

Geotechnical Engineering Investigation

Proposed Hotel and Office Building Development
945 N. Pepper Avenue
Colton, California

Executive Development
17777 Center Court Drive, #725
Cerritos, California 90703

Attn.: Mr. Philip Lee

Project Number 23010-21
January 3, 2022

NorCal Engineering

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Executive Development
17777 Center Court Drive, #725
Cerritos, California 90703

Attn.: Mr. Philip Lee

**RE: Geotechnical Engineering Investigation - Proposed Hotel and Office Building
Development - Located at 945 N. Pepper Avenue, in the City of Colton, California**

Dear Mr. Lee

Pursuant to your request, this firm has performed a Geotechnical Engineering Investigation for the above referenced project in accordance with your approval of proposal dated November 29, 2021. The purpose of this investigation is to evaluate the geotechnical conditions of the subject site and to provide recommendations for the proposed hotel and office building development. The scope of work included the following: 1) site reconnaissance; 2) subsurface geotechnical exploration and sampling; 3) laboratory testing; 4) engineering analysis of field and laboratory data; 5) preparation of a geotechnical engineering report.

1.0 Project Description

It is proposed to construct a four-story, multi-unit hotel development for Home 2 Suites by Hilton and a two-story, 30,000 square feet office building on the 5.16-acre parcel as shown on the attached Site Plan. The proposed structures will both be supported by a conventional slab-on-grade foundation system with perimeter-spread footings and isolated interior footings. Other improvements will include concrete and asphalt pavement, swimming pool, recreation court, hardscape and landscaping.

The proposed grading is anticipated to consist of minor cuts and fills to achieve finished grade elevations. Final building plans shall be reviewed by this firm prior to submittal for city approval to determine the need for any additional study and revised recommendations pertinent to the proposed development, if necessary.

2.0 Site Description

The subject property is located within the north 900 block and west side of Pepper Avenue, in the City of Colton. The generally L-shaped parcel is elongated in a north to south direction with topography of the relatively level site descending gradually from the north to south on the order of a few feet. The site is currently an undeveloped lot covered with a low vegetation growth of natural grasses and weeds.

3.0 Site Exploration

The investigation consisted of the placement of eight (8) subsurface exploratory borings by a truck mounted drill rig with eight-inch outside diameter hollow-stem, continuous flight augers to depths ranging between 5 and 20 feet below current ground elevations. The boring explorations were visually classified and logged by a field engineer with locations of the subsurface explorations shown on the attached Site Plan. The exploratory borings revealed the existing earth materials to consist of fill and natural soil. Detailed descriptions of the subsurface conditions are listed on the boring logs in Appendix A. It should be noted that the transition from one soil type to another as shown on the borings logs is approximate and may in fact be a gradual transition. The soils encountered are described as follows:

Fill: A fill soil classifying as a brown, fine to medium grained, silty SAND was encountered across the site to a depth of 1 to 1.5 feet below ground surface. These soils were noted to be loose and moist.

Natural: An undisturbed native alluvium soil classifying as brown to light brown, fine to medium grained, silty to slightly silty SAND was encountered beneath the fill soils. The native soils were observed to be medium dense and damp. Deeper soils consisted of a sandy SILT which were noted to be stiff and moist.

The overall engineering characteristics of the earth material were relatively uniform with each excavation. Groundwater was not encountered to the depth of our borings and slight caving occurred in the deeper cohesionless soils.

4.0 Laboratory Tests

Relatively undisturbed samples of the subsurface soils were obtained to perform laboratory testing and analysis for direct shear, consolidation tests, and to determine in-place moisture/densities. These relatively undisturbed ring samples were obtained by driving a thin-walled steel sampler lined with one-inch long brass rings with an inside diameter of 2.42 inches into the undisturbed soils. The sampler was driven a total of six inches into undisturbed soils. Bulk bag samples were obtained in the upper soils for expansion index tests and maximum density tests. All test results are included in Appendix B, unless otherwise noted.

- 4.1 **Field Moisture Content** (ASTM: D 2216) and the dry density of the ring samples were determined in the laboratory. This data is listed on the logs of explorations.
- 4.2 **Maximum Density tests** (ASTM: D 1557) were performed on typical samples of the upper soils. Results of these tests are shown on Table I.
- 4.3 **Expansion Index tests** (ASTM: D 4829) were performed on remolded samples of the upper soils to determine the expansive characteristics. Results of these tests are provided on Table II.
- 4.5 **Corrosion tests** consisting of sulfate, pH, resistivity and chloride analysis to determine potential corrosive effects of soils on concrete and underground utilities. Test results are provided on Table III.
- 4.6 **R-Value test** per California Test Method 301 was performed on a representative sample, which may be anticipated to be near subgrade to determine pavement design. Results are provided within the pavement design section of the report.

- 4.7 **Direct Shear tests** (ASTM: D 3080) were performed on undisturbed and/or remolded samples of the subsurface soils. The test is performed under saturated conditions at loads of 1,000 lbs./sq.ft., 2,000 lbs./sq.ft., and 3,000 lbs./sq.ft. with results shown on Plate A.
- 4.8 **Consolidation tests** (ASTM: D 2435) were performed on undisturbed samples to determine the differential and total settlement which may be anticipated based upon the proposed loads. Water was added to the samples at a surcharge of one KSF and the settlement curves are plotted on Plates B and C.

5.0 Seismicity Evaluation

The proposed development lies outside of any Alquist Priolo Special Studies Zone and the potential for damage due to direct fault rupture is considered unlikely. The San Jacinto (San Bernardino) Fault is located 2 kilometers from the site and is capable of producing a Magnitude 6.7 earthquake. Ground shaking originating from earthquakes along other active faults in the region is expected to induce lower horizontal accelerations due to smaller anticipated earthquakes and/or greater distances to other faults.

The following seismic design acceleration parameters for the project site are provided below based on the ASCE/SEI 7-22 American Society of Civil Engineers (ASCE) website, <https://asce7hazardtool.online/>. The ASCE/SEI 7-22 report is attached is Appendix C

Seismic Design Acceleration Parameters

Latitude	34.075
Longitude	-117.354
Site Class	D
Risk Category	II
Peak Ground Acceleration	$PGA_M = 0.85$
Adjusted Maximum Acceleration	$S_{MS} = 2.45$ $S_{M1} = 2.38$
Design Spectral Response Acceleration Parameters	$S_{DS} = 1.63$ $S_{D1} = 0.59$
Mapped Spectral Response Acceleration	$S_S = 2.47$ $S_1 = 0.89$

Use of these values is dependent on the latest requirements of the ASCE, 11-4.8, Exception 2 that requires the value of the seismic response coefficient C_s be determined by Equation 12.8.2 for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either 12.8-3 for $T_L \geq T \geq 1.5T_s$ or Equation 12.8-4 for $T > T_L$. Computations and verification of these conditions is referred to the structural engineer.

6.0 Liquefaction Evaluation

The site is expected to experience ground shaking and earthquake activity that is typical of the Southern California area. It is during severe shaking that loose, granular soils below the groundwater table can liquefy. Based on review of the *County of San Bernardino County Land Use Plan – General Plan – Geologic Hazard Overlays (2009)*, the site lies outside a zone of “Suspected Liquefaction Susceptibility”. Thus, the design of the proposed construction in conformance with the latest Building Code provisions for earthquake design is expected to provide mitigation of ground shaking hazards that are typical to Southern California.

7.0 Infiltration Characteristics

Infiltration tests within the site were performed to provide preliminary infiltration rates for the purpose of planning and design of an on-site water disposal system field testing the San Bernardino County Stormwater Program. A truck mounted Simco 2800 Drill Rig equipped with a hollow stem auger was used to excavate the exploratory borings (B-1 and B-2) to depths of 5 and 10 feet below existing ground surface within the proposed infiltration areas.

The borings consisted of six-inch diameter test holes. A three-inch diameter perforated PVC casing with solid end cap was installed in the borings and then surrounded with gravel materials to prevent caving. The infiltration holes were carefully filled with clean water and refilled after two initial readings. Based upon the initial rates of infiltration at each location, test measurements were measured at selected maximum intervals thereafter. Measurements were obtained by using an electronic tape measure with 1/16-inch divisions and timed with a stopwatch. Field data sheets are provided in Appendix D.

Based upon the results of our testing, the soils encountered in the planned on-site drainage disposal system area exhibit the following field infiltration rates calculated using the Porchet Method (aka Inverse Borehole Method). The drainage disposal system shall utilize design infiltration rates based on the safety factor required by the county standard.

Boring/Test No.	Depth	Soil Classification	Field Infiltration Rate
B-1/TH-1	5'	Silty SAND	4.1 in/hr
B-2/TH-2	10'	Silty SAND	5.4 in/hr

No groundwater was encountered to the depth of our borings to a maximum depth of 20 feet below existing ground surface. Based on review of local groundwater maps, the depth of groundwater is in excess of 250 feet (Carson & Matti 1982). A nearby groundwater monitoring well located approximately 0.4 miles to the southeast from the subject site noted a groundwater depth in excess of 150 feet below ground surface.

