Drive and the Lockwood Street extension in the City of Oxnard (Figure 1). The property is bordered on the north by the southbound 101 Freeway, south by the Lockwood Street extension, east by a concrete drainage ditch, paved parking and existing buildings, and west by a paved parking lot. (see plate 1.1). The subject site is undeveloped, relatively flat, covered by sparse grass and low-lying vegetation. The site is situated in an alluvial plain.

Historical aerial imagery shows that the subject site was used for agricultural purposes before 1970. Between 1945 and 1959 a citrus grove was planted. Farming operations ceased sometime between 1970 and 1994 and the lot remained undeveloped. Farm structures were in the west portion of the site as early as 1938.

PREVIOUS STUDIES

Geotechnical investigations have been performed adjacent/south of the subject site.

Geolabs-Westlake Village (GWV) conducted a preliminary geotechnical investigation for the extension of Lockwood Street along the south side of the subject site. The investigation included subsurface exploration with a backhoe, laboratory testing, engineering analysis, and preparation of a report to provide geotechnical design criteria for the construction of Lockwood Street. The grading for the extension has been completed. During grading, infiltration testing was performed for stormwater improvements.

South of Lockwood Street preliminary geotechnical investigations were performed by GWV in 2021 and MTC Engineering, Inc. (MTC) in 2019. The referenced preliminary geotechnical reports included an evaluation of the liquefaction potential for the site.

FIELD INVESTIGATION

For this study, five exploratory locations were selected to characterize the nature of the earth materials throughout the site. Exploratory borings were excavated with a truck-mounted hollow-stem auger drill rig. Samples were driven with a 140 lb. automatic safety hammer lifted 30 inches. The estimated efficiency of the auto hammer is approximately 81.5 percent. Drill rod was used to allow the hammer to remain above the auger. The boring diameter was approximately eight inches (outer diameter). The samplers consisted of both SPT split spoon sampler and a lined California split spoon sampler (2.375-inch I.D.). All borings were backfilled upon the completion of our exploration with cuttings from the boring.

Both disturbed (bulk) and relatively undisturbed samples were obtained from the borings. These samples were secured and transported to our laboratory for testing. From these samples, select materials were sent to an independent laboratory for corrosivity testing.

GEOLOGIC SETTING

The site is located in the Transverse Ranges geomorphic province of Southern California. The Transverse Ranges are essentially east-west trending elongate mountain ranges and valleys that are geologically complex. Also included in the province are the Channel Islands.

Structurally, the province reflects the north-south compressional forces that are the result of a bend in the San Andreas Fault. As the Pacific Plate (westerly side of the fault) and the North American Plate (easterly side) move laterally past one another along the fault, the bend creates a deflection which allows for large accumulations of compressional energy. Some of these forces are spent in deforming the crust into roughly east-west trending folds and secondary faults. The most significant of these faults are typically reverse or thrust faults, which allow for the crustal shortening taking place regionally. Great thicknesses of folded and faulted Tertiary-age sediments are characteristic of the Transverse Ranges.

The subject property is situated in the western portion of the province, within the city of Oxnard. The city is situated on a broad and flat alluvial plain of the Santa Clara River. Based on our exploration of the parcel and our review of regional geologic maps, the subject site is underlain in the near surface by alluvium (Plate 1.3).

EARTH MATERIALS

The subject property is underlain by artificial/agricultural fill over alluvium to the maximum depth explored (see Plate 1.3 and Appendix A). A brief description of the materials is provided in the following.

ARTIFICIAL/AGRICULTURAL FILL (af)

Historically, the site was used for farming and the top couple feet of soil have obviously been disturbed. However, in the borings there was no clear delineation between the artificial/agricultural fill and alluvium. These surficial soils were homogenous silty sand in a medium dense condition.

ALLUVIUM (Qal)

Alluvial material consists of various admixtures of sand, silt, clay, and sandy clay in a moist, medium dense/stiff condition.

GROUNDWATER

At the time of our field exploration, groundwater was encountered in Boring B1 at approximately 41 feet below the existing ground surface. Historical high groundwater level is mapped as being approximately ten feet below the ground surface at the subject site (CGS, 2002).

Adjacent to the site/south of Lockwood Street, exploratory borings performed by our office in 2021 did not encounter ground water to the maximum depth of 30 feet. In 2019, Yeh and Associates, Inc. exploratory borings encountered no groundwater to the maximum depth of 31.5 feet. MTC reported groundwater in Boring B-1 at 36.25 feet below existing ground surface.

Nearby investigation at St. John's Oxnard facility encountered groundwater at 35 feet below the ground surface in 2016 (Independent Solutions, 2016).

Seasonal variations in groundwater conditions are expected and are influenced by storm runoff, irrigation, and local groundwater pumping.

SEISMIC HAZARDS

The subject site contains no known active or potentially active faults, nor is it within an Alquist-Priolo Fault Rupture Hazard Zone. Therefore, the potential for ground rupture is considered to be very low. However, the subject site is situated within the seismically active Southern California region and ground shaking is likely to occur due to earthquakes caused by movement along nearby faults.

The subject site is not within a seismic landslide hazard zone but is located within a liquefaction hazard zone (Plate 1.5).

SEISMIC GROUND MOTION VALUES (MAPPED)

This report includes preliminary seismic ground motion values in accordance with the methodology of ASCE Standard 7-16. Seismic ground motion values were determined using the ASCE 7 Hazard Tool (https://asce7hazardtool.online). This website presents data from seismic design maps for a maximum considered earthquake ground motion, defined by an earthquake with a 2 percent probability of exceedance within a 50-year return period (recurrence interval of 2475 years). Output from these analyses is provided in Appendix C and summarized herein.

Latitude: 34.2224º Longitude: -119.1497º	**Factor/Coefficient**	**Value**
Site Profile Type	Site Class	D
Short-Period MCE at 0.2s	S_s	1.801
1.0s Period MCE	S_1	0.669
Site Coefficient	F_a	1.0
Site Coefficient	F_v	---
Adjusted MCE Spectral Response Parameters	S_{ms} S_{m1}	1.801 ---
Design Spectral Acceleration Parameters	S_{DS} S_{D1}	1.201 ---
Long-Period Transition Period	T_L	8.0 sec
Peak Ground Acceleration	PGA_M	0.87

Structures on soil profiles designated as Site Class D with S_1 values greater than or equal to 0.2, need not use site-specific ground motion values provided the value of the seismic response coefficient C_S is determined in accordance with the procedures in ASCE 7-16 §12.8.1.1 (per exception 2 of §11.4.8). The following parameters are considered appropriate for use in determining C_S per exception 2. If the project engineer does not make use of the exception, GWV should be notified and a site-specific seismic analyses can be performed upon request.

Factor/Coefficient		**Value**	**ASCE 7-16 Equation**
Site amplification factor at 0.2 second	F_a=	1.00	
Site amplification factor at 1.0 second	F_v=	1.70	
Site-modified spectral acceleration value	S_{MS}=	1.801	(11.4-1)
Site-modified spectral acceleration value	S_{M1}=	1.137	(11.4-2)
Numeric seismic design value at 0.2 second SA	S_{DS}=	1.201	(11.4-3)
Numeric seismic design value at 1.0 second SA	S_{D1}=	0.758	(11.4-4)
$T_s=S_{D1}/S_{DS}$	T_s=	0.63	(§ 11.3)

If the designer uses the simplified lateral force analysis procedure, §12.14.8 allows F_a to be taken as 1.0 for rock sites, or 1.4 for soil sites, for development of S_{DS}. Also, the value of S_S can be capped at 1.5 for development of parameters in accordance with §11.4.4. Sites are permitted to be considered rock if the soil thickness is no greater than 10 feet below the footing.

The mean earthquake magnitude was approximated using the USGS Unified Hazard Tool website (https://earthquake.usgs.gov/hazards/interactive/index.php). For ground motions with a 2475-year return period, the deaggregated mean earthquake magnitude is estimated at M=7.05 with a mean source distance of 9 km. For ground motions with a 475-year return period, the mean earthquake magnitude is estimated at M=6.89 with a mean source distance of 13.8 km.

LIQUEFACTION POTENTIAL

Liquefaction is a condition where the soil undergoes continued deformation at a constant low residual stress due to the build-up of high porewater pressures. The possibility of liquefaction occurring at a given site is dependent upon the occurrence of a significant earthquake in the vicinity; sufficient groundwater to cause high pore pressures; and on the grain size, relative density, and confining pressures of the soil at the site.

As part of our analyses of the liquefaction potential on the site, we have performed boring B1 on site to obtain subsurface data. Based upon the subsurface information and review of published data, groundwater is present on the site within the upper fifty feet of the soil profile. Considering the historic groundwater information, there is a likelihood of groundwater rising to within 10 feet of the ground surface. This, coupled with the likelihood of significant ground shaking, was cause to perform a quantitative evaluation of the liquefaction potential at the site.

GENERAL DISCUSSION

In the liquefied condition, soil may deform with little shear resistance. The amount of soil deformation following liquefaction depends on the looseness of the material, the depth, thickness, and areal extent of the liquefied layers, the ground slope, and the distribution of loads applied by structures. When liquefaction is accompanied by ground displacement or ground failure, it can be destructive. Adverse effects of liquefaction can include ground oscillation, lateral spreads, flow failures, loss of bearing strength, settlement, and increased pressures on retaining walls.

Discussion of Liquefaction Hazard Assessment

To address the possible impacts of liquefaction, the practice of geotechnical engineering currently has methods of approximating the potential for liquefaction, the potential liquefaction-induced settlement, lateral spreading, and the possibility of surface manifestations. For this project we performed a quantitative analyses of the potential for liquefaction based on our findings in boring B1. The results indicate that liquefaction on this site is not likely. The results are summarized in appendix C of this report.

Seismic Settlement Potential

The potential for seismic settlement of unsaturated soil has been evaluated using the procedures proposed by Tokimatsu and Seed (1987). Our analysis indicates there is not likely to be significant seismic settlement due to an earthquake with ground motions based on a 2475 year return period (2% chance of exceedance in 50 years.

Tsunamis and Seiches

The site is located in elevated terrain. Review of hazard zones as depicted in the Ventura County View website indicates the site is not within a Tsunamis inundation hazard zone. The potential for tsunamis to impact the site is considered negligible. The site is also not near an enclosed body of water; therefore, the potential for seiches impacting the site is considered negligible.

DISCUSSION AND DESIGN CRITERIA

Data from field exploration on this and adjacent properties performed by this office and MTC, laboratory testing performed by this office and MTC, and engineering analyses, coupled with inferred conditions about exploratory excavations, are the basis for the following discussion. Geotechnical design criteria, based upon the presently available data, are presented for your consideration.

Based on the findings developed during the investigation, the site is feasible for the intended project from a geotechnical perspective. The subject site is underlain by some artificial fill associated with past agricultural use. We anticipate the thickness will vary across the site. Grading of the site will be necessary to prepare the soil for support of the proposed project elements. Considering the type of structures and typical loads associated with those building types, it is our opinion the structures can be supported on conventional spread footings or mat foundations. The geohazards related with the potential for liquefaction at the site is primarily the potential for liquefaction induced total and differential settlement.

GRADING REMOVAL FOR STRUCTURAL AREAS

Disturbed material after demolition of existing structures, pavement, and utilities, stockpile removal, including agricultural fill, are not considered suitable to support structures. We recommend that disturbed material and areas to support structures be improved by removing the unsuitable material and replacing these materials with engineered fill. At least three feet of engineered fill should be placed below the bottom of the future foundations. Removals for the building area should extend at least five feet horizontally beyond the proposed exterior foundations.

COMPACTION STANDARD

On-site materials are suitable for use as engineered fill. These materials should be moistened and/or air-dried to near optimum moisture content and compacted to at least 90% of their maximum density as determined using the Modified Proctor Test (ASTM D1557). The density of earth materials is to be measured using the nuclear gauge (ASTM D6938) or sand cone (ASTM D1556) test methods. The frequency of field density tests should be at least one density test for every 500 cubic yards of fill or each two vertical feet of fill.

GRADING – ENGINEERED FILL

The following criteria pertain to preparation for, and placement of engineered fill:

1. The on-site soils are suitable for use as engineered fill. Any import materials that are to be used as structural fill should be approved by this office prior to placement.
2. Shrinkage refers to the lesser volume of fill that results from a given volume of excavation. The shrinkage of the alluvial materials is anticipated to be between 7% and 12%.
3. Subsidence includes the general lowering of the ground due to in-place compaction by construction equipment. Subsidence is anticipated to range from 1.0 to 3.0 tenths of a foot in the alluvial areas.
4. All vegetation, trash, construction debris, asphalt, or other deleterious material should be stripped from the area to be filled or to receive the proposed improvements.
5. Compressible soils and any disturbed soil that lie within the areas to receive engineered fill should be removed to relatively incompressible material, moisture conditioned, and replaced as properly compacted fill. Portions of the compressible materials that are sufficiently thin may be scarified, watered or air dried to approximately the material's optimum moisture content, and compacted in-place.
6. Exposed surfaces should be scarified, moistened or air dried as appropriate, and compacted to the appropriate percentage of the material's maximum dry density prior to placement of fill (see COMPACTION STANDARD section).

7. We recommend a uniform blanket of compacted fill be created for support of structural footings. The fill cap should extend to at least three feet below the base of proposed footings and five feet beyond their perimeter. Special consideration should be paid to locations where property lines or existing improvements (buildings, retaining walls, fences, power poles, etc.) interfere with the creation of the desired fill cap. Such conditions should be brought to the attention of this office so that the specific site conditions may be evaluated and recommendations provided. Depending upon the circumstances, special excavating techniques may be employed (i.e. slot cutting), alternative foundation designs may be used (i.e. grade beams supported by pad footings or piles), or the compaction standard may be increased.
8. Areas that are to be paved should be scarified to at least 12 inches below the existing or rough grade (whichever is deeper), brought to near the material's optimum moisture content, and compacted to the appropriate relative compaction (see COMPACTION STANDARD section).
9. Fill materials should be placed in thin lifts, watered to near the material's optimum moisture content (or to near 2% over optimum moisture content, and compacted to the applicable level of relative compaction prior to placing the next lift).
10. All grading should comply with the grading specifications and requirements of the local governing agency.

FOUNDATION SYSTEMS

Grading will be performed so foundations are supported by at least three feet of engineered fill. For the conditions at the site, conventional shallow spread footings or mat foundations are considered appropriate.

Conventional Spread Footings

Continuous or pad footings may be used to support the proposed structures. In order to achieve the capacities specified below, they should be founded a minimum of 24 inches into engineered fill, with the concrete placed against in-place, undisturbed material. Foundation design criteria are based, in part, upon the expansive properties of the materials anticipated to be present near the finished pad grade. The subject site contains soil considered to have very low expansion potential (EI of 0 – 20).

The parameters provided in the following table are minimum design values for the pertinent expansion range. Some of these values are empirical in nature. The foundation and slab designer should evaluate and design the foundations for the effects of expansive soils (CBC § 1805.8). The final foundation and slab-on-grade configuration should contain details that are not less than the values provided. Laboratory testing to verify the expansive properties of the near-pad-grade materials should be performed at the completion of rough grading.

FOUNDATION DESIGN PARAMETER	DESIGN CRITERIA EI = 0 - 20	UNITS	NOTES
Pre-saturation depth	moisten	in	
Allowable Bearing Capacity (net) (FS>3)	2000	psf	1,2
Allowable Lateral Resistance (FS=1.5)	225	psf/ft	2,3
Maximum Allowable Lateral Resitance	1500	psf	2,3
Coefficient of Friction (FS=1.0)	0.35		
Minimum Embedment Below Adjacent Grade			
One-Story	12	in	4
Multi-Story	24	in	4
Minimum Embedment Into Supporting Material	12	in	
Minimum Reinforcement	2 - #5, 1 near top and 1 near bottom		
SLAB-ON-GRADE DESIGN PARAMETER			
Minimum Concrete Thickness	6	in	
Minimum Reinforcement (On-Center-Each-Way)	#4 @ 16”		5
NOTES			
1) Bearing portions of all footings should be at least five feet (measured horizontally) from the face of adjacent descending slopes. All footings should bear at least three feet below an imaginary plane projected upward at 1.5:1 from the toe of locally over-steepened slopes. Pad footings should be at least 24 inches square. Continuous footings should be at least 12 inches wide for one-story and 15 inches wide for two-story construction.			
2) May be increased by 1/3 for short duration loading such as by wind or seismic forces.			
3) Decrease by 1/3 when combined with friction.			
4) Applies to exterior footings.			
5) Dowel slab to exterior footing using #3 bars @ 24” on-center, bent 36” into slab.			

Slab-On-Grade Subgrade

Concrete slabs-on-grade may be used in this project. The design criteria for these slabs consider the subgrade soils to be engineered fill placed in accordance with the jurisdictional standards and the design criteria in this report. The material on-site is considered low expansive. Concrete slabs-on-grade should be a minimum four inches thick and reinforced with #4 rebar at 16 inches on center, each way, placed in the middle of the slab section.

Approximately four inches of sand should be placed across the slab subgrade. A vapor retarder should be placed on top of the sand in all areas where moisture penetration of the slab is undesirable. The vapor retarder should consist of a Class A (ASTM E1745), minimum 10 mil thick, polyolefin plastic or better. Concrete for the floor slab should be placed directly upon the vapor retarder. The vapor retarder should be placed in general conformance with ASTM E1643. The permeance (propensity to transmit water) and strength of vapor retarder, as well as the water/cement ratio, mix design and strength of the concrete, will influence a variety of things, including slab finishing, construction schedules, moisture released from the slab, and floor coverings. Project design and construction professionals should consider these factors when developing specifications for, and/or selecting materials for, the vapor retarder, concrete, and floor covering.

MAT FOUNDATION

A mat foundation is considered appropriate to support the proposed buildings. Mat foundations may be designed to impose an allowable net bearing pressure of 2000 psf for dead loads plus live loads at an embedment of at least one foot below the adjacent ground level. These values may be increased by ⅓ for short duration loading such as by wind or seismic forces.

For design of the mat foundation, a modulus-of-subgrade reaction of 120 psi/in may be used. This value is a unit value for use with a 1-foot-square mat. The modulus should be reduced in accordance with the following equation when used with a larger mat:

$$K_v = K_{v1}\left[\frac{B+1}{2B}\right]^2$$

Where: K_v =Vertical subgrade modulus
K_{v1} =Subgrade modulus for 1'x1' plate
B =Foundation width in feet

During design, we recommend the foundation designer collaborate with the geotechnical consultant to refine the K_v value for this specific foundation design.

