Appendix E: Geotechnical Supporting Information

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E.1 - Geotechnical Report

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Geotechnical Engineering Investigation

Proposed Industrial Warehouse Development
Corner of Barton Road and Terrace Avenue
Colton, California

Hager Pacific Properties, LLC
4100 Newport Place, Suite 820
Newport Beach, California 92660

Attn: Mr. Robert Neal

Project Number 20852-18
January 25, 2019

NorCal Engineering

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Hager Pacific Properties, LLC
4100 Newport Place, Suite 820
Newport Beach, California 92660

Attn: Mr. Robert Neal

RE: **Geotechnical Engineering Investigation** - Proposed Industrial Warehouse Development - Located at the Corner of Barton Road and Terrace Avenue, in the City of Colton, California

Dear Mr. Neal:

Pursuant to your request, this firm has performed a Geotechnical Engineering Investigation for the above referenced project in accordance with your approval of our proposal dated November 28, 2018. The purpose of this investigation is to evaluate the geotechnical conditions of the subject site and to provide recommendations for the proposed industrial warehouse development.

The scope of work included the following: 1) site reconnaissance; 2) subsurface geotechnical exploration and sampling; 3) laboratory testing; 4) soil infiltration testing; 5) engineering analysis of field and laboratory data; 5) preparation of a geotechnical engineering report. It is the opinion of this firm that the proposed development is feasible from a geotechnical standpoint provided that the recommendations presented in this report are followed in the design and construction of the project.

1.0 Project Description

It is proposed to construct an industrial warehouse development consisting of 410,620 and 539,360 square feet buildings on the subject property as shown on the attached Site Plan. The proposed concrete tilt-up buildings will be supported by a conventional slab-on-grade foundation system with perimeter-spread footings and isolated interior footings. Other improvements will include asphalt and concrete pavement areas, hardscape and landscaping.

It is assumed that the proposed grading for the development will include cut and fill procedures on the order of a few feet 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 45.91-acre subject property is located at the corner of Barton Road and Terrace Avenue, bordered by De Berry Street, in the City of Colton. The generally rectangular-shaped parcel is elongated in a north to south direction with topography of the relatively level property descending slightly from a northeast to southwest direction. The site is occupied by two large industrial buildings with surrounding asphalt and concrete pavement. An undeveloped parcel covered with sparse vegetation growth of natural grasses and weeds is situated toward the southeast quadrant of the site.

3.0 Site Exploration

The investigation consisted of the placement of twenty-one (21) 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 borings were placed at accessible locations throughout the property. The explorations were visually classified and logged by a field engineer with locations of the subsurface explorations shown on the attached plan.

The exploratory borings revealed the existing earth materials to consist of fill and natural soil and bedrock zones. 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 to grey, sandy to clayey SILT was encountered across the site to depths ranging from 1 to 2 feet below ground surface. These soils were noted to be loose and damp.
>
> **Natural:** A natural undisturbed soil classifying as a brown to brown grey, sandy to clayey SILT and silty CLAY was encountered beneath the upper fill soils. The native soils as encountered were observed to be firm to stiff and moist.
>
> **Bedrock:** A decomposed granite material classifying as a fine to coarse grained, silty SAND was encountered beneath the upper fill and natural soils at a depth of 7 to 13 feet below ground surface. The bedrock was observed to be hard to very hard 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 no caving occurred.

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 expansive characteristics. Results of these tests are provided on Table II.

4.4 **Atterberg Limits** (ASTM: D 4318) consisting of liquid limit, plastic limit and plasticity index were performed on representative soil samples. Results are shown on Table III.

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 IV.

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 Plates A and B.

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 C to F.

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 Fault is located 3 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 parameters are provided below and are based upon the 2016 California Building Code (CBC) for the referenced project. Data was obtained from American Society of Civil Engineers (ASCE) website, https://asce7hazardtool.online/. The *ASCE 7 Hazards Report* is attached in Appendix C.

Seismic Design Acceleration Parameters

Latitude	34.034
Longitude	-117.332
Site Class	D
Risk Category	I/II/III
Mapped Spectral Response Acceleration	S_S = 1.806g S_1 = 0.795g
Adjusted Maximum Acceleration	S_{MS} = 1.806g S_{M1} = 1.193g
Design Spectral Response Acceleration Parameters	S_{DS} = 1.204g S_{D1} = 0.795g

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. A truck mounted Simco 2800 Drill Rig equipped with a hollow stem auger was used to excavate the exploratory borings to depths ranging from 10.7 to 15.7 below existing ground surface. 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 10and 30-minute maximum intervals thereafter. Readings typically were performed in less time due to all water completely seeping out of the borings during the testing. Measurements were obtained by using an electronic tape measure with 1/16-inch divisions and timed with a stopwatch.

The field infiltration rate was computed using a reduction factor – R_f based on the field measurements with our calculations given 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 infiltration rates.

Test No. (Boring)	Depth (ft)	Infiltration Rate
TH-1 (B-6)	15.5	2.0 in/hr
TH-2 (B-7)	15.7	1.4 in/hr
TH-3 (B-13)	13.1	2.3 in/hr
TH-4 (B-12)	11.6	1.2 in/hr
TH-5 (B-17)	10.9	0.4 in/hr
TH-6 (B-16)	10.7	0.4 in/hr

The correction factors CF_t, CF_v and CF_s are given below based on soils at 10.7 to 15.7 feet from our field tests.

a) $CF_t = R_f = 27.9$ to 33.3 for our six (6) field infiltration test holes.

b) $CF_v = 1.0$ based on uniform soils encountered for infiltration tests

c) $CF_s = 2.0$ for long-term siltation, plugging and maintenance. The subsurface soils are likely to have some plugging and regular maintenance of storm water discharge devices is required.

All systems must meet the latest city and/or county specifications and the California Regional Water Quality Control Board (CRWQCB) requirements. A review of the groundwater maps of the Upper Santa Ana River Basin (Carson and Matti, 1982) reveals a groundwater depth in excess of 30 feet.

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 soils 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 be 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. Any unusual conditions which may be encountered in the course of the project development may require the need for additional study and revised recommendations.

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 Recommednations

All disturbed soils and/or fill (about 1 to 7 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.

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. Adequate drainage away from the structures, pavement and slopes should be provided at all times.

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 5 to 10% 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 die 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 unsurcharged 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. 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 soils 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 may be designed utilizing the following allowable bearing capacities for an embedded depth of 24 inches 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 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.

Any foundations located along property line or where lateral overexcavation is not possible may utilize an allowable bearing capacity of 1,500 psf. All foundations will require to reinforced with a minimum of one No. 4 bar, top and bottom. 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 C to F. Computations utilizing these curves and the recommended allowable soil bearing capacities reveal that the foundations will experience settlements on the order of ¾ inch and differential settlements of less than ¼ 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 - 0.35
Equivalent Passive Fluid Pressure = 200 lbs./cu.ft.
Maximum Passive Pressure = 2,000 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 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 granular backfill to be utilized immediately adjacent to retaining walls shall consist of an approved select 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 ¾ to 1 (horizontal to vertical).

8.8 Slab Design

All concrete slabs shall be a minimum of six inches in thickness in the proposed warehouse areas and four inches in office and hardscape, all reinforced using No. 3 bars at sixteen-inch spacing in each direction and positioned in the center of the slab. Additional reinforcement requirements and an increase in thickness of the slabs-on-grade may be necessary based upon soils expansion potential and proposed loading conditions in the structures and should be evaluated further by the project engineers and/or architect.

A vapor retarder (10-mil minimum thickness) 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 Pavement Section Design

The table below provides a preliminary pavement design based upon an R-Value of 27 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.

Type of Traffic	Traffic Index	Asphalt (in.)	Base Material (in.)
Automobile Parking Stalls	4.0	3.0	4.0
Light Vehicle Circulation Areas	5.5	3.5	7.5
Heavy Truck Access Areas	7.0	4.0	8.0

Any concrete slab-on-grade in pavement areas shall be a minimum of seven inches in thickness and may be placed on approved subgrade soils. The recommendations are based upon estimated traffic loads. Client should submit any other anticipated traffic loadings for the building areas and roadways to the soils engineer, if necessary, so that pavement sections may be reviewed to determine adequacy to support the proposed loadings.

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.

8.10 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.

8.11 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 alkaline 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 IV.

8.12 Expansive Soil

The upper on-site soils are non-expansive (EI < 20). When soils have an expansion index (EI) of 20 or more, 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.

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

Keith D. Tucker
Project Engineer
R.G.E. 841

REGISTERED PROFESSIONAL ENGINEER
KEITH D. TUCKER
No. 841
Exp. 12/31/2020
GEOTECHNICAL
STATE OF CALIFORNIA

Scott D. Spensiero
Project Manager

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 Soils 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 Geotechncial 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 Soils 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 Soils 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.

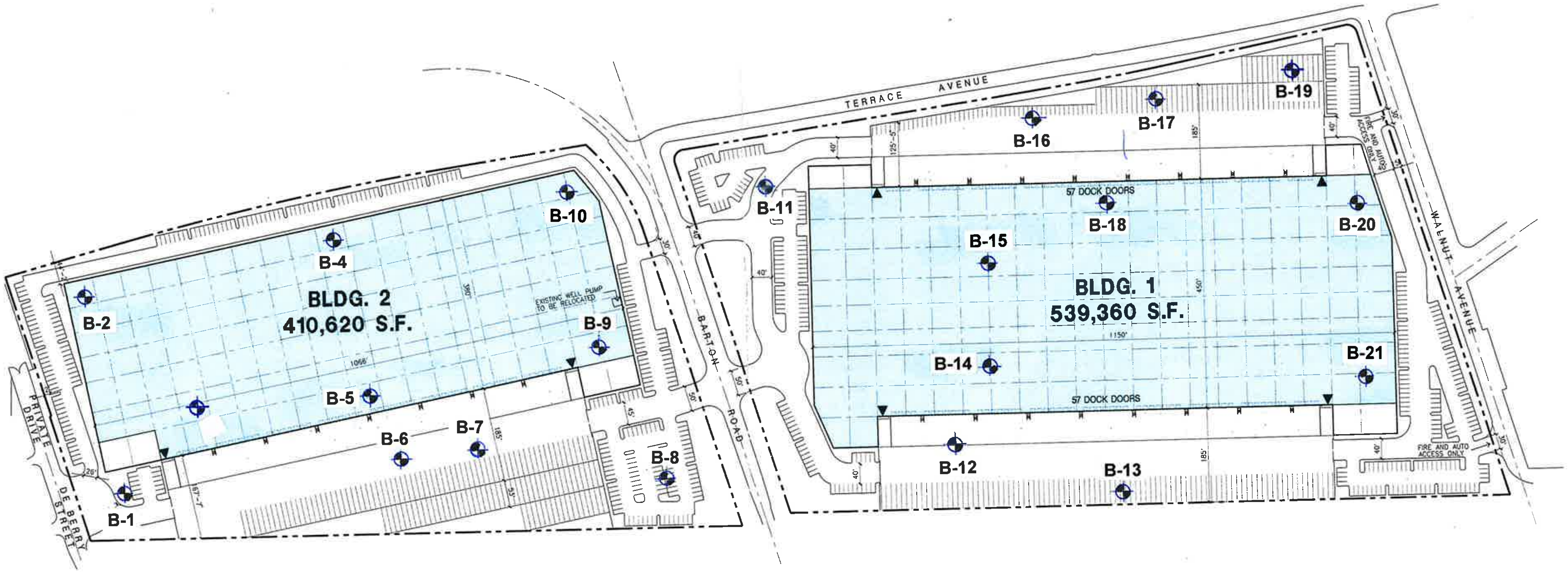
- Irrigation should be strictly controlled around building foundations, slabs and pavement and may need to be adjusted depending upon season. This control is essential to maintain a relatively uniform moisture content in the expansive soils and to prevent swelling and contracting. Over-watering adjacent to improvements may result in damage to those improvements. NorCal Engineering makes no specific recommendations regarding landscape irrigation schedules.

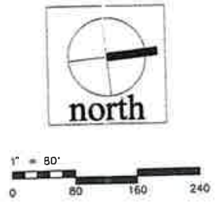
- Planting schemes for landscaping around structures and pavement should be analyzed carefully. Plants (including sod) requiring high amounts of water may result in excessive wetting of soils. Trees and large shrubs may actually extract moisture from the expansive soils, thus causing contraction of the 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 Soil Engineer.





NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

PROJECT 20852-18

DATE JANUARY 2019

SITE PLAN

List of Appendices

(in order of appearance)

Appendix A

MAJOR DIVISION			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	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 MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	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 MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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 PROPORTIONS

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

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)

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.