All systems must meet the latest city and/or county specifications and the California Regional Water Quality Control Board (CRWQCB) requirements. It is recommended that foundations shall be setback a minimum distance of 10 feet from the drainage disposal system and the bottom of footing shall be a minimum of 10 feet from the expected zone of saturation. The boundary of the zone of saturation may be assumed to project downward from the top of the permeable portion of the disposal system at an inclination of 1 to 1 or flatter, as determined by the geotechnical engineer.

8.0 Conclusions and Recommendations

Based upon our evaluations, the proposed development is acceptable from a geotechnical engineering standpoint. By following the recommendations and guidelines set forth in our report, the structures will be safe from excessive settlements under the anticipated design loadings and conditions. The proposed development shall meet all requirements of the City Building Ordinance and will not impose any adverse effect on existing adjacent structures.

The following recommendations are based upon soil conditions encountered in our field investigation; these near-surface soil conditions could vary across the site. Variations in the soil conditions may not become evident until the commencement of grading operations for the proposed development and revised recommendations from the soils engineer may be necessary based upon the conditions encountered.

It is recommended that site inspections are performed by a representative of this firm during all grading and construction of the development to verify the findings and recommendations documented in this report. The following sections present a discussion of geotechnical related requirements for specific design recommendations of different aspects of the project.

8.1 **Site Grading Recommendations**

Any vegetation and/or demolition debris shall be removed and hauled from proposed grading areas prior to the start of grading operations. Existing vegetation shall not be mixed or disced into the soils. Any removed soils may be reutilized as compacted fill once any deleterious material or oversized materials (in excess of eight inches) is removed. Grading operations shall be performed in accordance with the attached *Specifications for Placement of Compacted Fill*.

8.1.1 **Removal and Recompaction Recommendations**

All disturbed soils and/or fill (about 1 to 1.5 feet below ground surface) shall be removed to competent native material, the exposed surface scarified to a depth of 12 inches, brought to within 2% of optimum moisture content and compacted to a minimum of 90% of the laboratory standard (ASTM: D 1557) prior to placement of any additional compacted fill soils, foundations, slabs-on-grade and pavement. Grading shall extend a minimum of five horizontal feet outside the edges of foundations or equidistant to the depth of fill placed, whichever is greater.

It is possible that isolated areas of undiscovered fill not described in this report are present on site; if found, these areas should be treated as discussed earlier. A diligent search shall also be conducted during grading operations in an effort to uncover any underground structures, irrigation or utility lines. If encountered, these structures and lines shall be either removed or properly abandoned prior to the proposed construction.

Any imported fill material should be preferably soil similar to the upper soils encountered at the subject site. All soils shall be approved by this firm prior to importing at the site and will be subjected to additional laboratory testing to assure concurrence with the recommendations stated in this report.

If placement of slabs-on-grade and pavement is not completed immediately upon completion of grading operations, additional testing and grading of the areas may be necessary prior to continuation of construction operations. Likewise, if adverse weather conditions occur which may damage the subgrade soils, additional assessment by the soils engineer as to the suitability of the supporting soils may be needed.

8.1.2 **Fill Blanket Recommendations**

Due to the potential for differential settlement of foundations placed on compacted fill and native materials, it is recommended that all foundations including floor slab areas be underlain by a uniform compacted fill blanket at least two feet in thickness. This fill blanket shall extend a minimum of five horizontal feet outside the edges of foundations or equidistant to the depth of fill placed, whichever is greater.

8.2 **Shrinkage and Subsidence**

Results of our in-place density tests reveal that the soil shrinkage will be on the order of 10 to 15% due to excavation and recompaction, based upon the assumption that the fill is compacted to 92% of the maximum dry density per ASTM standards. Subsidence should be 0.2 feet due to earthwork operations. The volume change does not include any allowance for vegetation or organic stripping, removal of subsurface improvements, or topographic approximations. Although these values are only approximate, they represent our best estimate of lost yardage, which will likely occur during grading. If more accurate shrinkage and subsidence factors are needed, it is recommended that field testing the actual equipment and grading techniques should be conducted.

8.3 Temporary Excavations

Temporary unshored excavations in the existing site materials may be made at vertical inclinations up to 4 feet in height unless cohesionless soils are encountered. In areas where soils with little or no binder are encountered, where adverse geological conditions are exposed, or where excavations are adjacent to existing structures, shoring or flatter excavations may be required. Additional recommendations regarding specific excavations may be provided once typical detail sections are made available.

The temporary cut slope gradients given above do not preclude local raveling and sloughing. All excavations shall be made in accordance with the requirements of the geotechnical engineer, CAL-OSHA and other public agencies having jurisdiction. Care should be taken to provide or maintain adequate lateral support for all adjacent improvements and structures at all times during the grading operations and construction phase.

8.4 Foundation Design

All foundations for the office and hotel structures may be designed utilizing the following allowable bearing capacities for an embedded depth of 18 and 24 inches respectively into approved engineered fill with the corresponding widths:

Allowable Bearing Capacity (psf)		
Width (feet)	Continuous Foundation	Isolated Foundation
1.5	2000	2500
2.0	2075	2575
4.0	2375	2875
6.0	2500	3000

The bearing value may be increased by 500 psf for each additional foot of depth in excess of the 18 and 24-inch minimum depth, up to a maximum of 4,000 psf. A one-third increase may be used when considering short-term loading and seismic forces. Smaller structures (site walls, trash enclosure, etc.) may utilize an allowable bearing capacity of 1,500 psf and be embedded a depth of 18 inches into competent native soils or approved engineered fill. A representative of this firm shall inspect all foundation excavations prior to pouring concrete.

8.5 Settlement Analysis

Resultant pressure curves for the consolidation tests are shown on Plates B and C. Computations utilizing these curves and the recommended allowable soil bearing capacities reveal that the foundations will experience settlements on the order of 3/4 inch and differential settlements of less than 1/4 inch.

8.6 Lateral Resistance

The following values may be utilized in resisting lateral loads imposed on the structure. Requirements of the California Building Code should be adhered to when the coefficient of friction and passive pressures are combined.

Coefficient of Friction - 0.40

Equivalent Passive Fluid Pressure = 250 lbs./cu.ft.

Maximum Passive Pressure = 2,500 lbs./cu.ft.

The passive pressure recommendations are valid only for approved compacted fill soils or competent native materials.

8.7 Retaining Wall Design Parameters

Active earth pressures against retaining walls will be equal to the pressures developed by the following fluid densities. These values are for **granular backfill material** placed behind the walls at various ground slopes above the walls.

Surface Slope of Retained Materials (Horizontal to Vertical)	Equivalent Fluid Density (lb./cu.ft.)
Level	30
5 to 1	35
4 to 1	38
3 to 1	40
2 to 1	45

Any applicable short-term construction surcharges and seismic forces should be added to the above lateral pressure values. An equivalent fluid pressure of 45 pcf may be utilized for the restrained wall condition with a level grade behind the wall.

The seismic-induced lateral soil pressure for walls greater than 6 feet may be computed using a triangular pressure distribution with the maximum value at the top of the wall. The maximum lateral pressure of $(20 \text{ pcf}) H$ where H is the height of the retained soils above the wall footing should be used in final design of retaining walls. Sliding resistance values and passive fluid pressure values may be increased by $1/3$ during short-term wind and seismic loading conditions.

All walls shall be waterproofed as needed and protected from hydrostatic pressure by a reliable permanent subdrain system. The subsurface drainage system shall consist of a 4-inch diameter perforated PVC pipe encased with gravel and wrapped with filter fabric. The granular backfill to be utilized immediately adjacent to retaining walls shall consist of an approved granular soil with a sand equivalency greater than 30. This backfill zone of free draining material shall consist of a wedge beginning a minimum of one horizontal foot from the base of the wall extending upward at an inclination of no less than $3/4$ to 1 (horizontal to vertical).

8.8 **Slab Design**

All slabs shall be a minimum of four inches in thickness and placed on approved subgrade soils. A vapor retarder should be utilized in areas which would be sensitive to the infiltration of moisture. This retarder shall meet requirements of ASTM E 96, *Water Vapor Transmission of Materials* and ASTM E 1745, *Standard Specification for Water Vapor Retarders used in Contact with Soil or Granular Fill Under Concrete Slabs*. The vapor retarder shall be installed in accordance with procedures stated in ASTM E 1643, *Standard practice for Installation of Water Vapor Retarders used in Contact with Earth or Granular Fill Under Concrete Slabs*.

The moisture retarder may be placed directly upon compacted subgrade soils conditioned to near optimum moisture levels, although one to two inches of sand beneath the membrane is desirable. The subgrade upon which the retarder is placed shall be smooth and free of rocks, gravel or other protrusions which may damage the retarder. Use of sand above the retarder is under the purview of the structural engineer; if sand is used over the retarder, it should be placed in a dry condition.