RETAINING WALL RECOMMENDATIONS

Development plans may include retaining walls. Foundation design criteria are provided in the preceding section. Lateral loading criteria for cantilevered wall designs with level backfills are presented in the table below. The loading criteria are in part a function of the type of backfill material. Criteria for various Unified Soil Classification designations are provided. Earth materials supported by the retaining wall and bearing support may be assumed to have a total soil unit weight of 125 pcf.

Lateral Design (1)

	Equivalent Fluid Density (pcf)
USCS Class:	SM-SC, ML
Active Pressure	45
At-rest Pressure	100

(1) Considering Table 1610A.1 of the 2019 CBC and laboratory strength results

Retaining walls that are free to deflect at the top may be designed for active pressure. Retaining walls that are restrained at the top should be designed for at-rest pressure. The 2019 CBC §1610A.1 allows basement walls which extend not more than six feet below grade with supporting flexible floor systems to be designed for active pressure.

The equivalent fluid densities in the table should be increased for walls supporting slopes steeper than 5:1 (H:V). The values should be increased one pcf for each two degrees of backfill gradient. For example, ascending backfill with a gradient of 2:1 may use an equivalent fluid density that is increased by 13 pcf. Recommendations for other backfill conditions may be provided upon request.

All retaining walls should be provided with adequate backdrainage systems. Pipe outlets are generally preferred over weep holes. Free draining material should be used behind weep holes or about pipe drains. Care should be exercised to see that weep holes are installed and maintained above finish grade adjacent to the face of the wall. Waterproofing should be included in the design where moisture penetration of the wall and mineral deposits/staining on the wall face are undesirable.

Backfill for retaining walls should be properly compacted. Use of expansive soil as backfill for retaining walls will result in a surcharge to the wall, the magnitude of which is dependent upon the expansion index of the backfill. An impervious cap should be provided at the top of the backfill to retard infiltration of water. A typical backfill detail is provided in the Typical Details appendix of this report.

Seismic Increment of Earth Pressure

As required by California Building Code §1803A.5.12 geotechnical reports for structures assigned to Seismic Design Category D, E or F must include information regarding lateral pressures on foundation walls and retaining walls due to earthquake motions. Recent writings such as Lew et al. (2010), Al Atik et al. (2010), and Sitar and Wagner (2015) attempt to address the appropriate means to implement this code requirement. These works conclude in part that seismic earth pressures can be neglected when the peak ground acceleration is below 0.3g. For this site, the peak ground acceleration is considered to be above this threshold.

For retaining walls, the following design criteria are provided considering the general provisional recommendations proposed by Sitar and Wagner (2015) for walls founded on non-saturated, level ground conditions. Per CBC §1803A.5.12 item 1, the seismic earth pressure increment need only be included in design when walls support more than six feet of backfill. When this criterion is met, cantilever walls free to move and rotate can be designed for a seismic earth pressure increment considering an equivalent fluid pressure of 23 pcf (triangular pressure distribution). Walls restricted from moving or rotating, such as basement walls, can be designed for a seismic earth pressure increment considering an equivalent fluid pressure of 44 pcf (triangular pressure distribution). The resultant of this seismic earth pressure increment is considered to act at one-third H above the base of the wall, where H is the wall height. The seismic earth pressure increment should be applied to the active earth pressure for both the free-to-rotate and restrained cases. Often, for the case of walls restricted from moving or rotating, this combination of active earth pressure and seismic earth pressure increment will not exceed the at-rest earth pressure for the static case when considering factored loads used for the basic load combinations prescribed in the California Building Code.

ELEVATOR PITS AND RETAINING WALL BACKDRAINS

Subsurface elevator pits and retaining walls should be provided with waterproofing, and backdrains for the alleviation of porewater pressure as illustrated in the Retaining Wall Detail provided in the Typical Details appendix of this report. Such drains should be connected to a nearby storm drain or be provided gravity-flow outletting to a sump. In lieu of installing such backdrainage measures, retaining walls would need to be designed considering hydrostatic pressure.

SETTLEMENT

Considering the preliminary nature of the building design, general static settlement of shallow spread foundations is anticipated to be minor, on the order of one inch. Differential settlement between footings is anticipated to be less than 1/2 inch. We anticipate the majority of settlement to occur during construction. When foundation designs are available, they should be provided to our office for review. Additional geotechnical design criteria may be provided at that time.

CORROSIVITY

For structural elements, a site is considered to be corrosive if one or more of the following conditions exist for the representative soil samples taken at the site: Chloride concentration is 500 ppm or greater, sulfate concentration is 2000 ppm or greater, or the pH is 5.5 or less (Caltrans, 2015; GMED, 2013). For structural elements, the minimum resistivity of soil and/or water indicates the relative quantity of soluble salts present in the soil or water. In general, a minimum resistivity value for soil and/or water less than 1000 ohm-cm indicates the presence of high quantities of soluble salts and a higher propensity for corrosion.

Samples of soil from the subject site were forwarded to consulting corrosion engineers Project X Corrosion Engineering. Resistivity results indicate resistivity of saturated samples of 9,380 ohm-cm. Soluble sulfate test results yielded concentrations of less than 0.10 percent by mass. This level of soluble sulfate is in the S0 exposure class per Table 19.3.1.1 of ACI 318-19. Chlorides were 22.0 ppm. The pH was determined to be approximately 8.1. A copy of the test results is provided in Appendix B.

Based on these results, the on-site soil does not meet any of the corrosion criteria. Samples of the on-site soils are not considered corrosive to structural elements based on the aforementioned definition.

TEMPORARY EXCAVATIONS

All temporary excavations (including utility trenches, grading removals, and backcuts for retaining wall construction) should comply with CAL/OSHA requirements. The safety and stability of excavations for the planned improvements are the responsibility of the contractor. The materials encountered in the exploratory excavations are classified as Type "C" soils. Temporary excavations (such as backcuts for stability fills, removals, and retaining wall excavations) may be considered stable if cut vertical, providing they are restricted to a maximum of 5 feet in height, are provided with permanent support as soon as possible, and they are protected from erosion and saturation. Portions of temporary excavations in excess of 5 feet high should be laid back to 1.5:1 unless specific alternative treatments are evaluated and found acceptable.

UTILITY TRENCH BACKFILL

Backfill for utility trench excavations should be compacted to the appropriate relative compaction (see COMPACTION STANDARD section). Where installed in sloping areas, the backfill should be properly keyed and benched.

PRELIMINARY PAVEMENT STRUCTURAL SECTIONS

For preliminary planning purposes, we provide the following pavement structural sections. These results are based upon testing of the subgrade materials in the area of the recently constructed section of Lockwood Street that produced a preliminary R-value of 63.

ASPHALT SECTIONS

TRAFFIC INDEX	ASPHALT THICKNESS	BASE THICKNESS
5.0	3.0 in.	4.0 in.
6.0	3.0 in.	4.0 in.

Based on Plate 100 of the City of Oxnard Standard Plan, the upper 12 inches of the subgrade soil should be compacted to at least 95% relative compaction. Base materials should be compacted to at least 95% relative compaction. Near the completion of grading, subgrade materials should be sampled and tested to confirm the R-value of the subgrade materials. Final pavement structural sections will be prepared at that time.

DRAINAGE

Preserving proper surface drainage is important. Planters, decorative walls, plants, trees or accumulations of organic matter should not be allowed to retard surface drainage. Area drains should be kept free of obstruction. Swales and/or area drains should outlet to the street or acceptable non-erodible device. Positive drainage along the backs of retaining walls should be maintained. Any other measures that will facilitate positive surface drainage should be employed.

CONSTRUCTION MONITORING

Grading plans and foundation plans should be submitted to this office. The project Civil Engineer should incorporate the removal recommendations into the grading plans. Additional recommendations may be provided at that time for our review, if such are considered warranted.

Placement of all fill and backfill should be monitored by representatives of this office. This includes our observation of prepared bottoms prior to filling. Supplemental recommendations may prove warranted based upon the materials exposed in the actual excavations.

Foundation excavations should be observed by representatives of this office to see if the recommended penetration of proper supporting strata has been achieved. Such observations should be made prior to placing concrete, steel or forms. This office should be notified at least 24 hours prior to placing concrete.

CLOSURE

This geotechnical report has been prepared in accordance with generally accepted engineering practices at this time and location. No other warranties, either express or implied, are made as to the professional advice provided under the terms of our agreement and included in this report.

Thank you for this opportunity to be of service. Please do not hesitate to call if you have any questions regarding this report.

Respectfully submitted,
GEOLABS-WESTLAKE VILLAGE

Joanna Nygren
Staff Geologist

Lawrence K. Stark
G.E. 2772

REGISTERED PROFESSIONAL ENGINEER
LAWRENCE K. STARK
No. 2772
GEOTECHNICAL
STATE OF CALIFORNIA

JN:af

XC: (1) Addressee

REFERENCE LIST

California Geological Survey, 2002; Seismic Hazard Zone Report for the Oxnard 7.5-Minute Quadrangle, Ventura County, California: Seismic Hazard Zone Report 52.

…, 2002; Earthquake Zones of Required Investigation Oxnard Quadrangle, Ventura County, California, scale 1:24 000, 1 sheet.

Department of Water Resources, February 2009; Water Data Library, http://wdl.water.ca.gov/waterdatalibrary/index.cfm, accessed March 2020.

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…, September 8, 2020b; Results of Percolation Testing for Proposed Bio-Retention Planters, Lockwood Street Extension, A Portion of Lot 3 and 4, Tract 4881, City of Oxnard, California.

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…August 12, 2022; Update Geotechnical Report and Change of Consultant, Proposed Lockwood Phase I Senior Apartments, Outlet Center Drive, APN 213-0-090-105, City of Oxnard, California

MTC Engineering, Inc., April 30, 2020; Preliminary Geotechnical Engineering Investigation, Proposed Commercial Building Complex, Driveways, and Parking Lots, 1053 Outlet Center Drive, (Southwest corner of Outlet Center Drive and Lockwood Street (APN: 213-0-090-105)), Oxnard, CA 93030

Ventura County GIS n.d.; County View Ventura County, California < https://maps.ventura.org/countyview/> (accessed 20 March, 2020).

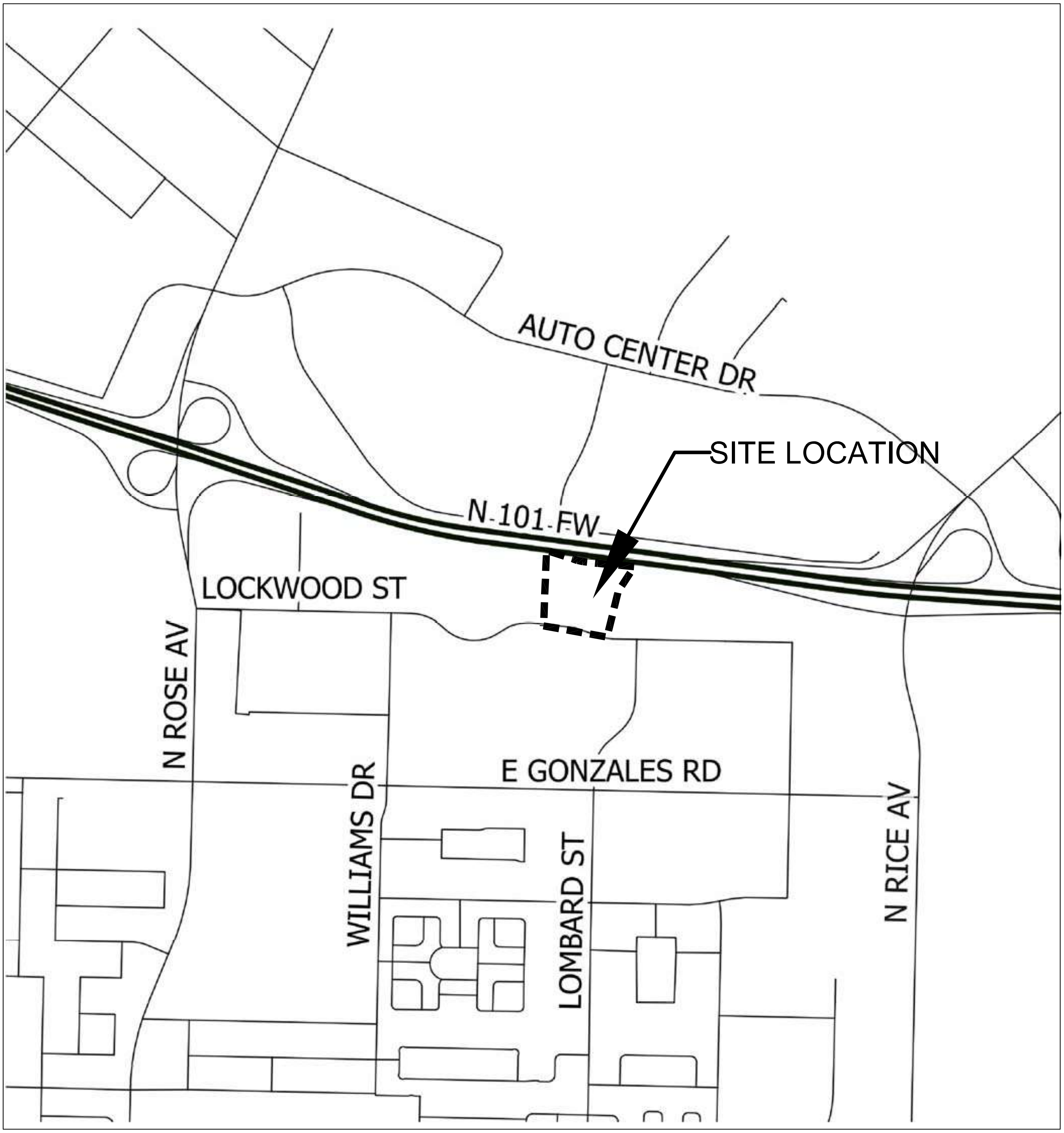
Ventura County GIS, November 2011; centerline [shapefile]. Available via Mapping Base https://www.ventura.org/gis-and-mapping/mapping-base/, accessed March 20, 2020

Yeh and Associates, Inc., October 2019; Geotechnical Design Memorandum, Field Infiltration Testing for Permanent Onsite Stormwater Management, Lockwood Street West of Outlet Center Drive, Oxnard, California.

..., May 2019; Geotechnical Design Memorandum, Field Infiltration Testing for Permanent Onsite Stormwater Management, Lockwood Street West of Outlet Center Drive, Oxnard, California.

LOCATION MAP

Proposed Multi-Family Residential Development
Lockwood Street, APN 213-0-090-75
City of Oxnard, California



SOURCE : County of Ventura. Centerline, 2019, https://www.ventura.org/gis-and-mapping/mapping-base, Ventura County, 2011. Accessed March 20, 2020.

Path: P:\9511\Geo Invest - Apartments Parcel 1.dwg (Layout: Plate 1.1 Site Location Map)

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DATE 9/20/2022	BY JN
SCALE NTS	W.O. 9511

PLATE 1.1

PLOT MAP

Proposed Multi-Family Residential Development
Lockwood Street, APN 213-0-090-75
City of Oxnard, California

SITE PLAN BY : Lauterbach & Associates Architects, Inc., Print date May 4, 2022

EXPLANATION

B5 Approximate location of boring by GWV, 2022

0 50 75 100

SCALE 1" = 50'

Path: P:\9511\Geo Invest - Apartments Parcel 1.dwg (Layout: Plate 1.2 Plot Map)

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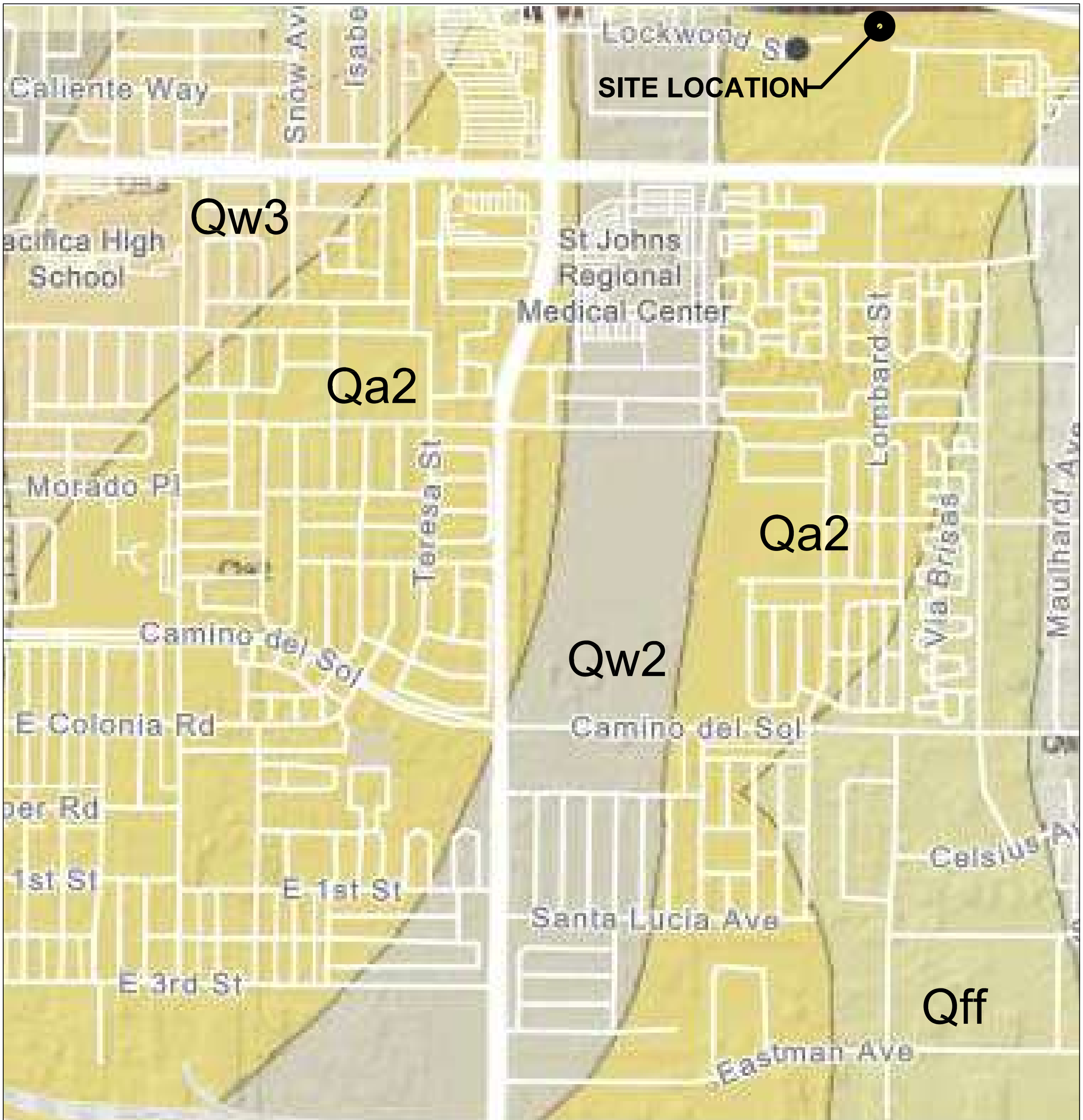
GEOLOGY AND SOIL ENGINEERING

