GEOTECHNICAL AND INFILTRATION EVALUATION
PROPOSED MULTI-FAMILY RESIDENTIAL DEVELOPMENT
VERNOLA MARKETPLACE APARTMENTS, NEIGHBORHOOD B
JURUPA VALLEY, RIVERSIDE COUNTY, CALIFORNIA

PREPARED FOR

Vernola Trust
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Upland, California 91785-0217

PREPARED BY

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PROJECT NO. 2654-CR **MARCH 10, 2021**

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March 10, 2021
Project No. 2654-CR

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Attention: Mr. Rick Bondar

Subject: Geotechnical and Infiltration Evaluation
Proposed Multi-Family Residential Development
Vernola Marketplace Apartments, Neighborhood B
Jurupa Valley, Riverside County, California

Dear Mr. Bondar:

We are pleased to provide herein the results of our geotechnical and infiltration evaluation for the subject site located in Jurupa Valley, Riverside County, California. This report presents a discussion of our evaluation and provides preliminary geotechnical recommendations for earthwork, foundation design, and construction.

In our opinion, site development appears feasible from a geotechnical viewpoint provided that the recommendations included herein are incorporated into the design and construction phases of site development.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to call our office.

Respectfully submitted,
GeoTek, Inc.

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1. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to complete an updated evaluation of the existing geotechnical conditions at the project site with respect to the currently proposed development, as outlined in our proposal P-1203920-CR, dated January 5, 2021. Services provided for this study included the following:

- Research and review of available geologic and geotechnical data, and general information pertinent to the site,
- Perform a site reconnaissance,
- Site exploration consisting of the excavation and sampling of seven exploratory borings observed and logged by a geologist from our firm,
- Excavation of four additional borings for infiltration testing and performance of percolation tests within those borings,
- Collection of representative soil samples from the test borings and performing laboratory testing on select samples,
- Review and evaluation of site seismicity, and
- Compilation of this updated geotechnical report which presents our recommendations for site development.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The approximate 8.3-acre site is located westerly of Pats Ranch Road, south of an existing shopping center at the southwest corner of Pats Ranch Road and Limonite Avenue and north of 68th Street in Jurupa Valley, California. The site is currently vacant and undeveloped. The site slopes gently downward to the south-southeast with about 20 to 25 feet of elevation differential. The site is bordered to the north by an existing commercial center, Interstate I-15 to the west, vacant land to the south and Pats Ranch Road to the east with residential developments further east.

2.2 PROPOSED DEVELOPMENT

We understand that site development will include the construction of 12 multi-family structures, a recreation area, stormwater areas along with associated street and lot improvements. It is anticiapted that the residential structures will consist of one- to three-story structures that will include a conventional slab on-grade and will be supported by conventional shallow foundations. Although structural loading information was not provided, we have assumed maximum column and wall loads on the order of 70 kips and 4 kips per foot, respectively. Once actual loads are known, that information should be provied to GeoTek to determine if modifications to the recommendations presented in this report are warranted. Dependent upon the actual structural loads, additional field investigation and analysis may be warranted.

Based on the current site topography, we anticipate that the maximum depths of cut and fill will be less than about 7 feet, not including any remedial grading. If site development differs from the assumptions made herein, the recommendations included in this report should be subject to further review and evaluation. Site development plans should be reviewed by GeoTek when they become available.

2.3 AERIAL PHOTOGRAPH REVIEW

GeoTek reviewed aerial photographs dated 1931, 1938, 1948, 1953, 1959, 1967, 1975, 1985, 1989, 1990, 1994, 2002, 2006, 2009, 2012, 2016 and 2020, which included coverage of the subject site.

The site appears to be vacant and undeveloped land in the 1931, 1938, 1948, and 1953 aerial photographs and appears to be used for agriculture in the 1959 through the 2006 aerial photographs.

The site appears to be vacant land in the 2009 and 2012 aerial photographs and is cleared of vegetation in the 2016 aerial photograph. The southern portion of the site was utilized for construction storage for the apartment complex that is under construction to the south of the site in the 2020 aerial photograph.

3. FIELD EXPLORATION & LABORATORY TESTING

3.1 FIELD EXPLORATION

The field exploration for GeoTek's update evaluation was conducted on February 22, 2021 and consisted of excavating seven (7) geotechnical exploratory borings, extended to depths ranging from about 8 to 51-½ feet below ground surface. One of the borings was terminated at a depth shallower than planned due to practical refusal. The approximate locations of the GeoTek excavations are shown on the Boring Location Map (Figure 2). Logs of the GeoTek borings and test pits are included in Appendix A.

Relatively undisturbed soil samples were recovered at various intervals in the geotechnical borings with a California sampler. The California sampler is a 3-inch outside diameter, 2.4-inch inside diameter, split barrel sampler lined with brass rings. The sampler was 18 inches long. The sampler conformed to the requirements of ASTM D 3550. Standard Penetration Tests (SPT) were performed within Boring B-3 per ASTM D-1586 to assess the relative density of the encountered soils. A 140-pound automatic trip hammer was utilized, dropping 30 inches for each blow. The relatively undisturbed samples, together with bulk samples of representative soil types, were returned to the laboratory for testing and evaluation. The California ring and SPT sampler data is presented on the boring logs.

3.2 LABORATORY TESTING

Laboratory testing was performed by GeoTek on selected soil samples obtained from the borings. The purpose of the laboratory testing was to confirm the field classification of the soils encountered and to evaluate the physical properties of the soils for use in engineering design and analysis.

Included in our laboratory testing were moisture-density determinations and collapse testing on selected relatively undisturbed samples. The optimum moisture content-maximum dry density relationship was established for typical soil types so that the relative compaction of the subsoils could be determined. Direct shear testing was performed on selected samples to help evaluate the bearing capacity of the soils. Expansion index testing was performed on three selected sample to evaluate the expansion potential of the site soils. Chemical testing comprised of pH, soluble sulfate, chloride and resistivity testing was conducted on fifteen selected samples. The moisture-density data is presented on the exploration logs in Appendix A. The maximum density, direct shear, collapse tests, expansion index and chemical test data are presented in Appendix B.

3.3 PERCOLATION TESTING

Percolation testing was performed at boring locations I-1 through I-4 to assess the infiltration characteristics of the site soils within the future stormwater management areas. These borings were excavated to depths ranging from approximately 3 to 19 feet below the existing grade, as requested. The boring diameter was approximately eight inches. Subsequent to pre-soaking, percolation testing was performed within the lower approximately 20 inches in the borings. The percolation rates were then corrected to account for discharge of water from both the sides and bottom of the borings. This correction was performed using the Porchet Method, obtaining the infiltration rates tabulated below:

SUMMARY OF RESULTS			
Boring	Measured Field Percolation Rate (minutes per inch)	Depth of Infiltration Test (feet below grade)	Calculated Infiltration Rate (inches per hour)
I-1	6	18	0.63
I-2	15	19	0.38
I-3	30	3	0.19
I-4	24	6	0.23

Copies of the field data sheets and infiltration conversion sheets (Porchet Method) are included in Appendix C. The reported infiltration rate is the measured rate without any factor of safety applied. Over the lifetime of the detention basin, the infiltration rates may be affected by silt build up and biological activities, as well as local variations in near surface soil conditions. A suitable factor of safety should be applied to the field rates in design the infiltration system.

It should be noted that the infiltration rates provided above were performed in relatively undisturbed native soils. Infiltration rates will vary and are mostly dependent on the underlying consistency of the site soils and relative density. Infiltration rates will be impacted by weight of equipment travelling over the soils, placement of engineered fill and other various factors. GeoTek, Inc. assumes no responsibility or liability for the ultimate design or performance of the storm water facility.

4. GEOLOGIC AND SOILS CONDITIONS

4.1 REGIONAL SETTING

The subject property is situated in the Peninsular Ranges geomorphic province. The Peninsular Ranges province is one of the largest geomorphic units in western North America. It extends from the point of contact with the Transverse Ranges geomorphic province, southerly to the tip of Baja California. This province varies in width from about 30 to 100 miles. It is bounded on the west by the Pacific Ocean, on the south by the Gulf of California and on the east by the Colorado Desert Province.

The Peninsular Ranges are essentially a series of northwest-southeast oriented fault blocks. Several major fault zones are found in this province. The Elsinore Fault zone and the San Jacinto Fault zone trend northwest-southeast and are mostly found near the middle of the province. The San Andreas Fault zone borders the northeasterly margin of the province, and the San Jacinto fault borders the province adjacent the Colorado Desert province.

The County of Riverside (Map My County) has designated the site area as "not in fault zone" or "not in a fault line". The site is designated by the County as being within a "moderate" to "high" liquefaction potential area. The site is also not situated within a State of California liquefaction hazard area and is not within a designated *"Alquist-Priolo"* fault hazard zone.

More specific to the subject property, the site is located in an area geologically mapped to be underlain by older alluvium with younger alluvium near the east border of the site (Morton, D.M. and Miller, F.K., 2006).