8.9 Swimming Pool Design

The swimming pool should be designed as free-standing structure with a maximum water level condition. The bottom of the pool excavation shall be embedded entirely into engineered fill or competent native soils. An equivalent fluid pressure of 30 pcf is applicable for these soils with a level grade condition and no surcharge loads. Differential settlements within the swimming pool structure shall be less than ¼ inch. Total settlements should not exceed ½ inch. Drainage shall be directed away from all structures by either approved drainage devices or concrete pavement.

8.10 Pavement Section Design

The table below provides a preliminary pavement design based upon an R-Value of 67 for the subgrade soils for the proposed pavement areas. Final pavement design may need to be based on R-Value testing of the subgrade soils near the conclusion of site grading to assure that these soils are consistent with those assumed in this preliminary design. The recommendations are based upon estimated traffic loads. Client should submit any other anticipated traffic loadings to the geotechnical engineer, if necessary, so that pavement sections may be reviewed to determine adequacy to support the proposed loadings.

Type of Traffic	Traffic Index	Asphalt (in.)	Base Material (in.)
Automobile Parking Stalls	4.0	3.0	3.0
Light Vehicle Circulation Drive Areas	5.5	3.0	4.0

Any concrete slab-on-grade in pavement areas including truck aprons shall be a minimum of six inches in thickness and may be placed on approved subgrade soils. All pavement areas shall have positive drainage toward an approved outlet from the site. Drain lines behind curbs and/or adjacent to landscape areas should be considered by client and the appropriate design engineers to prevent water from infiltrating beneath pavement. If such infiltration occurs, damage to pavement, curbs and flow lines, especially on sites with expansive soils, may occur during the life of the project.

Any approved base material shall consist of a Class II aggregate or equivalent and should be compacted to a minimum of 95% relative compaction. All pavement materials shall conform to the requirements set forth by the City of Colton. The base material; and asphaltic concrete should be tested prior to delivery to the site and during placement to determine conformance with the project specifications. A pavement engineer shall designate the specific asphalt mix design to meet the required project specifications.

8.11 Utility Trench and Excavation Backfill

Trenches from installation of utility lines and other excavations may be backfilled with on-site soils or approved imported soils compacted to a minimum of 90% relative compaction. All utility lines shall be properly bedded with clean sand having a sand equivalency rating of 30 or more. This bedding material shall be thoroughly water jetted around the pipe structure prior to placement of compacted backfill soils.

8.12 Corrosion Design Criteria

Representative samples of the surficial soils, typical of the subgrade soils expected to be encountered within foundation excavations and underground utilities were tested for corrosion potential. The minimum resistivity value obtained for the samples tested is representative of an environment that may be severely corrosive to metals. The soil pH value was considered mildly acidic and may not have a significant effect on soil corrosivity.

Consideration should be given to corrosion protection systems for buried metal such as protective coatings, wrappings or the use of PVC where permitted by local building codes. According to Table 4.3.1 of ACI 318 Building Code and Commentary, these contents revealed negligible sulfate concentrations. Therefore, a Type II cement according to latest CBC specifications may be utilized for building foundations at this time.

It is recommended that additional sulfate tests be performed at the completion of site grading to assure that the as graded conditions are consistent with the recommendations stated in this design. Corrosion test results may be found on the attached Table III.

8.13 Expansive Soil

If expansive soils are encountered, special attention should be given to the project design and maintenance. The attached *Expansive Soil Guidelines* should be reviewed by the engineers, architects, owner, maintenance personnel and other interested parties and considered during the design of the project and future property maintenance.

9.0 Closure

The recommendations and conclusions contained in this report are based upon the soil conditions uncovered in our test excavations. No warranty of the soil condition between our excavations is implied. NorCal Engineering should be notified for possible further recommendations if unexpected to unfavorable conditions are encountered during construction phase. It is the responsibility of the owner to ensure that all information within this report is submitted to the Architect and appropriate Engineers for the project.

This firm should have the opportunity to review the final plans to verify that all our recommendations are incorporated. This report and all conclusions are subject to the review of the controlling authorities for the project.

A preconstruction conference should be held between the developer, general contractor, grading contractor, city inspector, architect, and soil engineer to clarify any questions relating to the grading operations and subsequent construction. Our representative should be present during the grading operations and construction phase to certify that such recommendations are complied within the field.

This geotechnical investigation has been conducted in a manner consistent with the level of care and skill exercised by members of our profession currently practicing under similar conditions in the Southern California area. No other warranty, expressed or implied is made.

We appreciate this opportunity to be of service to you. If you have any further questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
NORCAL ENGINEERING



Keith D. Tucker
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R.G.E. 841



Scott D. Spensiero
Project Manager

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3. California Department of Conservation, California Geological Survey, 2007, Fault-Rupture Hazard Zones in California; Special Publication 42.
4. California Department of Water Resources, Internet Website, <http://www.water.ca.gov/waterdatalibrary/index.cfm>.
5. California Division of Mines and Geology, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California: Special Publication 117A.
6. Morton, D.M., and Miller, F.K., 2006 "Geologic Map of the San Bernardino and Santa Ana 30' x 60' Quadrangles", U.S. Geologic Survey, scale 1:100,00.
7. San Bernardino County – Appendix VII - Infiltration Rate Evaluation Protocol and Factor of Safety Recommendations dated May 19, 2011.
8. San Bernardino County Land Use Plan – General Plan Geologic Hazard Overlays dated March 9, 2010.
9. U.S. Geological Survey – J.C. Matti and S.E. Carson – Contour Map Showing Minimum Depth to Groundwater, Upper Santa Ana River Valley, California 1973-1979, 1983.
10. U.S. Geological Survey, 1977, San Bernardino South Quadrangle: 7.5 Minute Series (Topographic) scale 1:24,000.

SPECIFICATIONS FOR PLACEMENT OF COMPACTED FILL

Excavation

Any existing low-density soils and/or saturated soils shall be removed to competent natural soil under the inspection of the Geotechnical Engineering Firm. After the exposed surface has been cleansed of debris and/or vegetation, it shall be scarified until it is uniform in consistency, brought to the proper moisture content and compacted to a minimum of 90% relative compaction (in accordance with ASTM: D 1557).

In any area where a transition between fill and native soil or between bedrock and soil are encountered, additional excavation beneath foundations and slabs will be necessary in order to provide uniform support and avoid differential settlement of the structure.

Material for Fill

The on-site soils or approved import soils may be utilized for the compacted fill provided they are free of any deleterious materials and shall not contain any rocks, brick, asphaltic concrete, concrete or other hard materials greater than eight inches in maximum dimensions. Any import soil must be approved by the Geotechnical Engineering firm a minimum of 72 hours prior to importation of site.

Placement of Compacted Fill Soils

The approved fill soils shall be placed in layers not excess of six inches in thickness. Each lift shall be uniform in thickness and thoroughly blended. The fill soils shall be brought to within 2% of the optimum moisture content, unless otherwise specified by the Geotechnical Engineering firm. Each lift shall be compacted to a minimum of 90% relative compaction (in accordance with ASTM: D 1557) and approved prior to the placement of the next layer of soil. Compaction tests shall be obtained at the discretion of the Geotechnical Engineering firm but to a minimum of one test for every 500 cubic yards placed and/or for every 2 feet of compacted fill placed.

The minimum relative compaction shall be obtained in accordance with accepted methods in the construction industry. The final grade of the structural areas shall be in a dense and smooth condition prior to placement of slabs-on-grade or pavement areas. No fill soils shall be placed, spread or compacted during unfavorable weather conditions. When the grading is interrupted by heavy rains, compaction operations shall not be resumed until approved by the Geotechnical Engineering firm.

Grading Observations

The controlling governmental agencies should be notified prior to commencement of any grading operations. This firm recommends that the grading operations be conducted under the observation of a Geotechnical Engineering firm as deemed necessary. A 24-hour notice must be provided to this firm prior to the time of our initial inspection.

Observation shall include the clearing and grubbing operations to assure that all unsuitable materials have been properly removed; approve the exposed subgrade in areas to receive fill and in areas where excavation has resulted in the desired finished grade and designate areas of overexcavation; and perform field compaction tests to determine relative compaction achieved during fill placement. In addition, all foundation excavations shall be observed by the Geotechnical Engineering firm to confirm that appropriate bearing materials are present at the design grades and recommend any modifications to construct footings.

EXPANSIVE SOIL GUIDELINES

The following expansive soil guidelines are provided for your project. The intent of these guidelines is to inform you, the client, of the importance of proper design and maintenance of projects supported on expansive soils. ***You, as the owner or other interested party, should be warned that you have a duty to provide the information contained in the soil report including these guidelines to your design engineers, architects, landscapers and other design parties in order to enable them to provide a design that takes into consideration expansive soils.***

In addition, you should provide the soil report with these guidelines to any property manager, lessee, property purchaser or other interested party that will have or assume the responsibility of maintaining the development in the future.