DATE 09/20/2021 BY JN
SCALE 1'=50' W.O. 9511

PLATE 1.2

GEOLOGIC MAP

Proposed Multi-Family Residential Development
Lockwood Street, APN 213-0-090-75
City of Oxnard, California



SOURCE : Johnson, S.Y., et al, 2012; California State Waters Map Series - HuenemeCanyon and Vicinity, California

Path: P:\9511\Geo Invest - Apartments Parcel 1.dwg (Layout: Plate 1.3 Seismic Hazards Map)

EXPLANATION

Qa2	Alluvial Deposits	Qw2	Wash Deposits
Qa3	Alluvial Deposits	Qw3	Wash Deposits
Qt3	Stream Terrace Deposits	Qff	Alluvial Fan Deposits

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GEOLOGY AND SOIL ENGINEERING

DATE 9/20/2022 BY JN
SCALE NTS W.O. 9511

PLATE 1.3

HISTORIC HIGH GROUNDWATER

Proposed Multi-Family Residential Development
Lockwood Street, APN 213-0-090-75
City of Oxnard, California

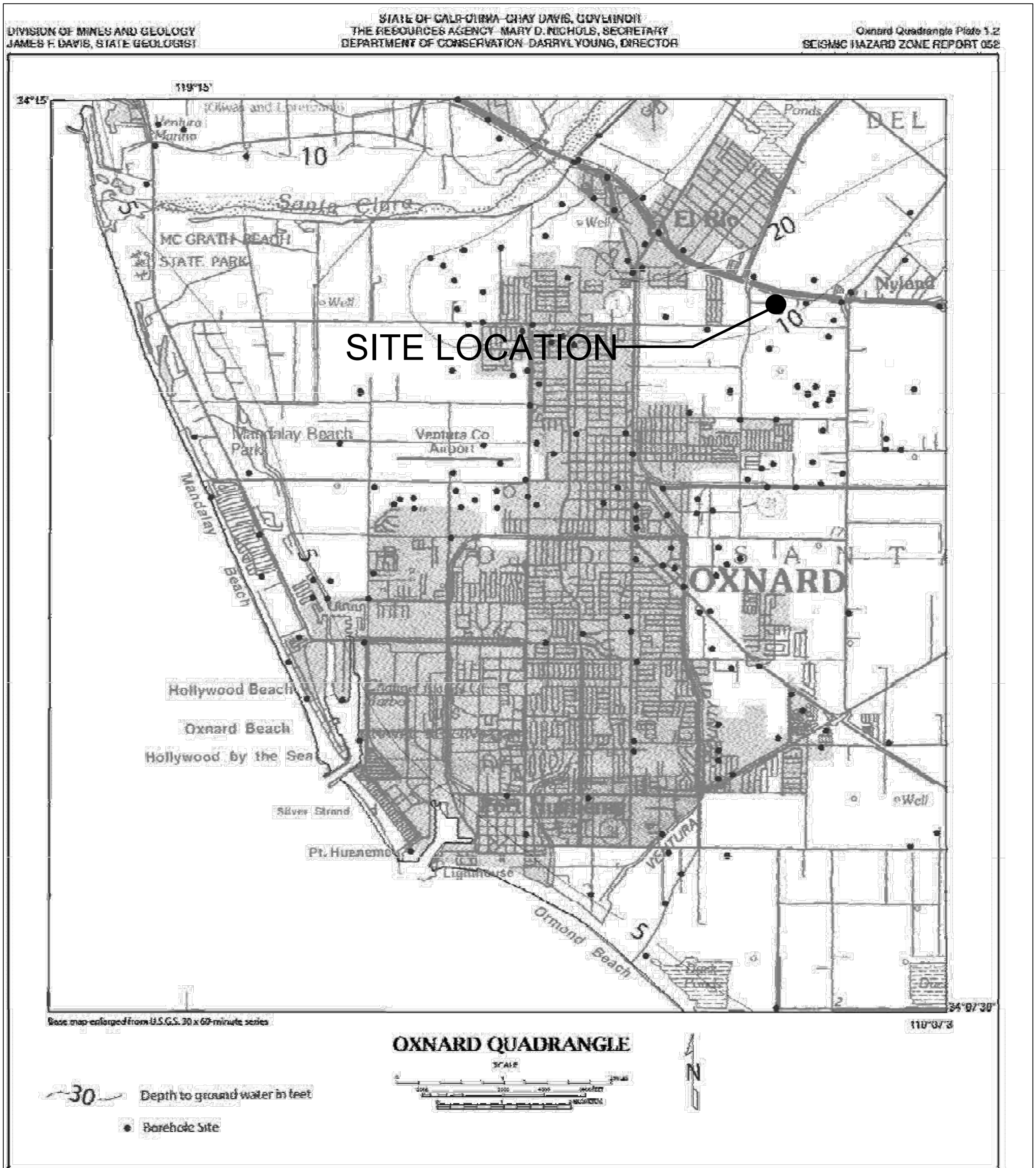

Plate 1.2 Depth to historically highest groundwater and borehole locations, Oxnard 7.5-minute quadrangle, California

Path: P:\9511\Geo Invest - Apartments Parcel 1.dwg (Layout: Plate 1.4 GW)

SOURCE : California Geological Survey, 2002

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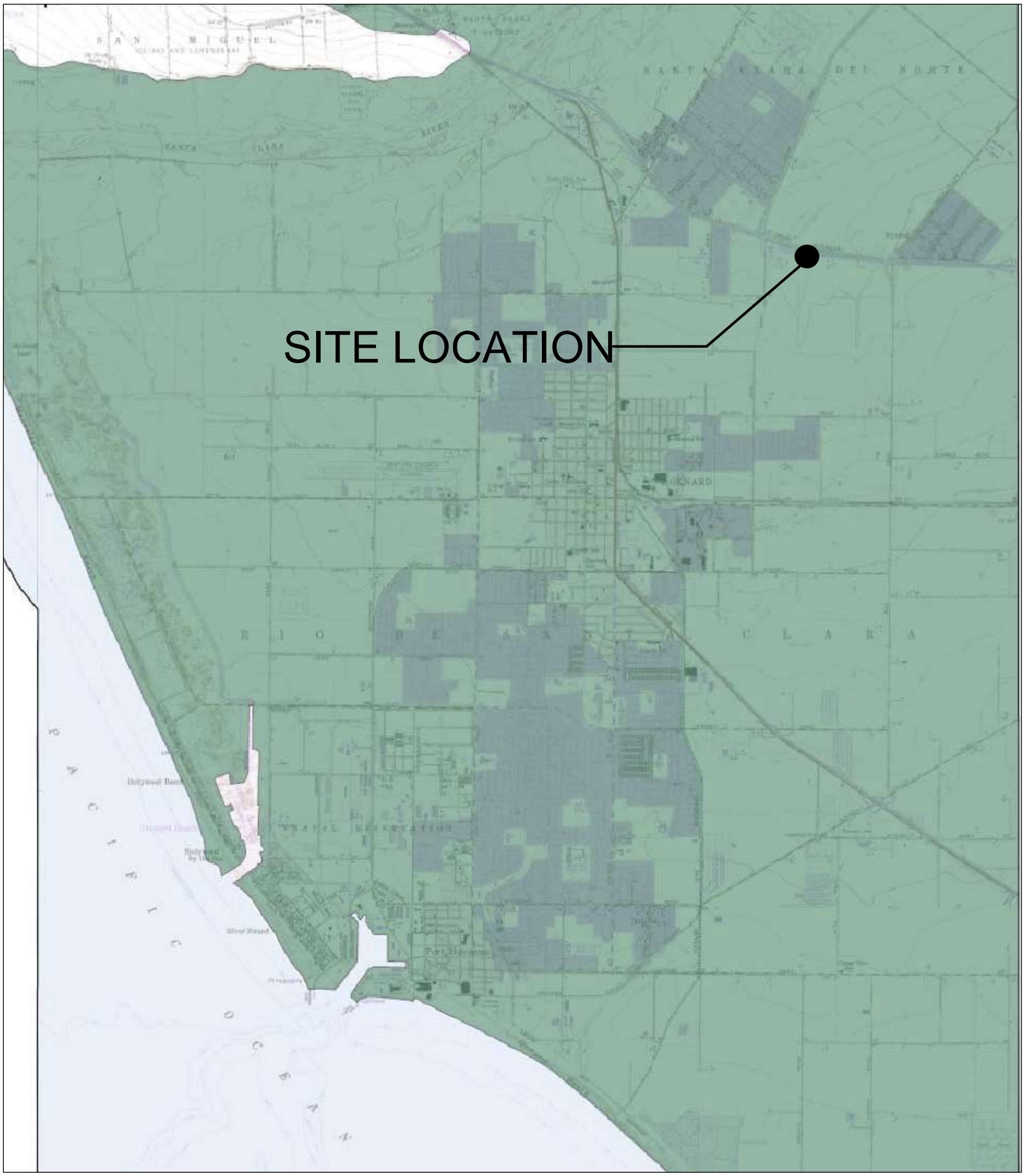
DATE 9/20/2022	BY JN
SCALE NTS	W.O. 9511
PLATE	1.4

SEISMIC HAZARDS MAP

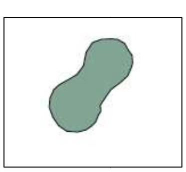
Proposed Multi-Family Residential Development
Lockwood Street, APN 213-0-090-75
City of Oxnard, California



SOURCE : California Geological Survey, 2002

Path: P:\9511\Geo Invest - Apartments Parcel 1.dwg (Layout: Plate 1.5 Seismic Hazards Map)

EXPLANATION



LIQUEFACTION HAZARD ZONE

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DATE 9/20/2022	BY JN
SCALE NTS	W.O. 9511
PLATE	1.5

APPENDIX A
Exploration Logs

September 20, 2022
W.O. 9511

WO: 9511.006	**RIG TYPE:** H S A	**%Eff.:** 81.5%	**DATE:** 9/1/2022
CLIENT: SVM Lockwood LLC	**HAMMER TYPE:** Auto	**HAMMER DROP(IN.):** 30"	**GEOLOGIST:** JN
PROJECT: Multi Family Residential	**HAMMER WEIGHTS:**	140 lbs.	**ELEVATION:** ±80'
LOCATION: Oxnard			**DRILLING CO.:** 2R Drilling

	N	U	B	M	DD	DESCRIPTION	COMMENTS
0						Alluvium (Qal): @0' - Light grayish brown silty SAND (SM), dry, rodent burrows, sparse grass/shrubs.	
2.5	4,5,5	C		29.5	87.6	@2.5' - Light brown silty very fine SAND (SM), loose, moist, poorly graded, slightly weathered.	
5	3,6,7	C		27.1	92.1	@5' - Light brown silty very fine SAND (SM), poorly graded, loose, moist, micaceous.	
7.5	2,4,7	C		25.9	94.7	@7.5' - Light gray and orange silty very fine SAND (SM), medium dense, moist, micaceous, mottled.	
10	7,8,21	C		16.3	104.3	@10' - Light gray and orange lean CLAY (CL), moist, slightly plastic, organics (decomposed wood) over light gray-white fine SAND (SP), poorly graded, very dense, moist, weathered, mottled.	
15	8,18,20		S			@15' - Light grayish brown fine to coarse SAND (SP-SW), poorly to moderately graded, dense, moist, weathered (oxidation staining).	
20	20,38,50	C		3.5	111.7	@20' - Light brown and gray medium to coarse SAND (SP-SW) with fine subrounded gravel, graded, very dense, moist.	
25	9,15,30		S			@25' - Light grayish brown fine SAND (SP) with trace coarse sand, poorly graded, dense, moist.	
30	30,50-6	C				@30' - No recovery.	
35	12,20,19		S			@35' - Light brown fine SAND (SP) over light gray to white coarse SAND (SP) with trace fine gravel, poorly graded, dense, moist, slightly friable.	
40	22,50-6	C		12.4	111.9	@40' - Light gray coarse SAND (SP), poorly graded, very dense, wet. @±41' - Groundwater.	

ADDITIONAL COMMENTS:

C = Modified California Sample
S = Standard Penetration Test

N = Field Blowcount
U = Undisturbed Sample
B = Disturbed Sample
X = Disturbed Bulk Sample
M = Moisture %
DD = Dry Density (pcf)

WO: 9511.006	**RIG TYPE:** H S A	**%Eff.:** 81.5%	**DATE:** 9/1/2022
CLIENT: SVM Lockwood LLC	**HAMMER TYPE:** Auto	**HAMMER DROP(IN.):** 30"	**GEOLOGIST:** JN
PROJECT: Multi Family Residential	**HAMMER WEIGHTS:**	140 lbs.	**ELEVATION:** ±79'
LOCATION: Oxnard			**DRILLING CO.:** 2R Drilling

	N	U	B	M	DD	DESCRIPTION	COMMENTS
45	5,11,24		S			Alluvium (Qal): @45' - Light gray coarse SAND (SP) over fine to medium SAND (SP-SW) with some fine gravel, poorly to well-graded, dense, wet, increasing fines with depth.	
47.5	2,6,6		S			@47.5' - Upper (10") Light gray coarse SAND (SP) wet, over (±1") gray very fine sandy CLAY (CL) oxidation (±7") gray silty very fine SAND (SM) medium dense.	
50	5,6,8		S			@50' - Gray silty very fine SAND (SM) with trace some CLAY (CL), poorly graded, medium dense, moist, micaceous.	
55							
60							
65						TD 50' Groundwater @ ±41' No Caving	
70							
75							
80							
85							

ADDITIONAL COMMENTS:

C = Modified California Sample
S = Standard Penetration Test

N = Field Blowcount
U = Undisturbed Sample
B = Disturbed Sample
X = Disturbed Bulk Sample
M = Moisture %
DD = Dry Density (pcf)

SUBSURFACE DATA | BORING LOG : B2

WO: 9511.006	**RIG TYPE:** H S A	**%Eff.:** 81.5%	**DATE:** 9/1/2022
CLIENT: SVM Lockwood LLC	**HAMMER TYPE:** Auto	**HAMMER DROP(IN.):** 30"	**GEOLOGIST:** JN
PROJECT: Multi Family Residential	**HAMMER WEIGHTS:**	140 lbs.	**ELEVATION:** ±79'
LOCATION: Oxnard			**DRILLING CO.:** 2R Drilling

	N	U	B	M	DD	DESCRIPTION	COMMENTS
0						Alluvium (Qal): @0' - Light brown silty SAND (SM), dry, rodent burrows throughout.	
2.5	3,3,5	C		26.4	84.1	@2.5' - Light grayish brown silty fine SAND (SM) with clay, poorly graded, moist, loose, micaceous on the bottom.	
5	2,2,3		S			@5' - Light pale brown silty very fine SAND (SM) to fine sandy SILT, with trace clay, moist, loose, micaceous.	
7.5	4,5,6	C		27.1	89.3	@7.5' - Light brown and orange silty very fine SAND (SM) over sandy CLAY (CL), poorly graded, moist, loose, slightly mottled layers.	
10	3,5,7		S			@10' - Light brown and orange (mottled) very silty very fine SAND (SM) with trace clay, miicaceous, moist over bottom (7") light gray fine SAND (SP), medium dense, moist.	
15	22,37,40	C		2.7	117.2	@15' - Light grayish brown fine gravelly fine to coarse SAND (SW), graded, over fine SAND (SP), dense, moist, weathered.	
20	7,8,6		S			@20' - Light gray and orange fine gravelly fine to coarse SAND (SP-SW), moderately graded, medium dense, over grayish brown (4") clay, fine SAND (SC), moist.	
25	5,5,5					@25' - Mottled light brown, orange, tan silty very fine SAND (SM) with clay over dark brown to black very fine sandy CLAY (CL), medium stiff, moist, slightly plastic, micaceous.	
30							
35						TD 25' No Groundwater No Caving	
40							

ADDITIONAL COMMENTS:

C = Modified California Sample
S = Standard Penetration Test

N = Field Blowcount
U = Undisturbed Sample
B = Disturbed Sample
X = Disturbed Bulk Sample
M = Moisture %
DD = Dry Density (pcf)

WO: 9511.006	**RIG TYPE:** H S A	**%Eff.:** 81.5%	**DATE:** 9/1/2022
CLIENT: SVM Lockwood LLC	**HAMMER TYPE:** Auto	**HAMMER DROP(IN.):** 30"	**GEOLOGIST:** JN
PROJECT: Multi Family Residential	**HAMMER WEIGHTS:**	140 lbs.	**ELEVATION:** ±79'
LOCATION: Oxnard			**DRILLING CO.:** 2R Drilling