4.2 GENERAL SOIL/GEOLOGIC CONDITIONS

A brief description of the earth materials encountered below the site and within the area of anticipated construction is presented in the following section. Based on our field exploration, the area of anticipated improvements is underlain by older alluvium.

4.2.1 Older Alluvium

Older alluvium was encountered within each test boring excavated at the site and extended to the maximum depth explored of about 51-½ feet below grade. The older alluvium consisted of a loose to very dense silty sand and sand and medium stiff to stiff sandy clay.

According to the results of the laboratory testing performed on two samples of the near surface soils, the near surface soils have a "very low" expansion potential (EI=1) when tested and classified in accordance with ASTM D 4829. The test results are provided in Appendix B.

4.3 SURFACE AND GROUNDWATER

4.3.1 Surface Water

If encountered during the earthwork construction, surface water on this site is the result of precipitation or surface run-off from surrounding sites. Provisions for surface drainage will need to be accounted for by the project civil engineer.

4.3.2 Groundwater

Groundwater was encountered within the deeper test boring (B-3) at a depth of about 45 feet below existing grade. A review of groundwater information noted on the State Department of Water Resources Water Data Library website indicates a groundwater depth within wells in the site vicinity to be about 100 feet below grade. Therefore, we estimate a depth to the hydrostatic groundwater to be about 100 feet below grade. The water encountered within Boring B-3 is most likely a perched water condition.

It is possible that seasonal variations (temperature, rainfall, etc.) will cause fluctuations in the groundwater level. Additionally, perched water may be encountered at shallow depths following extensive rain events. If shallow perched water is encountered, we anticipate that it can be managed with conventional sump pumps.

4.4 FAULTING AND SEISMICITY

The geologic structure of the entire southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is in a seismically active region. No active or potentially active fault is known to exist at this site nor is the site situated within an *"Alquist-Priolo"* Earthquake Fault Zone. The subject property is not located within a State of California Seismic Hazard Zone for earthquake induced landsliding. The nearest zoned faults are the Elsinore Fault zone (Chino Section), located approximately 7 miles to the southwest and the San Jacinto fault zone situated about 15 miles to the northeast.

4.4.1 Seismic Design Parameters

The site is located at approximately 33.9699 degrees Latitude and -117.5477 degrees Longitude. Site spectral accelerations (S_a and S_1), for 0.2 and 1.0 second periods for a Class "D" site, was determined from the SEAOC/OSHPD web interface that utilizes the USGS web services and retrieves the seismic design data and presents that information in a report format. Using the ASCE 7-16 option on the SEAOC/OSHPD website results in the values for S_{M1} and S_{D1} reported as "null-See Section 11.4.8" (of ASCE 7-16). As noted in ASCE 7-16, Section 11.4.8, a site-specific ground motion procedure is recommended for Site Class D when the value S_1 exceeds 0.2. The value S_1 for the subject site exceeds 0.2.

For a site Class D, an exception to performing a site-specific ground motion analysis is allowed in ASCE 7-16 where S_1 exceeds 0.2 provided the value of the seismic response coefficient, Cs, is conservatively calculated by Eq 12.8-2 of ASCE 7-16 for values of $T \leq 1.5Ts$ and taken as equal to 1.5 times the value computed in accordance with either Eq. 12.8-3 for $T_L \geq T > 1.5Ts$ or Eq. 12.8-4 for $T > T_L$.

The results, based on the 2015 NEHRP and the 2019 CBC, are presented in the following table and we have assumed that the exception as allowed in ASCE 7-16 is applicable. If the exception is deemed not appropriate, a site-specific ground motion analysis will be required.

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_s	1.612g
Mapped 1.0 sec Period Spectral Acceleration, S_1	0.581g
Site Coefficient for Site Class "D", F_a	1.0
Site Coefficient for Site Class "D", F_v	1.719
Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, S_{MS}	1.612g
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, S_{M1}	0.998g
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	1.075g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	0.666g
Peak Ground Acceleration Adjusted for Site Class Effects, PGA_M	0.73g
Seismic Design Category	D

4.5 LIQUEFACTION CONSIDERATIONS

A review of the Riverside County GIS (Map My County) website indicates the site is situated within an area that is designated as possessing a "moderate" to "high" liquefaction potential. As previously noted, we estimate a depth to the hydrostatic water table to be about 100 feet below grade. However, perched water was encountered within Boring B-3 at a depth of about 45 feet below grade.

An analysis was performed to assess the liquefaction potential for the site using the perched water condition encountered. For this analysis, we utilized a groundwater depth of 45 feet, the soil profile from Boring B-3, a ground acceleration of 0.73g (PGA_M) and a mean earthquake magnitude of 6.73. The ground acceleration and earthquake magnitude were obtained from the USGS websites. The computer software program LiquefyPro was also utilized.

The results of this analysis indicates the site soils are not susceptible to liquefaction upon application of the design earthquake event. The soils above the perched water table are potentially susceptible to dry settlement (dynamic densification) as a result of seismic ground shaking. Our analysis indicates a potential ground surface settlement of about 1.37 inches. A differential seismic settlement of about 2/3 inch over a 30-foot span is estimated. Based on these magnitudes of seismic settlement, ground modification and/or special foundation design are not considered necessary. The results of the seismic settlement are presented in Appendix D.

4.6 OTHER SEISMIC HAZARDS

Evidence of ancient landslides or slope instabilities at this site was not observed during our investigation. Thus, the potential for landslides is considered negligible for design purposes.

The potential for secondary seismic hazards such as a seiche or tsunami is considered negligible due to site elevation and distance to an open body of water.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

Development of the site appears feasible from a geotechnical viewpoint. The following recommendations should be incorporated into the design and construction phases of development.

5.2 EARTHWORK CONSIDERATIONS

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the City of Jurupa Valley, the 2019 California Building Code (CBC) and recommendations contained in this report. Site grading plans should be reviewed by this office when they become available. Additional recommendations will likely be offered subsequent to review of these plans. The General Grading Guidelines included in Appendix E outline general procedures and do not anticipate all site-specific situations. In the event of conflict, the recommendations presented in the text of this report should supersede those contained in Appendix E.

5.2.1 Site Clearing

Initial site preparation should include removal of vegetation and any other deleterious materials. The horizontal limits of the clearing should extend at least 5 feet beyond the planned improvements.

Voids resulting from removing any materials should be replaced with engineered fill materials with expansion characteristics similar to the onsite materials.

5.2.2 Site Preparation

Due to the collapse potential of the near-surface alluvium, we recommend that any encountered fill and at least the upper five feet of alluvium be removed beneath and extending at least 10 feet laterally beyond all planned buildings. As a minimum, over-excavations should be extended (where necessary) so that all building foundations and floor slabs are underlain by at least 3 feet of newly placed engineered fill. The soils exposed at the base of the over-excavation should then be examined by a GeoTek representative to confirm that the exposed soils are suitable for structural support. If unsuitable soils are encountered, those materials should be removed as recommended by GeoTek. Due to the presence of loose soil in Boring B-5, additional over-excavation in this area of the site should be expected. In this area, we estimate an over-excavation depth of about 10 feet from existing grade beneath the planned buildings.

Once approved, the exposed soils should be scarified to a depth of about 12 inches, be moisture treated to slightly above the soil's maximum dry density, per ASTM D1557, and then be compacted to at least 90% of the soil's maximum dry density (ASTM D1557).

Beneath pavement areas and other surface improvements and following lowering of site grades, where necessary, we recommend that the subgrade soils be proof rolled with a heavy rubber tired piece of construction equipment (gross weight of at least 10 tones) in the presence of a GeoTek representative. The proof rolling should consist of at least four passes, two in each perpendicular direction. Any soil that ruts or excessively deflects during proof rolling should be removed as recommended by the on-site GeoTek representative. Following proof rolling and any needed over-excavation, the exposed soils should be scarified, moisture treated and compacted as noted in the prior paragraph.

5.2.3 Fills

On-site materials are generally considered suitable for reuse as engineered fill, provided they are free from vegetation, roots, and other deleterious material. Engineered fill materials should be placed in horizontal lifts not exceeding 8 inches in loose thickness, moisture conditioned to slightly over the optimum moisture content and compacted to a minimum relative compaction of 90 percent (ASTM D 1557).

5.2.4 Excavation Characteristics

Excavation in the on-site soils is expected to be feasible utilizing heavy-duty grading equipment in good operating condition. All temporary excavations for grading purposes and installation of underground utilities should be constructed in accordance with local and Cal-OSHA guidelines.

5.2.5 Shrinkage/Bulking Estimates

Several factors will impact earthwork balancing on the site, including shrinkage, subsidence, trench spoil from utilities and footing excavations, as well as the accuracy of topography.

Shrinkage is primarily dependent upon the degree of compactive effort achieved during construction. For planning purposes, a shrinkage factor of approximately 5 to 15 percent may be considered for the materials requiring recompaction. Subsidence on the order of 0.1 feet may also occur.