Expansive soils are fine-grained silts and clays which are subject to swelling and contracting. The amount of this swelling and contracting is subject to the amount of fine-grained clay materials present in the soils and the amount of moisture either introduced or extracted from the soils. Expansive soils are divided into five categories ranging from “very low” to “very high”. Expansion indices are assigned to each classification and are included in the laboratory testing section of this report. *If the expansion index of the soils on your site, as stated in this report, is 21 or higher, you have expansive soils.* The classifications of expansive soils are as follows:

Classification of Expansive Soil*

Expansion Index	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

*From Table 18A-I-B of California Building Code (1988)

When expansive soils are compacted during site grading operations, care is taken to place the materials at or slightly above optimum moisture levels and perform proper compaction operations. Any subsequent excessive wetting and/or drying of expansive soils will cause the soil materials to expand and/or contract. These actions are likely to cause distress of foundations, structures, slabs-on-grade, sidewalks and pavement over the life of the structure. ***It is therefore imperative that even after construction of improvements, the moisture contents are maintained at relatively constant levels, allowing neither excessive wetting or drying of soils.***

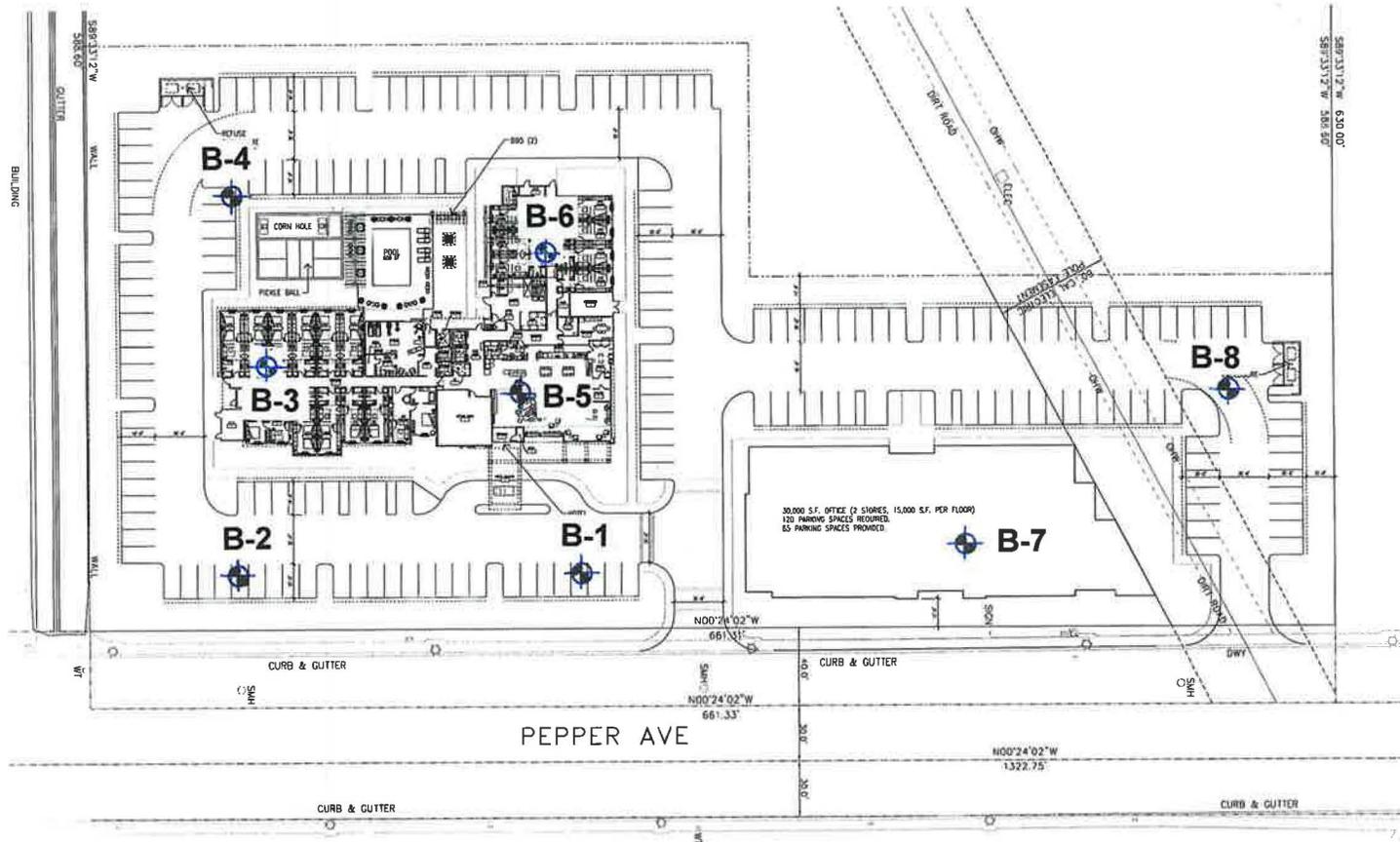
Evidence of excessive wetting of expansive soils may be seen in concrete slabs, both interior and exterior. Slabs may lift at construction joints producing a trip hazard or may crack from the pressure of soil expansion. Wet clays in foundation areas may result in lifting of the structure causing difficulty in the opening and closing of doors and windows, as well as cracking in exterior and interior wall surfaces. In extreme wetting of soils to depth, settlement of the structure may eventually result. Excessive wetting of soils in landscape areas adjacent to concrete or asphaltic pavement areas may also result in expansion of soils beneath pavement and resultant distress to the pavement surface.

Excessive drying of expansive soils is initially evidenced by cracking in the surface of the soils due to contraction. Settlement of structures and on-grade slabs may also eventually result along with problems in the operation of doors and windows.

Projects located in areas of expansive clay soils will be subject to more movement and "hairline" cracking of walls and slabs than similar projects situated on non-expansive sandy soils. There are, however, measures that developers and property owners may take to reduce the amount of movement over the life the development. The following guidelines are provided to assist you in both design and maintenance of projects on expansive soils:

- Drainage away from structures and pavement is essential to prevent excessive wetting of expansive soils. Grades should be designed to the latest building code and maintained to allow flow of irrigation and rain water to approved drainage devices or to the street. Any “ponding” of water adjacent to buildings, slabs and pavement after rains is evidence of poor drainage; the installation of drainage devices or regrading of the area may be required to assure proper drainage. Installation of rain gutters is also recommended to control the introduction of moisture next to buildings. Gutters should discharge into a drainage device or onto pavement which drains to roadways.
- Irrigation should be strictly controlled around building foundations, slabs and pavement and may need to be adjusted depending upon season. This control is essential to maintain a relatively uniform moisture content in the expansive soils and to prevent swelling and contracting. Over-watering adjacent to improvements may result in damage to those improvements. NorCal Engineering makes no specific recommendations regarding landscape irrigation schedules.
- Planting schemes for landscaping around structures and pavement should be analyzed carefully. Plants (including sod) requiring high amounts of water may result in excessive wetting of soils. Trees and large shrubs may actually extract moisture from the expansive soils, thus causing contraction of the fine-grained soils.
- Thickened edges on exterior slabs will assist in keeping excessive moisture from entering directly beneath the concrete. A six-inch thick or greater deepened edge on slabs may be considered. Underlying interior and exterior slabs with 6 to 12 inches or more of non-expansive soils and providing presaturation of the underlying clayey soils as recommended in the soil report will improve the overall performance of on-grade slabs.

- Increase the amount of steel reinforcing in concrete slabs, foundations and other structures to resist the forces of expansive soils. The precise amount of reinforcing should be determined by the appropriate design engineers and/or architects.
- Recommendations of the soil report should always be followed in the development of the project. Any recommendations regarding presaturation of the upper subgrade soils in slab areas should be performed in the field and verified by the Geotechnical Engineer.



NORTH



1 INCH = 100 FEET

NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

SITE PLAN

PROJECT: 23010-21

DATE: JANUARY 2022

List of Appendices **(in order of appearance)**

Appendix A – Log of Excavations

Log of Borings B-1 to B-8

Appendix B – Laboratory Tests

Table I – Maximum Dry Density

Table II – Expansion

Table III – Corrosion

R Value Test

Plate A – Direct Shear

Plates B and C - Consolidation

Appendix C

ASCE Seismic Hazards Report

Appendix D

Soil Infiltration Data

Appendix A Log of Explorations

MAJOR DIVISION			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINE (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

KEY:

- Indicates 2.5-inch Inside Diameter. Ring Sample.
- ⊗ Indicates 2-inch OD Split Spoon Sample (SPT).
- Indicates Shelby Tube Sample.
- Indicates No Recovery.
- Indicates SPT with 140# Hammer 30 in. Drop.
- ⊗ Indicates Bulk Sample.
- ⊗ Indicates Small Bag Sample.
- Indicates Non-Standard
- ⊗ Indicates Core Run.

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5mm) to No. 200 (0.074mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074 mm)

COMPONENT PROPORTIONS

DESCRIPTIVE TERMS	RANGE OF PROPORTION
Trace	1 - 5%
Few	5 - 10%
Little	10 - 20%
Some	20 - 35%
And	35 - 50%

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
DAMP	Some perceptible moisture; below optimum
MOIST	No visible water; near optimum moisture content
WET	Visible free water, usually soil is below water table.