	N	U	B	M	DD	DESCRIPTION	COMMENTS
0						Alluvium (Qal): @0' - Silty fine SAND (SM), rodent burrows throughout, dry, gravel and cobbles throughout, sparse shrubs/grass.	
2.5	3,3,4	C		18.8	95.9	@2.5' - Light grayish brown and orange fine SAND (SM) over silty very fine SAND (SM), moist, very loose, micaceous.	
5	1,2,2		S			@5' - Light gray brown very silty fine SAND (SM) with some clay, poorly graded, moist, very loose.	
7.5	3,5,8	C		30.7	91.0	@7.5' - Mottled light gray orange very silty fine SAND (SM) and fine sandy CLAY (CL), moist, loose, micaceous, weathered.	
10	1,2,6		S			@10' - Light gray and light brown silty very fine SAND (SM), very moist, micaceous, over light grayish red (4') CLAY (CL), moist, plastic over (4") light gray and orange fine SAND (SP), horizontal layers, loose.	
15	17,29,30	C		3.7	106.1	@15' - Light gray fine to medium SAND (SP) with coarse scattered sand, moderately graded, dense, moist.	
20	7,9,20		S			@20' - Light gray to white fine to coarse SAND (SP-SW) with some subrounded gravel, graded, medium dense, moist.	
25	9,11,9	C		25.0	91.3	@25' - Light gray, orange mottled very fine sandy CLAY (CL), stiff, plastic, moist, micaceous, over silty very fine SAND (SM).	
30	4,5,11		S			@30' - Light gray to light brown silty fine SAND (SM), poorly graded, medium dense, moist.	
35						TD 30' No Groundwater No Caving	
40							

ADDITIONAL COMMENTS:

C = Modified California Sample
S = Standard Penetration Test

N = Field Blowcount
U = Undisturbed Sample
B = Disturbed Sample
X = Disturbed Bulk Sample
M = Moisture %
DD = Dry Density (pcf)

WO: 9511.006	**RIG TYPE:** H S A **%Eff.:** 81.5%	**DATE:** 9/1/2022
CLIENT: SVM Lockwood LLC	**HAMMER TYPE:** Auto **HAMMER DROP(IN.):** 30"	**GEOLOGIST:** JN
PROJECT: Multi Family Residential	**HAMMER WEIGHTS:** 140 lbs.	**ELEVATION:** ±80'
LOCATION: Oxnard		**DRILLING CO.:** 2R Drilling

	N	U	B	M	DD	DESCRIPTION	COMMENTS
0						Alluvium (Qal): @0' - Light gray brown silty fine SAND with scattered gravel and cobbles throughout, dry, poorly graded, rodent burrows.	
2.5	1,1,2		S			@2.5' - Light grayish yellow brown silty very fine SAND (SM) with CLAY, poorly graded, moist, very loose, micaceous.	
5	3,5,6	C		18.2	99.6	@5' - Light grayish brown very silty very fine SAND (SM), poorly graded, moist, loose.	
7.5	3,3,4		S			@7.5' - Mottled light gray and orange very fine silty very fine SAND (SM), poorly graded, moist, loose, micaceous, weathered.	
10	3,5,7	C				@10' - Same as @7.5', weathered and few organics (wood), loose, moist over coarse gravel and fine to coarse SAND (SP).	
15	5,9,12		S			@15' - Light grayish brown fine SAND (SP) with trace fine subrounded gravel, poorly graded, medium dense, moist.	
20	18,30,35	C		5.9	105.1	@20' - Light grayish brown fine to coarse SAND (SP-SW), moderately graded, dense, moist.	
25	9,8,3		S			@25' - Light gray fine to coarse SAND (SW) with trace some fine subrounded gravel over (bottom 2") dark brown to dark gray CLAY (CL), medium dense, moist, plastic. @28' - Auger grinding, driller stopped lifting rig. Light gray fine to coarse gravelly SAND (GC). Large cobble on bottom of sample.	@28' very gravelly Auger grinding
30							
35						TD 28' No Groundwater No Caving	
40							

ADDITIONAL COMMENTS:

C = Modified California Sample
S = Standard Penetration Test

N = Field Blowcount
U = Undisturbed Sample
B = Disturbed Sample
X = Disturbed Bulk Sample
M = Moisture %
DD = Dry Density (pcf)

WO: 9511.006	RIG TYPE: H S A	%Eff.: 81.5%	DATE: 9/1/2022
CLIENT: SVM Lockwood LLC	HAMMER TYPE: Auto	HAMMER DROP(IN.): 30"	GEOLOGIST: JN
PROJECT: Multi Family Residential	HAMMER WEIGHTS:	140 lbs.	ELEVATION: ±79'
LOCATION: Oxnard			DRILLING CO.: 2R Drilling

	N	U	B	M	DD	DESCRIPTION	COMMENTS
0						Alluvium (Qal): @0' - Light gray brown silty fine SAND (SM), dry gravel scattered throughout, sparse grass.	
2.5	3,5,6	C		10.1	99.9	@2.5' - Light brown very silty fine SAND (SM), poorly graded, moist, loose.	
5	4,4,3	C				@5' - Same as @2.5', moist, very loose, over light brown fine to medium SAND (SP).	
7.5	2,3,5		S			@7.5' - Light gray and orange very silty very fine SAND (SM) with CLAY(CC), moist, loose, weathered, root casts, orange and gray laminations.	
10	4,9,23	C		27.7	85.7	@10' - Gray and orange fine sandy CLAY (CL) over light gray and orange fine SAND (SP), poorly graded, medium dense, moist, weathered.	
15	8,14,17		S			@15' - Light gray to white fine to coarse SAND (SP-SW), moderately graded, medium dense, moist.	
20	28,50-6	C		3.4	108.9	@20' - Light grayish light brown fine to medium SAND (SP-SW), moderately graded, very dense, moist.	
25	7,10,12		S			@25' - Light grayish light brown fine to medium to fine SAND (SP), poorly graded, medium dense, moist.	
30	2,4,33	C		22.0	105.5	@30' - Gray silty fine to medium SAND (SM) with CLAY over light gray to white well-graded fine to coarse SAND (SW), medium dense, moist, organics (wood).	@30' upper rings gray soft CLAY (CL) very moist.
35						TD 30' No Groundwater No Caving	
40							

ADDITIONAL COMMENTS:

C = Modified California Sample
S = Standard Penetration Test

N = Field Blowcount
U = Undisturbed Sample
B = Disturbed Sample
X = Disturbed Bulk Sample
M = Moisture %
DD = Dry Density (pcf)

APPENDIX B
Laboratory Results

September 20, 2022
W.O. 9511

LABORATORY TESTING

Undisturbed and bulk samples of soil and rock materials encountered at the site were collected during the course of our fieldwork. Selected laboratory tests completed on the retrieved samples are described below. A comprehensive summary of laboratory test results is provided in Plate LS.

MOISTURE-DENSITY

The field moisture content and dry unit weight were determined for each undisturbed sample. Dry unit weight is expressed in pounds per cubic foot and the moisture content represents a percentage of the dry unit weight. This test data is presented in the Laboratory Test Summary table in this appendix.

COMPACTION TESTS

To determine the compaction characteristics of the onsite materials, compaction tests are performed in accordance with ASTM D1557. The maximum dry density is reported in pounds per cubic foot and the optimum moisture content as a percentage of the maximum dry density. The results of these tests are provided in the Laboratory Test Summary table in this appendix.

SHEAR TEST

Drained Direct shear tests were performed in a Direct Shear Machine of the strain control type. The rate of deformation is approximately 0.01 inches per minute. Shearing occurred under a variety of confining loads to determine the Coulomb shear strength parameters. The test was performed on undisturbed and remolded (@ 90% relative compaction) samples in an artificially saturated condition. The test results are presented graphically in this appendix.

CONSOLIDATION TEST

Settlement predictions of the soil's behavior under load are made on the basis of consolidation tests. A one-inch high sample is loaded in a geometric progression and the resulting deformation is recorded at selected time intervals. Porous stones are placed in contact with the sample (top and bottom) to permit addition and release of pore fluid. The sample is inundated at a selected load during the progression. Results are plotted on the enclosed Consolidation-Pressure Curves in this appendix.

PARTICLE SIZE ANALYSIS

The distribution of various particle sizes in selected representative samples was determined using mechanical sieves in general accordance with ASTM D6913. The particle distribution is presented as the relative percentages of sand, silt and clay particles in each sample tested. The results are presented on the Laboratory Summary in this appendix.

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX

The Liquid Limit, Plasticity Limit, and Plasticity Index for selected cohesive soil samples were determined in the laboratory. The Standard Test Method (ASTM D4318) was utilized. These parameters are used in the classification of cohesive soils.

A cohesive plastic soil may go through four consistency states as the moisture content of the soil is increased. These states are the solid state, the semisolid state, the plastic state, and the liquid state. The limits between these consistency states are the Shrinkage limit, Plastic limit, and the Liquid Limit (respectively). These limits are often referred to as the Atterberg limits. The Plasticity Index is defined as the numeric value of the Liquid limit minus the numeric value of the Plastic limit. The results are presented graphically in this appendix.

CORROSIVITY

The laboratory test for resistivity is performed in order to determine the relative quantity of soluble salts present in a specific soil. It is most often used as a method to determine the likelihood of corrosion potential for steel pipe, pile, or reinforced concrete structures. The resistivity test is also a means for determining the necessity of further chemical analysis of the soil or water for pH, sulfate and chloride-ion content.

A representative sample of the earth materials encountered at the site was delivered to Project X Corrosion Engineering where it was tested for resistivity. The test method utilized is in conformity with the procedures outlined in ASTM G187. Resistivity of soils is inversely proportional to corrosiveness. Thus, the analysis helps in determining whether the soils may have a deleterious affect on underground metallic structures. A generally accepted correlation between resistivity and soil corrosiveness toward metals is provided discussed in the Corrosivity section of this report.

Selected samples were submitted to Project X Corrosion Engineering for soluble sulfate and Chloride analysis in accordance with ASTM D4327. Please refer to the table below for results. When soluble sulfate test results exceed 0.10 percent by weight, special considerations for concrete design are appropriate per ACI 318. The results are discussed in the body of this report.

The pH of selected samples was tested in accordance with ASTM G51. The results indicate the samples ranged from slightly basic.

Laboratory Test Summary

Depth	Geology	Sample Description	ST	w	DD	S	Max	Opt	EI	LL	PI	% Gravel	% Sand	%Fines	W.O. 9511.006
Excavation: B01 (TD= 50 ft, GW @ 41 ft)															
0	Alluvium	Silty SAND (SM)	(B)				119.0	10.5							
2.5	Alluvium	Silty v.f. SAND (SM)	(U)	29.5	97.6	100									
5	Alluvium	Silty v.f. SAND (SM)	(U)	27.1	92.1	89									
7.5	Alluvium	Silty v.f. SAND (SM)	(U)	25.9	94.7	91									
10	Alluvium	Lean CLAY (CL)	(U)	16.3	104.3	72									
20	Alluvium	SAND (SP-SW) w/ gravel	(U)	3.5	111.7	19									
40	Alluvium	Coarse SAND (SP)	(U)	12.4	111.9	67									
47.5	Alluvium	v. f. Sandy CLAY (CL)	(S)							27	9		36	64	
Excavation: B02 (TD= 25 ft, No GW)															
2.5	Alluvium	Silty f. SAND (SM) w/ Clay	(U)	26.4	84.1	72									
7.5	Alluvium	f. Sandy CLAY (CL)	(U)	27.1	89.3	83									
15	Alluvium	Gravelly f-c SAND (SW)	(U)	2.7	117.2	17									
Excavation: B03 (TD= 30 ft, No GW)															
2.5	Alluvium	Silty f. SAND (SM)	(U)	18.8	95.9	68									
7.5	Alluvium	f. Sandy CLAY (CL)	(U)	30.7	91	98									
15	Alluvium	f-m SAND (SP)	(U)	3.7	106.1	17									
25	Alluvium	f. Sandy CLAY (CL)	(U)	25	91.3	81									
Excavation: B04 (TD= 28 ft, No GW)															
5	Alluvium	Silty v.f. SAND (SM) w/ Clay	(U)	18.2	99.6	72									
20	Alluvium	f-c SAND (SP-SW)	(U)	5.9	105.1	27									
25	Alluvium	f-c SAND (SW)	(S)							NP	NP	20	72	9	
Excavation: B05 (TD= 30 ft, No GW)															
2.5	Alluvium	Silty v.f. SAND (SM)	(U)	10.1	99.9	40									
5	Alluvium	silty v.f. SAND (SM)	(U)	7.5	102.7	32									
10	Alluvium	f Sandy CLAY (CL)	(U)	27.7	85.7	78									
20	Alluvium	f-m SAND (SP)	(U)	3.4	108.9	17									
30	Alluvium	Silty f. SAND (SM) w/ Clay	(U)	22	105.5	100									

For abbreviation explanation see Legend on PLATE LS 2

Depth	Geology	Sample Description	ST	w	DD	S	Max	Opt	EI	LL	PI	% Gravel	% Sand	%Fines	W.O. 9511.006

LEGEND

Depth = Sample Depth (ft) below ground surface
ST = Sample Type*
w = Initial Moisture Content (%)
DD = Initial Dry Unit Weight (pcf)
Max = Maximum Dry Unit Weight (pcf)
Opt = Optimum Moisture Content (%)
EI = Expansion Index
S = Degree of Saturation (%)

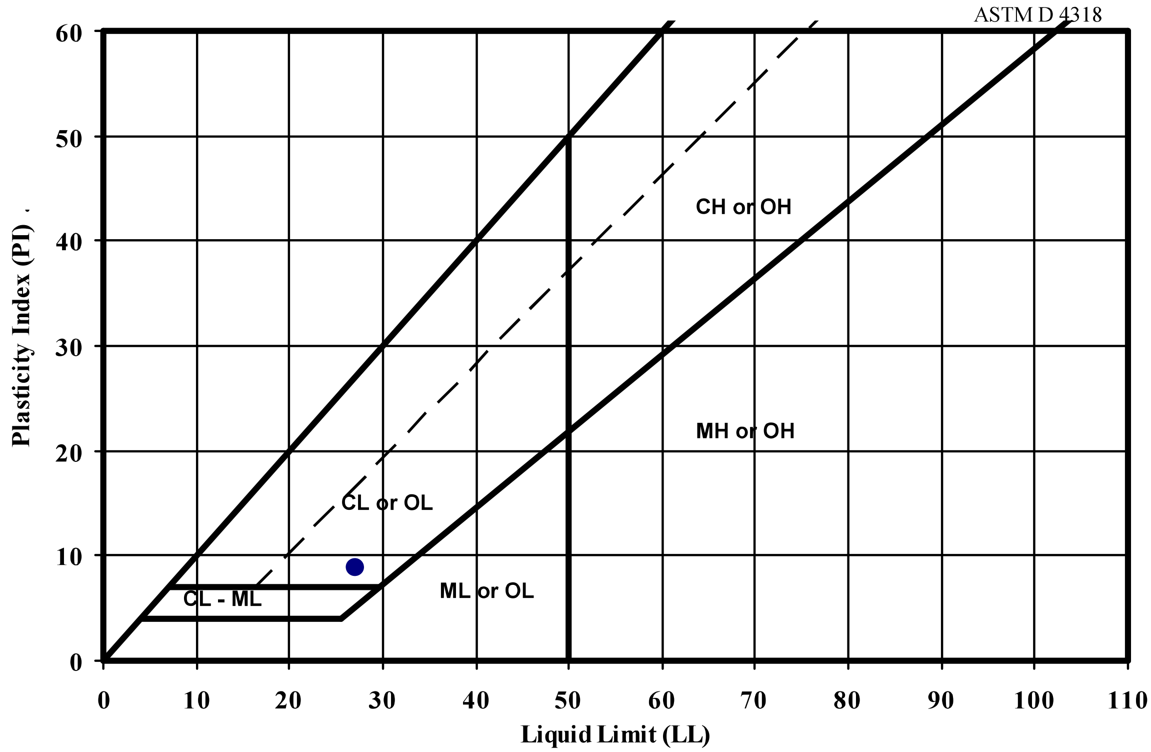
LL = Liquid Limit
PI = Plasticity Index
e = Void Ratio
n = Porosity (%)
WD = Initial Wet Unit Weight (pcf)
SD = Saturated Unit Weight (pcf)
BD = Bouyant (Submerged) Unit Weight (pcf) - Assuming water unit weight of 62.4 pcf

Consol = Consolidation Test Diagram (Plate No.)
Shear = Shear Test Diagram (Plate No.)

* Sample Types: (U) = relatively Undisturbed; (S) = SPT; (B) = Bulk; (N) = Nuclear; (SC) = Sand Cone

ATTERBERG LIMITS

PLASTICITY CHART

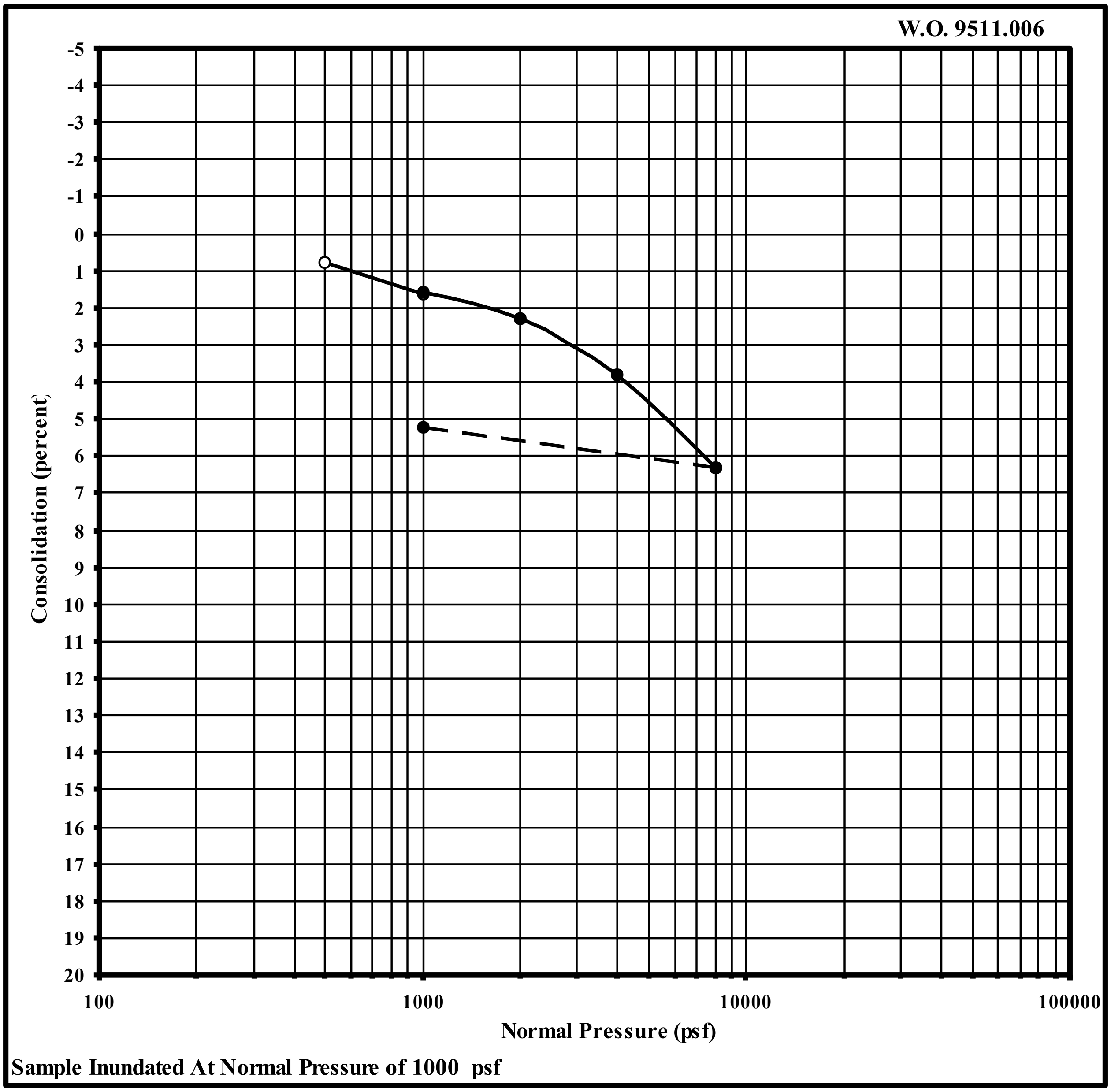


Excavation	Depth (ft)	Geology	Soil Description	LL	PI	% Clay (0.002mm)	Fines Class	w	w/LL
B01	47.5	Qal	v. f. Sandy CLAY (CL)	27	9		CL		
B04	25	Qal	f-c SAND (SW)	NP	NP				

LL = Liquid Limit, PI = Plasticity Index, NP = Non-Plastic , w = Field Moisture

CONSOLIDATION RESULTS

Undisturbed Sample



Sample Location: B01

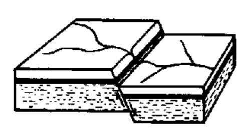
Sample Depth: 5 ft.