5.2.7 Trench Excavations and Backfill

Temporary excavations within the onsite materials should be stable at 1:1 inclinations for short durations during construction, and where cuts do not exceed 10 feet in height. Temporary cuts to a maximum height of 4 feet can be excavated vertically, but local sloughing and/or failure could occur due to the granulated nature of the soils at this site. Increased caution should be applied when working near or within any excavations at this site.

Trench excavations should conform to Cal-OSHA regulations. The contractor should have a competent person, per OSHA requirements, on site during construction to observe conditions and to make the appropriate recommendations.

Utility trench backfill should be compacted to at least 90 percent relative compaction (as determined per ASTM D 1557). Under-slab trenches should also be compacted to project specifications. Onsite materials are not considered suitable for use as bedding material but should be suitable as backfill provided they are properly moisture conditioned and compacted.

Compaction should be achieved with a mechanical compaction device. Ponding or jetting of trench backfill is not recommended. If backfill soils have dried out, they should be thoroughly moisture conditioned prior to placement in trenches.

5.3 DESIGN RECOMMENDATIONS

Foundation design criteria for a conventional foundation system, in general conformance with the 2019 CBC, are presented below. The soils are classified as having a "very low" expansion potential in accordance with ASTM D 4829; however, some "low" expansive soils may also be present. Typical design criteria for the site based upon a "very low" and "low" expansion potentials are tabulated below. These are minimal recommendations and are not intended to supersede the design by the project structural engineer. Once structural loading information is provided, revisions to the recommendations provided in this report may be necessary.

The conventional foundation elements for the proposed buildings should bear entirely in engineered fill soils. Foundations should be designed in accordance with the 2019 CBC.

Expansion index and soluble sulfate evaluation of the soils should be performed during construction to evaluate the as-graded conditions. Final recommendations should be based upon the as-graded soils conditions.

A summary of our foundation design recommendations is presented in the following table:

GEOTECHNICAL RECOMMENDATIONS FOR FOUNDATION DESIGN

Design Parameter	"Very Low" Expansion Potential	"Low" Expansion Potential
Foundation Depth or Minimum Perimeter Beam Depth (inches below lowest adjacent grade)	12-1 & 2 Story 18-3 Story	18
Minimum Foundation Width (Inches)*	12	12
Minimum Slab Thickness (actual)	4 – Actual	4 – Actual
Minimum Slab Reinforcing	6" x 6" – W1.4/W1.4 welded wire fabric placed in middle of slab or No. 3 bars at 24 inch centers	No. 3 bars at 18 inch centers, each way
Minimum Footing Reinforcement	Two No. 4 reinforcing bars, one placed near the top and one near the bottom	Two No. 4 reinforcing bars, one placed near the top and one near the bottom
Effective Plasticity Index	PI<15	PI<22
Presaturation of Subgrade Soil (Percent of Optimum)	Minimum of 100% of the optimum moisture content to a depth of at least 12 inches prior to placing concrete	Minimum of 110% of the optimum moisture content to a depth of at least 12 inches prior to placing concrete

* Code minimums per Table 1809.7 of the 2019 CBC

An allowable soil bearing capacity of 2,000 pounds per square foot (psf) may be used for design of building foundations for footing depths and widths of 12 inches. This allowable soil bearing capacity can be increased by 500 psf and 150 psf for each additional foot of footing depth or width to a maximum value of 3,500 psf. The allowable bearing capacity may also be increased by one-third when considering short-term wind and seismic loads.

For footings designed in accordance with the recommendations presented in this report, we would anticipate a maximum static settlement of less than one inch and a maximum differential static settlement of less than ½-inch in a 40-foot span.

The passive earth pressure may be computed as an equivalent fluid having a density of 220 psf per foot of depth, to a maximum earth pressure of 3,000 psf for footings cast adjacent to competent fill. A coefficient of friction between soil and concrete of 0.35 may be used with dead load forces. The upper one foot of soil below the adjacent grade should not be used in calculating passive pressure unless the ground surface is covered with pavement. When combining passive and frictional resistance, the passive pressure component should be reduced by one-third.

A moisture and vapor retarding system should be placed below slabs-on-grade where moisture migration through the slab is undesirable. Guidelines for these are provided in the 2019 California Green Building Standards Code (CALGreen) Section 4.505.2 and the 2019 CBC Section 1907.1 and ACI 360R-10. The vapor retarder design and construction should also meet the requirements of ASTM E1643. A portion of the vapor retarder design should be the implementation of a moisture vapor retardant membrane.

It should be realized that the effectiveness of the vapor retarding membrane can be adversely impacted as a result of construction related punctures (e.g. stake penetrations, tears, punctures from walking on the aggregate layer, etc.). These occurrences should be limited as much as possible during construction. Thicker membranes are generally more resistant to accidental puncture than thinner ones. Products specifically designed for use as moisture/vapor retarders may also be more puncture resistant. Although the CBC specifies a six-mil vapor retarder membrane, it is GeoTek's opinion that a minimum 10 mil thick membrane with joints properly overlapped and sealed should be considered, unless otherwise specified by the slab design professional. The membrane should consist of Stego wrap or the equivalent.

Moisture and vapor retarding systems are intended to provide a certain level of resistance to vapor and moisture transmission through the concrete, but do not eliminate it. The acceptable level of moisture transmission through the slab is to a large extent based on the type of flooring used and environmental conditions. Ultimately, the vapor retarding system should be comprised of suitable elements to limit migration of water and reduce transmission of water vapor through the slab to acceptable levels. The selected elements should have suitable properties (i.e., thickness, composition, strength, and permeability) to achieve the desired performance level. Consideration should be given to consulting with an individual possessing specific expertise in this area for additional evaluation.

Moisture retarders can reduce, but not eliminate, moisture vapor rise from the underlying soils up through the slab. Moisture retarders should be designed and constructed in accordance with applicable American Concrete Institute, Portland Cement Association, Post-Tensioning Concrete Institute, ASTM and California Building Code requirements and guidelines.

GeoTek recommends that a qualified person, such as the flooring contractor, structural engineer, and/or architect be consulted to evaluate the general and specific moisture vapor transmission paths and associated potential impact.

In addition, the recommendations in this report and our services in general are not intended to address mold prevention, since we along with geotechnical consultants in general, do not practice in areas of mold prevention. If specific recommendations are desired, a professional mold prevention consultant should be contacted.

5.3.1 Miscellaneous Foundation Recommendations

5.3.1.1 To minimize moisture penetration beneath the slab on grade areas, utility trenches should be backfilled with engineered fill, lean concrete or concrete slurry where they intercept the perimeter footing or thickened slab edge.

5.3.1.2 Soils from the footing excavations should not be placed in the slab-on-grade areas unless properly compacted and tested. The excavations should be free of loose/sloughed materials and be neatly trimmed at the time of concrete placement.

5.3.1.3 Under-slab utility trenches should be compacted to project specifications. Compaction should be achieved with a mechanical compaction device. If backfill soils have dried out, they should be thoroughly moisture conditioned prior to placement in trenches.

5.3.1.4 Utility trench excavations should be shored or laid back in accordance with applicable CAL/OSHA standards.

5.3.1.5 On-site materials may not be suitable for use as bedding material but will be suitable as backfill. Jetting of native soils will not be acceptable.

5.3.2 Foundation Setbacks

Foundations should comply with the following setbacks. Improvements not conforming to these setbacks are subject to the increased likelihood of excessive lateral movements and/or differential settlements. If large enough, these movements can compromise the integrity of the improvements. The following recommendations are presented:

- The outside bottom edge of all footings should be set back a minimum of H/3 (where H is the slope height) from the face of any descending slope. The setback should be at least 7 feet and need not exceed 40 feet.
- The bottom of all footings for structures near retaining walls should be deepened so as to extend below a 1:1 projection upward from the bottom inside edge of the wall stem.
- The bottom of any existing foundations for structures should be deepened so as to extend below a 1:1 projection upward from the bottom of the nearest excavation.

5.4 RETAINING WALL DESIGN AND CONSTRUCTION

5.4.1 General Design Criteria

Recommendations presented in this report apply to typical masonry or concrete vertical retaining walls. These are typical design criteria and are not intended to supersede the design by the structural engineer.

Retaining wall foundations should be designed in accordance with *Section 5.3* of this report. A minimum foundation embedment of 12 inches into engineered compacted fill with a "very low" to "low" expansion potential is recommended. Structural needs may govern and should be evaluated by the project structural engineer.

All earth retention structure plans, as applicable, should be reviewed by this office prior to finalization.

The backfill material placement for all earth retention structures should meet the requirement of *Section 5.4.4* in this report.

In general, cantilever earth retention structures, which are designed to yield at least 0.001H, where H is equal to the height of the wall to the base of the footing, may be designed using the active condition. Rigid earth retention structures (including but not limited to rigid walls, and walls braced at top, such as typical basement walls) should be designed using the at-rest condition.