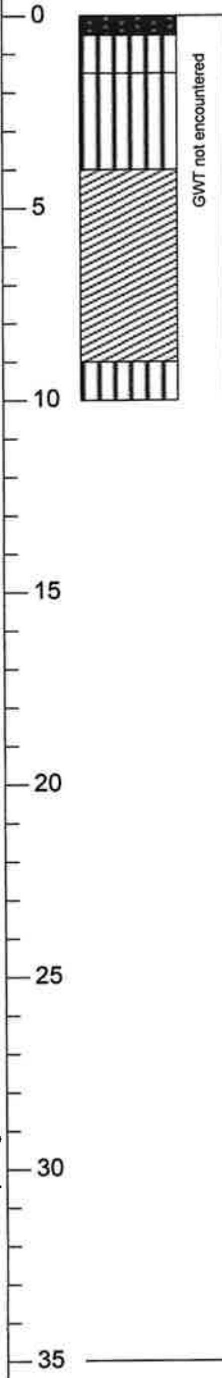
RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N -VALUE

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

Hager Pacific Properties, LLC
20852-18

Log of Boring B-1

Boring Location: Barton and Terrace, Colton
Date of Drilling: 12/19/18
Groundwater Depth: None Encountered
Drilling Method: Simco 2800HS
Hammer Weight: 140 lbs
Drop: 30"
Surface Elevation: Not Measured



Material Description	Samples Type	Samples Blow Counts	Laboratory Moisture	Laboratory Dry Density	Laboratory Fines Content %
Asphalt Pavement with Petromat					
FILL Sandy SILT Grey, firm, moist					
NATURAL Sandy SILT Brown, stiff, moist	■	8/12	8.9	114.0	
Clayey SILT Brown, stiff, moist	■	10/15	12.7	108.9	
Sandy SILT Brown, stiff, moist					

Boring completed at depth of 10'

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Hager Pacific Properties, LLC
20852-18

Log of Boring B-2

Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18

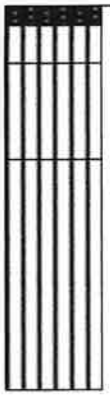
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lith-ology		Material Description	Samples		Laboratory		
				Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		GWT not encountered	Asphalt Pavement with Petromat					
			FILL Sandy to clayey SILT Grey, firm, moist					
5			NATURAL Clayey SILT Brown, stiff, moist					
			Sandy SILT Brown, stiff, moist					
10			Boring completed at depth of 10'					
15								
20								
25								
30								
35								

NorCal Engineering

Hager Pacific Properties, LLC
20852-18

Log of Boring B-3

Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18 **Groundwater Depth:** None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs **Drop:** 30"

Surface Elevation: Not Measured

Depth (feet)	Lith-ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	GWT not encountered	Asphalt Pavement with Petromat					
		FILL Sandy SILT Grey, firm, moist	■	5/14	13.4	112.8	
5		NATURAL Sandy SILT Brown, stiff, moist	■	11/13	14.7	111.4	
		Clayey SILT Brown, stiff, moist					
		Sandy SILT Brown, stiff, moist					
10			■	17/30	9.7	106.6	
15			■	35/45	11.3	110.7	
20		BEDROCK Decomposed Granite Silty (fine to coarse grained) SAND Brown, hard, moist	■	50-4"	8.0	115.3	
		Boring completed at depth of 20'					
25							
30							
35							

Hager Pacific Properties, LLC
20852-18

Log of Boring B-4

Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18

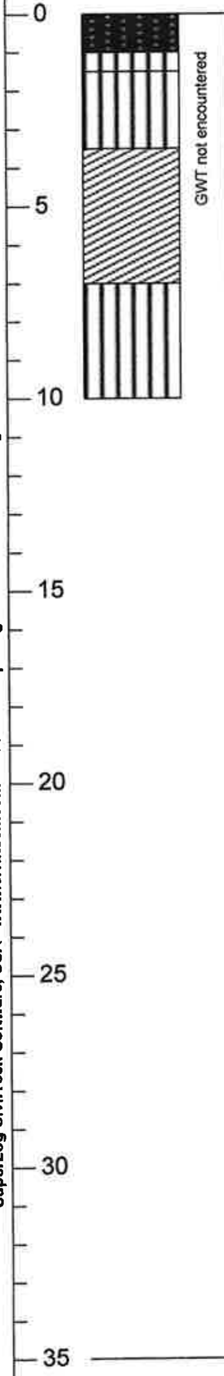
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured



Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
Asphalt Pavement with Petromat					
FILL Sandy SILT Grey, firm, moist					
NATURAL Sandy SILT Brown, firm, moist	■	3/5	12.9	103.9	
Clayey SILT Brown, stiff, moist					
Sandy SILT Brown, stiff, moist	■	8/12	10.5	111.2	

Boring completed at depth of 10'

Hager Pacific Properties, LLC
20852-18

Log of Boring B-5

Boring Location: Barton and Terrace, Colton
Date of Drilling: 12/19/18
Groundwater Depth: None Encountered
Drilling Method: Simco 2800HS
Hammer Weight: 140 lbs
Drop: 30"
Surface Elevation: Not Measured

GWT not encountered

Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	FILL Sandy SILT Grey, firm, moist					
	NATURAL Sandy SILT Brown, firm, moist	■ ☐	7/7	5.3	105.1	
5	Clayey SILT Brown, stiff to very stiff, moist	■	18/37	8.8	117.5	
10		■	16/23	7.7	112.5	
15	BEDROCK Decomposed Granite Silty (fine to coarse grained) SAND Brown, very hard, moist	■	50-3"	6.0	120.1	
	Boring completed at depth of 15'					
20						
25						
30						
35						

Hager Pacific Properties, LLC

20852-18

Log of Boring B-6

Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18

Groundwater Depth: None Encountered

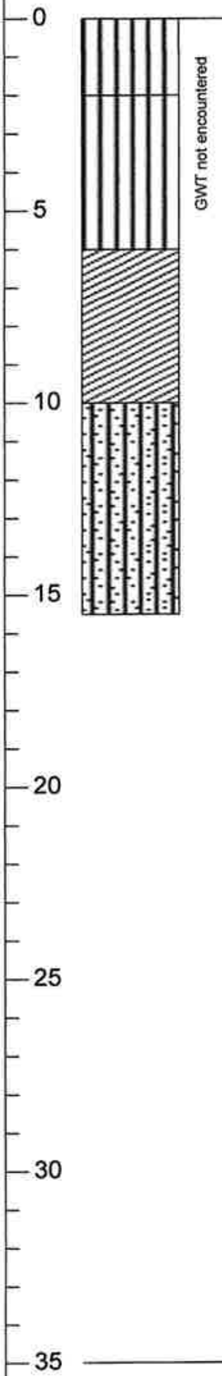
Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet) **Lith-ology**



Material Description	Samples		Laboratory		
	Type	Blow Counts	Moisture	Dry Density	Fines Content %
FILL Sandy SILT Grey, firm, moist					
NATURAL Sandy SILT Brown, stiff, moist					
Clayey SILT Brown, stiff, moist					
BEDROCK Decomposed Granite Silty (fine to coarse grained) SAND Brown, hard to very hard, moist					

Boring completed at depth of 15.5'

Hager Pacific Properties, LLC

20852-18

Log of Boring B-7

Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18

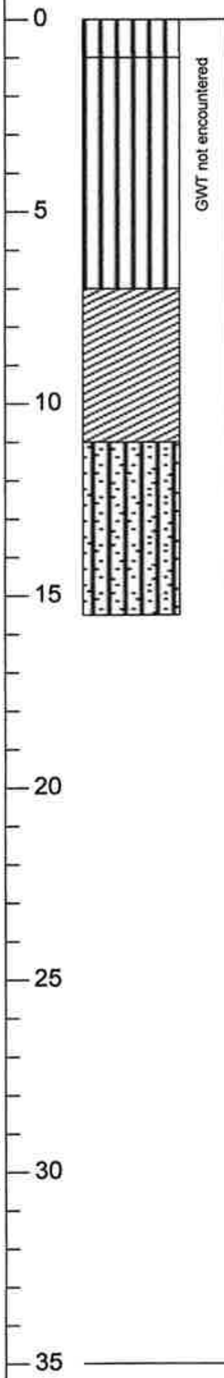
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured



Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
FILL Sandy SILT Grey, firm, moist					
NATURAL Sandy SILT Brown, stiff, moist					
Clayey SILT Brown, stiff, moist					
BEDROCK Decomposed Granite Silty (fine to coarse grained) SAND Brown, hard to very hard, moist					

Boring completed at depth of 15.5'

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Hager Pacific Properties, LLC

20852-18

Log of Boring B-8

Boring Location: Barton and Terrace, Colton	
Date of Drilling: 12/19/18	**Groundwater Depth:** None Encountered
Drilling Method: Simco 2800HS	
Hammer Weight: 140 lbs	**Drop:** 30"
Surface Elevation: Not Measured	

Depth (feet)	Lith-ology		Material Description	Samples		Laboratory		
				Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	▥	GWT not encountered	FILL Sandy SILT Grey, firm, moist					
	▨		NATURAL Sandy SILT Brown, stiff, moist					
5			Clayey SILT Brown, stiff, moist					
			Boring completed at depth of 5'					
10								
15								
20								
25								
30								
35								

Hager Pacific Properties, LLC
20852-18

Log of Boring B-9

Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18

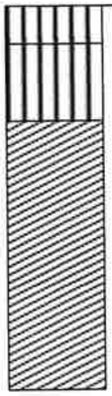
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured



Depth (feet)	Material Description	Samples		Laboratory		
		Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	FILL Sandy SILT Grey, firm, moist					
	NATURAL Sandy SILT Brown, stiff, moist					
5	Clayey SILT Brown, stiff, moist	■	8/15	10.7	114.9	
10	Boring completed at depth of 10'	■	12/18	13.8	116.0	
15						
20						
25						
30						
35						

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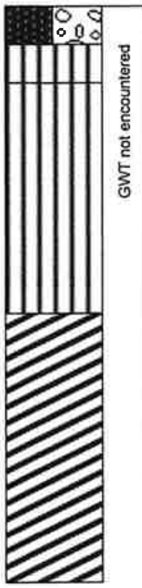
NorCal Engineering

Hager Pacific Properties, LLC 20852-18	Log of Boring B-10

Boring Location: Barton and Terrace, Colton	
Date of Drilling: 12/19/18	Groundwater Depth: None Encountered
Drilling Method: Simco 2800HS	
Hammer Weight: 140 lbs	Drop: 30"
Surface Elevation: Not Measured	



Depth (feet)	Lith-ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		Asphalt Pavement / Base Material					
		FILL Sandy SILT Brown, firm, moist	■	3/4	12.7	110.9	
5		NATURAL Sandy SILT Brown, firm, moist	■	3/5	14.4	107.6	
		Silty CLAY Brown, stiff, moist					
10			■	11/21	12.1	118.6	
15		Boring completed at depth of 15'	■	12/18	14.2	115.0	
20							
25							
30							
35							

NorCal Engineering

Hager Pacific Properties, LLC
20852-18

Log of Boring B-11

Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18

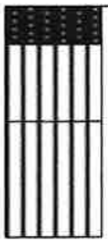
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured



Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	Asphalt Pavement with Petromat					
	FILL Sandy SILT Grey, firm, moist					
5	NATURAL Sandy SILT Brown, stiff, moist					
	Boring completed at depth of 6'					
10						
15						
20						
25						
30						
35						

Hager Pacific Properties, LLC
20852-18

Log of Boring B-12

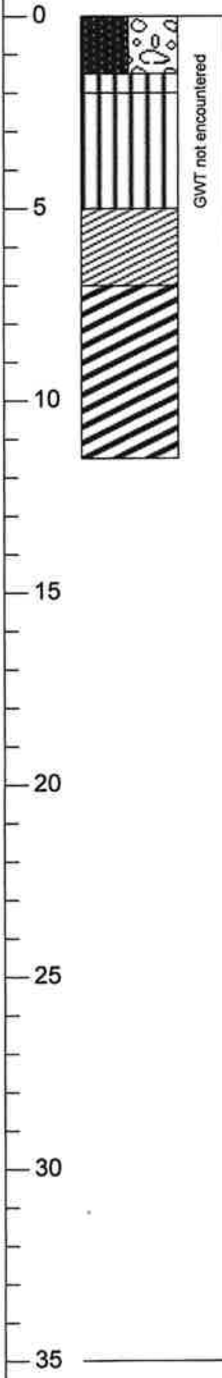
Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18 | **Groundwater Depth: None Encountered**

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs | **Drop: 30"**

Surface Elevation: Not Measured



Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
Asphalt Pavement / Base Material					
FILL Sandy SILT Brown, firm, moist					
NATURAL Sandy SILT Brown, stiff, moist					
Clayey SILT Brown, stiff, moist					
Silty CLAY Brown, stiff, moist					

Boring completed at depth of 11.5'

NorCal Engineering

Hager Pacific Properties, LLC

20852-18

Log of Boring B-13

Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18

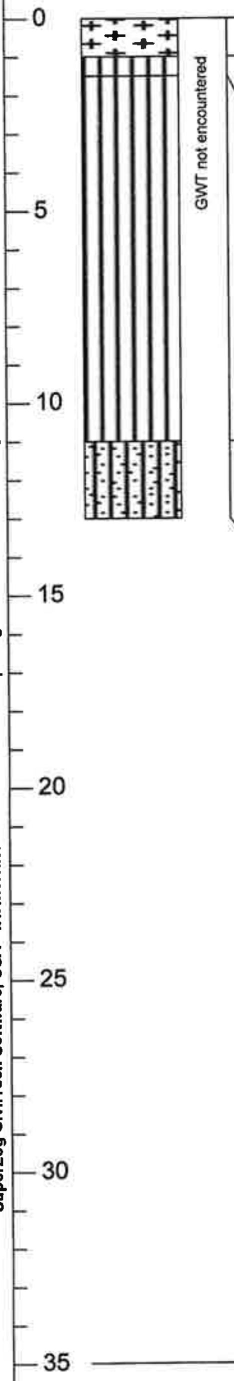
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured



Depth (feet)	Lith-ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
		Gravel					
		FILL Sandy SILT Grey, firm, moist					
		NATURAL Clayey SILT Brown, stiff, moist					
		BEDROCK Decomposed Granite Silty (fine to coarse grained) SAND Brown, hard, moist					
		Boring completed at depth of 13'					

Hager Pacific Properties, LLC

20852-18

Log of Boring B-14

Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18

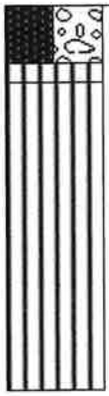
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured



GWT not encountered

Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	Asphalt Pavement / Base Material					
	FILL Clayey SILT Grey, firm, moist	☒				
	NATURAL Clayey SILT Brown, firm to stiff, moist	■	4/7	20.6	100.3	
		■	10/22	24.7	105.8	
10	Boring completed at depth of 10'					

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Hager Pacific Properties, LLC
20852-18

Log of Boring B-15

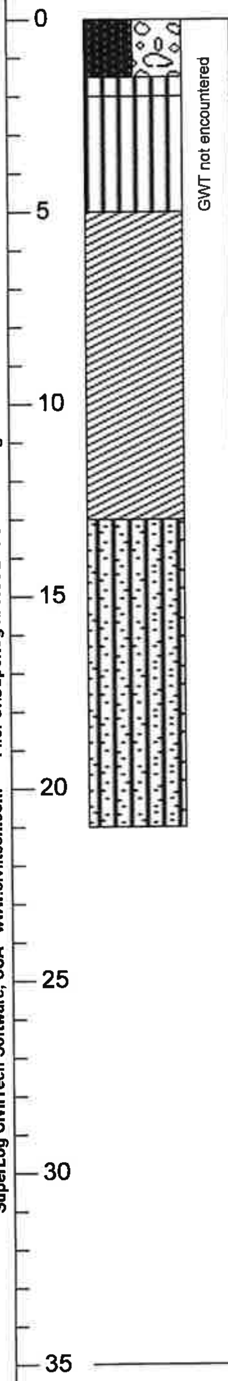
Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18 | **Groundwater Depth: None Encountered**