Initial Moisture: 27.1 %

Init. Dry Density: 92.1 pcf

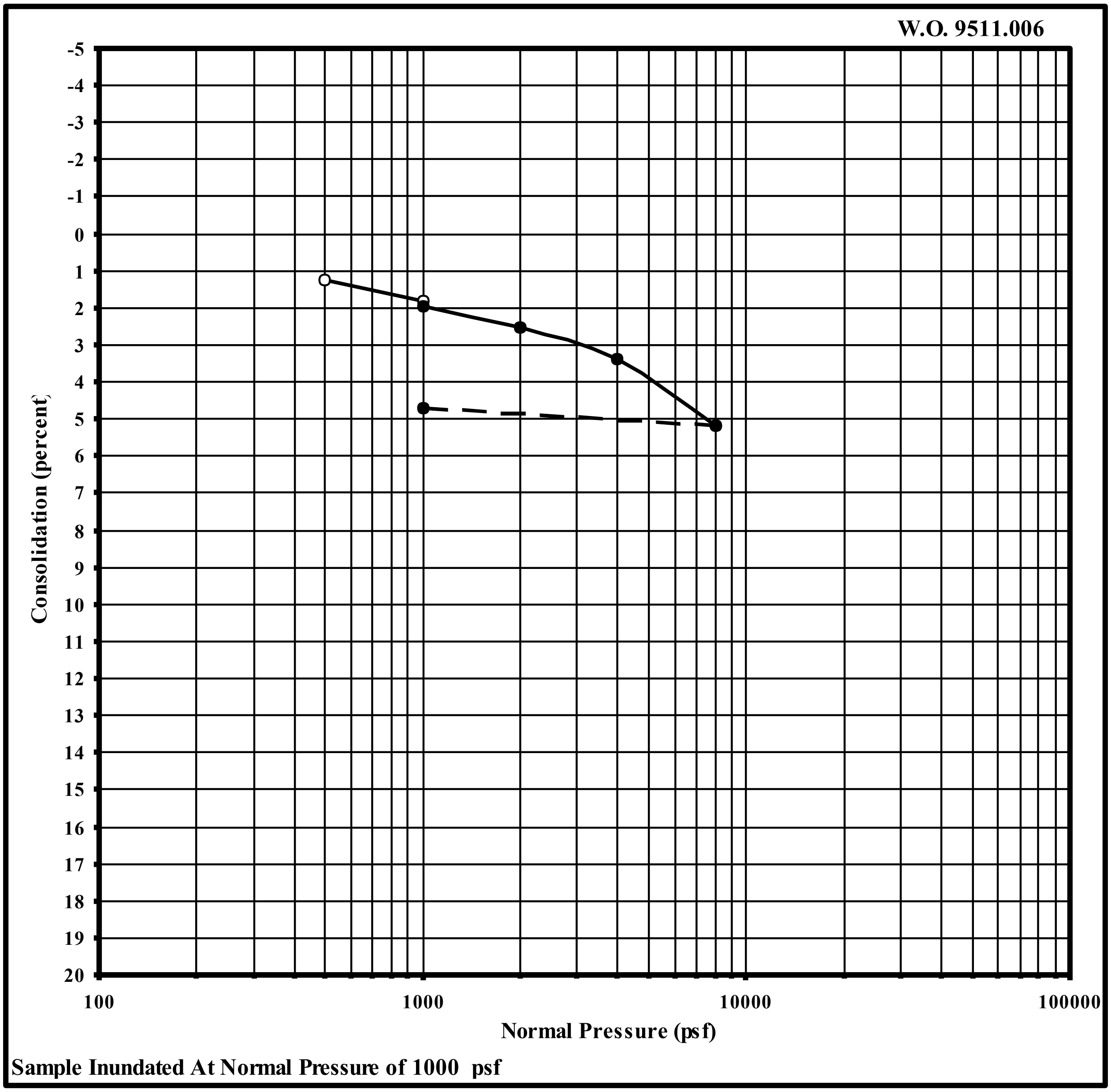
Geologic Unit: Alluvium

Material: Silty v.f. SAND (SM)



CONSOLIDATION RESULTS

Undisturbed Sample



Sample Location: B01

Sample Depth: 10 ft.

Initial Moisture: 16.3 %

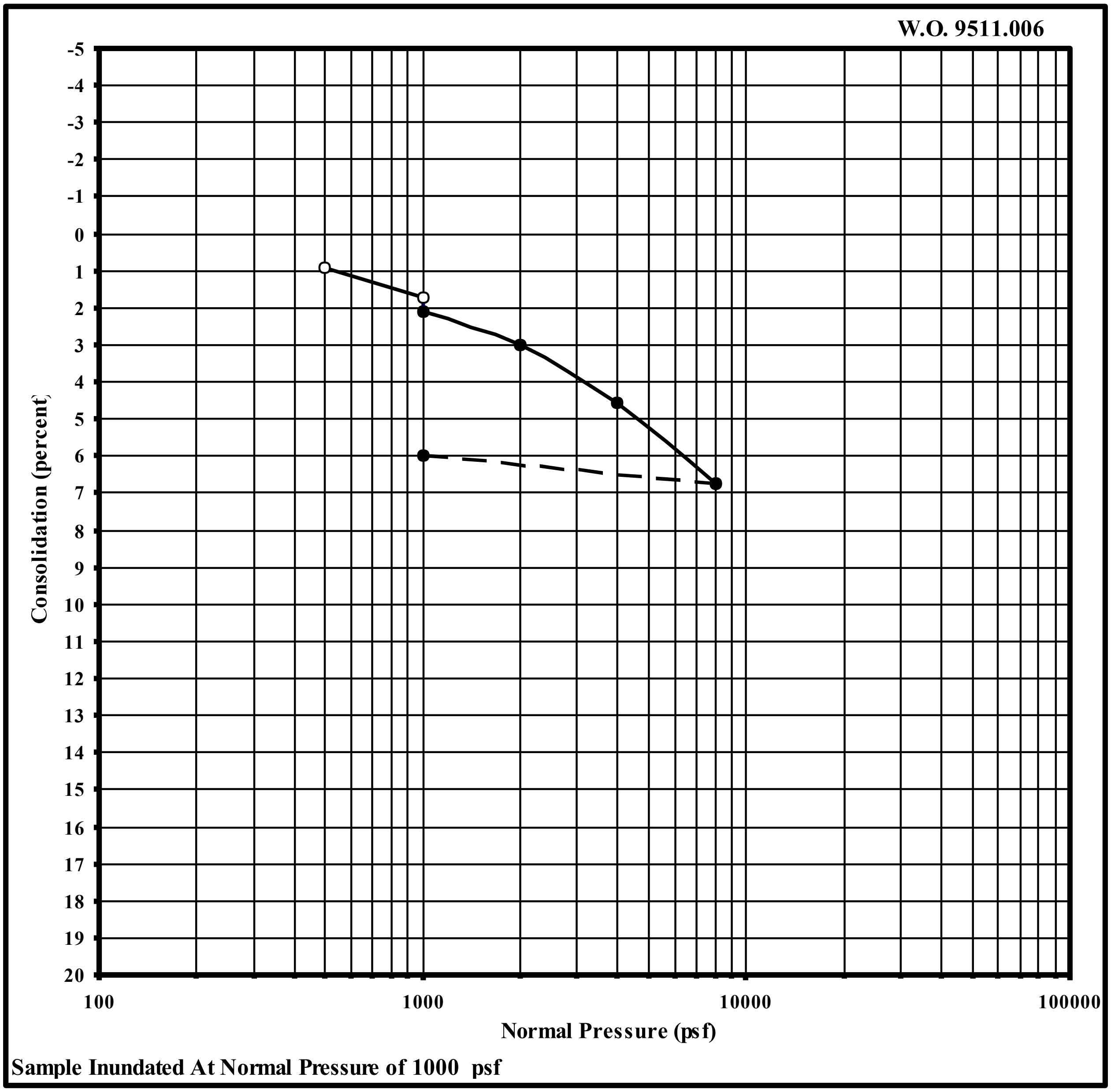
Init. Dry Density: 104.3 pcf

Geologic Unit: Alluvium

Material: Lean CLAY (CL)

CONSOLIDATION RESULTS

Undisturbed Sample



Sample Location: B04

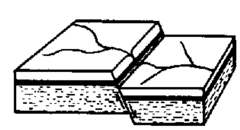
Sample Depth: 5 ft.

Initial Moisture: 18.2 %

Init. Dry Density: 99.6 pcf

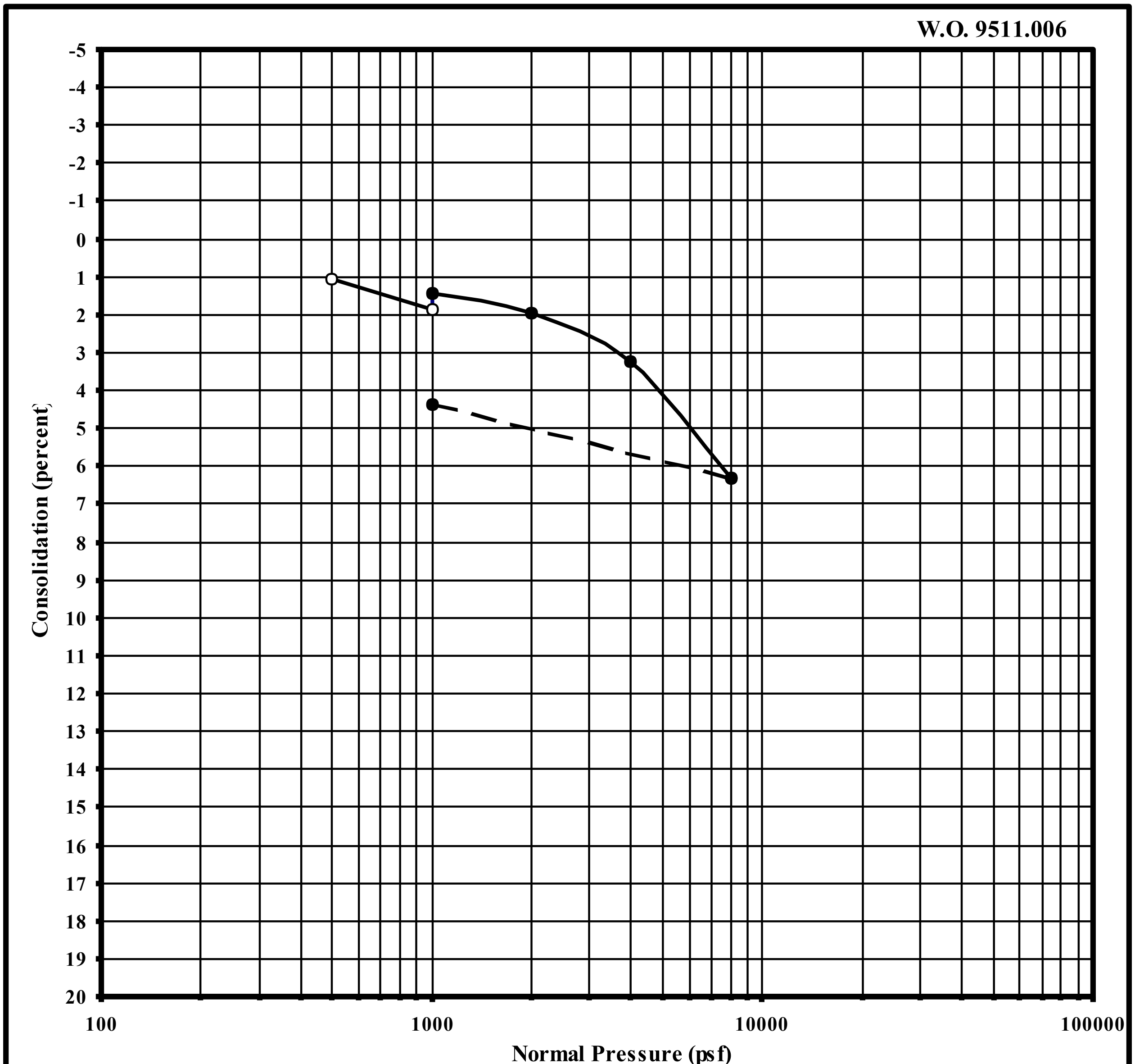
Geologic Unit: Alluvium

Material: Silty v.f. SAND (SM) w/ Clay



CONSOLIDATION RESULTS

Undisturbed Sample



Sample Inundated At Normal Pressure of 1000 psf

Sample Location: B05

Sample Depth: 10 ft.

Initial Moisture: 27.7 %

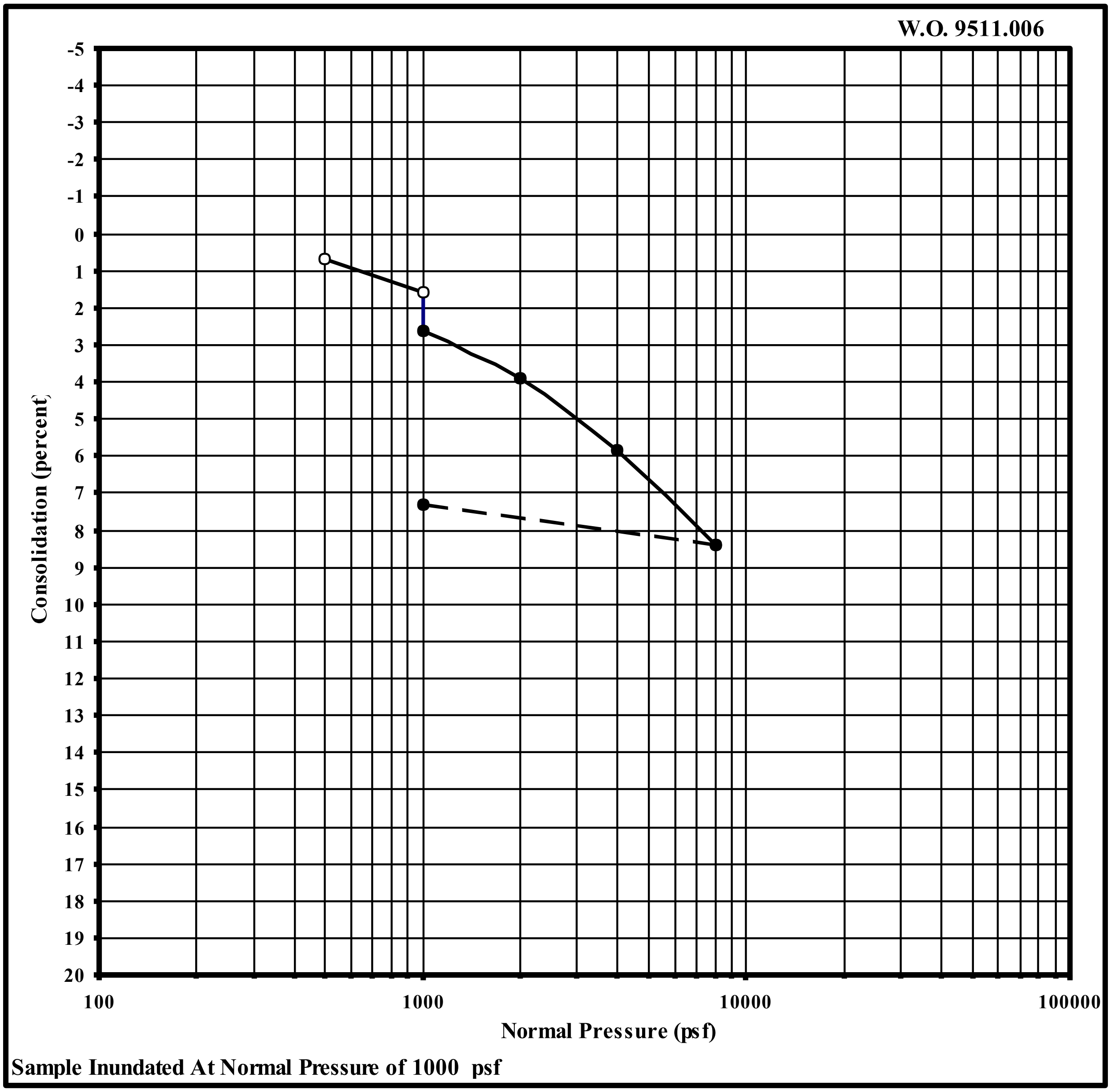
Init. Dry Density: 85.7 pcf

Geologic Unit: Alluvium

Material: f Sandy CLAY (CL)

CONSOLIDATION RESULTS

Undisturbed Sample



Sample Location: B05

Sample Depth: 5 ft.