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N -VALUE

COHESIONLESS SOILS		COHESIVE SOILS		
Density	N (blows/ft)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	Very Soft	0 to 2	< 250
Loose	4 to 10	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	Very Stiff	15 to 30	2000 - 4000
		Hard	over 30	> 4000

**Executive Development
23010-21**

Log of Boring B-1

Boring Location: 945 N Pepper Ave., Colton

Date of Drilling: 12/14/2021

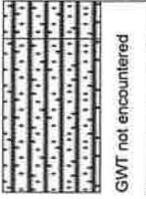
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lithology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL Silty (fine to medium grained) SAND Brown, loose, moist					
5		NATURAL Silty (fine to medium grained) SAND Brown, medium dense, damp Boring completed at depth of 5'					
10							
15							
20							
25							
30							
35							

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**Executive Development
23010-21**

Log of Boring B-2

Boring Location: 945 N Pepper Ave., Colton

Date of Drilling: 12/14/2021

Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lithology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL					
		Silty (fine to medium grained) SAND Brown, loose, moist					
		NATURAL					
5		Silty (fine to medium grained) SAND Brown, medium dense, damp					
10		Boring completed at depth of 10'					
15							
20							
25							
30							
35							

**Executive Development
23010-21**

Log of Boring B-3

Boring Location: 945 N Pepper Ave., Colton

Date of Drilling: 12/14/2021

Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lithology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	 GWMT not encountered	FILL Silty (fine to medium grained) SAND Brown, loose, moist		4/6	2.8	104.8	
5		NATURAL Silty (fine to medium grained) SAND Brown, medium dense, damp		5/7	3.5	107.5	
10		SAND (fine to medium grained) Light brown, medium dense to dense, damp; slightly silty		10/14	3.2	104.9	
15				10/16	3.5	106.0	
20		Sandy SILT Grey-brown, stiff, moist		8/11	8.6	100.3	
		Boring completed at depth of 21'					

**Executive Development
23010-21**

Log of Boring B-4

Boring Location: 945 N Pepper Ave., Colton

Date of Drilling: 12/14/2021

Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lithology	Material Description	Samples		Laboratory	
			Type	Blow Counts	Moisture	Dry Density
0		FILL Silty (fine to medium grained) SAND Brown, loose, moist				
5		NATURAL Silty (fine to medium grained) SAND Brown, medium dense, damp	█	5/8	2.3	109.9
10		Boring completed at depth of 10'	█	6/6	2.7	102.3
15						
20						
25						
30						
35						

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**Executive Development
23010-21**

Log of Boring B-5

Boring Location: 945 N Pepper Ave., Colton

Date of Drilling: 12/14/2021

Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lithology	Material Description	Samples		Laboratory	
			Type	Blow Counts	Moisture	Dry Density
0		FILL Silty (fine to medium grained) SAND Brown, loose, moist				
5		NATURAL Silty (fine to medium grained) SAND Brown, medium dense, damp	█	6/6	2.5	105.8
10		Boring completed at depth of 10'	█	6/8	3.1	107.1
15						
20						
25						
30						
35						

NorCal Engineering

**Executive Development
23010-21**

Log of Boring B-6

Boring Location: 945 N Pepper Ave., Colton

Date of Drilling: 12/14/2021

Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lithology	Material Description	Samples		Laboratory	
			Type	Blow Counts	Moisture	Dry Density
0	 GWT not encountered	FILL Silty (fine to medium grained) SAND Brown, loose, moist	█	7/11	2.0	109.7
5		NATURAL Silty (fine to medium grained) SAND Brown, medium dense, damp	█	7/9	2.5	107.1
10		SAND (fine to medium grained) Light brown, medium dense, damp; slightly silty	█	8/15	2.6	106.6
15		Boring completed at depth of 15'	█	11/14	3.1	103.2
20						
25						
30						
35						

**Executive Development
23010-21**

Log of Boring B-7

Boring Location: 945 N Pepper Ave., Colton

Date of Drilling: 12/14/2021

Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lithology	Material Description	Samples		Laboratory	
			Type	Blow Counts	Moisture	Dry Density
0	 GWT not encountered	FILL Silty (fine to medium grained) SAND Brown, loose, moist	█	4/6	2.6	104.7
5		NATURAL Silty (fine to medium grained) SAND Brown, medium dense, damp	█	5/6	2.6	104.1
10		SAND (fine to medium grained) Light brown, medium dense, damp; slightly silty	█	10/10	3.9	103.2
15		Sandy SILT Grey-brown, stiff, moist	█	9/12	2.9	101.1
20		Boring completed at depth of 21'	█	9/12	8.1	95.3

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\23010-21.log Date: 12/29/2021

**Executive Development
23010-21**

Log of Boring B-8

Boring Location: 945 N Pepper Ave., Colton

Date of Drilling: 12/14/2021

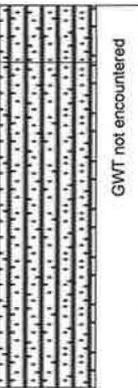
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lithology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL Silty (fine to medium grained) SAND Brown, loose, moist					
5		NATURAL Silty (fine to medium grained) SAND Brown, medium dense, damp					
10		Boring completed at depth of 10'					
15							
20							
25							
30							
35							

Appendix B Laboratory Tests

TABLE I
MAXIMUM DENSITY TESTS

Sample	Classification	Optimum Moisture (%)	Maximum Dry Density (lbs/cu.ft)
B-3 @ 2'	Silty SAND	8.0	126.0

TABLE II
EXPANSION TESTS

Sample	Classification	Expansion Index
B-3 @ 2'	Silty SAND	0

TABLE III
CORROSION TESTS

Sample	pH	Electrical Resistivity	Sulfate (%)	Chloride (ppm)
B-3 @ 2'	7.1	6,136	0.001	203

% by weight
ppm – mg/kg



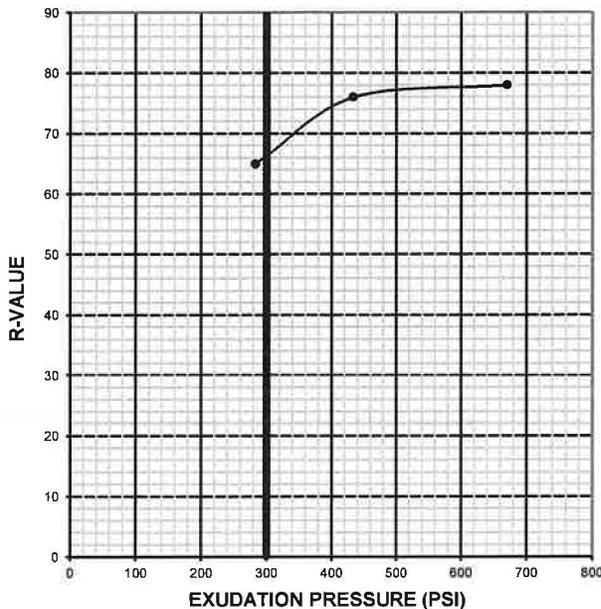
R-VALUE TEST REPORT

CT-301 ASTM-D2844

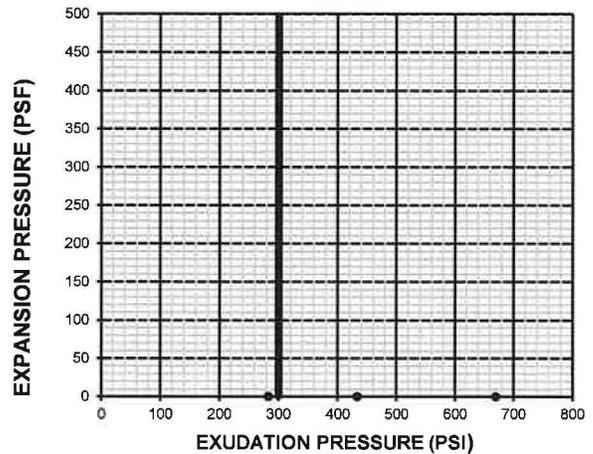
PROJECT NAME: Norcal: Executive Development PROJECT NUMBER: L-211201
 SAMPLE LOCATION: Near SWC of N. Pepper Ave and San Bernardino Ave, Colton, CA SAMPLE NUMBER: B1
 SAMPLE DESCRIPTION: SILTY SAND with few Gravels (SM), dark brown SAMPLE DEPTH: 2'
 SAMPLED BY: Norcal: JS 12/15/21 TESTED BY: JPG
 DATE TESTED: 12/20/2021

TEST SPECIMEN	A	B	C
MOISTURE AT COMPACTION %	9.1	9.6	10.1
WEIGHT OF SAMPLE, grams	1057	1092	1105
HEIGHT OF SAMPLE, Inches	2.45	2.49	2.55
DRY DENSITY, pcf	119.9	121.3	119.4
COMPACTOR AIR PRESSURE, psi	300	280	260
EXUDATION PRESSURE, psi	670	433	283
EXPANSION, Inches x 10 ^{exp-4}	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	23	25	35
TURNS DISPLACEMENT	4.11	4.35	4.84
R-VALUE UNCORRECTED	78	76	65
R-VALUE CORRECTED	78	76	65
EXPANSION PRESSURE (psf)	0.0	0.0	0.0