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs | **Drop: 30"**

Surface Elevation: Not Measured



Material Description	Samples		Laboratory		
	Type	Blow Counts	Moisture	Dry Density	Fines Content %
Asphalt Pavement / Base Material					
FILL Sandy SILT Brown, firm, moist	■	7/7	9.5	108.7	
NATURAL Sandy SILT Brown, stiff, moist	■	4/10	15.0	115.6	
Clayey SILT BRown, stiff, moist	■	9/11	13.6	117.3	
BEDROCK Decomposed Granite Silty (fine to coarse grained) SAND Brown, hard to very hard, moist	■	50-5"	12.3	110.9	
	■	40/50	8.1	112.4	

Boring completed at depth of 21'

Hager Pacific Properties, LLC
20852-18

Log of Boring B-16

Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18

Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lith-ology		Material Description	Samples		Laboratory		
				Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	▨	GWT not encountered	Asphalt Pavement / Base Material					
	▥		FILL Sandy SILT Brown, firm, moist					
	▥		NATURAL Sandy SILT Brown, firm to stiff, moist					
5	▨		Clayey SILT Brown, stiff, moist					
10	▥		Sandy SILT Brown, stiff, moist					
			Boring completed at depth of 10.5'					
15								
20								
25								
30								
35								

Hager Pacific Properties, LLC
20852-18

Log of Boring B-17

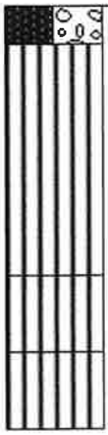
Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18 **Groundwater Depth:** None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs **Drop:** 30"

Surface Elevation: Not Measured



GWT not encountered

Depth (feet)	Lith-ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		Asphalt Pavement / Base Material					
5		FILL Sandy SILT Grey-brown, firm, moist					
		NATURAL Clayey SILT Brown, stiff, moist					
10		Sandy SILT Brown, stiff, moist					
		Boring completed at depth of 11'					
15							
20							
25							
30							
35							

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20852-18

Log of Boring B-18

Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18

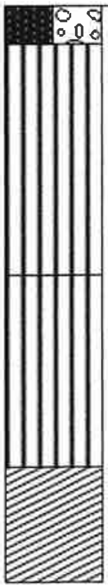
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured



Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	Asphalt Pavement / Base Material					
	FILL Sandy SILT Grey-brown to brown, firm to stiff, moist	■	9/14	13.1	117.4	
5		■	3/4	11.6	104.7	
	NATURAL Sandy SILT Brown, firm, moist					
10						
	Clayey SILT Brown, stiff, moist	■	13/21	13.4	117.1	
15	Boring completed at depth of 15'					
20						
25						
30						
35						

Hager Pacific Properties, LLC
20852-18

Log of Boring B-19

Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18

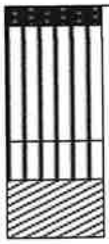
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

			Samples		Laboratory		
Depth (feet)	**Lith-ology**	**Material Description**	**Type**	**Blow Counts**	**Moisture**	**Dry Density**	**Fines Content %**
0		Asphalt Pavement					
	GWT not encountered	FILL Sandy to clayey SILT Grey, firm to stiff, moist	■	7/12	13.4	110.9	
5		NATURAL Sandy SILT Brown, stiff, moist					
		Clayey SILT Brown, stiff, moist					
		Boring completed at depth of 6'					
10							
15							
20							
25							
30							
35							

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\20852-18.log Date: 1/31/2019

Hager Pacific Properties, LLC
20852-18

Log of Boring B-20

Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18

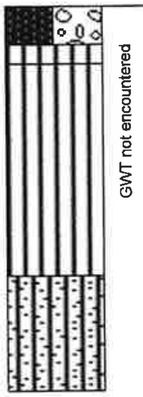
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured



Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	Asphalt Pavement / Base Materials					
	FILL Sandy SILT Brown, firm, moist	■	8/10	13.8	113.8	
5	NATURAL Sandy SILT Brown, stiff, moist	■	10/14	12.1	115.7	
	BEDROCK Decomposed Granite Silty (fine to coarse grained) SAND Brown, hard, moist	■	50-5"	8.5	119.7	
10	Boring completed at depth of 10'					
15						
20						
25						
30						
35						

Hager Pacific Properties, LLC
20852-18

Log of Boring B-21

Boring Location: Barton and Terrace, Colton

Date of Drilling: 12/19/18

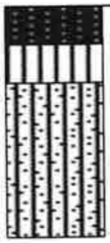
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured



			Samples		Laboratory		
Depth (feet)	Lith-ology	Material Description	Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		Asphalt Pavement / Base Material					
		FILL Sandy SILT Brown, firm, moist	■	7/24	12.6	111.2	
5		BEDROCK Decomposed Granite Silty (fine to coarse grained) SAND Brown, hard to very hard, moist	■	27/35	9.2	114.0	
		Boring completed at depth of 6'					
10							
15							
20							
25							
30							
35							

NorCal Engineering

Appendix B

TABLE I
MAXIMUM DENSITY TESTS

Sample	Classification	Optimum Moisture	Maximum Dry Density (lbs./cu.ft.)
B-5 @ 2'	Sandy SILT	13.0	124.0
B-14 @ 2'	Clayey SILT	15.0	115.0

TABLE II
EXPANSION TESTS

Sample	Classification	Expansion Index
B-5 @ 2'	Sandy SILT	18
B-14 @ 2'	Clayey SILT	60

TABLE III
ATTERBERG LIMITS

Sample	Liquid Limit	Plastic Limit	Plasticity Index
B-1 @ 5"	32	22	10
B-1 @ 10'	38	24	14
B-14 @ 5'	35	22	13
B-14 @ 10'	30	21	9

TABLE IV
CORROSION TESTS

Sample	pH	Electrical Resistivity	Sulfate (%)	Chloride (ppm)
B-5 @ 2'	7.1	2,111	0.003	233
B-14 @ 2'	7.2	2,854	0.005	221

% by weight
ppm – mg/kg

GMU
GEOTECHNICAL, INC.

R-VALUE TEST REPORT

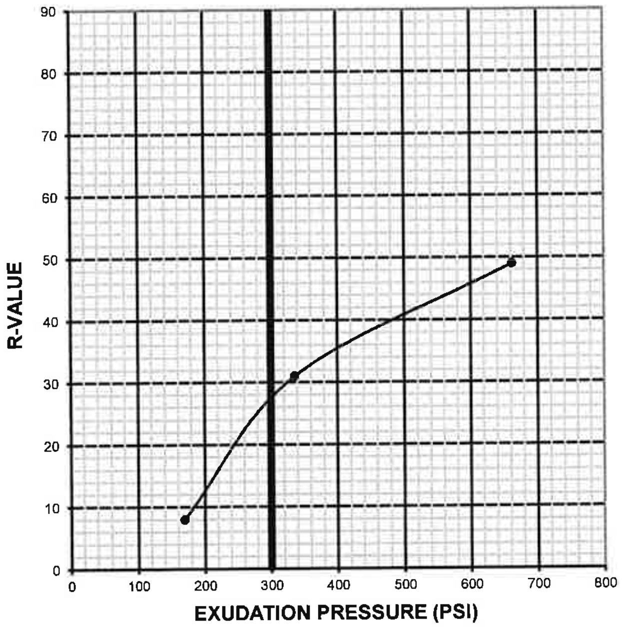
☑ CT-301 ☐ ASTM-D2844

PROJECT NAME: Norcal (Hager Pacific Properties, LLC)
SAMPLE LOCATION: Corner of Barton & Lacadena Dr. S, Colton CA
SAMPLE DESCRIPTION: Sandy Clay (CL), reddish brown
SAMPLED BY: J.S 12/19/18

PROJECT NUMBER: L-190101
SAMPLE NUMBER: B1
SAMPLE DEPTH: 1.5'
TESTED BY: RC
DATE TESTED: 1/16/2019

TEST SPECIMEN	A	B	C
MOISTURE AT COMPACTION %	14.9	12.5	11.3
WEIGHT OF SAMPLE, grams	1173	1127	1095
HEIGHT OF SAMPLE, Inches	2.68	2.47	2.42
DRY DENSITY, pcf	115.5	123.0	123.2
COMPACTOR AIR PRESSURE, psi	100	154	175
EXUDATION PRESSURE, psi	170	336	662
EXPANSION, Inches x 10exp-4	1	12	35
STABILITY Ph 2,000 lbs (160 psi)	134	84	51
TURNS DISPLACEMENT	5.66	5.08	5.58
R-VALUE UNCORRECTED	8	31	49
R-VALUE CORRECTED	8	31	49
EXPANSION PRESSURE (psf)	4.3	51.8	151.2

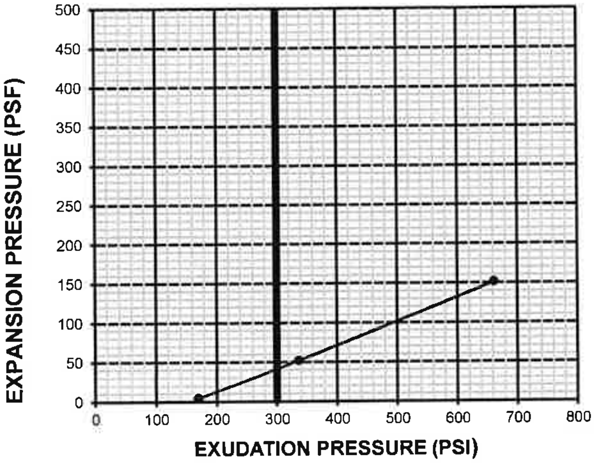
R-VALUE VS. EXUDATION PRESSURE



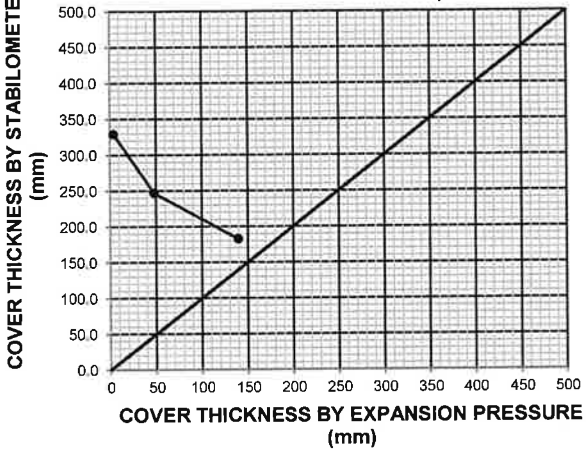
R-VALUE AT EQUILIBRIUM:	**27**

R-VALUE BY EXUDATION PRESSURE:	**27**
R-VALUE BY EXPANSION PRESSURE:	**N.A**
EXPANSION PRESSURE AT 300 PSI EXUDATION:	**40**
TRAFFIC INDEX (Assumed):	**5.5**
GRAVEL FACTOR (Assumed):	**1.5**
UNIT MASS OF COVER MATERIAL, kg/m^3 (Assumed):	**2100.0**

EXPANSION PRESSURE VS. EXUDATION PRESSURE

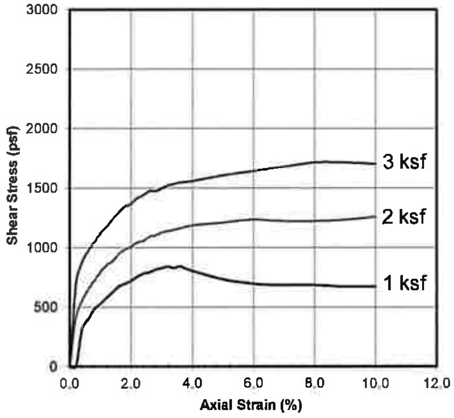


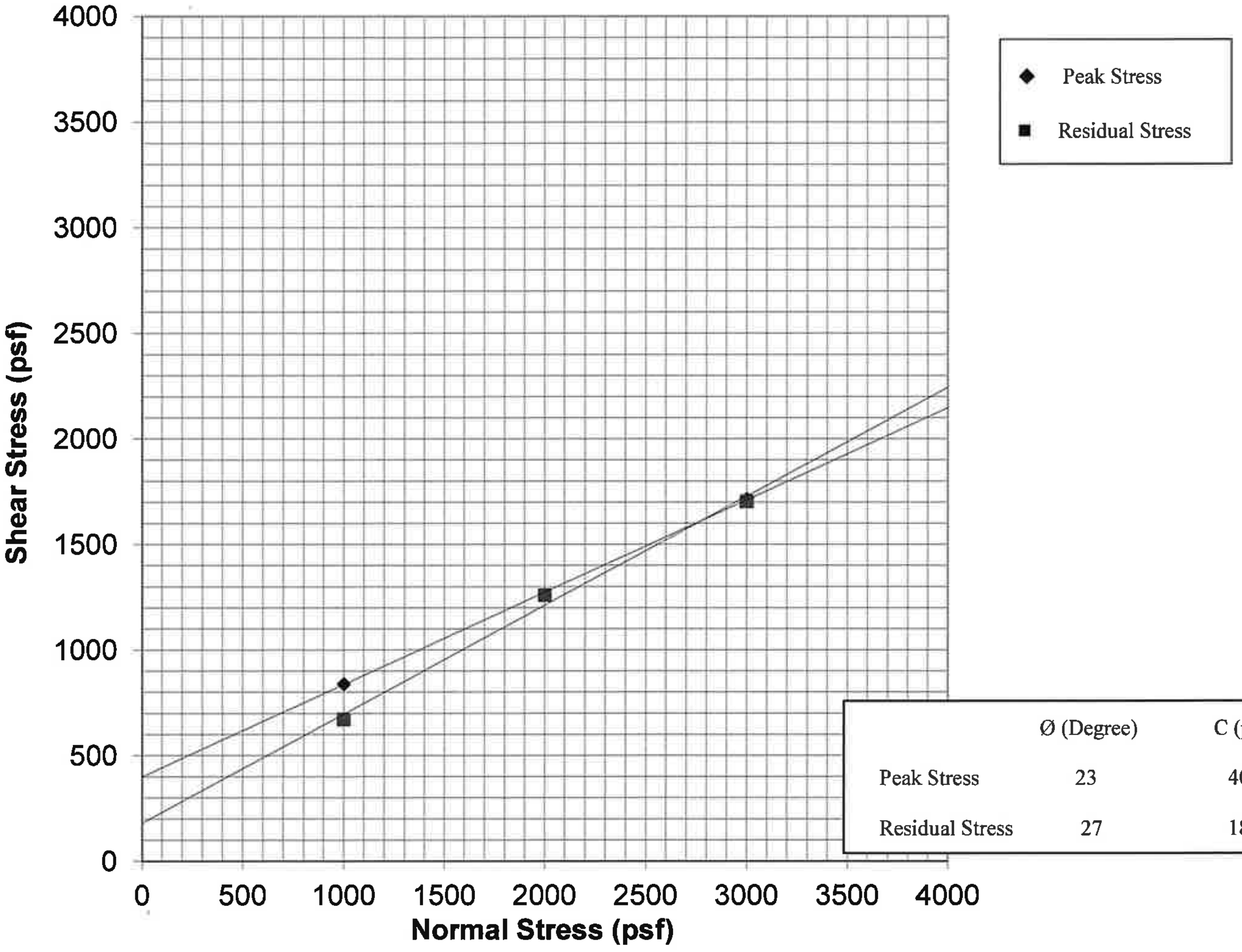
COVER THICKNESS (STABILOMETER BY EXPANSION PRESSURE)