Initial Moisture: 7.5 %

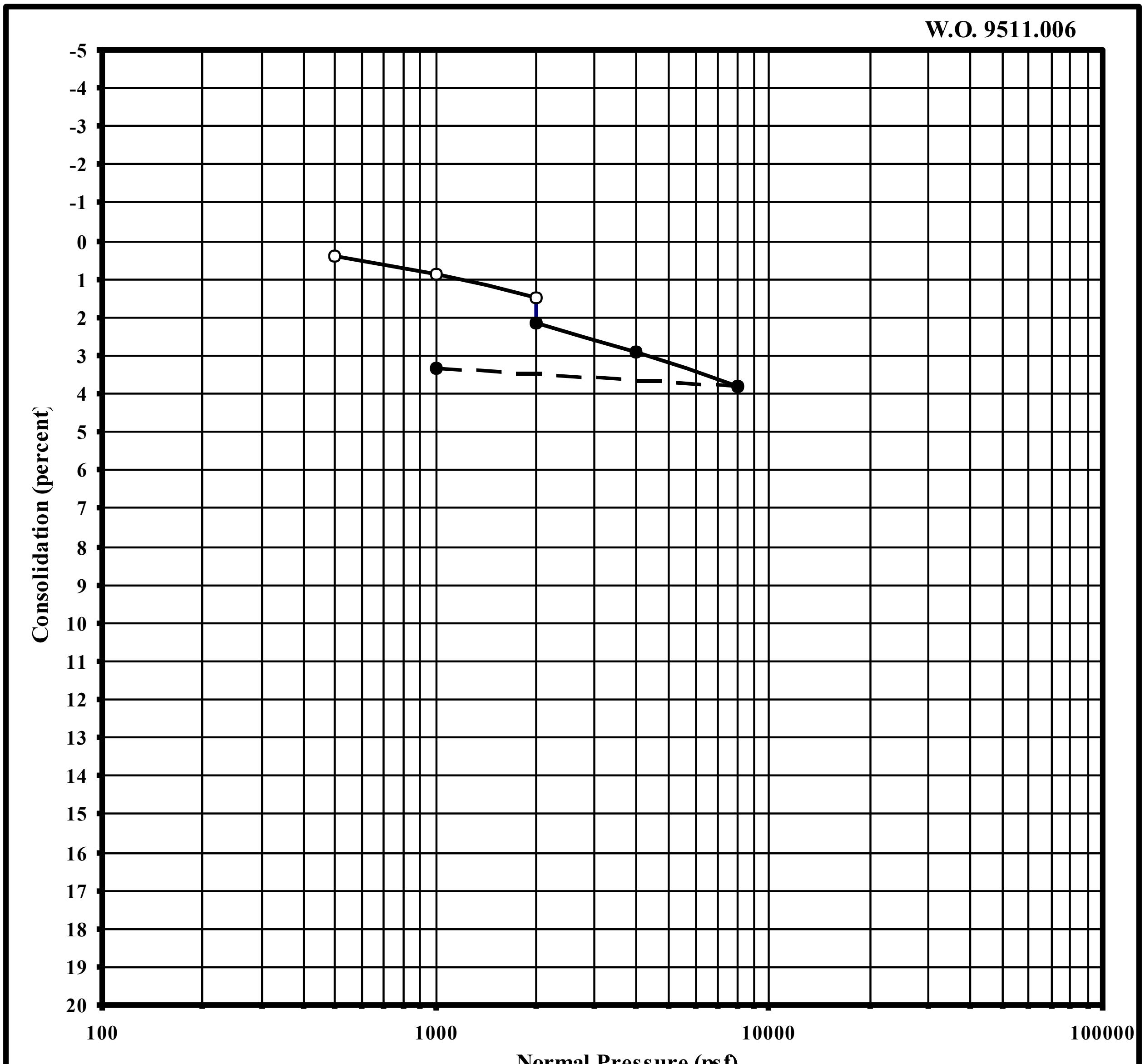
Init. Dry Density: 102.7 pcf

Geologic Unit: Alluvium

Material: silty v.f. SAND (SM)

CONSOLIDATION RESULTS

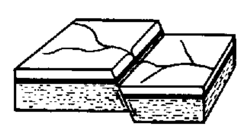
Undisturbed Sample



Sample Inundated At Normal Pressure of 2000 psf

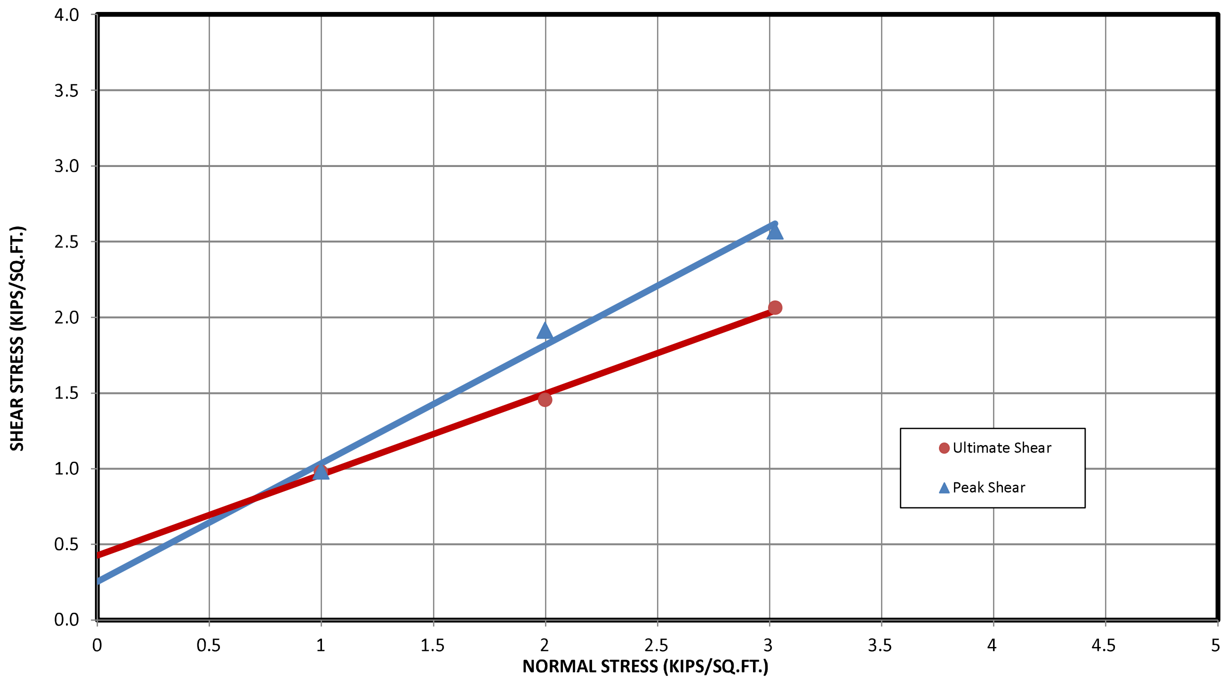
Sample Location: B05
Sample Depth: 20 ft.
Initial Moisture: 3.4 %
Init. Dry Density: 108.9 pcf

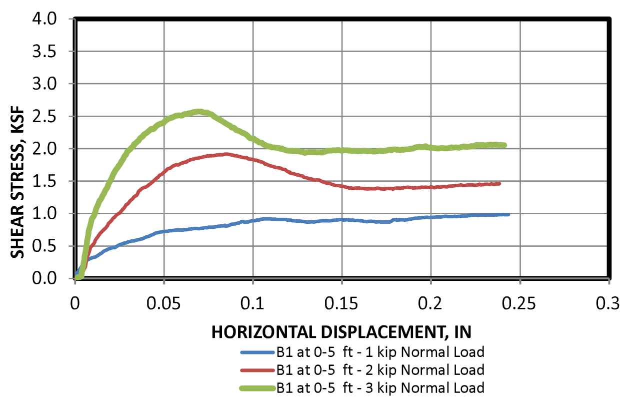
Geologic Unit: Alluvium
Material: f-m SAND (SP)



DIRECT SHEAR TEST RESULTS

Remolded 90% Relative Compaction





PROJECT:	LockWood 3
W.O:	9511
EXCAVATION:	B1
DEPTH:	0-5 ft

TEST DATA:	#1	#2	#3
NORM. PRES. (KSF)	1.0	2.0	3.0
ULTIMATE			
SHEAR STRESS (KSF):	0.98	1.46	2.06
H.DISPL. (IN)	0.24	0.24	0.24
DISP. RATE (IN/MIN)	0.01	0.01	0.01
PEAK			
SHEAR STRESS (KSF):	0.98	1.39	2.57
H.DISPL. (IN)	0.24	0.16	0.07

	ULTIMATE		PEAK
COHESION (KSF):	0.425		0.250
PHI (DEG):	28		38

PRESHEAR DRY DENSITY (PCF):	111.1	111.9	111.9
PRESHEAR MOISTURE (% OF DD):		20.0	
EST.VOID RATIO, e (preshear):	0.50	0.49	0.49

TEST FILES:

S:\GEOTEST\shears\9511.006\TEST563.DAT
S:\GEOTEST\shears\9511.006\TEST564.DAT
S:\GEOTEST\shears\9511.006\TEST565.DAT

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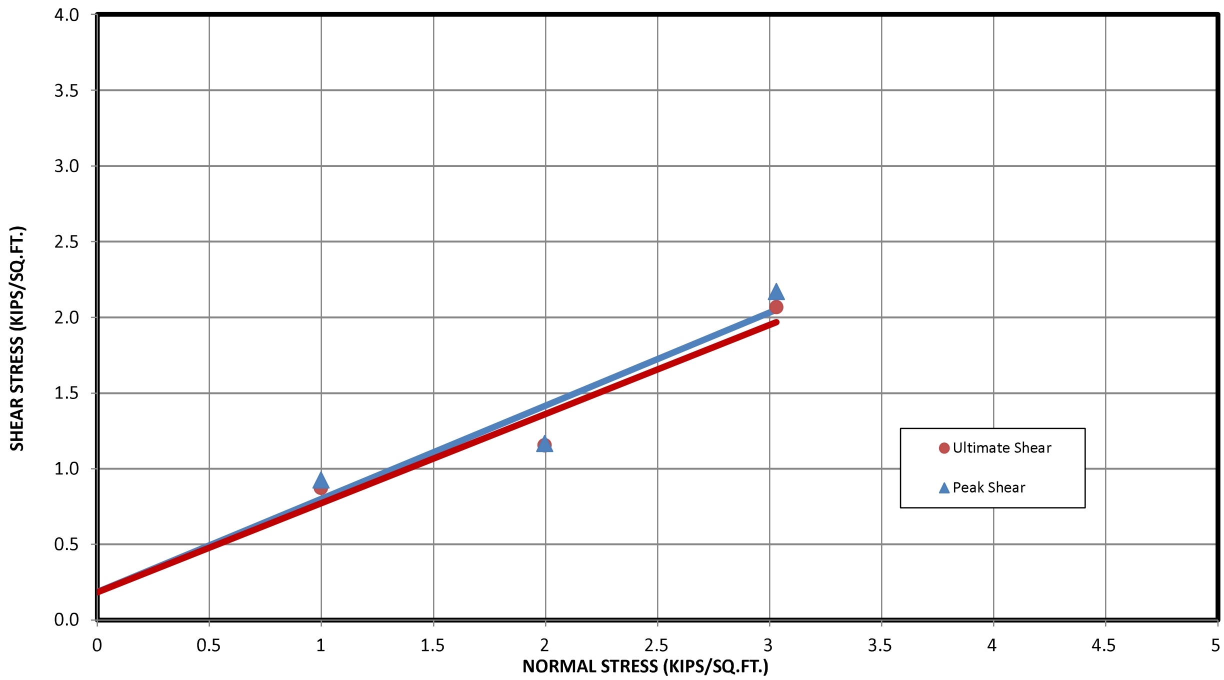
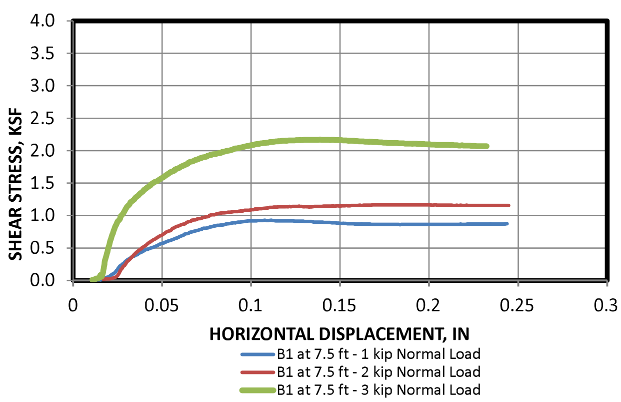
Corporation

DIRECT SHEAR TEST RESULTS

Undisturbed Sample





PROJECT:	LockWood 3
W.O:	9511
EXCAVATION:	B1
DEPTH:	7.5 ft

	ULTIMATE		PEAK
COHESION (KSF):	0.175		0.200
PHI (DEG):	30		32

TEST DATA:	#1	#2	#3
NORM. PRES. (KSF)	1.0	2.0	3.0
ULTIMATE			
SHEAR STRESS (KSF):	0.87	1.16	2.07
H.DISPL. (IN)	0.24	0.25	0.23
DISP. RATE (IN/MIN)	0.01	0.01	0.01
PEAK			
SHEAR STRESS (KSF):	0.92	1.16	2.17
H.DISPL. (IN)	0.11	0.25	0.13

PRESHEAR DRY DENSITY (PCF):	96.3	98.0	98.2
PRESHEAR MOISTURE (% OF DD):		31.4	
EST.VOID RATIO, e (preshear):	0.74	0.71	0.70

TEST FILES:

S:\GEOTEST\shears\9511.006\TEST556.DAT
S:\GEOTEST\shears\9511.006\TEST558.DAT
S:\GEOTEST\shears\9511.006\TEST559.DAT

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Soil Analysis Lab Results

Client: Geolabs-Westlake Village
Job Name: SVM Lockwood
Client Job Number: 9511.006
Project X Job Number: S220908D
September 12, 2022

	Method	ASTM D4327		ASTM D4327		ASTM G187		ASTM G51	ASTM G200	SM 4500-D	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D4327	ASTM D4327
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-		**Resistivity** As Rec'd	Minimum	**pH**	**Redox**	**Sulfide** S^{2-}	**Nitrate** NO_3^-	**Ammonium** NH_4^+	**Lithium** Li^+	**Sodium** Na^+	**Potassium** K^+	**Magnesium** Mg^{2+}	**Calcium** Ca^{2+}	**Fluoride** F_2^-	**Phosphate** PO_4^{3-}
	(ft)	(mg/kg)	(wt%)	(mg/kg)	(wt%)	(Ohm-cm)	(Ohm-cm)		(mV)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
B1	0-5	58.3	0.0058	22.0	0.0022	63,650	9,380	8.1	112	0.66	5.8	0.2	0.36	46.0	15.2	45.0	97.4	7.9	19.7

Cations and Anions, except Sulfide and Bicarbonate, tested with Ion Chromatography
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
ND = 0 = Not Detected | NT = Not Tested | Unk = Unknown
Chemical Analysis performed on 1:3 Soil-To-Water extract
PPM = mg/kg (soil) = mg/L (Liquid)

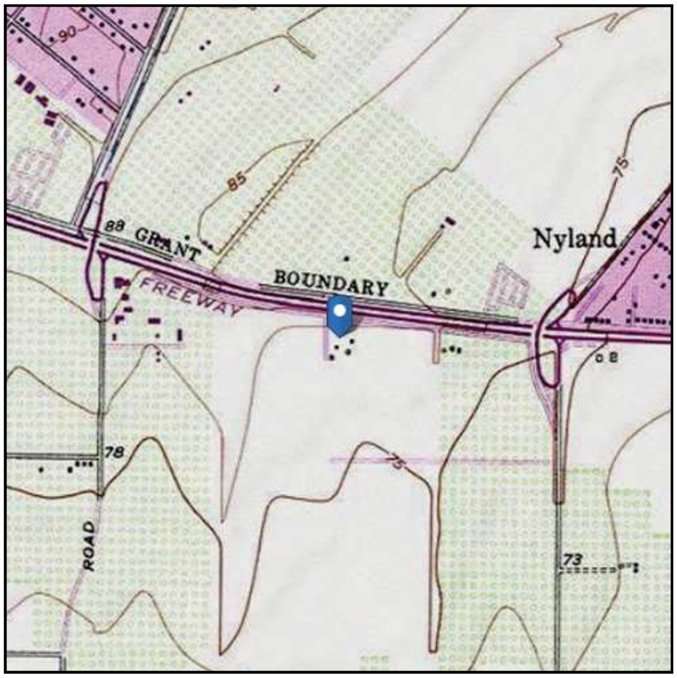
<u>APPENDIX C</u>
Seismicity Analysis

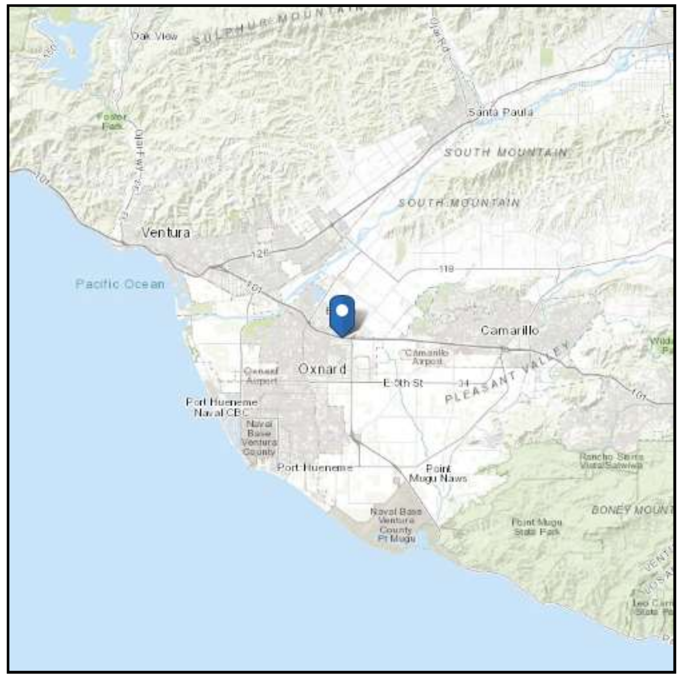
September 20, 2022
W.O. 9511

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

ASCE 7 Hazards Report

Address:		**Standard:**	ASCE/SEI 7-16	**Elevation:**	0 ft (NAVD 88)
No Address at This Location		**Risk Category:**	II	**Latitude:**	34.2224
		Soil Class:	D - Stiff Soil	**Longitude:**	-119.1497





AMERICAN SOCIETY OF CIVIL ENGINEERS

Seismic

Site Soil Class: D - Stiff Soil

Results:

S_S :	1.801	S_{D1} :	N/A
S_1 :	0.669	T_L :	8
F_a :	1	PGA :	0.791
F_v :	N/A	PGA_M :	0.87
S_{MS} :	1.801	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1
S_{DS} :	1.201	C_v :	1.46

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Tue Sep 20 2022

Date Source: USGS Seismic Design Maps

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided "as is" and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

ASCE does not intend, nor should anyone interpret, the results provided by this Tool to replace the sound judgment of a competent professional, having knowledge and experience in the appropriate field(s) of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the contents of this Tool or the ASCE 7 standard.