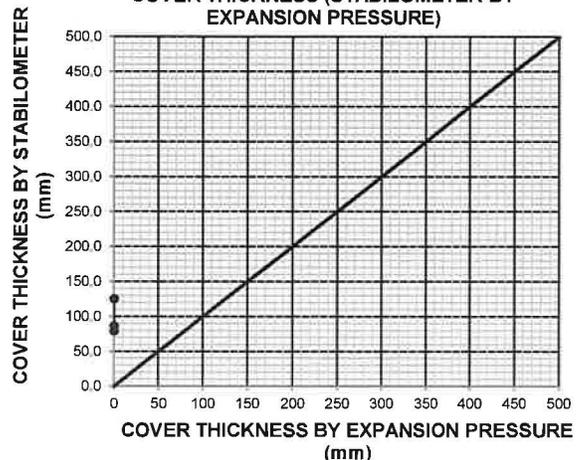
R-VALUE VS. EXUDATION PRESSURE



EXPANSION PRESSURE VS. EXUDATION PRESSURE



COVER THICKNESS (STABILOMETER BY EXPANSION PRESSURE)

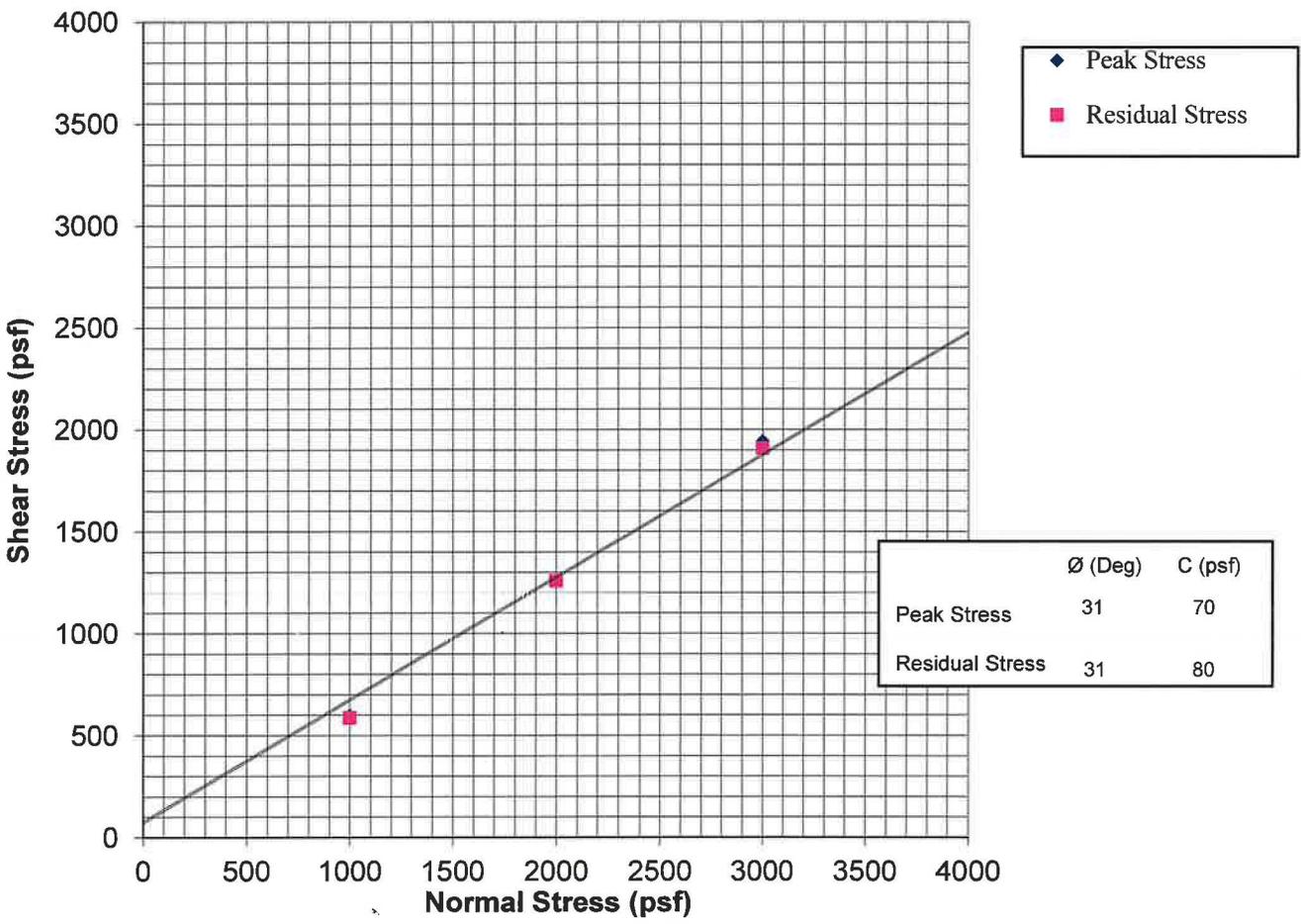
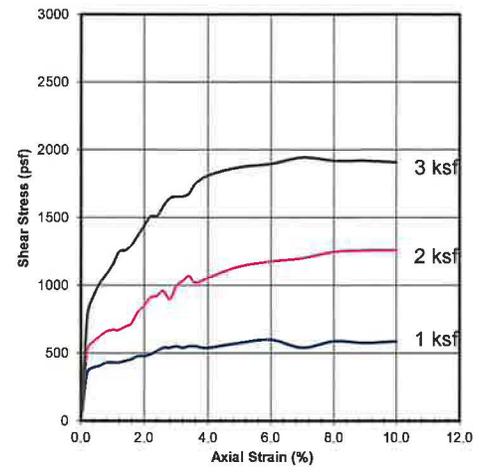


R-VALUE AT EQUILIBRIUM: **67**

R-VALUE BY EXUDATION PRESSURE:	67
R-VALUE BY EXPANSION PRESSURE:	N.A.
EXPANSION PRESSURE AT 300 PSI EXUDATION:	63
TRAFFIC INDEX (Assumed):	5.5
GRAVEL FACTOR (Assumed):	1.5
UNIT MASS OF COVER MATERIAL, kg/m ³ (Assumed):	2100.0

Sample No. B3@2'
 Sample Type: Undisturbed-Saturated
 Soil Description: Silty F-M Grained Sand

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	600	1260	1944
Displacement	(in.)	0.150	0.225	0.175
Residual Stress	(psf)	588	1260	1908
Displacement	(in.)	0.250	0.250	0.250
Initial Dry Density	(pcf)	107.5	107.5	107.5
Initial Water Content	(%)	2.8	2.8	2.8
Strain Rate	(in./min.)	0.020	0.020	0.020