In addition to the design lateral forces due to retained earth, surcharges due to improvements, such as an adjacent building or traffic loading, should be considered in the design of the earth retention structures. Loads applied within a 1:1 (h:v) projection from the surcharge on the stem of the earth retention structure should be considered in the design.

Final selection of the appropriate design parameters should be made by the designer of the earth retention structures.

5.4.2 Cantilevered Walls

The recommendations presented below are for cantilevered retaining walls. Active earth pressure may be used for retaining wall design, provided the top of the wall is not restrained from minor deflections. An equivalent fluid pressure approach may be used to compute the horizontal pressure against the wall. Appropriate fluid unit weights are given below for specific slope gradients of the retained material. These do not include other superimposed loading conditions such as traffic, structures, seismic events, or adverse geologic conditions.

Surface Slope of Retained Materials (h:v)	Equivalent Fluid Pressure (pcf) Native Backfill*
Level	40

* The design pressures assume the backfill material has an expansion index less than or equal to 20. Backfill zone includes area between the back of the wall and footing to a plane (1:1 h:v) up from the bottom of the wall foundation to the ground surface.

As required by code, walls with a retained height greater than 6 feet and for a Site Class D, must also included an incremental seismic pressure. Based on the Mononobe-Okabe method and the project seismic setting, we recommend that an incremental seismic pressure of 22.8 pcf be included into the wall design, where required. This seismic load can be applied as a conventional triangular distribution.

5.4.3 Restrained Retaining Walls

Retaining walls that will be restrained prior to placing and compacting backfill material, or that have reentrant or male corners, should be designed for an at-rest equivalent fluid pressure of 60 pcf, plus any applicable surcharge loading, for very low expansive backfill (EI<20) and level back slope condition. For areas of male or reentrant corners, the restrained wall design should extend a minimum distance of twice the height of the wall laterally from the corner, or a distance otherwise determined by the project structural engineer.

5.4.4 Retaining Wall Backfill and Drainage

Retaining wall backfill should consist of materials with expansion index (EI) ≤ 20 and free of deleterious and/or oversized materials. The wall backfill should also include a minimum one-foot wide section of ¾- to 1-inch clean crushed rock (or approved equivalent). The rock should be placed immediately adjacent to the back of wall and extend up from the back drain to within approximately 12 inches of finish grade. The upper 12 inches should consist of compacted onsite materials or pavements. Presence of other materials might necessitate revision to the parameters provided and modification of wall designs. The backfill materials should be placed in lifts no greater than 8-inches in thickness and compacted to a minimum of 90 percent relative compaction in accordance with ASTM Test Method D 1557. Proper surface drainage needs to be provided and maintained. Bracing of the walls during backfilling and compaction may also be necessary.

All earth retention structures should be provided with an adequate pipe and gravel back drain system to reduce the potential for hydrostatic pressure build up. As a minimum, backdrains should consist of a four-inch diameter perforated collector pipe (Schedule 40, SDR 35, or approved equivalent) embedded in a minimum of one cubic foot per lineal foot of ¾- to 1-inch clean crushed rock or equivalent, wrapped in filter fabric (Mirafi 140N or approved equivalent). The drain system should be connected to a suitable outlet, as determined by the civil engineer. Drain outlets should be maintained over the life of the project and should not be obstructed or plugged by adjacent improvements. Waterproofing of site walls should be performed where moisture migration through the wall is undesirable.

Proper surface drainage needs to be provided and maintained. Water should not be allowed to pond behind retaining walls. Waterproofing of site walls should be performed where moisture migration through the wall is undesirable.

5.5 SOIL CORROSIVITY

Based on the chemical test results performed on two samples collected from the site as presented in Appendix B, the corrosivity test results indicate that the on-site soils are "highly corrosive" to buried ferrous metal. This corrosion classification is obtained from "Handbook of Corrosion Engineering," by Pierre R. Roberge, 2nd Edition, 2000. Recommendations for protection of buried ferrous metal should be provided by a corrosion engineer. Additional corrosion testing should be performed at the time of site grading to assess the corrosion of potential of the as-graded soils.

5.5.1 Soil Sulfate Content

The sulfate content was determined in the laboratory for two representative onsite soil samples. The results indicate that the water-soluble sulfate is less than 0.1 percent by weight which is considered "not applicable" (i.e. negligible) as per Table 4.2.1 of ACI 318. Based upon the test results, no special concrete mix design is required by Code for sulfate attack resistance.

5.5.2 Import Soils

Import soils (if needed) should have an Expansion Index of less than 20 (very low) and should not possess oversized or deleterious materials. GeoTek also recommends that, as a minimum, any proposed import soils be tested for soluble sulfate content. GeoTek should be notified a minimum of 72 hours of potential import sources so that appropriate sampling and laboratory testing can be performed.

5.6 PRELIMINARY PAVEMENT DESIGN

Preliminary pavement design for proposed street improvements was conducted per Caltrans *Highway Design Manual* guidelines for flexible pavements. Based on an assumed design R-value of 40 and for Traffic Indices (TIs) of 5.0 and 6.0, the following preliminary sections were calculated:

PRELIMINARY MINIMUM PAVEMENT SECTION		
Traffic Index	Thickness of Asphalt Concrete (inches)	Thickness of Aggregate Base (inches)
5.0	3	4
6.0	3-½	6

Traffic Indices (TIs) used in our pavement design are considered reasonable values for the proposed residential street areas and should provide a pavement life of approximately 20 years with a normal amount of flexible pavement maintenance. Irrigation adjacent to pavements, without a deep curb or other cutoff to separate landscaping from the paving may result in premature pavement failure. Traffic parameters used for design were selected based upon engineering judgment and not upon information furnished to us such as an equivalent wheel load analysis or a traffic study.

The recommended pavement sections provided are intended as a minimum guideline and final selection of pavement cross section parameters should be made by the project civil engineer, based upon the local laws and ordinates, expected subgrade and pavement response, and desired level of conservatism. If thinner or highly variable pavement sections are constructed, increased maintenance and repair could be expected. Final pavement design should be checked by testing of soils exposed at subgrade (the upper five feet) after final grading has been completed.

Asphalt concrete and aggregate base should conform to current Caltrans Standard Specifications Section 39 and 26-1.02, respectively. As an alternative, asphalt concrete can conform to Section 203-6 of the current Standard Specifications for Public Work (Green Book). Crushed aggregate base or crushed miscellaneous base can conform to Section 200-2.2 and 200-2.4 of the Green Book, respectively. Pavement base should be compacted to at least 95 percent of the ASTM D1557 laboratory maximum dry density (modified proctor).

All pavement installation, including preparation and compaction of subgrade, compaction of base material, placement and rolling of asphaltic concrete should be done in accordance with the City of Jurupa Valley specifications, and under the observation and testing of GeoTek and a City

Inspector where required. Jurisdictional minimum compaction requirements in excess of the aforementioned minimums may govern.

Deleterious material, excessive wet or dry pockets, oversized rock fragments, and other unsuitable yielding materials encountered during grading should be removed. Once existing compacted fill are brought to the proposed pavement subgrade elevations, the subgrade should be proof-rolled in order to check for a uniform and unyielding surface. The upper 12 inches of pavement subgrade soils should be scarified, moisture conditioned at or near optimum moisture content, and recompacted to at least 95 percent of the laboratory maximum dry density (ASTM D1557). If loose or yielding materials are encountered during construction, additional evaluation of these areas should be carried out by GeoTek. All pavement section changes should be properly transitioned.

5.7 CONCRETE FLATWORK

5.7.1 Exterior Concrete Slabs and Sidewalks

Exterior concrete slabs and sidewalks should be designed using a four (4) inch minimum thickness. No specific reinforcement is required due to the non-structural nature. However, the use of some reinforcement should be considered. Recommendations can be provided upon request. Some shrinkage and cracking of the concrete should be anticipated as a result of typical mix designs and curing practices commonly utilized in residential construction.

Sidewalks and driveways may be under the jurisdiction of the governing agency. If so, jurisdictional design and construction criteria would apply, if more restrictive than the recommendations presented herein.

Subgrade soils, classified as having “very low” and “low” expansion potential, should be pre-moistened prior to placing concrete. The subgrade soils below exterior slabs, sidewalks, driveways, etc. at the subject site should be pre-saturated to a minimum of 100% or 110% of optimum moisture content to a depth of 12 inches for “very low” and “low” expansive soils, respectively.

All concrete installation, including preparation and compaction of subgrade, should be done in accordance with City of Jurupa Valley specifications, and under the observation and testing of GeoTek and a City Inspector, if necessary.

5.7.2 Concrete Performance

Concrete cracks should be expected. These cracks can vary from sizes that are essentially unnoticeable to more than 1/8 inch in width. Most cracks in concrete, while unsightly, do not significantly impact long-term performance. While it is possible to take measures (proper concrete mix, placement, curing, control joints, etc.) to reduce the extent and size of cracks that occur, some cracking will occur despite the best efforts to minimize it. Concrete can also undergo chemical processes that are dependent on a wide range of variables, which are difficult, at best, to control. Concrete, while seemingly a stable material, is also subject to internal expansion and contraction due to external changes over time.