In using this Tool, you expressly assume all risks associated with your use. Under no circumstances shall ASCE or its officers, directors, employees, members, affiliates, or agents be liable to you or any other person for any direct, indirect, special, incidental, or consequential damages arising from or related to your use of, or reliance on, the Tool or any information obtained therein. To the fullest extent permitted by law, you agree to release and hold harmless ASCE from any and all liability of any nature arising out of or resulting from any use of data provided by the ASCE 7 Hazard Tool.

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…

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

34.22118179

Time Horizon

Return period in years

2475

Longitude

Decimal degrees, negative values for western longitudes

-119.15013042

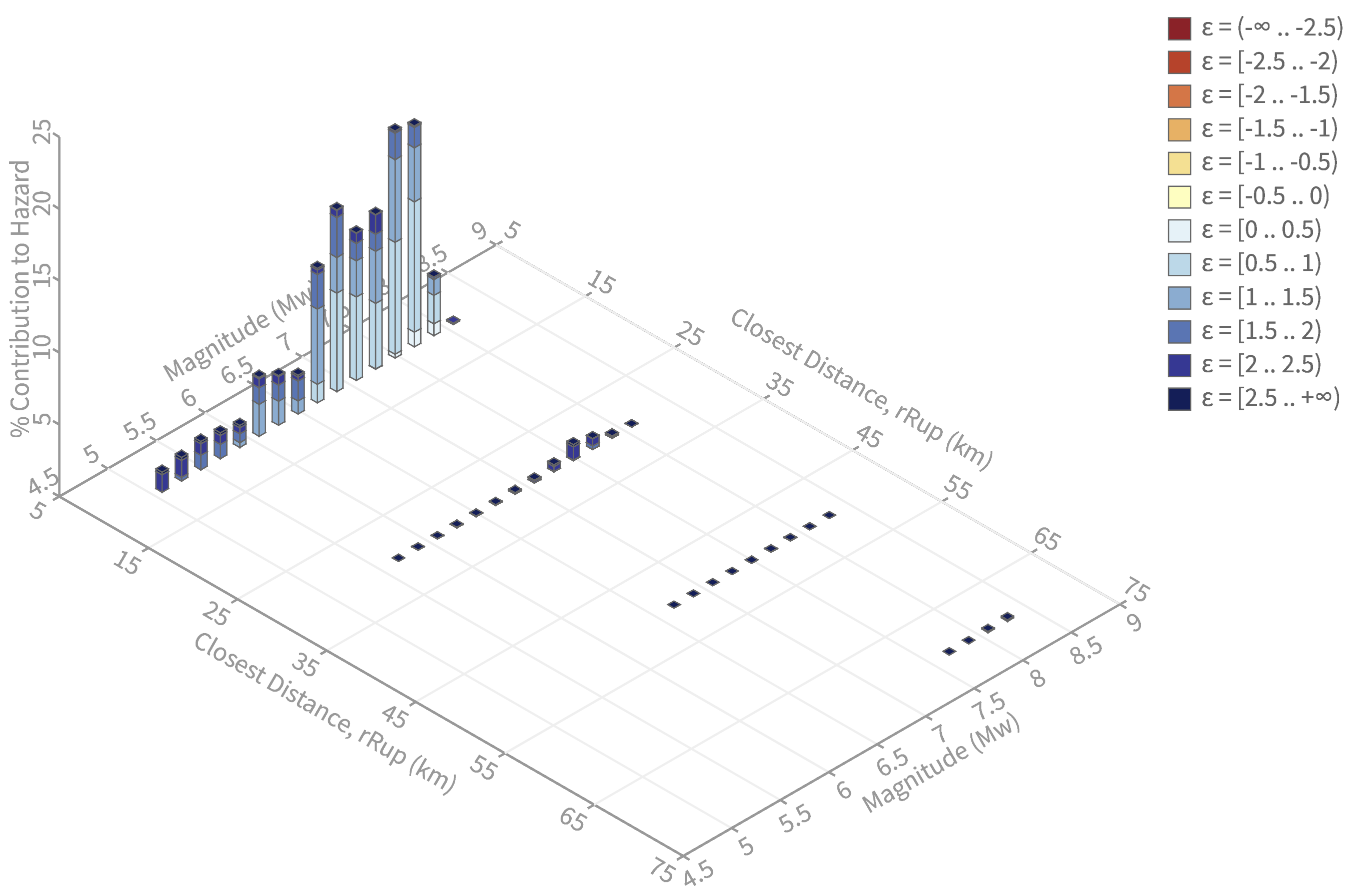
Site Class

259 m/s (Site class D)

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.80484094 g

Recovered targets

Return period: 2879.8776 yrs
Exceedance rate: 0.00034723698 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.07 %

Mean (over all sources)

m: 7.05
r: 8.67 km
ε_0: 1.26 σ

Mode (largest m-r bin)

m: 7.53
r: 7.93 km
ε_0: 1.03 σ
Contribution: 15.77 %

Mode (largest m-r-ε_0 bin)

m: 7.69
r: 6.92 km
ε_0: 0.72 σ
Contribution: 9.06 %

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_FM32	System							42.72
Simi-Santa Rosa [6]		4.93	6.97	1.00	119.102°W	34.222°N	88.27	11.79
Oak Ridge (Onshore) [0]		5.48	7.34	0.83	119.156°W	34.263°N	353.29	11.60
Ventura-Pitas Point [2]		8.92	7.44	1.30	119.186°W	34.292°N	337.15	4.47
Oak Ridge (Onshore) [1]		8.33	7.55	1.01	119.113°W	34.285°N	25.65	4.26
Oak Ridge (Offshore) [5]		11.44	6.89	1.67	119.273°W	34.240°N	280.60	3.86
Malibu Coast (Extension) alt 2 [3]		16.74	7.55	1.50	119.168°W	34.070°N	185.58	1.17
UC33brAvg_FM31	System							42.00
Simi-Santa Rosa [6]		4.93	7.00	0.98	119.102°W	34.222°N	88.27	12.78
Oak Ridge (Onshore) [0]		5.48	7.42	0.79	119.156°W	34.263°N	353.29	11.81
Ventura-Pitas Point [2]		8.92	7.34	1.36	119.186°W	34.292°N	337.15	5.52
Oak Ridge (Onshore) [1]		8.33	7.64	0.94	119.113°W	34.285°N	25.65	4.06
Channel Islands Thrust [0]		17.10	6.89	1.75	119.265°W	34.044°N	208.24	1.72
Red Mountain [0]		19.93	7.28	2.17	119.304°W	34.347°N	314.83	1.16
UC33brAvg_FM31 (opt)	Grid							7.67
PointSourceFinite: -119.150, 34.271		7.19	5.79	1.69	119.150°W	34.271°N	0.00	2.12
PointSourceFinite: -119.150, 34.271		7.19	5.79	1.69	119.150°W	34.271°N	0.00	2.12
PointSourceFinite: -119.150, 34.307		9.80	5.89	1.99	119.150°W	34.307°N	0.00	1.12
PointSourceFinite: -119.150, 34.307		9.80	5.89	1.99	119.150°W	34.307°N	0.00	1.12
UC33brAvg_FM32 (opt)	Grid							7.61
PointSourceFinite: -119.150, 34.271		7.19	5.79	1.69	119.150°W	34.271°N	0.00	2.13
PointSourceFinite: -119.150, 34.271		7.19	5.79	1.69	119.150°W	34.271°N	0.00	2.13
PointSourceFinite: -119.150, 34.307		9.79	5.89	1.99	119.150°W	34.307°N	0.00	1.13
PointSourceFinite: -119.150, 34.307		9.79	5.89	1.99	119.150°W	34.307°N	0.00	1.13

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…

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

34.22118179

Time Horizon

Return period in years

475

Longitude

Decimal degrees, negative values for western longitudes

-119.15013042

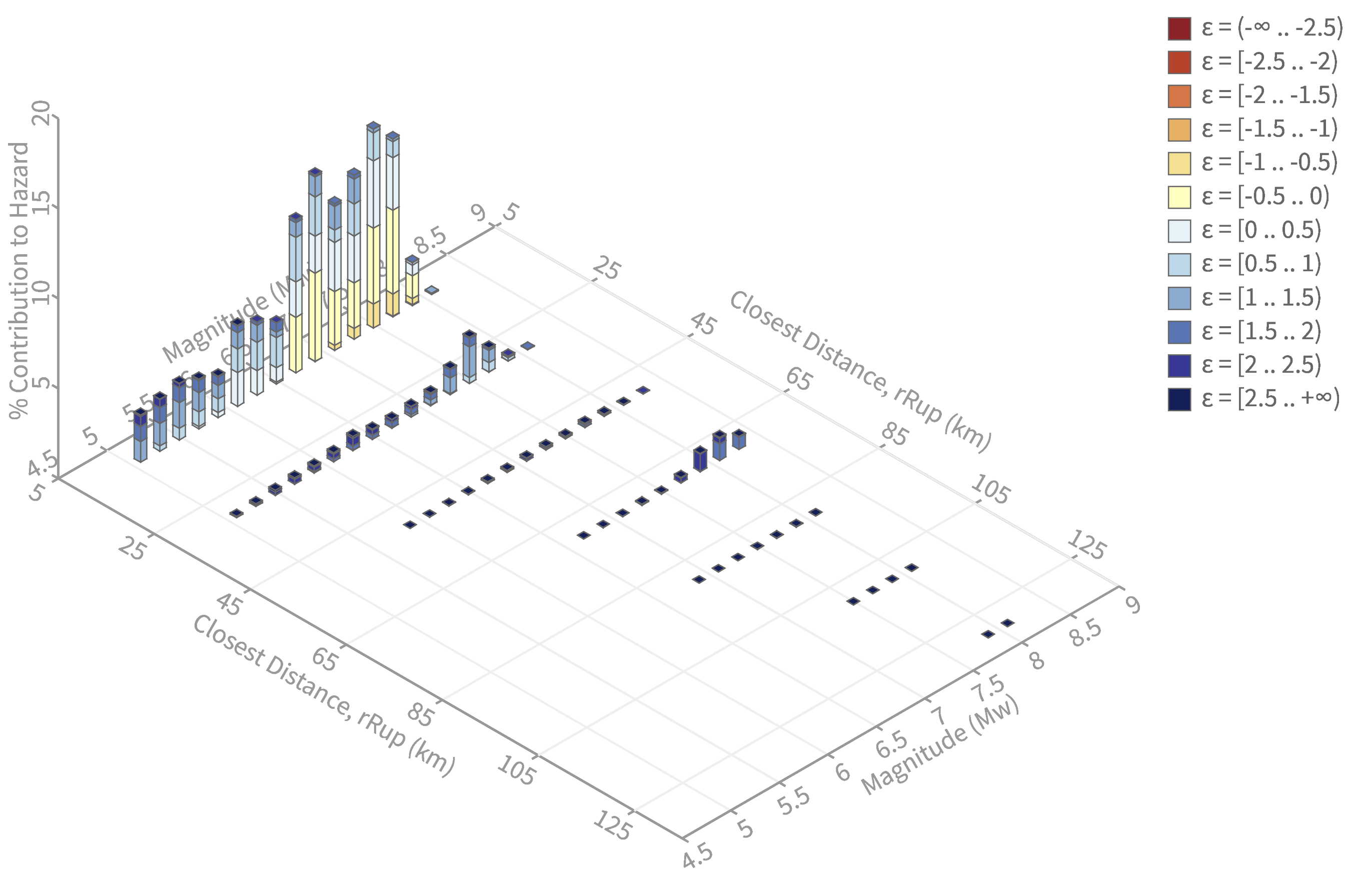
Site Class

259 m/s (Site class D)

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 475 yrs
Exceedance rate: 0.0021052632 yr^{-1}
PGA ground motion: 0.44688366 g

Recovered targets

Return period: 507.38426 yrs
Exceedance rate: 0.0019708928 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.15 %

Mean (over all sources)

m: 6.89
r: 13.79 km
ε_0: 0.63 σ

Mode (largest m-r bin)

m: 7.53
r: 8.74 km
ε_0: 0.03 σ
Contribution: 11.05 %

Mode (largest m-r-ε_0 bin)

m: 6.87
r: 5.26 km
ε_0: -0.22 σ
Contribution: 4.9 %

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_FM32	System							39.15
Simi-Santa Rosa [6]		4.93	6.93	-0.07	119.102°W	34.222°N	88.27	7.80
Oak Ridge (Onshore) [0]		5.48	7.32	-0.26	119.156°W	34.263°N	353.29	6.72
Oak Ridge (Offshore) [5]		11.44	6.86	0.63	119.273°W	34.240°N	280.60	4.52
Ventura-Pitas Point [2]		8.92	7.40	0.26	119.186°W	34.292°N	337.15	3.82
Oak Ridge (Onshore) [1]		8.33	7.53	-0.02	119.113°W	34.285°N	25.65	2.88
Red Mountain [0]		19.93	7.11	1.26	119.304°W	34.347°N	314.83	2.16
San Andreas (Big Bend) [5]		68.46	8.07	2.00	119.015°W	34.827°N	10.41	1.35
Malibu Coast (Extension) alt 2 [3]		16.74	7.50	0.49	119.168°W	34.070°N	185.58	1.19
Mission Ridge-Arroyo Parida-Santa Ana [16]		24.29	7.49	1.14	119.230°W	34.441°N	343.29	1.01
UC33brAvg_FM31	System							36.79
Simi-Santa Rosa [6]		4.93	6.95	-0.08	119.102°W	34.222°N	88.27	8.37
Oak Ridge (Onshore) [0]		5.48	7.39	-0.31	119.156°W	34.263°N	353.29	6.64
Ventura-Pitas Point [2]		8.92	7.24	0.34	119.186°W	34.292°N	337.15	5.02
Oak Ridge (Onshore) [1]		8.33	7.63	-0.10	119.113°W	34.285°N	25.65	2.59
Red Mountain [0]		19.93	7.20	1.18	119.304°W	34.347°N	314.83	2.34
Channel Islands Thrust [0]		17.10	6.85	0.73	119.265°W	34.044°N	208.24	2.18
San Andreas (Big Bend) [5]		68.46	8.07	2.00	119.015°W	34.827°N	10.41	1.35
Malibu Coast (Extension) alt 1 [5]		16.75	7.27	0.64	119.162°W	34.067°N	183.54	1.08
UC33brAvg_FM31 (opt)	Grid							12.11
PointSourceFinite: -119.150, 34.271		7.34	5.70	0.83	119.150°W	34.271°N	0.00	2.24
PointSourceFinite: -119.150, 34.271		7.34	5.70	0.83	119.150°W	34.271°N	0.00	2.24
PointSourceFinite: -119.150, 34.307		10.15	5.77	1.18	119.150°W	34.307°N	0.00	1.69
PointSourceFinite: -119.150, 34.307		10.15	5.77	1.18	119.150°W	34.307°N	0.00	1.69
UC33brAvg_FM32 (opt)	Grid							11.95
PointSourceFinite: -119.150, 34.271		7.34	5.70	0.83	119.150°W	34.271°N	0.00	2.25
PointSourceFinite: -119.150, 34.271		7.34	5.70	0.83	119.150°W	34.271°N	0.00	2.25
PointSourceFinite: -119.150, 34.307		10.15	5.77	1.17	119.150°W	34.307°N	0.00	1.69
PointSourceFinite: -119.150, 34.307		10.15	5.77	1.17	119.150°W	34.307°N	0.00	1.69

<u>APPENDIX D</u>
Liquefaction Analysis

September 20, 2022
W.O. 9511

Evaluation of Liquefaction Resistance of Soils
Using SPT Data

Boring: B01
G.W. Depth: 41 ft.
Design G.W. Depth: 10 ft.