Sample No.	B3@2'
Sample Type:	Undisturbed/Saturated
Soil Description:	Silty Clay w/ Some Fine Grained Sand

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	840	1260	1716
Displacement	(in)	0.080	0.250	0.200
Residual Stress	(psf)	672	1260	1704
Displacement	(in.)	0.250	0.250	0.250
In Situ Dry Density	(pcf)	112.8	112.8	112.8
In Situ Water Content	(%)	13.4	13.4	13.4
Saturated Water Content	(%)	18.2	18.2	18.2
Strain Rate	(in/min)	0.020	0.020	0.020





	Ø (Degree)	C (psf)
Peak Stress	23	400
Residual Stress	27	180

NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

Hager Pacific Properties, LLC

PROJECT NUMBER: 20852-18 DATE: 1/7/2019

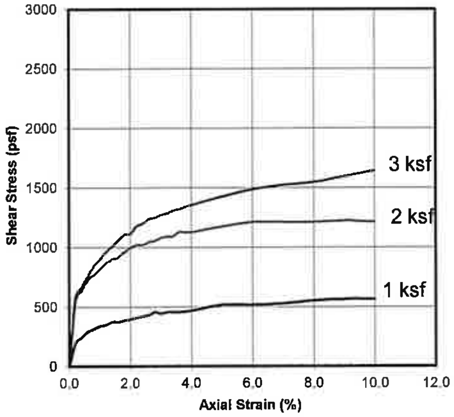
DIRECT SHEAR TEST

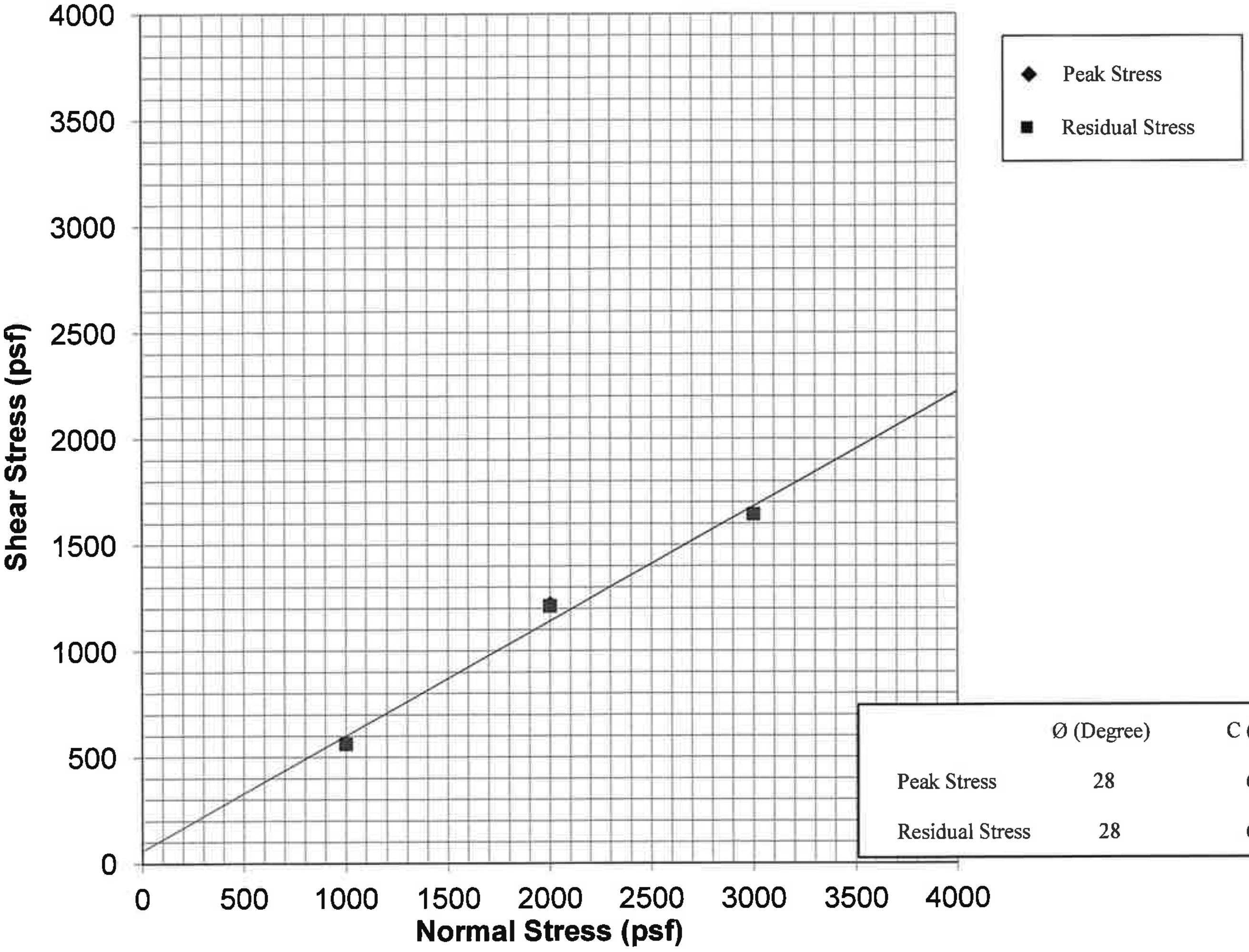
ASTM D3080

Plate A

Sample No.	B14@3'
Sample Type:	Undisturbed/Saturated
Soil Description:	Silty Clay

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	564	1224	1644
Displacement	(in.)	0.225	0.225	0.250
Residual Stress	(psf)	564	1212	1644
Displacement	(in.)	0.250	0.250	0.250
In Situ Dry Density	(pcf)	90.3	90.3	90.3
In Situ Water Content	(%)	20.6	20.6	20.6
Saturated Water Content	(%)	32.0	32.0	32.0
Strain Rate	(in/min)	0.020	0.020	0.020





	Ø (Degree)	C (psf)
Peak Stress	28	60
Residual Stress	28	60

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SOILS AND GEOTECHNICAL CONSULTANTS

Hager Pacific Properties, LLC

PROJECT NUMBER: 20852-18 DATE: 1/7/2019

DIRECT SHEAR TEST

ASTM D3080

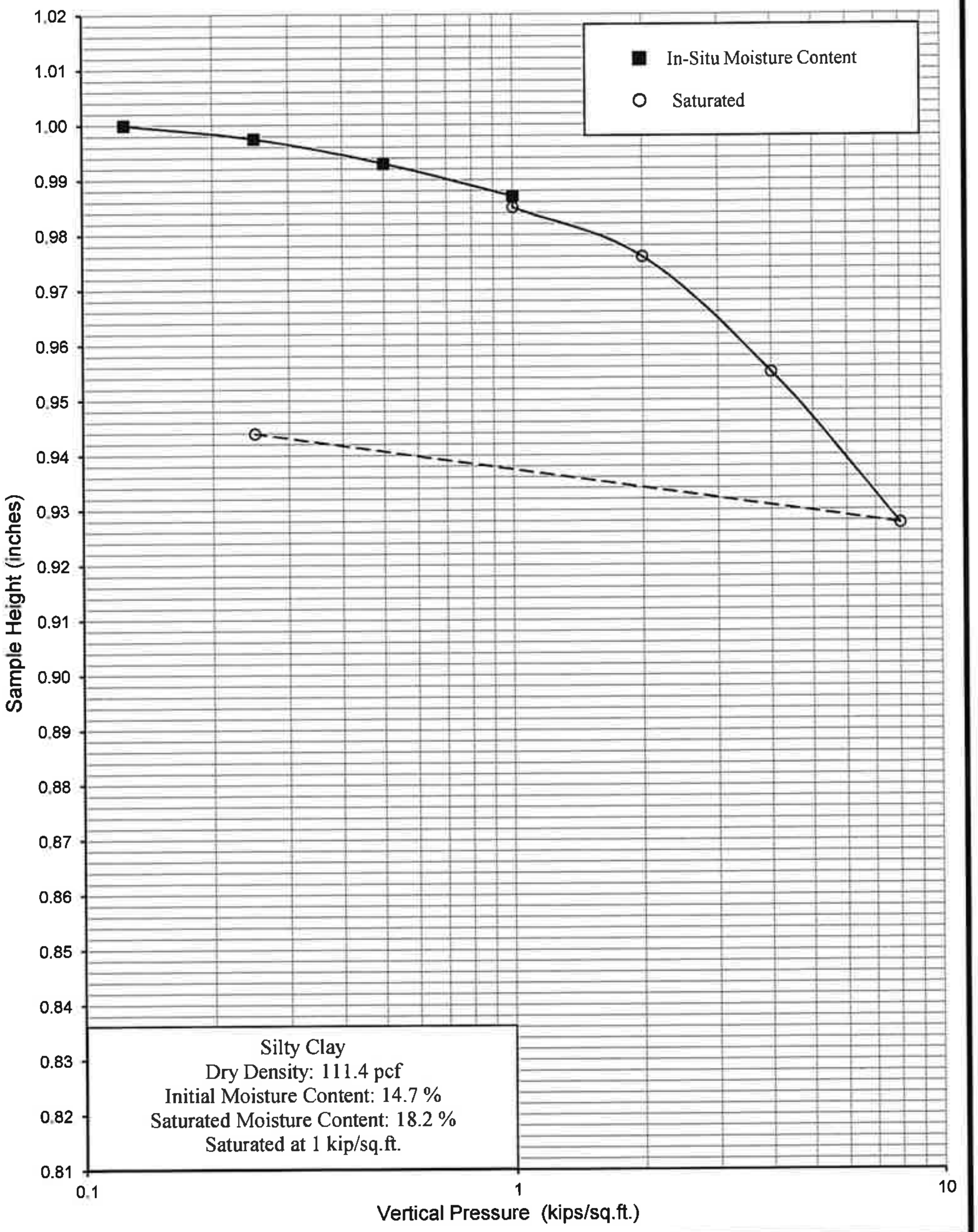
Plate B

Sample No. B3 | Depth 5' | Date 1/7/2019

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)
0.125	1.0000	0.0
0.25	0.9975	0.2
0.5	0.9930	0.7
1	0.9870	1.3
1	0.9850	1.5
2	0.9760	2.4
4	0.9550	4.5
8	0.9275	7.3
0.25	0.9440	5.6

Saturated

Date Tested: 1/2/2019
Sample: B3
Depth: 5'



Silty Clay
Dry Density: 111.4 pcf
Initial Moisture Content: 14.7 %
Saturated Moisture Content: 18.2 %
Saturated at 1 kip/sq.ft.

NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

Hager Pacific Properties, LLC

PROJECT NUMBER: 20852-18 DATE: 1/7/2019

CONSOLIDATION TEST

ASTM D2435

Plate C

Sample No. B3

Depth 10'

Date 1/7/2019

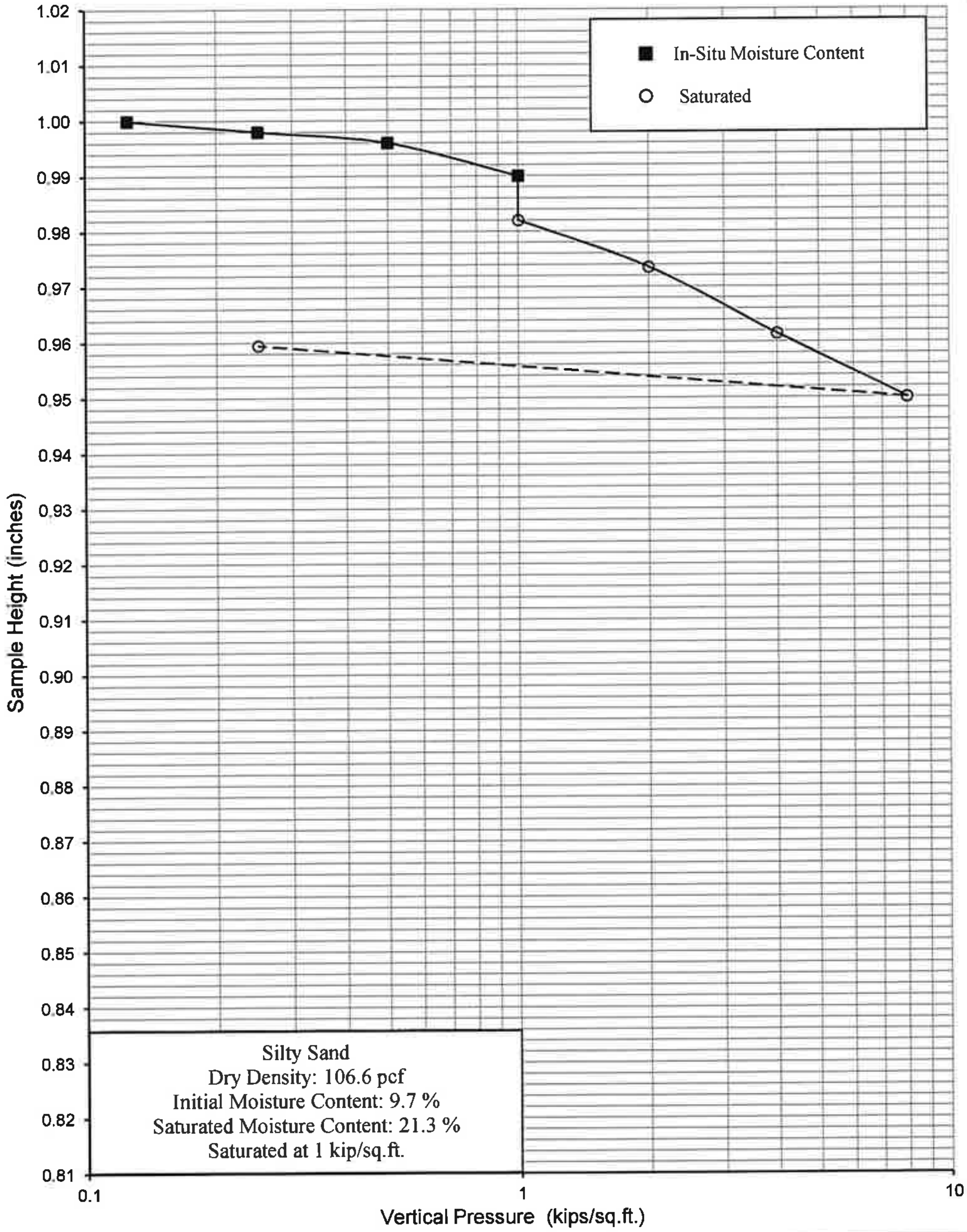
Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)
0.125	1.0000	0.0
0.25	0.9980	0.2
0.5	0.9960	0.4
1	0.9900	1.0
1	0.9820	1.8
2	0.9735	2.7
4	0.9615	3.9
8	0.9500	5.0
0.25	0.9595	4.1

Saturated

Date Tested: 1/2/2019

Sample: B3

Depth: 10'



Silty Sand
Dry Density: 106.6 pcf
Initial Moisture Content: 9.7 %
Saturated Moisture Content: 21.3 %
Saturated at 1 kip/sq.ft.

NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

Hager Pacific Properties, LLC

PROJECT NUMBER: 20852-18 DATE: 1/7/2019

CONSOLIDATION TEST

ASTM D2435

Plate D

Sample No. B15

Depth 5'

Date 1/7/2019

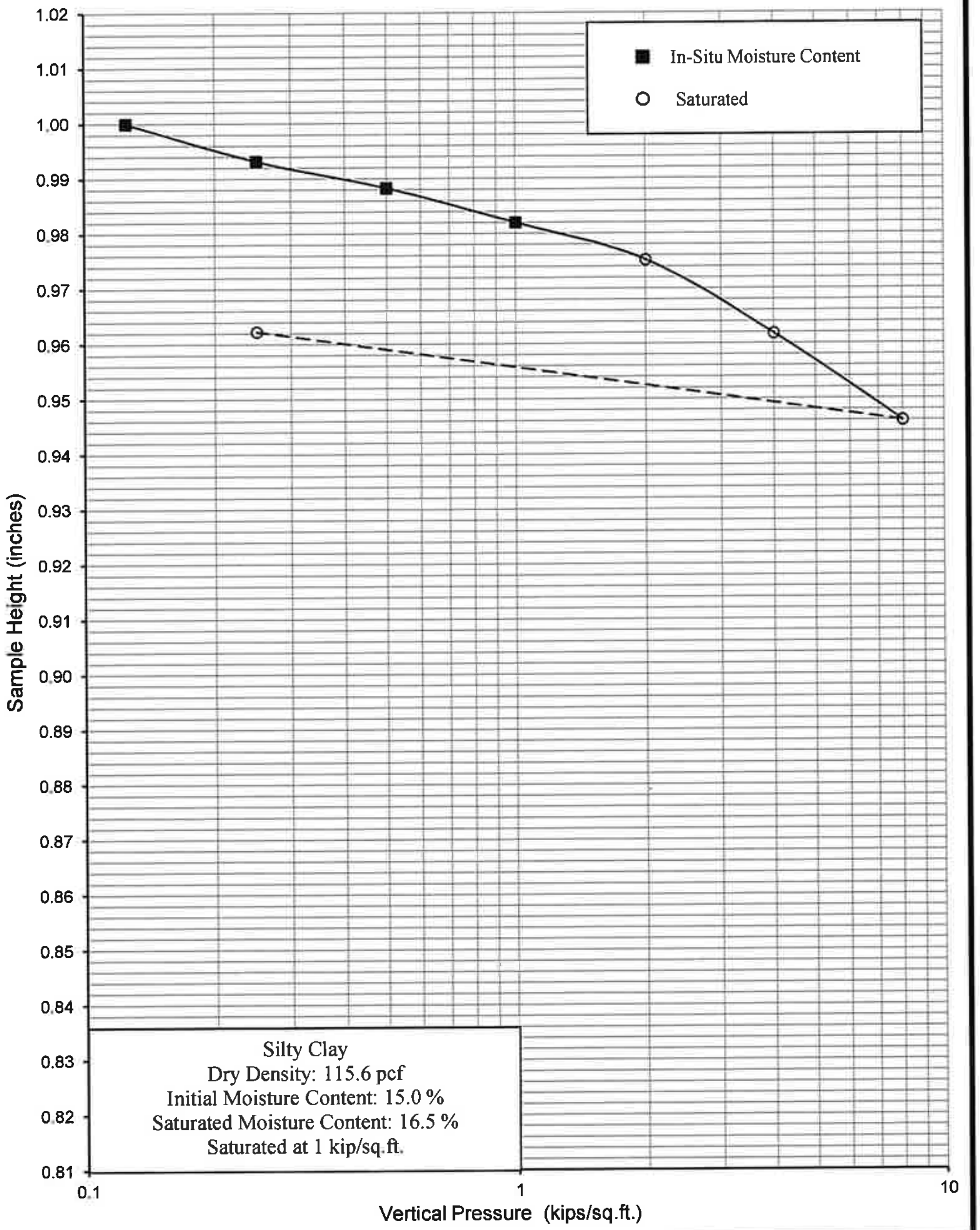
Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)
0.125	1.0000	0.0
0.25	0.9932	0.7
0.5	0.9883	1.2
1	0.9820	1.8
1	0.9820	1.8
2	0.9752	2.5
4	0.9618	3.8
8	0.9460	5.4
0.25	0.9623	3.8

Saturated

Date Tested: 1/2/2019

Sample: B15

Depth: 5'



Silty Clay
Dry Density: 115.6 pcf
Initial Moisture Content: 15.0 %
Saturated Moisture Content: 16.5 %
Saturated at 1 kip/sq.ft.

NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

Hager Pacific Properties, LLC

PROJECT NUMBER: 20852-18 DATE: 1/7/2019

CONSOLIDATION TEST

ASTM D2435

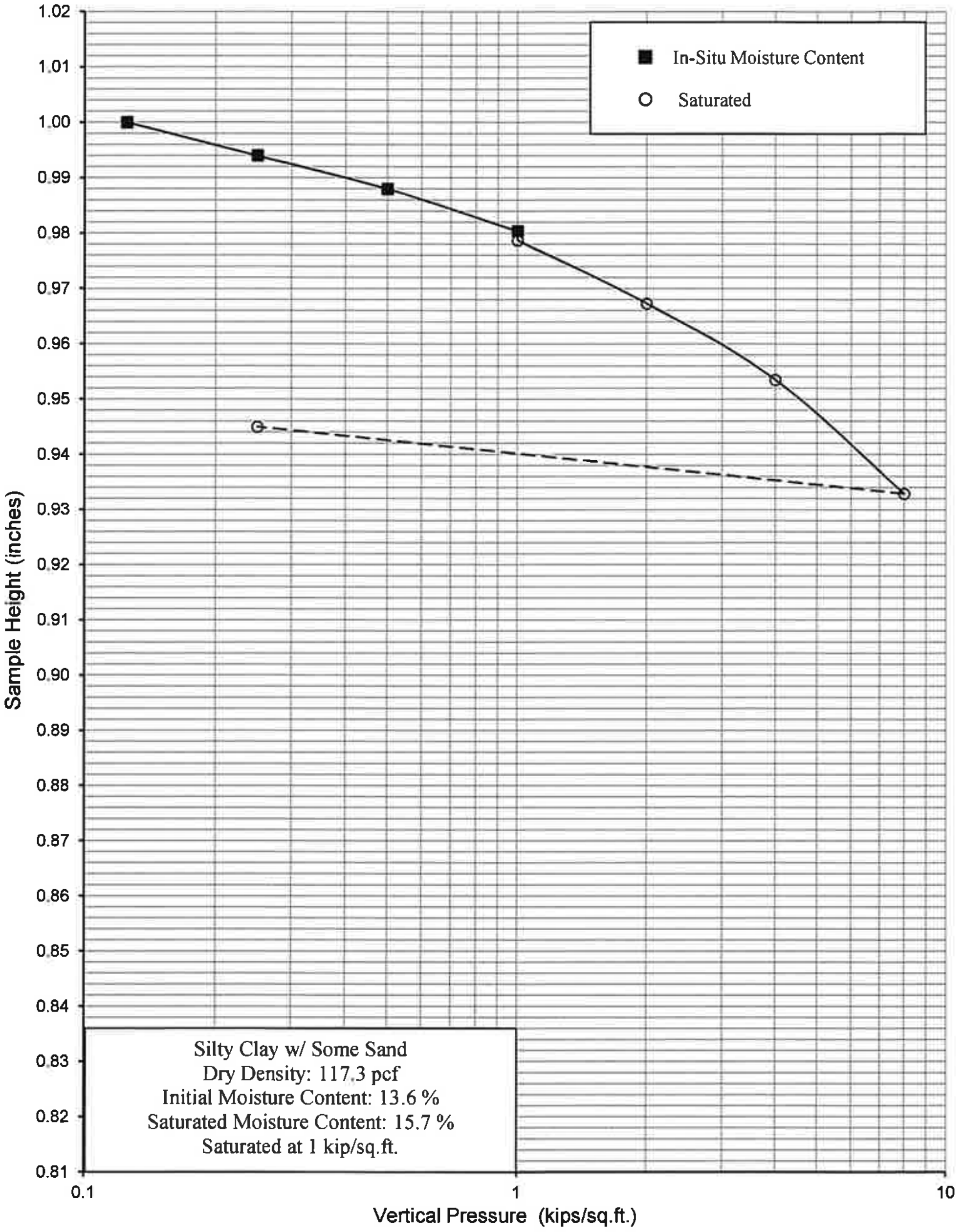
Plate E

Sample No. B15 | Depth 10' | Date 1/7/2019

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)
0.125	1.0000	0.0
0.25	0.9940	0.6
0.5	0.9880	1.2
1	0.9804	2.0
1	0.9787	2.1
2	0.9673	3.3
4	0.9535	4.7
8	0.9329	6.7
0.25	0.9450	5.5

Saturated

Date Tested: 1/3/2019
Sample: B15
Depth: 10'



Silty Clay w/ Some Sand
Dry Density: 117.3 pcf
Initial Moisture Content: 13.6 %
Saturated Moisture Content: 15.7 %
Saturated at 1 kip/sq.ft.

NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

Hager Pacific Properties, LLC

PROJECT NUMBER: 20852-18 DATE: 1/7/2019

CONSOLIDATION TEST

ASTM D2435

Plate F

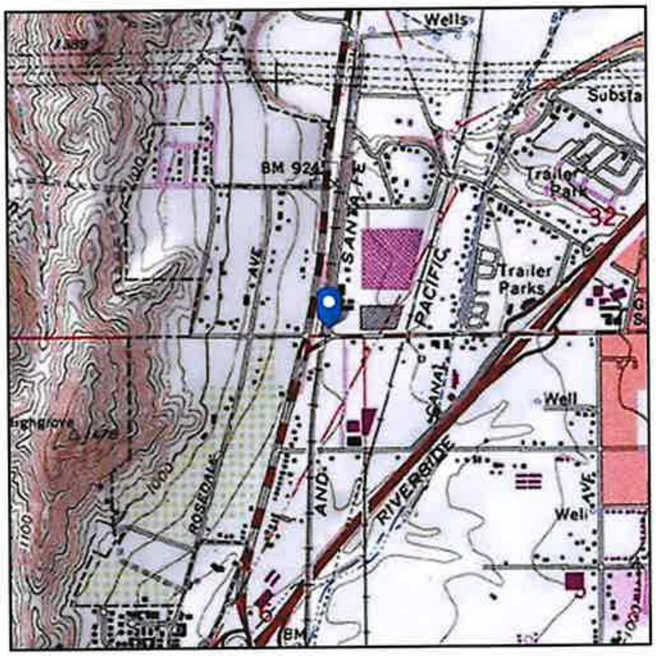
Appendix C

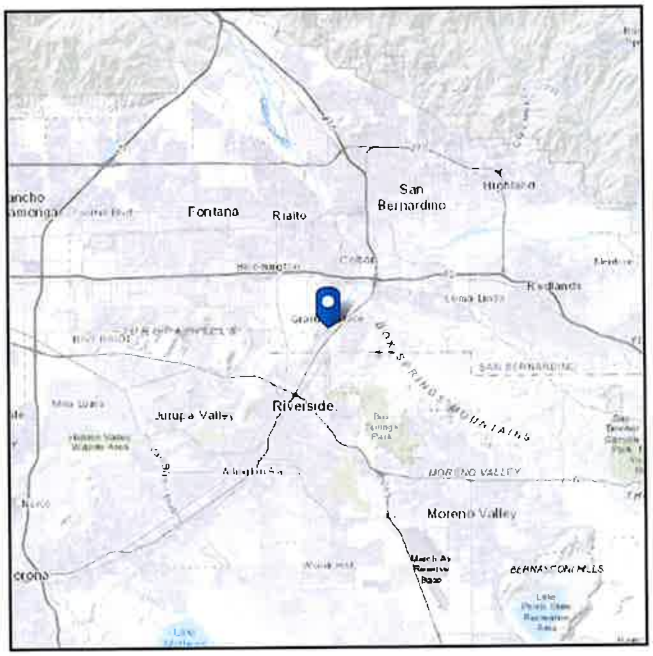
ASCE 7 Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-10
Risk Category: III
Soil Class: D - Stiff Soil

Elevation: 943.5 ft (NAVD 88)
Latitude: 34.033912
Longitude: -117.332349





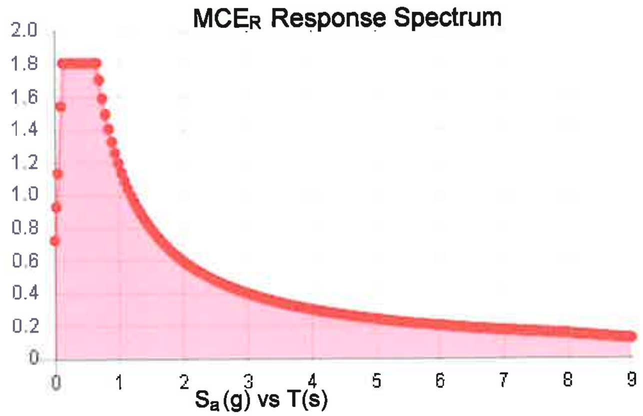
Seismic

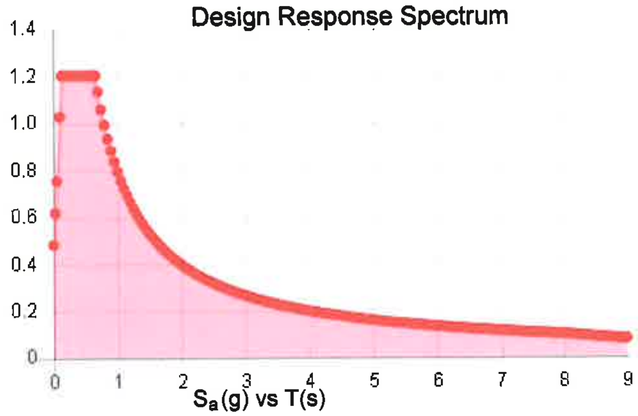
Site Soil Class: D - Stiff Soil

Results:

S_S :	1.806	S_{DS} :	1.204
S_1 :	0.795	S_{D1} :	0.795
F_a :	1	T_L :	8
F_v :	1.5	PGA :	0.706
S_{MS} :	1.806	PGA_M :	0.706
S_{M1} :	1.193	F_{PGA} :	1
		I_e :	1.25

Seismic Design Category E



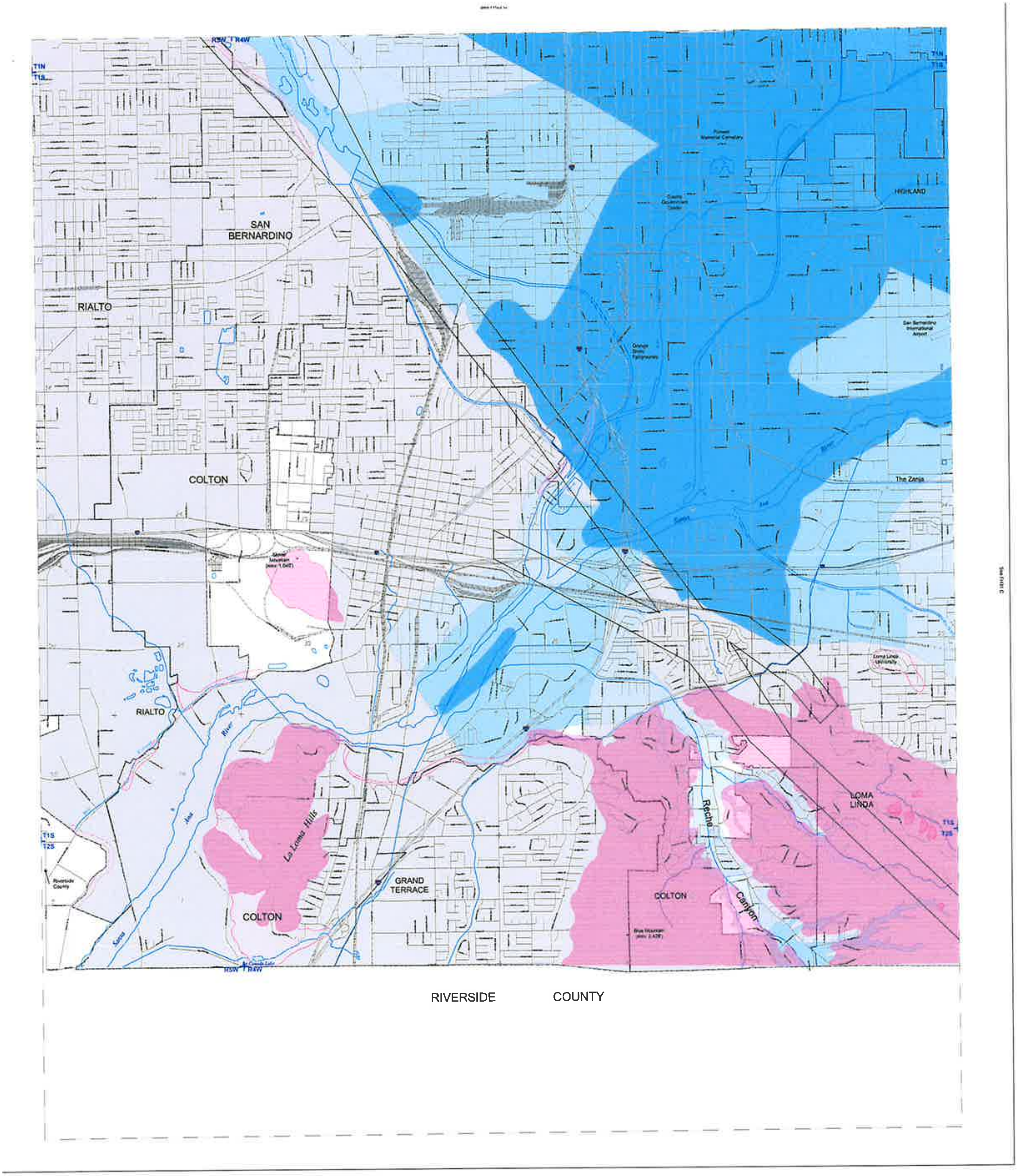


Data Accessed:	Tue Jan 22 2019
Date Source:	USGS Seismic Design Maps based on ASCE/SEI 7-10, incorporating Supplement 1 and errata of March 31, 2013, and ASCE/SEI 7-10 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-10 Ch. 21 are available from USGS.

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.

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.



San Bernardino County Land Use Plan
GENERAL PLAN
Geologic Hazard Overlays

Generalized Landslide Susceptibility

- ▭ Low to moderate
- ▬ Moderate to high
- ▭ Mapped, Existing Landslide
- ▭ Rockfall Debris-Flow Hazard Area (Inmost Falls Only)

Zone of Suspected Liquefaction Susceptibility

- ▭ Zone of Susceptibility

Generalized Liquefaction Susceptibility

- ▭ Low
- ▭ Medium
- ▬ High

Earthquake Fault Zones

- ▭ Cities
- —— Earthquake Fault Zone Boundary
- — - — County Designated Fault Zones

NOTICE

FH30 C
San Bernardino S

Appendix D

NORCAL
ENGINEERING
SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Hager Pacific Properties, LLC
Project Number: 20852-18
Test Hole No. 1

Name of Tester Javier Sanchez

Depth of Test Hole 15.5'

Date Tested 12/19/18

Diameter of Test Hole 8"

Caving______________

Date Excavated 12/18/18

Strata Peculiarities____

Sandy Soil Criteria Test

TIME	TRIAL NO	T1	H1	H2	D
1:55 2:25	1	30	0.0	30.0	30.0
2:25 2:55	2	30	0.0	28.5	28.5

_______ Soil Criteria

TIME	T1	TE	H1	H2	D
7:10 7:40	30	30	0.0	55.0	55.0
7:40 8:10	30	60	0.0	43.0	43.0
8:10 8:40	30	90	0.0	43.0	43.0
8:40 9:10	30	120	0.0	46.0	46.0
9:10 9:40	30	150	0.0	45.5	45.5
9:40 10:10	30	180	0.0	46.0	46.0
10:10 10:40	30	210	0.0	45.5	45.5
10:40 11:10	30	240	0.0	46.0	46.0
11:10 11:40	30	270	46.0	75.0	29.0
11:40 12:10	30	300	75.0	104.5	29.5

T1 – Time Interval (min.)
H2 – Final Water Level (in.)
TE – Total Elapsed Time (min.)
d – Change in H_2O Level (in.)
H1 – Initial Water Level

NORCAL ENGINEERING

SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Hager Pacific Properties, LLC
Project Number: 20852-18
Test Hole No. 2

Name of Tester Javier Sanchez

Depth of Test Hole 15.7'

Date Tested 12/19/18

Diameter of Test Hole 8"

Caving_______________

Date Excavated 12/18/18

Strata Peculiarities____

Sandy Soil Criteria Test

TIME	TRIAL NO	T1	H1	H2	D
2:20 2:50	1	30	0.0	48.5	48.5
2:50 3:20	2	30	0.0	39.0	39.0

_______ Soil Criteria

TIME	T1	TE	H1	H2	D
7:15 7:45	30	30	0.0	44.0	44.0
7:45 8:15	30	60	0.0	40.5	40.5
8:15 8:45	30	90	0.0	37.5	37.5
8:45 9:15	30	120	0.0	39.0	39.0
9:15 9:45	30	150	0.0	37.5	37.5
9:45 10:15	30	180	0.0	37.0	37.0
10:15 10:45	30	210	0.0	36.0	36.0
10:45 11:15	30	240	0.0	35.5	35.5
11:15 11:45	30	270	35.5	60.5	25.0
11:45 12:15	30	300	60.5	84.5	24.0

T1 – Time Interval (min.)
H2 – Final Water Level (in.)
TE – Total Elapsed Time (min.)
d – Change in H_2O Level (in.)
H1 – Initial Water Level

NORCAL
ENGINEERING
SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Hager Pacific Properties, LLC
Project Number: 20852-18
Test Hole No. 3

Name of Tester Javier Sanchez

Depth of Test Hole 13.1'

Date Tested 12/19/18

Diameter of Test Hole 8"

Caving______________

Date Excavated 12/18/18

Strata Peculiarities____

Sandy Soil Criteria Test

TIME	TRIAL NO	T1	H1	H2	D
10:40	1	30	0.0	104.0	104.0
11:10					
11:10	2	30	0.0	94.5	94.5
11:40					

______ Soil Criteria

TIME	T1	TE	H1	H2	D
11:42	10	10	0.0	72.0	72.0
11:52					
11:52	10	20	0.0	70.5	70.5
12:02					
12:02	10	30	0.0	71.0	71.0
12:12					
12:12	10	40	0.0	69.0	69.0
12:22					
12:22	10	50	0.0	70.5	70.5
12:32					
12:32	10	60	0.0	71.5	71.5
12:42					
12:42	10	70	0.0	69.0	69.0
12:52					
12:52	10	80	0.0	70.0	70.0
1:02					
1:02	10	90	70.0	77.5	7.5
1:12					
1:12	10	100	77.5	86.0	8.5
1:22					

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

TE – Total Elapsed Time (min.)
d – Change in H_2O Level (in.)

H1 – Initial Water Level

NORCAL
ENGINEERING
SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Hager Pacific Properties, LLC
Project Number: 20852-18
Test Hole No. 4

Depth of Test Hole 11.6’

Diameter of Test Hole 8”

Date Excavated 12/18/18

Name of Tester Javier Sanchez

Date Tested 12/19/18

Caving________________

Strata Peculiarities____

Sandy Soil Criteria Test

TIME	TRIAL NO	T1	H1	H2	D
8:13	1	30	0.0	18.1	18.0
8:43					
8:43	2	30	0.0	17.5	17.5
9:13					

________ Soil Criteria

TIME	T1	TE	H1	H2	D
7:20	30	30	0.0	19.0	19.0
7:50					
7:50	30	60	0.0	21.0	21.0
8:20					
8:20	30	90	0.0	14.5	14.5
8:50					
8:50	30	120	0.0	16.0	16.0
9:20					
9:20	30	150	0.0	15.0	15.0
9:50					
9:50	30	180	0.0	15.5	15.5
10:20					
10:20	30	210	0.0	16.5	16.5
10:50					
10:50	30	240	0.0	15.5	15.5
11:20					
11:20	30	270	15.5	34.0	18.5
11:50					
11:50	30	300	34.0	48.0	14.0
12:20					

T1 – Time Interval (min.)
H2 – Final Water Level (in.)
TE – Total Elapsed Time (min.)
d – Change in H_2O Level (in.)
H1 – Initial Water Level

NORCAL
ENGINEERING

SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Hager Pacific Properties, LLC
Project Number: 20852-18
Test Hole No. 5

Depth of Test Hole 10.9'

Diameter of Test Hole 8"

Date Excavated 12/18/18

Name of Tester Javier Sanchez

Date Tested 12/19/18

Caving__________

Strata Peculiarities____

Sandy Soil Criteria Test

TIME	TRIAL NO	T1	H1	H2	D
9:32	1	30	0.0	11.0	11.0
10:02					
10:02	2	30	0.0	10.0	10.0
10:32					

_______ Soil Criteria

TIME	T1	TE	H1	H2	D
7:27	30	30	0.0	7.5	7.5
7:57					
7:57	30	60	0.0	6.0	6.0
8:27					
8:27	30	90	0.0	6.0	6.0
8:57					
8:57	30	120	0.0	5.5	5.5
9:27					
9:27	30	150	0.0	6.0	6.0
9:57					
9:57	30	180	0.0	5.5	5.5
10:27					
10:27	30	210	0.0	6.5	6.5
10:57					
10:57	30	240	0.0	6.0	6.0
11:27					
11:27	30	270	6.0	12.0	6.0
11:57					
11:57	30	300	12.0	17.0	5.0
12:27					

T1 – Time Interval (min.)
H2 – Final Water Level (in.)
TE – Total Elapsed Time (min.)
d – Change in H_2O Level (in.)
H1 – Initial Water Level

NORCAL ENGINEERING

SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Hager Pacific Properties, LLC
Project Number: 20852-18
Test Hole No. 6

Name of Tester Javier Sanchez

Depth of Test Hole 10.7'

Date Tested 12/19/18

Diameter of Test Hole 8"

Caving ______________

Date Excavated 12/18/18

Strata Peculiarities ____

Sandy Soil Criteria Test

TIME	TRIAL NO	T1	H1	H2	D
8:57 9:27	1	30	0.0	10.0	10.0
9:27 9:57	2	30	0.0	9.0	9.0

_______ Soil Criteria

TIME	T1	TE	H1	H2	D
7:24 7:54	30	30	0.0	10.5	10.5
7:54 8:24	30	60	0.0	7.0	7.0
8:24 8:54	30	90	0.0	7.0	7.0
8:54 9:24	30	120	0.0	7.5	7.5
9:24 9:54	30	150	0.0	7.0	7.0
9:54 10:24	30	180	0.0	7.0	7.0
10:24 10:54	30	210	0.0	7.5	7.5
10:54 11:24	30	240	0.0	7.0	7.0
11:24 11:54	30	270	7.0	12.5	5.5
11:54 12:24	30	300	12.5	18.0	5.5

T1 – Time Interval (min.)	**TE – Total Elapsed Time (min.)**	**H1 – Initial Water Level**
H2 – Final Water Level (in.)	**d – Change in H_2O Level (in.)**	