One of the simplest means to control cracking is to provide weakened control joints for cracking to occur along. These do not prevent cracks from developing; they simply provide a relief point for the stresses that develop. These joints are a widely accepted means to control cracks but are not always effective. Control joints are more effective the more closely spaced they are. GeoTek suggests that control joints be placed in two directions and located a distance apart roughly equal to 24 to 36 times the slab thickness.

Exterior concrete flatwork (patios, walkways, driveways, etc.) is often some of the most visible aspects of site development. They are typically given the least level of quality control, being considered "non-structural" components. We suggest that the same standards of care be applied to these features as to the structure itself.

5.8 POST CONSTRUCTION CONSIDERATIONS

5.8.1 Landscape Maintenance and Planting

Water has been shown to weaken the inherent strength of soil, and slope stability is significantly reduced by overly wet conditions. Positive surface drainage away from graded slopes should be maintained and only the amount of irrigation necessary to sustain plant life should be provided for planted slopes. Controlling surface drainage and runoff and maintaining a suitable vegetation cover can minimize erosion. Plants selected for landscaping should be lightweight, deep-rooted types that require little water and are capable of surviving the prevailing climate.

Overwatering should be avoided. The soils should be maintained in a solid to semi-solid state as defined by the materials Atterberg Limits. Care should be taken when adding soil amendments to avoid excessive watering. Leaching as a method of soil preparation prior to planting is not recommended. An abatement program to control ground-burrowing rodents should be implemented and maintained. This is critical as burrowing rodents can decreased the long-term performance of slopes.

It is common for planting to be placed adjacent to structures in planter or lawn areas. This will result in the introduction of water into the ground adjacent to the foundation. This type of landscaping should be avoided. If used, then extreme care should be exercised with regard to the irrigation and drainage in these areas.

5.8.2 Drainage

The need to maintain proper surface drainage and subsurface systems cannot be overly emphasized. Positive site drainage should be maintained at all times. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond or seep into the ground. Pad drainage should be directed toward approved areas and not be blocked by other improvements.

It is the owner's responsibility to maintain and clean drainage devices on or contiguous to their lot. In order to be effective, maintenance should be conducted on a regular and routine schedule and necessary corrections made prior to each rainy season.

5.9 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

We recommend that site foundation plans and relevant project specifications be reviewed by this office prior to construction to check for conformance with the recommendations of this report. We also recommend that GeoTek representatives be present during site grading and foundation construction to check for proper implementation of the geotechnical recommendations. The owner/developer should verify that GeoTek representatives perform at least the following duties:

- Observe site clearing and grubbing operations for proper removal of unsuitable materials.
- Observe and test bottom of removals prior to fill placement.
- Evaluate the suitability of onsite and import materials for fill placement and collect soil samples for laboratory testing where necessary.
- Observe the fill for uniformity during placement, including utility trenches.
- Perform field density testing of the fill materials.
- Observe and probe foundation excavations to confirm suitability of bearing materials.

If requested, a construction observation and compaction report can be provided by GeoTek, which can comply with the requirements of the governmental agencies having jurisdiction over the project. We recommend that these agencies be notified prior to commencement of construction so that necessary grading permits can be obtained.

6. INTENT

It is the intent of this report to aid in the design and construction of the proposed development. Implementation of the advice presented in Section 5 of this report is intended to reduce risk associated with construction projects. The professional opinions and geotechnical advice contained in this report are not intended to imply total performance of the project or guarantee that unusual or variable conditions will not be discovered during or after construction.

The scope of our evaluation is limited to the boundaries of the subject residential lot. This review does not and should in no way be construed to encompass any areas beyond the specific area of the proposed construction as indicated to us by the client. Further, no evaluation of any existing site improvements is included. The scope is based on our understanding of the project and the client's needs, our fee estimate (P-0202521-CR) dated February 10, 2021 and geotechnical engineering standards normally used on similar projects in this region.

7. LIMITATIONS

The materials observed on the project site appear to be representative of the area; however, soil and bedrock materials vary in character between excavations and natural outcrops or conditions exposed during site construction. Site conditions may vary due to seasonal changes or other factors. GeoTek, Inc. assumes no responsibility or liability for work, testing or recommendations performed or provided by others.

Since our recommendations are based on the site conditions observed and encountered, and laboratory testing, our conclusion and recommendations are professional opinions that are limited to the extent of the available data. Observations during construction are important to allow for any change in recommendations found to be warranted. These opinions have been derived in accordance with current standards of practice and no warranty is expressed or implied. Standards of practice are subject to change with time.

8. SELECTED REFERENCES

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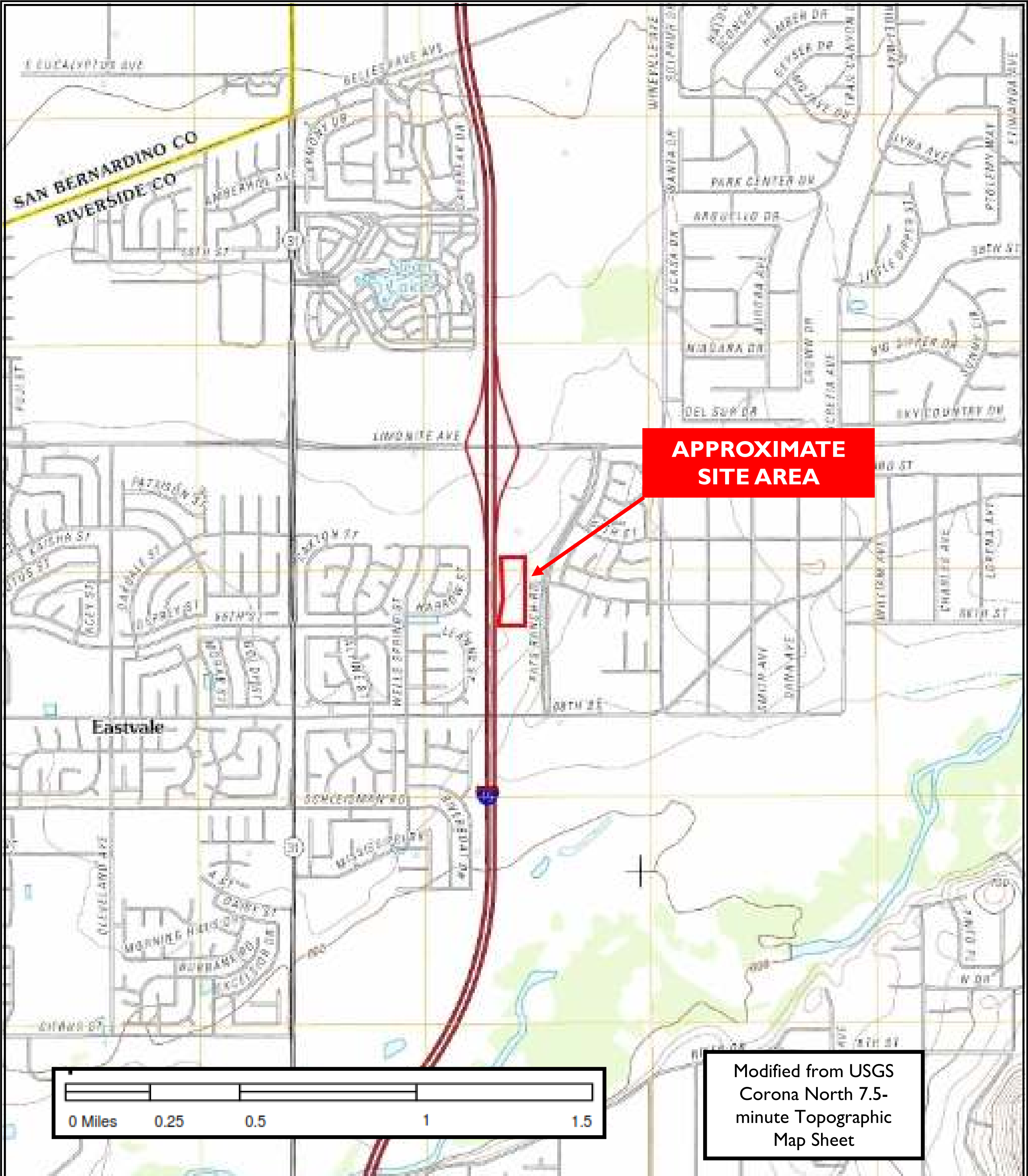


Verona Trust
Verona Marketplace Apartments Project
Neighborhood B
65th Street/Pats Ranch Road
Jurupa Valley, Riverside County, California