NorCal Engineering
 SOILS AND GEOTECHNICAL CONSULTANTS

Executive Development

PROJECT NUMBER: 23010-21

DATE: 1/3/2022

DIRECT SHEAR TEST
 ASTM D3080

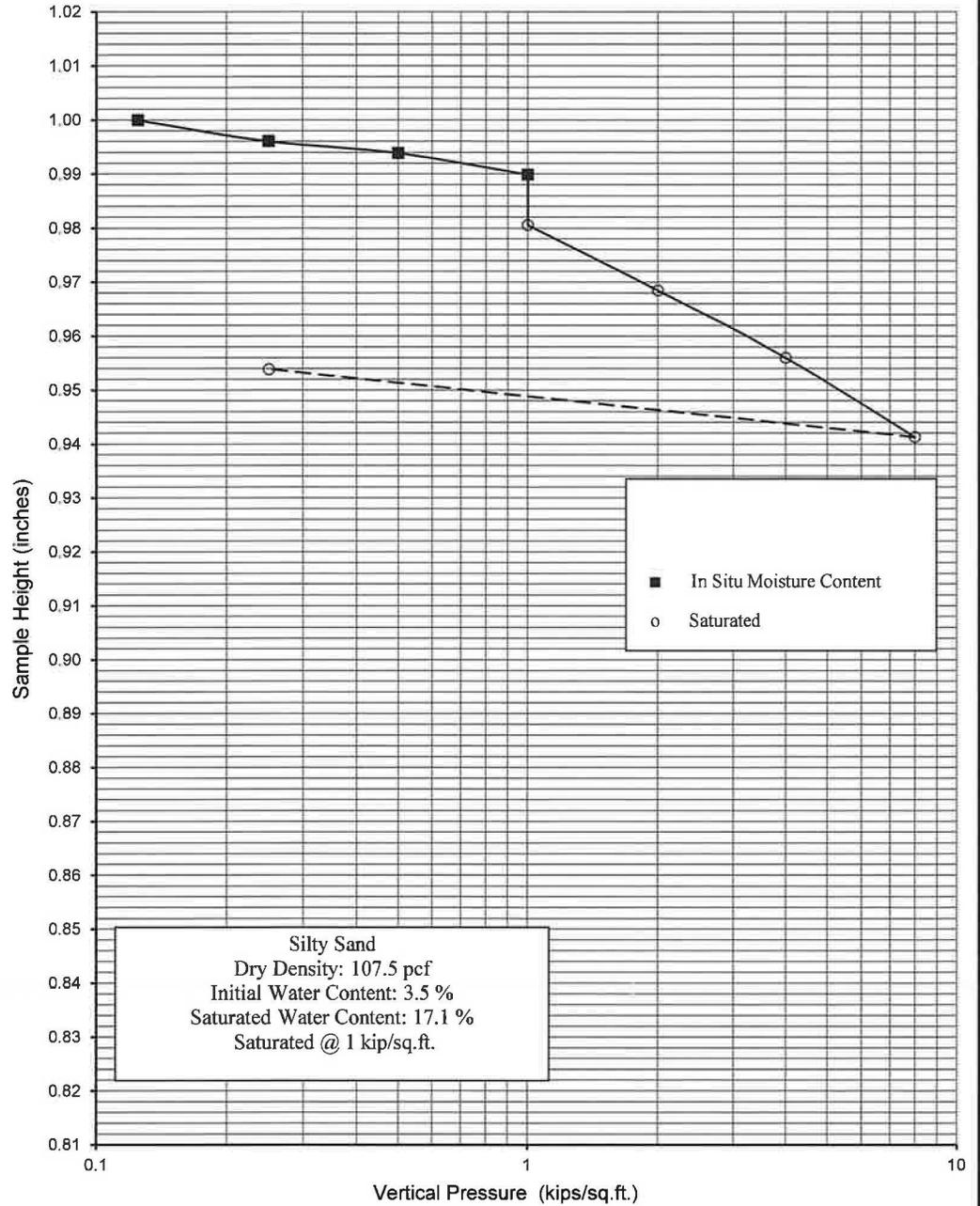
Plate A

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)	Sample No. B3	Depth 5'	Date 1/3/2022
------------------------------------	---------------------------	----------------------------	---------------	----------	---------------

0.125	1.0000	0.0
0.25	0.9961	0.4
0.5	0.9939	0.6
1	0.9899	1.0
1	0.9806	1.9
2	0.9685	3.2
4	0.9560	4.4
8	0.9413	5.9
0.25	0.9539	4.6

Date Tested: 12/27/2021
Sample: B3
Depth: 5'

Saturated



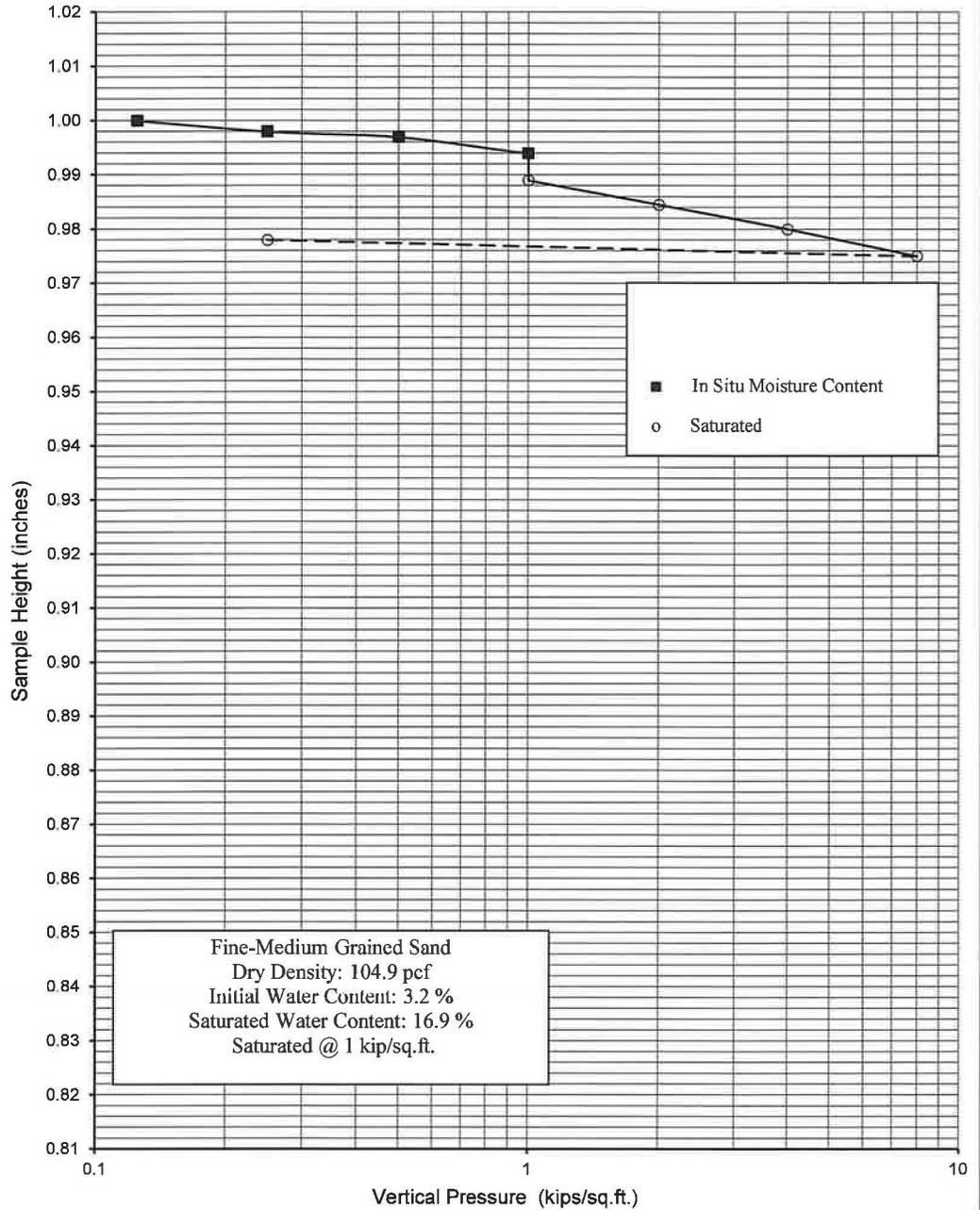
NorCal Engineering SOILS AND GEOTECHNICAL CONSULTANTS Executive Development	CONSOLIDATION TEST ASTM D2435 Plate B
PROJECT NUMBER: 23010-21	DATE: 1/3/2022

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)	Sample No. B1	Depth 10'	Date 1/3/2022
------------------------------------	---------------------------	----------------------------	---------------	-----------	---------------

0.125	1.0000	0.0
0.25	0.9980	0.2
0.5	0.9970	0.3
1	0.9940	0.6
1	0.9890	1.1
2	0.9845	1.6
4	0.9800	2.0
8	0.9750	2.5
0.25	0.9780	2.2

Saturated

Date Tested: 12/27/2021
Sample: B1
Depth: 10'



NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS
Executive Development
PROJECT NUMBER: 23010-21 DATE: 1/3/2022

CONSOLIDATION TEST
ASTM D2435
Plate C

Appendix C

Seismic Hazard Report

ASCE 7 Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-22

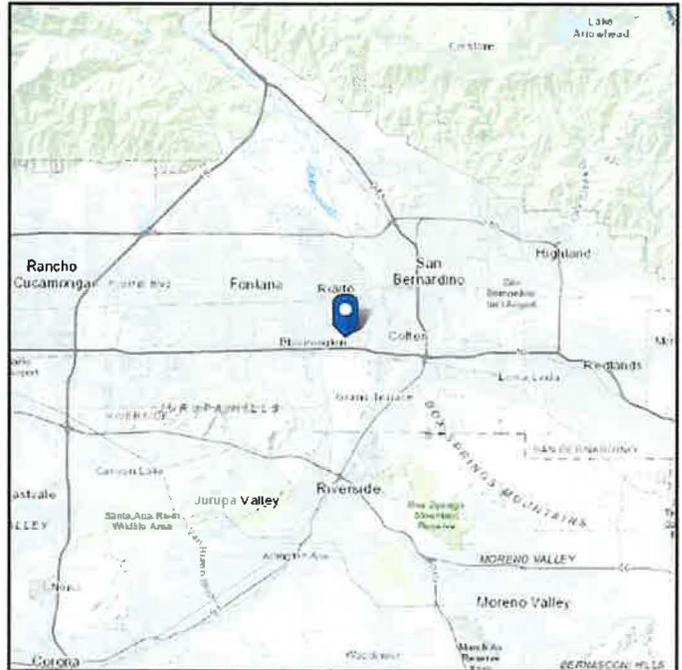
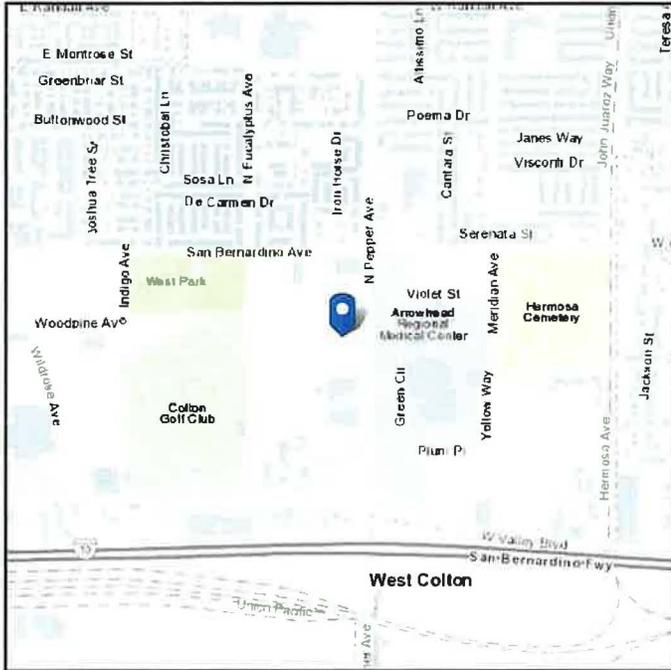
Elevation: 1087.32 ft (NAVD 88)