SOIL INFILTRATION RATE CALCS ⇒ Auger Boring

Location:	TH-1	TH-2	TH-3	TH-4	TH-5	TH-6
• Depth =	15.5'	15.7'	13.1'	11.6'	10.9'	10.7'
• Hole Dia. =	8"	8"	8"	8"	8"	8"
• Drop = Δd	58.5"	48"	16"	32.5"	11"	11"
• Time = Δt Interval	1.0hr	1.0hr	0.33hr	1.0hr	1.0hr	1.0hr
• Preadjusted Perc. Rate	58.5 in/hr	48 in/hr	48 in/hr	32.5 in/hr	11 in/hr	11 in/hr
• Initial Water Depth = d_1	140"	153"	87"	124"	125"	121"
• Reduction Factor = R_f	28.7	33.3	20.8	27.9	30.9	29.9
• INFILTRATION RATE	2.0 in/hr	1.4 in/hr	2.3 in/hr	1.2 in/hr	0.4 in/hr	0.4 in/hr

$$\text{Infiltration Rate} = \frac{\text{Preadjusted Perc. Rate}}{\text{Reduction Factor}}$$

$$\text{Reduction Factor} = R_f = \left[\frac{2 \cdot d_1 - \Delta d}{\text{Dia.}}\right] + 1$$

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

DATE

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E.2 - Geotechnical Report Review

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Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

May 5, 2020

Project No. 12628.001

To: First Carbon Solutions (FCS)
250 Commerce #250
Irvine, California 92602

Attention: Ms. Cecilia So

Subject: CEQA-Level Geologic and Geotechnical Review for the Proposed Barton Warehouse Project, Barton Road and Terrace Avenue, City of Colton, California

In accordance with your request and authorization, Leighton Consulting, Inc. (Leighton) has conducted a geologic and geotechnical review of the site of a proposed industrial warehousing/distribution development, located south of Walnut Avenue, east of the BNSF railroad tracks (which are east of La Cadena Drive), and north of De Berry Street in the City of Colton, California. Barton Road divides the site. The purpose of our study has been to assess the geologic and geotechnical conditions of the site with respect to the proposed development, based on available data and to discuss potential geologic and geotechnical impacts associated with the project in accordance with the California Environmental Quality Act (CEQA). As such, we followed the California Geological Survey's Guidelines for Geologic/Seismic Considerations in EIR's (CGS Note 46). As a part of our study, we reviewed the geotechnical report previously prepared for the site provided by you as noted below:

- *Geotechnical Engineering Investigation, Proposed Industrial Warehouse Development, Corner of Barton Road and Terrace Avenue, Colton, California*, prepared by NorCal Engineering, Inc., Project Number 20852-18, dated January 25, 2019.

Where appropriate, preliminary recommendations to mitigate potential geologic hazards have been provided.

Our work has included the following:

- Review and discuss site geology and potential geologic hazards based on review of available information, including the geotechnical engineering investigation study by NorCal (2019) previously prepared for the project.

- Review and discuss geotechnical characteristics of the subsurface earth materials based on available data, including data in the report by NorCal, to evaluate the potential impacts on the project site.

- Review and discuss the geotechnical recommendations for the site as presented in the report by NorCal.

- Preparation of this report presenting the results of our review.

No subsurface exploration or laboratory testing were conducted as part of our work.

Site Conditions and Proposed Development

The site of the proposed development is approximately 45.9 acres in area, located on both sides of Barton Road. The portion on the north side of Barton Road is bounded by Terrace Avenue on the west, Walnut Avenue on the north, and an overhead power line corridor on the east. The portion of the site on the south side of Barton Road is bounded by the BNSF railroad tracks to the west, De Berry Street to the south, and the overhead power line corridor on the east; the southern portion encompasses the existing Terrace Avenue. Adjacent to the subject site are commercial/residential properties to the north, industrial developments to the east and south, and residential properties to the west. The property currently contains two relatively large industrial buildings with surrounding asphalt and concrete pavement. An undeveloped parcel is located in the southeastern portion of the site. The property is relatively flat and drains gently to the southwest.

It is our understanding that the property is being considered for an industrial warehouse development consisting of 410,620- and 539,360-square-foot buildings. Plans are in development. We have referenced the site plan that accompanied the geotechnical engineering investigation report prepared by NorCal for our review.

Previous Geotechnical Report

NorCal Engineering, Inc. conducted a design-phase geotechnical study for the property in 2019. Their work included excavating, logging, and sampling 21 hollow-stem borings reaching a maximum depth of 20 feet below the existing surface to evaluate the site subsurface soils. Their study concluded that the proposed development is feasible from a geotechnical standpoint, provided that the recommendations in their report are incorporated and implemented during site development.

Earth Units

The site was mapped by Norcal as being underlain by fill, natural soils, and bedrock. The fill they encountered was loose, classified as sandy to clayey silt, and extended to depths ranging from 1 to 2 feet below the existing ground surface (bgs). The undifferentiated natural soils NorCal encountered were firm/stiff and classified as sandy to clayey silt or silty clay. The bedrock they encountered was decomposed granite, hard to very hard, encountered at depths ranging from 7 to 13 feet bgs (NorCal, 2019).

Groundwater

NorCal did not encounter groundwater in their borings and indicated bedrock to be relatively shallow beneath the site, and indicated that regional groundwater was not anticipated beneath the site. Groundwater does not appear to be a constraint to development.

Seismic Design Parameters

The NorCal 2019 geotechnical report included seismic recommendations based on the 2016 California Building Code (CBC). We have reviewed the seismic parameters and they are in accordance with the 2016 CBC. However, if the project will be designed based on the 2019 CBC (effective January 1, 2020), then the seismic parameters should be updated to be in accordance with the 2019 CBC and ASCE 7-16.

GEOLOGIC AND SEISMIC HAZARDS

Fault-Induced Ground Rupture

The site has been mapped to be outside of Earthquake Fault Zones as designated by the California Geological Survey. The site has no known active faults mapped onsite nor trending towards the site (see Figure 3, *Regional Fault Map*). The closest known active faults to the site are related to the San Jacinto Fault, which has been mapped to trace approximately 2.5 miles northeast of the site. Considering the site's location relative to mapped active faulting, the potential for fault-induced ground rupture is considered to be less than significant.

Seismic Ground Shaking

The intensity of ground shaking at a given location depends on several factors, but primarily on the earthquake magnitude, the distance from the hypocenter to the site of interest, and the response characteristics of the soil or bedrock units underlying the site. The San Jacinto Fault Zone is currently known to be potentially capable of producing the most intense ground accelerations at the site, due to its location and potential magnitude. The maximum earthquake expected from the San Jacinto Fault Zone in this area is of magnitude (M_w=6.5 to 7.5).

In the site area, the hazard posed by seismic shaking is considered high, due to the proximity of known active faults. Therefore, seismic ground shaking is considered to be a potentially significant impact.

Mitigation Measures: There is no realistic way in which the hazard of seismic shaking can be totally avoided. However, the potential for future ground shaking at the site appears no greater than at many other sites in southern California. Furthermore, it should be recognized that while it is not considered feasible to make structures totally resistant to seismic shaking, they should be designed not to collapse in accordance with the current California Building Code and ASCE 7. The effects of seismic shaking on structures can be reduced through conformance with the recommendations of the geotechnical consultant for the project, the Structural Engineers Association of California, the California Building Code, and/or other local governing agencies' codes or requirements. This has the purpose of promoting safety in the event of a large earthquake and minimizing damage. Design in accordance with these measures is expected to reduce the impact of ground shaking to less than significant.

Liquefaction and Lateral Spreading

The County of San Bernardino has mapped the site to be outside a Zone of Suspected Liquefaction Susceptibility. The State of California has not prepared a map delineating zones of potential liquefaction for the quadrangle that contains the site. The potential for liquefaction and lateral spreading are low due to the presence of shallow bedrock and the lack of groundwater underlying the site as reported in NorCal's report. The potential for liquefaction and lateral spreading is considered to be less than significant.

Seismically Induced Landslides

The County of San Bernardino has mapped the site to be outside an area of Generalized Landslide Susceptibility. The State of California has not prepared a map delineating zones seismically induced landsliding for the quadrangle that contains the site. The potential for landsliding onsite is considered less than significant due to the relative flatness and levelness of the site and immediate surroundings.

Seismically Induced Settlement

Based on NorCal's report, the site is underlain by 7 to 13 feet of fill and natural soil (consisting mostly of silts and clays), which mantle hard to very hard bedrock. Based on the relatively thin layer of soil, we anticipate that the potential total settlement resulting from seismic loading is within typical tolerable limits. Seismically induced differential settlement is not considered to be a major constraint. As such, the risk associated with seismically induced settlement is considered to be less than significant.

Flooding

As shown on Figure 4, *Flood Hazard Zone Map*, the site is located outside of 500-year and 100-year flood zones as recognized by the City of Colton (2018) as well as the Federal Emergency Management Agency (2008). Because the site is located outside mapped flood zones, the risk associated with flooding is considered to be less than significant.

Seismically Induced Flooding

Earthquake-induced flooding can be caused by failure of dams or other water-retaining structures as a result of an earthquake. The site is not located within a dam inundation area as delineated by the California Department of Water Resources (2020).

Additionally, the City of Colton's Safety Element of the General Plan (2018) indicates that the site is located outside an area susceptible to dam inundation from the Seven Oaks Dam, located approximately 14 miles to the northeast. Considering that the site is located outside State and City delineated dam inundation zones, the potential for inundation at the site from earthquake-induced dam failure is less than significant.

Seiches and Tsunamis

A tsunami, or seismically generated sea wave, is generally created by a large, distant earthquake occurring near a deep ocean trough. A seiche is an earthquake-induced wave in a confined body of water, such as a lake or reservoir. Damage from tsunamis is confined to coastal areas that are 20 feet or less above sea level. Since the project is not located near the coast or any confined bodies of water, the risk of inundation from a tsunami or seiche has no impact.

Slope Stability and Landslides

Grading plans were not available at the time of this report. However, if final design plans include the construction of manufactured slopes, slope stability constraints may then exist. Consequently, the hazard posed by unstable manufactured slopes is considered to be potentially significant.

Mitigation Measures: Future site-specific geotechnical analysis of the development site should be conducted once grading plans are developed. Future studies should analyze this potential hazard in light of the proposed grading and development plans and present recommendations to protect the proposed improvements. Slopes should be constructed in accordance with the recommendations of the project geotechnical engineer, California Building Code and any City and/or County guidelines. Implementation of slope stabilization measures during design and grading of the project will reduce the impact of slope instability in manufactured slopes to less than significant.

Soil Expansion

NorCal laboratory testing of selected samples indicated soils with Expansion Indices of 18 and 60. Based on laboratory testing results presented in NorCal's report, onsite soils are expected to have very low to medium expansion potential. Considering this, the impact posed by expansive soils is considered potentially significant.

Mitigation Measures: Geotechnical foundation and retaining wall recommendations should consider soils with medium expansion potential. With mitigation, impact of expansive soils will be considered less than significant.

Sedimentation and Erosion

The native soils onsite, as well as fill slopes constructed with native soils, will have a high susceptibility to erosion. These materials will be particularly prone to erosion during site development, especially during heavy rains. Therefore, the impact of erosion at the site is considered to be potentially significant.

Mitigation Measures: The potential for erosion can typically be reduced by appropriate paving of exposed ground surfaces, landscaping, providing terraces on slopes, placing berms or V-ditches near the tops of slopes, and installing adequate storm drain systems. Graded slopes should be protected until healthy plant growth is established. Typically, protection can be provided by the use of sprayed polymers, straw waddles, jute mesh or by other measures.

Temporary erosion control measures should be provided during construction, as required by current grading codes. Such measures typically include temporary catchment basins and/or sandbagging to control runoff and contain sediment transport within the project site. Appropriate implementation of these erosion control measures is expected to reduce the impact resulting from erosion to less than significant.

Regional Subsidence

USGS (2019) has reported the site to be outside a zone of historic regional subsidence from groundwater pumping. We are not aware of any reports of regional subsidence that have been reported in the site vicinity, and a lack of intense removal of significant quantities of water or oil extraction in the area makes the potential for ground subsidence very low and less than a significant impact.

Compressible Soils

NorCal’s reported approximately 1 to 7 feet of potentially compressible soils at the surface of the site. Therefore, the impact posed by compressible soils is considered to be potentially significant.

Mitigation Measures: Remedial removals of potentially compressible soil will be required in structural areas onsite. NorCal recommended to remove potentially compressible soils, which were estimated by them to be 1 to 7 feet thick from the surface. Furthermore, NorCal recommended that overexcavation should accommodate slab and foundations to be underlain by a fill blanket at least 2 feet thick. Implementation of the recommended removal and recompaction of the near surface soils should mitigate the significant portion of the soils that are prone to compression onsite. However, actual removal depths may vary based the project geotechnical consultant's observations of subsurface conditions during grading. With the implementation of recommended removals and overexcavation with appropriate observation by the project geotechnical consultant during grading, the impact posed by compressible soils to structures is expected to be less than significant.

Summary of Geologic and Seismic Hazard Review

The results of our geologic and seismic hazard review are summarized below.

GEOLOGIC AND SEISMIC HAZARDS	FINDINGS
• Fault rupture	Less than Significant Impact
• Seismic Ground Shaking	Less than Significant Impact with Mitigation
• Liquefaction	Less than Significant Impact
• Lateral Spreading	Less than Significant Impact
• Seismically Induced Landslides	Less than Significant Impact
• Seismically Induced Settlement	Less than Significant Impact
• Flooding	Less than Significant Impact
• Seismically Induced flooding	Less than Significant Impact
• Seiches and Tsunamis	No Impact
• Slope stability and Landslides	Less than Significant Impact with Mitigation
• Soil Expansion	Less than Significant Impact with Mitigation
• Sedimentation and Erosion	Less than Significant Impact with Mitigation
• Regional Subsidence	Less than Significant Impact
• Compressible Soils	Less than Significant Impact with Mitigation

Conclusions and Recommendations

In their report, NorCal Engineering stated that development of the site is feasible from a geotechnical perspective. We agree, based on our review of the geotechnical data presented in their report. The most significant constraints at the site include the potential for strong seismic shaking and the presence of potentially compressible soils. These constraints are typical for the area.

NorCal provided geotechnical recommendations for development that appear appropriate. However, we make the following comments:

- NorCal stated in their report that the upper on-site soils are non-expansive (EI≤20). However, a summary of NorCal's laboratory test results indicated Expansion Indices of 18 and 60 from samples collected from their borings. Based on these results, the onsite soils are expected to have very low to medium expansion potential. Accordingly, geotechnical foundation and retaining wall recommendations should consider soils with medium expansion potential. With mitigation, expansive soils will not be a significant issue.