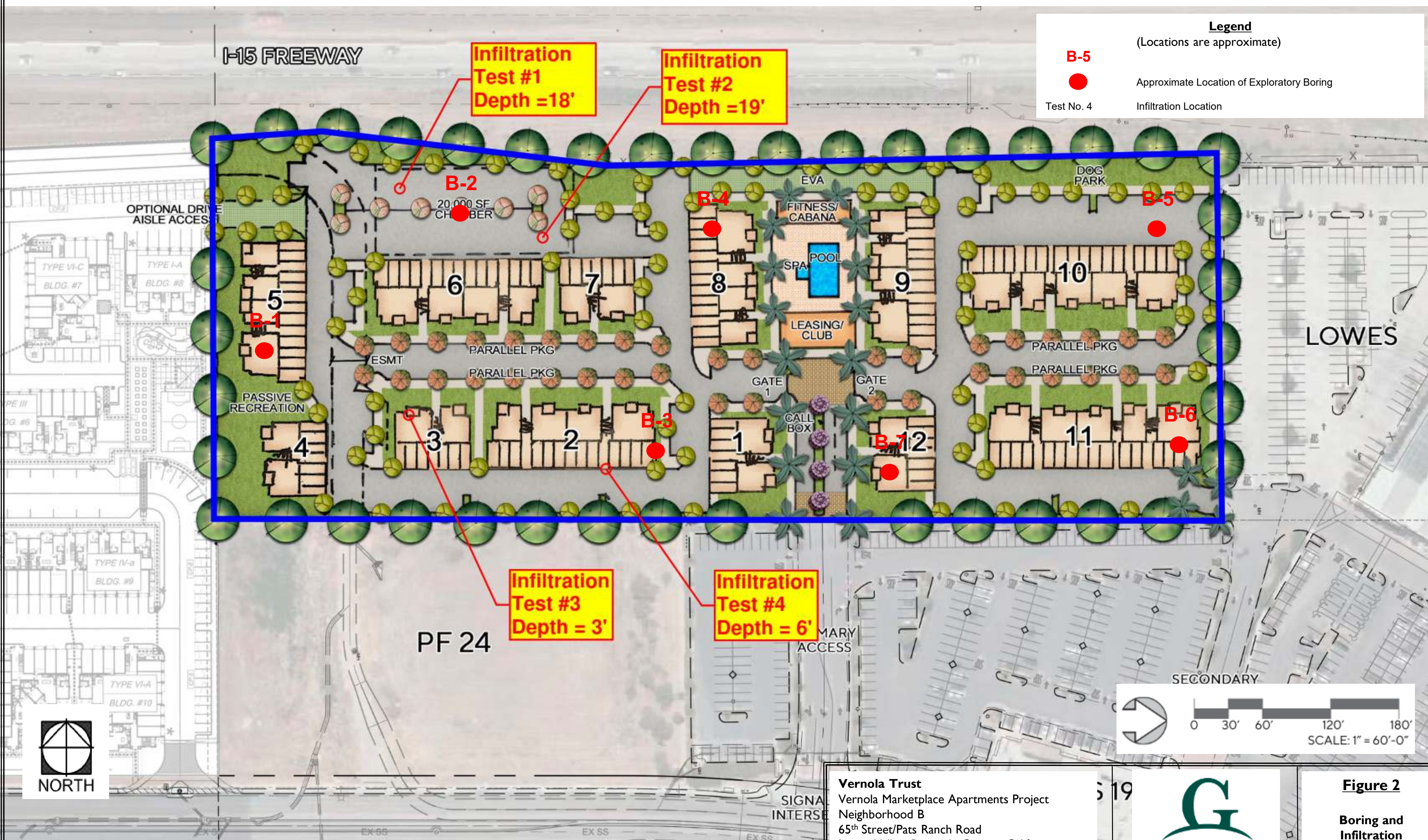
Project No. 2654-CR

NORTH

Figure 1

Site Location and Topography Map

GEOTEK



Vernola Trust
Vernola Marketplace Apartments Project
Neighborhood B
65th Street/Pats Ranch Road
Jurupa Valley, Riverside County, California
GeoTek Project No. 2654-CR

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Figure 2

Boring and Infiltration Test Location Map

APPENDIX A

LOGS OF EXPLORATORY BORINGS

Vernola Marketplace Apartments
Jurupa Valley, Riverside County, California
Project No. 2654-CR

GEOTEK

A - FIELD TESTING AND SAMPLING PROCEDURES

The Modified Split-Barrel Sampler (Ring)

The ring sampler is driven into the ground in accordance with ASTM Test Method D 3550. The sampler, with an external diameter of 3.0 inches, is lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sampler is typically driven into the ground 12 or 18 inches with a 140-pound hammer free falling from a height of 30 inches. Blow counts are recorded for every 6 inches of penetration as indicated on the log of boring. The samples are removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

Bulk Samples (Large)

These samples are normally large bags of earth materials over 20 pounds in weight collected from the field by means of hand digging or exploratory cuttings.

B – BORING/TRENCH LOG LEGEND

The following abbreviations and symbols often appear in the classification and description of soil and rock on the logs of borings/trenches:

SOILS

USCS	Unified Soil Classification System
f-c	Fine to coarse
f-m	Fine to medium

GEOLOGIC

B: Attitudes	Bedding: strike/dip
J: Attitudes	Joint: strike/dip
C: Contact line	
………..	Dashed line denotes USCS material change
———	Solid Line denotes unit / formational change
━━━	Thick solid line denotes end of boring/trench

(Additional denotations and symbols are provided on the log of borings/trenches)

GeoTek, Inc.

LOG OF EXPLORATORY BORING

GEOTEK

CLIENT:	Vernola Trust	**DRILLER:**	Martini	**LOGGED BY:**	JD
PROJECT NAME:	Vernola Trust Apartments	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Gene
PROJECT NO.:	2654-CR	**HAMMER:**	140 lbs. - 30 inches	**RIG TYPE:**	CME 75
LOCATION:	Jurupa Valley, CA			**DATE:**	2/22/2021

BORING NO.: B-1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Alluvium:			
	Ring	8	R1	SM	Silty f SAND, brown, moist, dense			
		22				9.5	98.0	
		27						
	Ring	11	R2		--becomes medium dense			Collapse
		12				9.4	99.3	
		12						
5	Ring	7	R3					
		11				7.7	113.8	
		20						
	Ring	13	R4					
		14				17.1	94.4	
		19						
	Ring	9	R5					
10		8						
		11						
15	Ring	7	R6		--becomes dense			
		17						
		26						
20	Ring	3	R7	CL	Sandy CLAY, grey, moist, stiff			
		4						
		11						
					BORING TERMINATED AT 21.5 FEET			
					No groundwater encountered			
					Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:

AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test
SR = Sulfate/Resisitivity Test	SH = Shear Test	HC= Consolidation	MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

GEOTEK

CLIENT:	Vernola Trust	**DRILLER:**	Martini	**LOGGED BY:**	JD
PROJECT NAME:	Vernola Trust Apartments	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Gene
PROJECT NO.:	2654-CR	**HAMMER:**	140 lbs. - 30 inches	**RIG TYPE:**	CME 75
LOCATION:	Jurupa Valley, CA			**DATE:**	2/22/2021

BORING NO.: B-2

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
	Large Bulk				**Alluvium:**			SR
	Ring	50-5"	R1	SM	Silty f SAND, dark brown, moist, very dense	10.4	91.5	
5	Ring	37 50-3"	R2		--becomes orange-brown and coarser	9.9	101.6	
	Ring	16 36 50-5"	R3		--becomes fine and tan-brown	7.0	100.6	
	Ring	20 43 50-4"	R4			22.9	103.5	
10	Ring	24 50-6"	R5					
15	Ring	11 26 38	R6		--becomes dense			
20	Ring	9 28 47	R7	SP	F-c SAND, grey, slightly moist, dense			
					BORING TERMINATED AT 21.5 FEET			
					No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Vernola Trust	**DRILLER:**	Martini	**LOGGED BY:**	JD
PROJECT NAME:	Vernola Trust Apartments	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Gene
PROJECT NO.:	2654-CR	**HAMMER:**	140 lbs. - 30 inches	**RIG TYPE:**	CME 75
LOCATION:	Jurupa Valley, CA			**DATE:**	2/22/2021

BORING NO.: B-3

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
	Large Bulk				**Alluvium:**			SH, EI, MD
	Ring	8 14 21	R1	SM	Silty f SAND, brown, moist, medium dense	8.6	108.4	EI=1
	Ring	12 15 17	R2			10.1	116.1	
5	Ring	8 10 12	R3			8.1	100.0	
	Ring	5 17 24	R4			16.5	113.5	
10	Ring	9 14 23	R5		--becomes grey			
15	Ring	3 4 6	R6	CL	Sandy CLAY, grey, moist, medium stiff			
20	Ring	15 27 18	R7	SW	F SAND, grey-brown, moist, dense			
25	SPT	15 27 18	S1	SP	F-c SAND, gravelly, tan-brown, moist, dense			SA % Passing #200 = 4.4
30	SPT	12 50-6"	S2		becomes very dense			

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:

AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test
SR = Sulfate/Resisitivity Test	SH = Shear Test	HC= Consolidation	MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Vernola Trust	**DRILLER:**	Martini	**LOGGED BY:**	JD
PROJECT NAME:	Vernola Trust Apartments	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Gene
PROJECT NO.:	2654-CR	**HAMMER:**	140 lbs. - 30 inches	**RIG TYPE:**	CME 75
LOCATION:	Jurupa Valley, CA			**DATE:**	2/22/2021

BORING NO.: B-3

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
					continued:			
35	SPT	29 17 22	S3	SM	Silty f-m SAND, slightly clayey, tan-brown, moist, dense			
40	SPT	5 15 19	S4		--becomes finer-grained and brown			
45	SPT (Water Table)	8 16 22	S5		Groundwater encountered at 45 feet --becomes coarser grained and grey			
50	SPT	10 25 50-6"	S6		--becomes very dense			
					BORING TERMINATED AT 51.5 FEET Groundwater encountered at 45 feet Boring backfilled with soil cuttings			
55								
60								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

GEOTEK

CLIENT:	Vernola Trust	**DRILLER:**	Martini	**LOGGED BY:**	JD
PROJECT NAME:	Vernola Trust Apartments	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Gene
PROJECT NO.:	2654-CR	**HAMMER:**	140 lbs. - 30 inches	**RIG TYPE:**	CME 75
LOCATION:	Jurupa Valley, CA			**DATE:**	2/22/2021

BORING NO.: B-4

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
					Alluvium:			
	Ring	17 18 15	R1	SM	Silty f SAND, dark brown, moist, dense	5.8	109.3	
5	Ring	18 25 32	R2		--becomes orange-brown and coarse	6.0	126.7	Collapse
	Ring	17 33 33	R3		--becomes fine and tan-brown	5.3	118.9	Collapse
	Ring	15 21 33	R4			4.4	122.3	
10	Ring	26 30 36	R5					
15	Ring	17 32 42	R6		--becomes dense			
20	Ring	14 33 50-6"	R7	SP	F-c SAND, grey, slightly moist, dense			
					BORING TERMINATED AT 21.5 FEET No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:

AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test
SR = Sulfate/Resisitivity Test	SH = Shear Test	HC= Consolidation	MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

GEOTEK

CLIENT:	Vernola Trust	**DRILLER:**	Martini	**LOGGED BY:**	JD
PROJECT NAME:	Vernola Trust Apartments	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Gene
PROJECT NO.:	2654-CR	**HAMMER:**	140 lbs. - 30 inches	**RIG TYPE:**	CME 75
LOCATION:	Jurupa Valley, CA			**DATE:**	2/22/2021

BORING NO.: B-5

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
	Large Bulk				**Alluvium:**			MD, EI, SR
	Ring	4 7 10	R1	SM	Silty f SAND, brown, moist, medium dense	4.6	107.8	EI=1
5	Ring	1 2 2	R2		--becomes loose	7.0	100.2	
	Ring	2 4 5	R3			7.8	108.5	
10	Ring	3 6 7	R4			5.0	112.1	
15	Ring	2 8 11	R5		--becomes coarser-grained, medium dense			
20	Ring	9 14 18	R6		--increased clay content			
					BORING TERMINATED AT 21.5 FEET			
					No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:

AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test
SR = Sulfate/Resisitivity Test	SH = Shear Test	HC= Consolidation	MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Vernola Trust	**DRILLER:**	Martini	**LOGGED BY:**	JD
PROJECT NAME:	Vernola Trust Apartments	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Gene
PROJECT NO.:	2654-CR	**HAMMER:**	140 lbs. - 30 inches	**RIG TYPE:**	CME 75
LOCATION:	Jurupa Valley, CA			**DATE:**	2/22/2021

BORING NO.: B-6

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Alluvium:			
	Ring	14 30 33	R1	SM	Silty f-m SAND, brown, moist, dense	12.7	118.6	
5	Ring	5 10 13	R2		--becomes coarse and medium dense	8.6	105.9	
	Ring	5 6 5	R3		--becomes loose	7.9	110.8	Collapse
	Ring	3 6 7	R4			10.6	109.6	
10	Ring	4 7 13	R5		--becomes finer grained and medium dense			
15	Ring	7 16 30	R6		--becomes grey-brown and dense			
20	Ring	30 50-5"	R7	SP	--becomes coarser grained, gravelly, and very dense			
					BORING TERMINATED AT 21 FEET			
					No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:
AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test
SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Vernola Trust	**DRILLER:**	Martini	**LOGGED BY:**	JD
PROJECT NAME:	Vernola Trust Apartments	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Gene
PROJECT NO.:	2654-CR	**HAMMER:**	140 lbs. - 30 inches	**RIG TYPE:**	CME 75
LOCATION:	Jurupa Valley, CA			**DATE:**	2/22/2021

BORING NO.: B-7

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Alluvium:			
		10 27 50-5"	R1	SM	Silty f-c SAND, brown, moist, very dense			
		22 44 41	R2					
5		19 25 22	R3		--becomes dense			
		33 50-6"	R4		--becomes very dense			
					PRACTICAL REFUSAL AT 8 FEET			
					No groundwater encountered Boring backfilled with soil cuttings			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:
AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test
SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Vernola Trust	**DRILLER:**	Martini	**LOGGED BY:**	JD
PROJECT NAME:	Vernola Marketplace	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Gene
PROJECT NO.:	2654-CR	**HAMMER:**	140 lbs. - 30 inches	**RIG TYPE:**	CME 75
LOCATION:	Jurupa Valley, CA			**DATE:**	2/22/2021

BORING NO.: I-1

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
					Alluvium:			
				SM	Silty f SAND, brown, moist			
5								
10					--becomes coarse-grained gravelly, and slightly moist			
15								
					BORING TERMINATED AT 18 FEET			
					No groundwater encountered			
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:
AL = Atterberg Limits
EI = Expansion Index
SA = Sieve Analysis
RV = R-Value Test
SR = Sulfate/Resisitivity Test
SH = Shear Test
HC= Consolidation
MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

GEOTEK

CLIENT:	Vernola Trust	**DRILLER:**	Martini	**LOGGED BY:**	JD
PROJECT NAME:	Vernola Marketplace	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Gene
PROJECT NO.:	2654-CR	**HAMMER:**	140 lbs. - 30 inches	**RIG TYPE:**	CME 75
LOCATION:	Jurupa Valley, CA			**DATE:**	2/22/2021

BORING NO.: I-2

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
					Alluvium:			
				SM	Silty f SAND, brown, moist			
5								
					--becomes coarse-grained			
10					--becomes fine-grained			
15								
					BORING TERMINATED AT 19 FEET			
20					No groundwater encountered			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:
AL = Atterberg Limits | EI = Expansion Index | SA = Sieve Analysis | RV = R-Value Test
SR = Sulfate/Resisitivity Test | SH = Shear Test | HC= Consolidation | MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Vernola Trust	**DRILLER:**	Martini	**LOGGED BY:**	JD
PROJECT NAME:	Vernola Marketplace	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Gene
PROJECT NO.:	2654-CR	**HAMMER:**	140 lbs. - 30 inches	**RIG TYPE:**	CME 75
LOCATION:	Jurupa Valley, CA			**DATE:**	2/22/2021

BORING NO.: I-3

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
					Alluvium:			
				SM	Silty f-c SAND, brown, moist			
					BORING TERMINATED AT 3 FEET			
					No groundwater encountered			
5								
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

GEOTEK

CLIENT:	Vernola Trust	**DRILLER:**	Martini	**LOGGED BY:**	JD
PROJECT NAME:	Vernola Marketplace	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Gene
PROJECT NO.:	2654-CR	**HAMMER:**	140 lbs. - 30 inches	**RIG TYPE:**	CME 75
LOCATION:	Jurupa Valley, CA			**DATE:**	2/22/2021

BORING NO.: I-4

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
					Alluvium:			
				SM	Silty f-c SAND, brown, moist			
5								
					BORING TERMINATED AT 6 FEET			
10								
					No groundwater encountered			
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

APPENDIX B

LABORATORY TEST RESULTS

Vernola Marketplace Apartments
Jurupa Valley, Riverside County, California
Project No. 2654-CR

GEOTEK

SUMMARY OF LABORATORY TESTING

Classification

Soils were classified visually in general accordance with the Unified Soil Classification System (ASTM Test Method D 2487). The soil classifications by GeoTek are shown on the logs of exploratory borings in Appendix A.

Consolidation/Collapse

Consolidation and collapse testing was performed on selected samples of the site soils according to ASTM Test Method D 4546. The results of this testing are presented in Appendix B.

Direct Shear

Shear testing was performed in a direct shear machine of the strain-control type in general accordance with ASTM Test Method D 3080. The rate of deformation is approximately 0.035 inch per minute. The samples were sheared under varying confining loads in order to determine the coulomb shear strength parameters, angle of internal friction and cohesion. The results of the testing are presented in Appendix B.

Expansion Index

Expansion Index testing was performed on one representative soil sample. Testing was performed in general accordance with ASTM Test Method D 4829. The results of the testing are provided below.