Max horizontal acc. @ surface: 0.87 g
Design earthquake magnitude: 6.89
Design Surcharge Pressure: ---- tsf

Layer	Layer Top (ft)	Sample Midpt. (ft)	Layer Bott. (ft)	Soil Density (pcf)	Field Spt N (bpf)	Spt N160 (bpf)	Spt N160cs (bpf)	Fines Fract. (%)	O.B. (tsf)	Eff. O.B. (tsf)	Design Eff. O.B. (tsf)	O.B. Corr. Cn	rd	Liq. CRR (M=7.5)	CSR (M=7.5)	Liq. F.S.	Cf	Ce	Cb	Cr	Cs	MSF	Csamp
1	**0.0**	3.5	**4.8**	113.4	5.0	8.1	**11.0**	15	0.199	0.199	0.199	1.583	0.992	**---**	**---**	**No GW**	2.89	1.35	1	0.75	1.00	1.24	1.98
2	**4.8**	6	**7.3**	117.1	6.8	9.9	**12.9**	15	0.343	0.343	0.343	1.440	0.986	**---**	**---**	**No GW**	2.97	1.35	1	0.75	1.00	1.24	1.92
3	**7.3**	8.5	**9.8**	119.2	5.7	7.6	**10.4**	15	0.490	0.490	0.490	1.318	0.980	**---**	**---**	**No GW**	2.86	1.35	1	0.75	1.00	1.24	1.94
4	**9.8**	11	**13.5**	127.8	20.0	24.6	**34.5**	50	0.641	0.641	0.613	1.213	0.974	**infinite**	**0.466**	**Cohesive**	9.91	1.35	1	0.75	1.00	1.24	1.45
5	**13.5**	16	**18.5**	132.6	38.0	55.0	**56.5**	9	0.937	0.937	0.783	1.049	0.963	**infinite**	**0.543**	**infinite**	1.49	1.35	1	0.83	1.24	1.24	1.00
6	**18.5**	21	**23.5**	132.4	47.3	53.7	**55.2**	9	1.227	1.227	0.958	0.926	0.951	**infinite**	**0.588**	**infinite**	1.47	1.35	1	0.91	1.00	1.24	1.86
7	**23.5**	26	**28.5**	132.6	45.0	62.1	**63.7**	9	1.528	1.528	1.134	0.826	0.939	**infinite**	**0.616**	**infinite**	1.61	1.35	1	0.97	1.28	1.24	1.00
8	**28.5**	31	**33.5**	132.6	53.8	53.9	**55.3**	9	1.843	1.843	1.309	0.742	0.922	**infinite**	**0.630**	**infinite**	1.47	1.35	1	1.00	1.00	1.24	1.86
9	**33.5**	36	**38.5**	132.6	39.0	44.0	**45.3**	9	2.158	2.158	1.485	0.673	0.881	**infinite**	**0.620**	**infinite**	1.31	1.35	1	1.00	1.24	1.24	1.00
10	**38.5**	41	**43.5**	132.5	53.8	44.7	**46.0**	9	2.481	2.481	1.660	0.615	0.840	**infinite**	**0.605**	**infinite**	1.32	1.35	1	1.00	1.00	1.24	1.86
11	**43.5**	46	**47.3**	132.6	35.0	33.8	**35.0**	9	2.804	2.648	1.835	0.589	0.800	**infinite**	**0.587**	**infinite**	1.13	1.35	1	1.00	1.22	1.24	1.00
12	**47.3**	48.5	**49.8**	132.6	12.0	10.1	**17.1**	64	2.965	2.731	1.923	0.576	0.779	**0.192**	**0.576**	**Cohesive**	7.02	1.35	1	1.00	1.08	1.24	1.00
13	**49.8**	51	**51.5**	132.6	14.0	11.6	**19.0**	64	3.127	2.815	2.011	0.565	0.759	**0.213**	**0.565**	**Cohesive**	7.33	1.35	1	1.00	1.09	1.24	1.00

Where:

N1(60): Normalized SPT blow count — N1(60) = N*Cn*Ce*Cb*Cr*Cs / Csamp
Cn: Overburden Correction Factor
Cf: Fines Correction Factor — N1(60)cs = N1(60)+Cf (equivalent "Clean Sand" N value)
Ce: Energy Ratio Correction Factor — (For 81 % Hammer Efficiency)
Cb: Borehole Diameter Correction Factor
Cr: Rod Length Correction Factor
Cs: Sampler Liner Correction Factor
MSF: Magnitude Scaling Factor — (For 6.89 Mag. Earthquake using Revised Idriss Scaling Factor)
Csamp: California Sampler Correction — (To create equivalent SPT N value)

Seismic Compression Analyses
Using SPT Data
(Dry Sands)

Boring: B01

Design G.W. Depth: 10 ft.

Max horizontal acc. @ surface: 0.87 g

Design earthquake magnitude: 6.9

Magnitude Scaling Factor: 0.88

Total Seismic (Dry) Settlement: 0.03 in (0 in after Removal)

Layer	Layer Top (ft)	Sample Midpt. (ft)	Layer Bott. (ft)	Layer Thick. (ft)	Soil Density (psf)	Field Spt N (bpf)	Spt N160 (bpf)	Spt N160cs (bpf)	Design Eff. O.B. (tsf)	Cyclic Shear Stress τ_{av} (psf)	Gmax (ksf)	γ_{eff} x (Geff/Gmax)	γ_{eff}	Vol. Strain (%)	Settlement (in)	Notes
1	**0.0**	**3.5**	**4.8**	4.8	113.4	5.0	8.1	**11.0**	0.199	223	7.21E+02	3.09E-04	-6.2E-03	0.00	**0.00**	No GW
2	**4.8**	**6.0**	**7.3**	2.5	117.1	6.8	9.9	**12.9**	0.343	382	9.94E+02	3.85E-04	-2.6E-02	0.00	**0.00**	No GW
3	**7.3**	**8.5**	**9.8**	2.5	119.2	5.7	7.6	**10.4**	0.490	544	1.12E+03	4.87E-04	1.7E-02	0.00	**0.00**	No GW
4	**9.8**	**11.0**	**13.5**	0.3	127.8	15.4	18.9	**27.7**	0.613	710	1.66E+03	4.28E-04	7.4E-03	0.88	**0.03**	No GW
5	**13.5**	**16.0**	**18.5**	0.0	132.6	38.0	55.0	**56.5**	0.783	0	0.00E+00	0.00E+00	0.0E+00	0.00	**0.00**	GW
6	**18.5**	**21.0**	**23.5**	0.0	132.4	47.3	53.7	**55.2**	0.958	0	0.00E+00	0.00E+00	0.0E+00	0.00	**0.00**	GW
7	**23.5**	**26.0**	**28.5**	0.0	132.6	45.0	62.1	**63.7**	1.134	0	0.00E+00	0.00E+00	0.0E+00	0.00	**0.00**	GW
8	**28.5**	**31.0**	**33.5**	0.0	132.6	53.8	53.9	**55.3**	1.309	0	0.00E+00	0.00E+00	0.0E+00	0.00	**0.00**	GW
9	**33.5**	**36.0**	**38.5**	0.0	132.6	39.0	44.0	**45.3**	1.485	0	0.00E+00	0.00E+00	0.0E+00	0.00	**0.00**	GW
10	**38.5**	**41.0**	**43.5**	0.0	132.5	53.8	44.7	**46.0**	1.660	0	0.00E+00	0.00E+00	0.0E+00	0.00	**0.00**	GW
11	**43.5**	**46.0**	**47.3**	0.0	132.6	35.0	33.8	**35.0**	1.835	0	0.00E+00	0.00E+00	0.0E+00	0.00	**0.00**	GW
12	**47.3**	**48.5**	**49.8**	0.0	132.6	12.0	10.1	**17.1**	1.923	0	0.00E+00	0.00E+00	0.0E+00	0.00	**0.00**	Cohesive
13	**49.8**	**51.0**	**51.5**	0.0	132.6	14.0	11.6	**19.0**	2.011	0	0.00E+00	0.00E+00	0.0E+00	0.00	**0.00**	Cohesive

Liquefaction-Induced Settlement Analyses
Using SPT Data
(Saturated Sands)

Boring: B01

Design G.W. Depth: 10 ft.

Magnitude Scaling Factor: 1.24

Total Liquefaction-Induced (saturated) Settlement: 0 in | 0.65 in

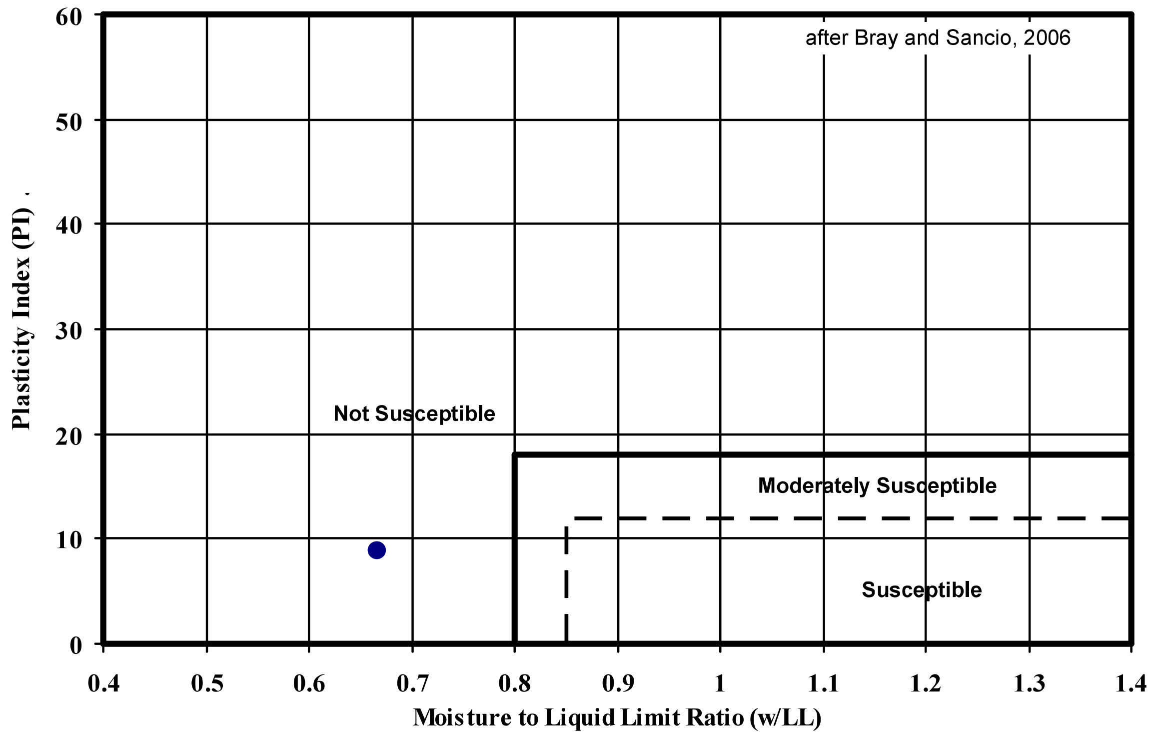
Layer	Layer Top (ft)	Sample Midpt. (ft)	Layer Bott. (ft)	Layer Thick. (ft)	Soil Density (psf)	Field Spt N (bpf)	Spt N160 (bpf)	Spt* N160cs (bpf)	Spt** N160liq (bpf)	CSR (M)	Sampler Type	Liq. F.S.	Sat* strain (%)	Sat** strain (%)	Just Trig Settlement* (in)	Liquefied Settlement** (in)
1	**0.0**	**3.5**	**4.8**	0.0	113.4	5.0	8.1	**11.0**	**8.2**	**---**	C	No GW	0.00	0.00	**0.00**	**0.00**
2	**4.8**	**6.0**	**7.3**	0.0	117.1	6.8	9.9	**12.9**	**11.1**	**---**	C	No GW	0.00	0.00	**0.00**	**0.00**
3	**7.3**	**8.5**	**9.8**	0.0	119.2	5.7	7.6	**10.4**	**8.8**	**---**	C	No GW	0.00	0.00	**0.00**	**0.00**
4	**9.8**	**11.0**	**13.5**	3.5	127.8	15.4	18.9	**27.7**	**20.1**	**0.579**	C	0.79	0.00	1.55	**0.00**	**0.65**
5	**13.5**	**16.0**	**18.5**	5.0	132.6	38.0	55.0	**56.5**	**56.5**	**0.675**	S	infinite	0.00	0.00	**0.00**	**0.00**
6	**18.5**	**21.0**	**23.5**	5.0	132.4	47.3	53.7	**55.2**	**54.5**	**0.730**	C	infinite	0.00	0.00	**0.00**	**0.00**
7	**23.5**	**26.0**	**28.5**	5.0	132.6	45.0	62.1	**63.7**	**62.8**	**0.765**	S	infinite	0.00	0.00	**0.00**	**0.00**
8	**28.5**	**31.0**	**33.5**	5.0	132.6	53.8	53.9	**55.3**	**54.6**	**0.782**	C	infinite	0.00	0.00	**0.00**	**0.00**
9	**33.5**	**36.0**	**38.5**	5.0	132.6	39.0	44.0	**45.3**	**44.8**	**0.770**	S	infinite	0.00	0.00	**0.00**	**0.00**
10	**38.5**	**41.0**	**43.5**	5.0	132.5	53.8	44.7	**46.0**	**45.4**	**0.752**	C	infinite	0.00	0.00	**0.00**	**0.00**
11	**43.5**	**46.0**	**47.3**	3.8	132.6	35.0	33.8	**35.0**	**34.6**	**0.729**	S	infinite	0.00	0.00	**0.00**	**0.00**
12	**47.3**	**48.5**	**49.8**	2.5	132.6	12.0	10.1	**17.1**	**10.9**	**0.716**	S	Cohesive	0.00	0.00	**0.00**	**0.00**
13	**49.8**	**51.0**	**51.5**	1.8	132.6	14.0	11.6	**19.0**	**16.3**	**0.702**	S	Cohesive	0.00	0.00	**0.00**	**0.00**

* Liquefaction induced settlement estimated using SPT fines correction for triggering of liquefaction

** Liquefaction induced settlement estimated using SPT fines correction for liquefied soils

LIQUEFACTION SUSCEPTIBILITY OF FINE-GRAINED SOILS

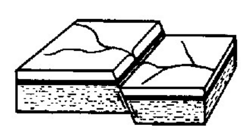
LIQUEFACTION SUSCEPTIBILITY CHART



Excavation	Depth (ft)	Geology	Soil Description	LL	PI	Fines Class	w	w/LL	Est. Liq Catagory*
B01	47.5	Qal	v. f. Sandy CLAY (CL)	27	9	CL	18	0.67	Not Susceptible
B04	25	Qal	f-c SAND (SW)	NP	NP				

LL = Liquid Limit, PI = Plasticity Index, NP = Non-Plastic , w = Field Moisture

* Considers Methodology Proposed by Bray and Sancio (2006) for fine-grained soils:
  - Loose soils with PI < 12 and w/LL > 0.85 are considered susceptible to liquefaction
  - Loose soils with 12 < PI < 18 and w/LL > 0.8 are considered more resistant
  - Soils with PI > 18 at low effective confining stresses are considered not susceptible



<u>APPENDIX E</u>
Typical Details

September 20, 2022
W.O. 9511

RETAINING WALL
BACKDRAIN & BACKFILL

Native or Import soil - USCS Class SM-SC or ML
EI < 20 or SE> 20 **

Upper 1 foot of backfill (level backslope) or backfill in sloping area should contain sufficient fines to provide adequate surficial slope stability and retard water infiltration.

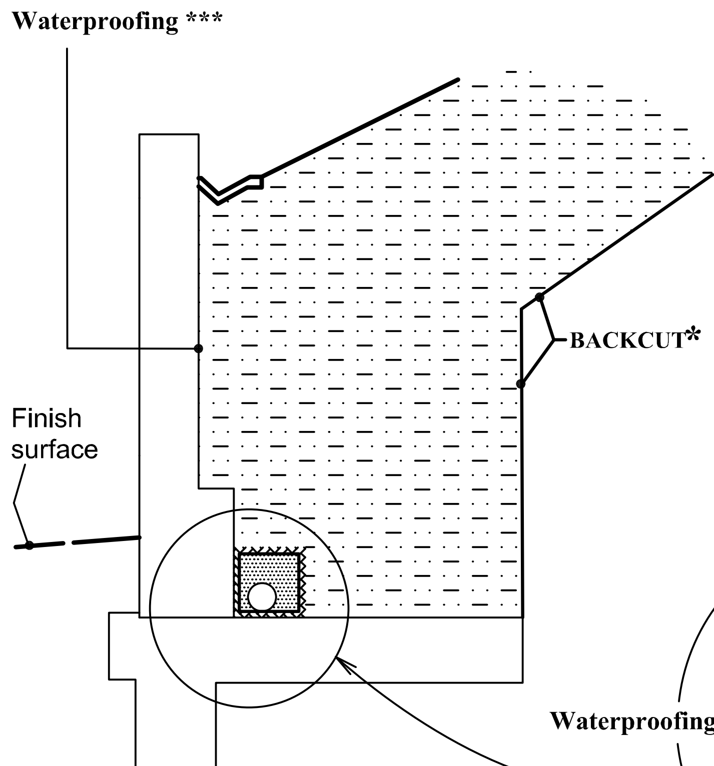
Backfill should be compacted to a minimum of 90% relative compaction.

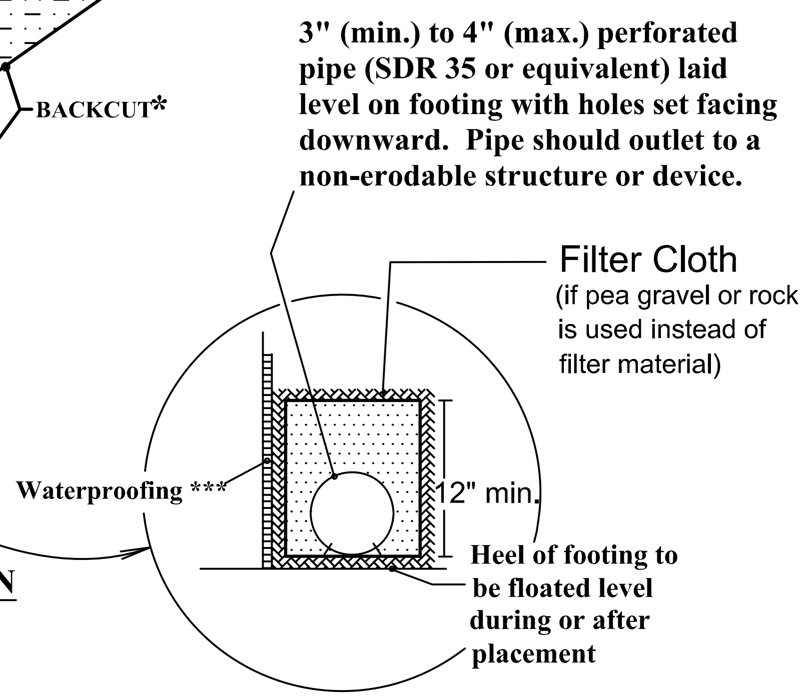
FILTER MATERIAL (see gradation), pea gravel or rock - Geotextile should be used to separate pea gravel or rock from backcut and backfill.

* All backcuts shall be in accordance with OSHA standards.

** EI 21-30 may be used if placed at 2% over optimum

*** Where moisture penetration of wall or wall staining is undesirable.





FILTER MATERIAL GRADATION

Sieve Size	% Passing
1"	100
3/4"	90-100
3/8"	40-100
#4	24-50
#8	15-35
#30	5-15
#50	0-7
#200	0-2

Geolabs – Westlake Village
GEOLOGY AND SOIL ENGINEERING

DATE 9/20/2022 BY
SCALE N.T.S. W.O. 9511

PLATE **RW1**