Risk Category: II

Latitude: 34.075234

Soil Class: D - Stiff Soil

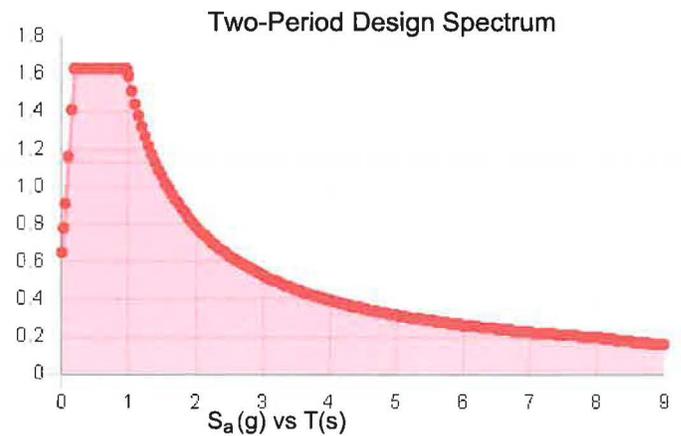
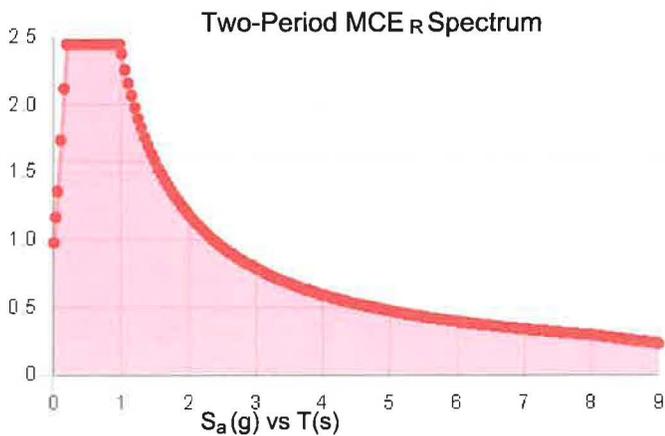
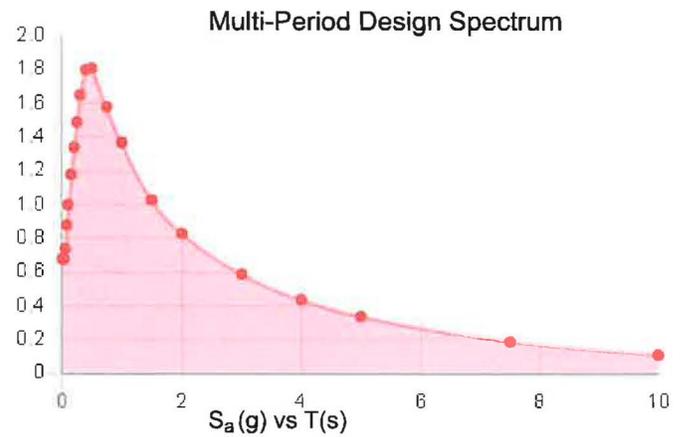
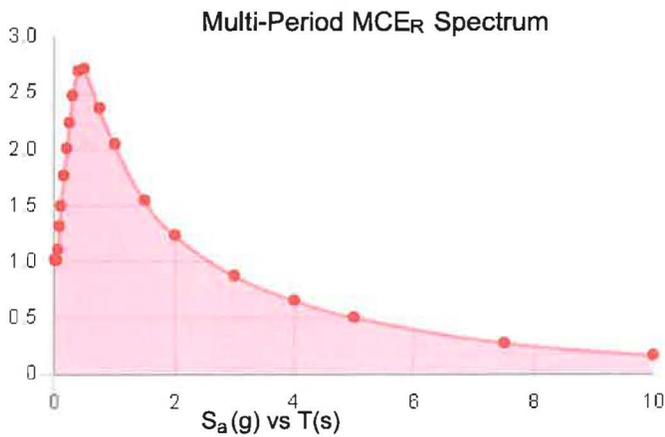
Longitude: -117.353887



Site Soil Class:

Results:

PGA _M :	0.85	T _L :	8
S _{MS} :	2.45	S _S :	2.47
S _{M1} :	2.38	S ₁ :	0.89
S _{DS} :	1.63	S _{DC} :	
S _{D1} :	1.59	V _{S30} :	260



MCE_R Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.



Data Accessed: Tue Dec 21 2021

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-22 and ASCE/SEI 7-22 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-22 Ch. 21 are available from USGS.

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.

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Appendix D

Soil Infiltration Data



SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Executive Development	Tested By: J.S.
Project No.: 23010-21	Date Tested: 12/14/2021
Test Hole: 1	Caving:
Depth of Test Hole: 5'	Notes:
Diameter of Test Hole: 8"	Strata Peculiarities:
Date Excavated: 12/14/2021	

Sandy Soil Criteria Test

TIME	TRIAL NO.	T1	H1	H2	D
7:32	1	30	0.0	58.0	58.0
8:02					
8:02	2	30	0.0	53.0	53.0
8:32					

Soil Criteria

TIME	T1	TE	H1	H2	D
8:32	10	10	0.0	26.5	26.5
8:42					
8:42	10	20	0.0	26.0	26.0
8:52					
8:52	10	30	0.0	26.0	26.0
9:02					
9:02	10	40	0.0	26.0	26.0
9:12					
9:12	10	50	0.0	25.0	25.0
9:22					
9:22	10	60	0.0	24.0	24.0
9:32					
9:32	10	70	0.0	24.0	24.0
9:42					
9:42	10	80	0.0	23.5	23.5
9:52					
9:52	10	90	23.5	37.0	12.5
10:02					
10:02	10	100	37.0	44.0	7.0
10:12					

T1 – Time Interval (min)
H2 – Final Water Level (in)

TE – Total Elapsed Time (min)
D – Change in H₂O Level (in)

H1 – Initial Water Level



SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Executive Development	Tested By: J.S.
Project No.: 23010-21	Date Tested: 12/14/2021
Test Hole: 2	Caving:
Depth of Test Hole: 10'	Notes:
Diameter of Test Hole: 8"	Strata Peculiarities:
Date Excavated: 12/14/2021	

Sandy Soil Criteria Test

TIME	TRIAL NO.	T1	H1	H2	D
8:07	1	28	0.0	120.0	120.0
8:35					
8:35	2	30	0.0	110.0	110.0
9:05					

Soil Criteria

TIME	T1	TE	H1	H2	D
9:05	10	10	0.0	69.0	69.0
9:15					
9:15	10	20	0.0	66.0	66.0
9:25					
9:25	10	30	0.0	60.0	60.0
9:35					
9:35	10	40	0.0	58.0	58.0
9:45					
9:45	10	50	0.0	57.0	57.0
9:55					
9:55	10	60	0.0	55.0	55.0
10:05					
10:05	10	70	0.0	55.0	55.0
10:15					
10:15	10	80	0.0	54.0	54.0
10:25					
10:25	10	90	54.0	78.0	24.0
10:35					
10:35	10	100	78.0	96.0	18.0
10:45					

T1 – Time Interval (min)
H2 – Final Water Level (in)

TE – Total Elapsed Time (min)
D – Change in H₂O Level (in)

H1 – Initial Water Level

SOIL INFILTRATION RATE CALCS ⇒ PORCHET METHOD

Location:	TH-1	TH-2
• Depth of Hole =	5.0'	10.0'
• Hole Radius =	4"	4"
• Drop = Δh	19.5"	42"
• Time = Δt Interval	20 min	20 min
• Initial Water Depth = H_0	36.5"	66"
• Final Water Depth = H_t	16"	24"
• Average Water Head = H_{avg}	26.25"	45"
• INFILTRATION RATE	4.1 in/hr	5.4 in/hr

$$\text{Infiltration Rate} = \frac{\Delta h (60)(r)}{\Delta t (r + z \cdot H_{avg})}$$

$$\text{Average Water Head} = \frac{1}{2} (H_t - H_0)$$

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

JOB NO. 23010-21 | DATE DEC. 2021