- NorCal recommended remedial removal of disturbed soils and artificial fill to depths of 1 to 7 feet below the surface prior to fill, foundation, slabs-on-grade, and pavement placement. NorCal stated later in their report that all foundations including floor slab areas are recommended to be underlain by a uniform compacted fill blanket at least two feet in thickness. We would like to clarify that remedial removals and overexcavation should be performed until potentially compressible soils have been removed or 2 feet below building foundations, whichever is deeper. Appropriate observation by the project geotechnical consultant should be performed during grading to confirm the appropriateness of the recommendations. With mitigation, compressible soils are not anticipated to be a significant issue.

- NorCal performed infiltration testing in selected borings onsite. The site plan included in their report did not indicate locations of infiltration facilities. Additional infiltration testing at the locations and depths of proposed infiltration facilities may be appropriate in the future based on designs by the project Civil Engineer.

An updated geotechnical evaluation should be conducted as the project proceeds. The evaluation should address the proposed plans for site improvements and the requirements of the current California Building Code (CBC).

We appreciate the opportunity to provide our services for this review. If you have any questions, please contact this office at your convenience.

Respectfully submitted,

LEIGHTON CONSULTING, INC.

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ECB/SGO/LP/JDH/rsm

Attachments: References
Figure 1 - Site Location Map
Figure 2 - Regional Geology Map
Figure 3 - Regional Fault Map

Distribution: (1) Addressee

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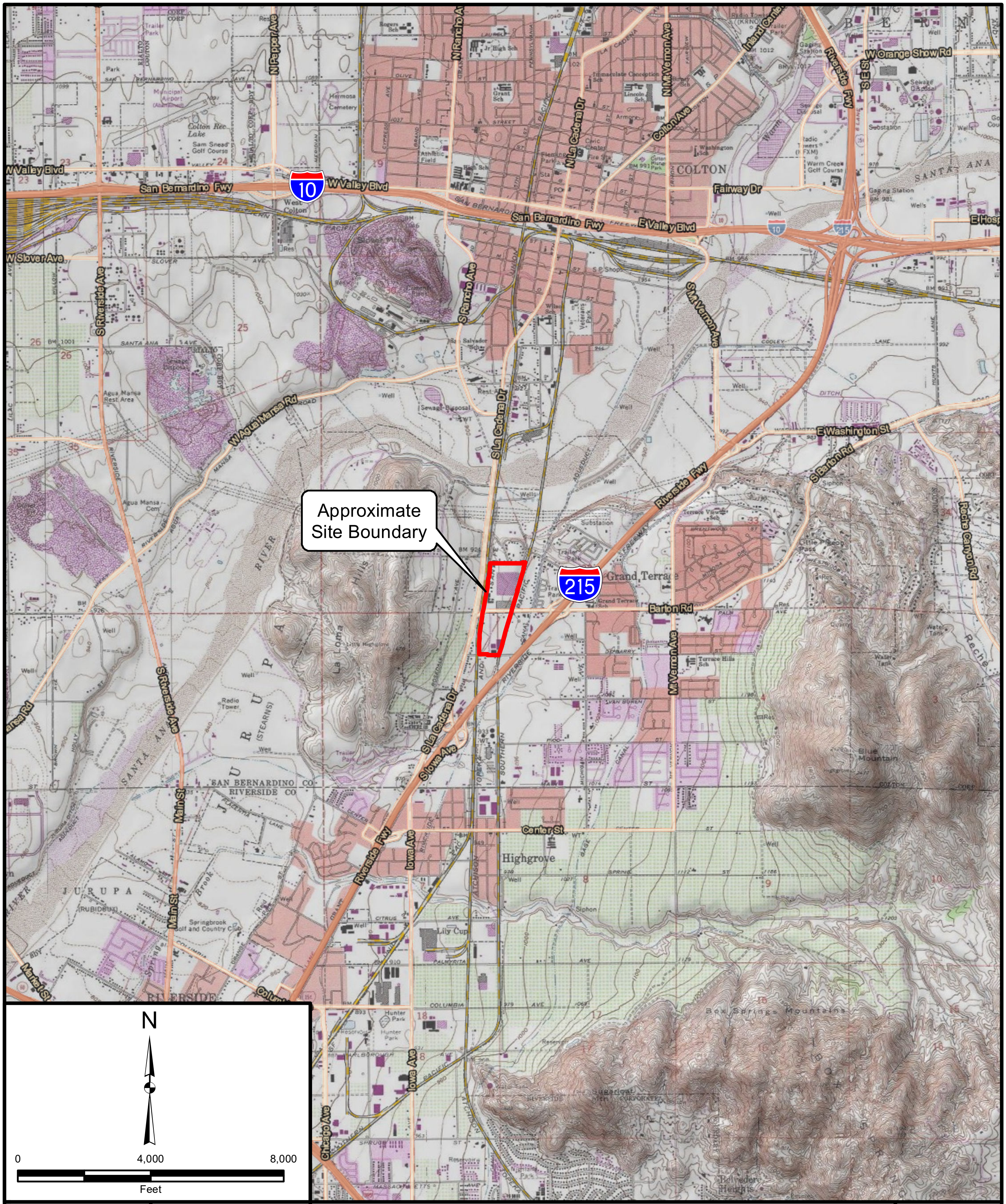

Approximate Site Boundary

Project: 12628.001	Eng/Geol: LP
Scale: 1 " = 4,000 '	Date: April 2020

Base Map: Bing Maps 2020
Thematic Information: Leighton
Author: (mmurphy)

SITE LOCATION MAP

Proposed Warehouses Site
Barton Road South of Terrace Avenue
City of Colton, California

Figure 1

Leighton

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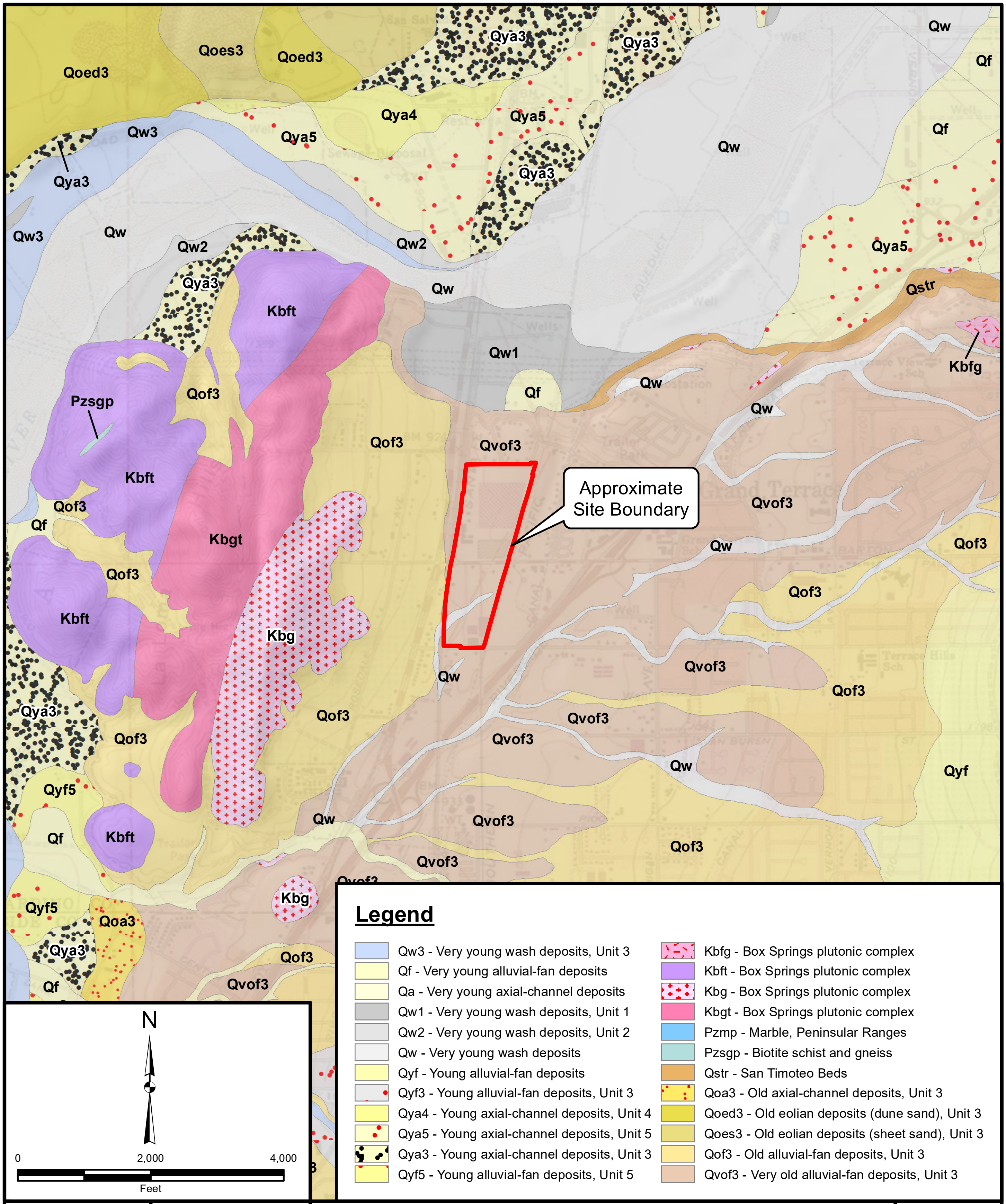


Project: 12628.001 | Eng/Geol: LP

Scale: 1 " = 2,000 ' | Date: April 2020

Reference: USGS, 2006 Geologic map of the San Bermardino and Santa Ana 30'x60 quadrangle, California Version 1,0 Open File Report 2006-1217.

Author: (mmurphy)

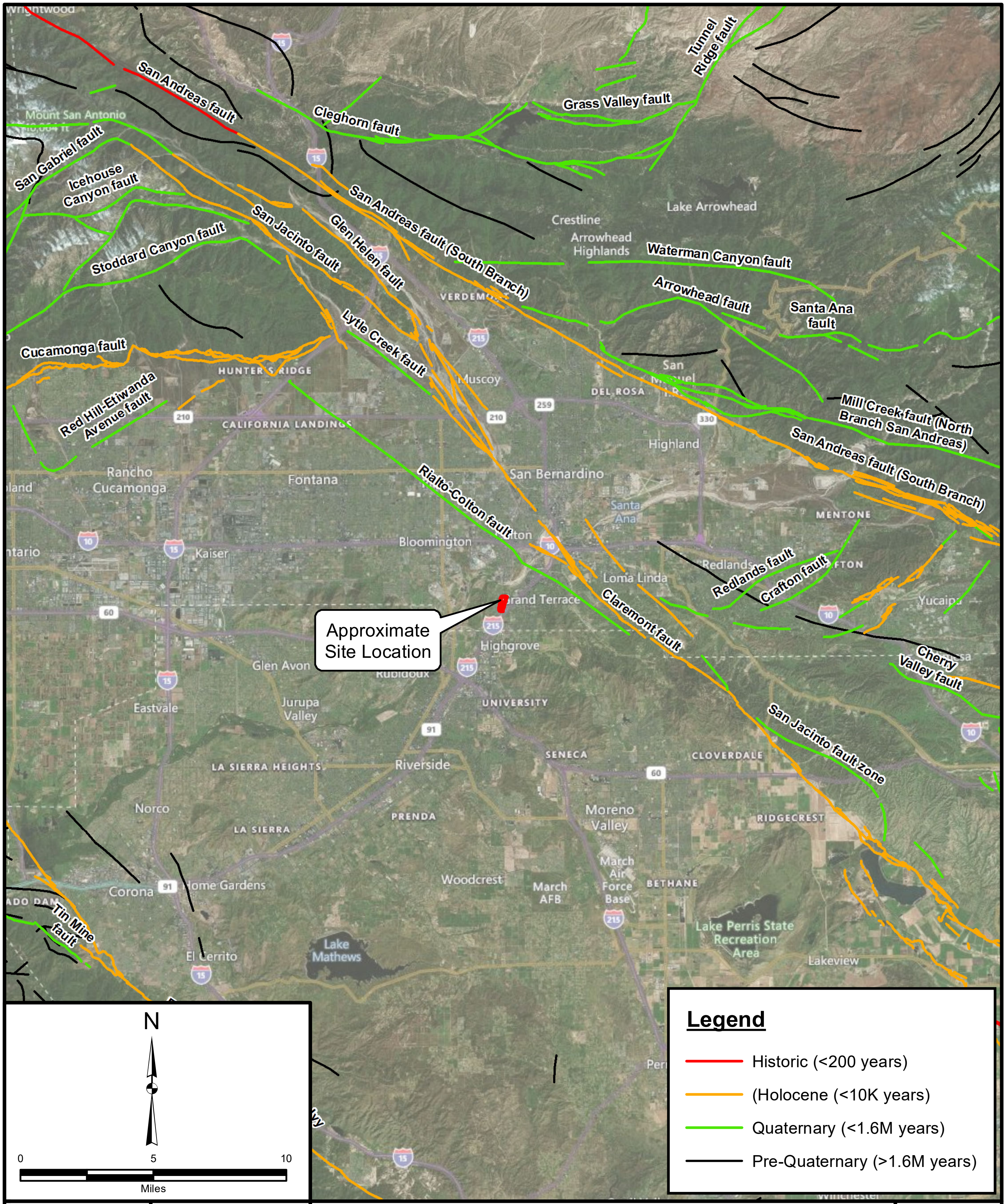
REGIONAL GEOLOGY MAP

Proposed Warehouses Site
Barton Road South of Terrace Avenue
City of Colton, California

Figure 2

Leighton

Map Saved as P:\Drafting\12628\001\Maps\12628-001_F02_RGM_2020-04-27.mxd on 4/27/2020 9:06:13 AM



Project: 12628.001

Eng/Geol: LP

Scale: 1 " = 5 miles

Date: April 2020

Base Map: ESRI ArcGIS Online 2020
Thematic Information: Leighton, Bryant, W. A. (compiler), 2005, Digital Database of Quaternary and Younger Faults from the Fault Activity Map of California, version 2.0: CGS, USGS, SCEC.
Author: (mmurphy)

REGIONAL FAULT MAP

Proposed Warehouses Site
Barton Road South of Terrace Avenue
City of Colton, California

Figure 3

Leighton

Map Saved as P:\Drafting\12628\001\Maps\12628-001_F03_RFM_2020-04-28.mxd on 4/28/2020 11:16:54 AM