Boring No.	Depth (ft.)	Soil Type	Expansion Index	Classification
B-3	0-5	Silty Sand	1	Very Low
B-5	0-5	Silty Sand	1	Very Low

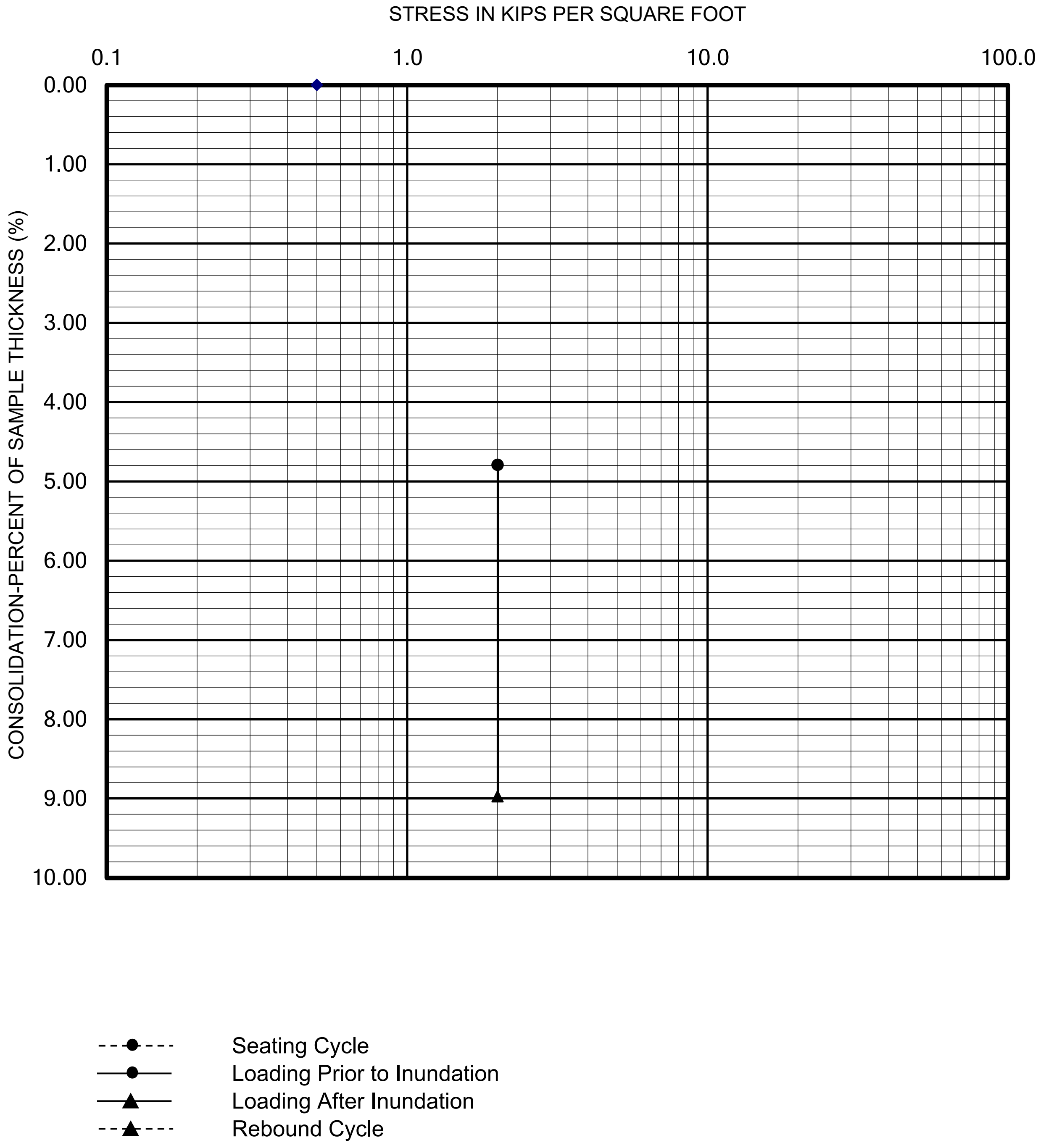
Moisture-Density Relationship

Laboratory testing was performed on representative site samples collected during the recent subsurface exploration. The laboratory maximum dry density and optimum moisture content for the samples tested were determined in general accordance with test method ASTM Test Procedure D 1557. The results are included in Appendix B.

Sulfate Content, Resistivity and Chloride Content

Testing to determine the water-soluble sulfate content, resistivity testing and the chloride content was performed by others. The results of the testing are provided below and in Appendix B.

Boring No.	Depth (ft.)	pH ASTM G51	Chloride ASTM D4327 (ppm)	Sulfate ASTM D4327 (% by weight)	Resistivity ASTM G187 (ohm-cm)
B-2	0-5	8.0	81.2	0.0139	1,139
B-5	0-5	8.2	113.7	0.0267	2,680



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4546

GEOTEK

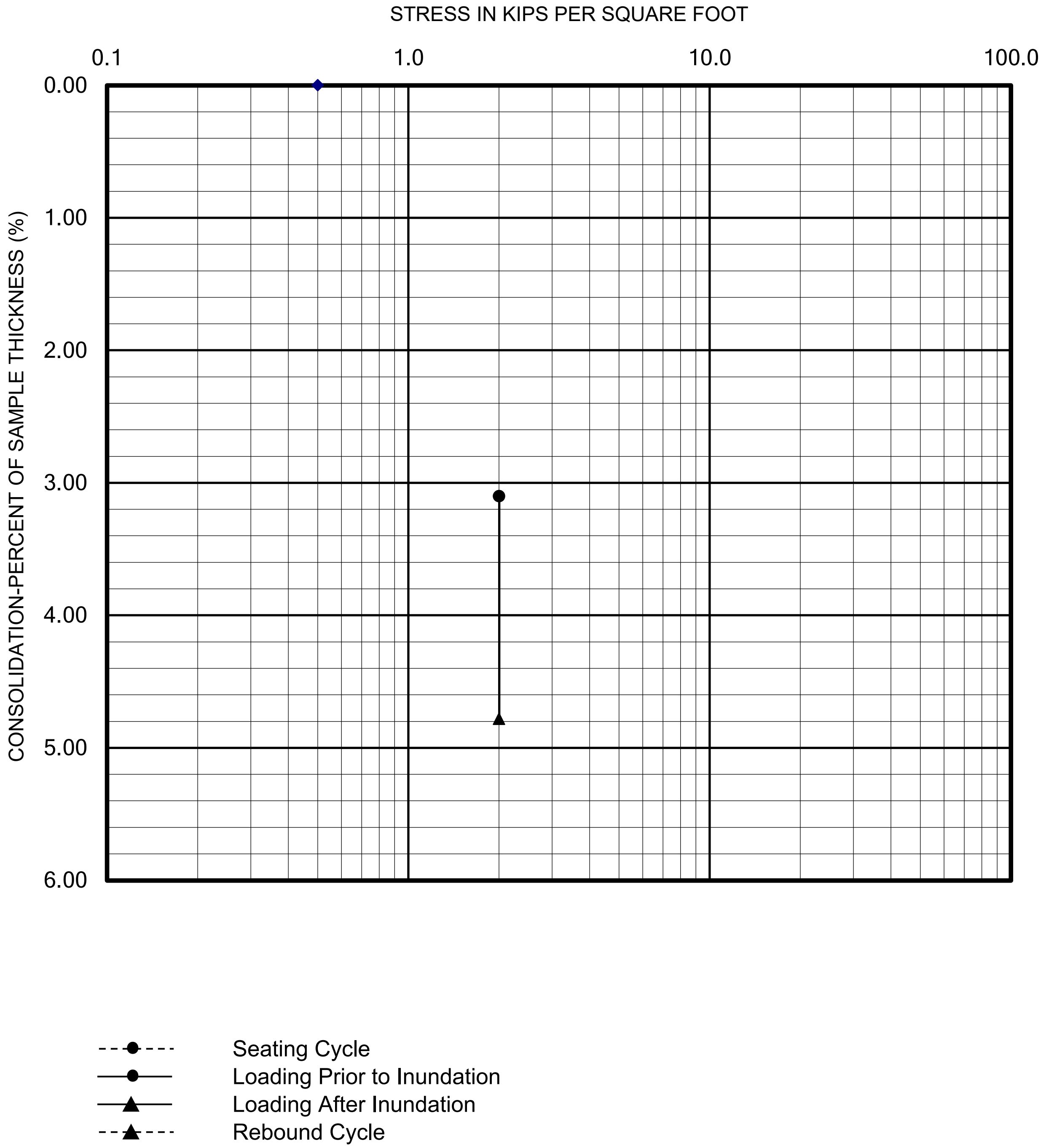
CHECKED BY: RJ	Lab: Corona
PROJECT NO.: 2654-CR	Date: 3-4-21

COLLAPSE REPORT

Sample: B-1 @ 3 feet

Vernola Marketplace Project
Jurupa Valley, CA

Plate B-1



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4546

GEOTEK

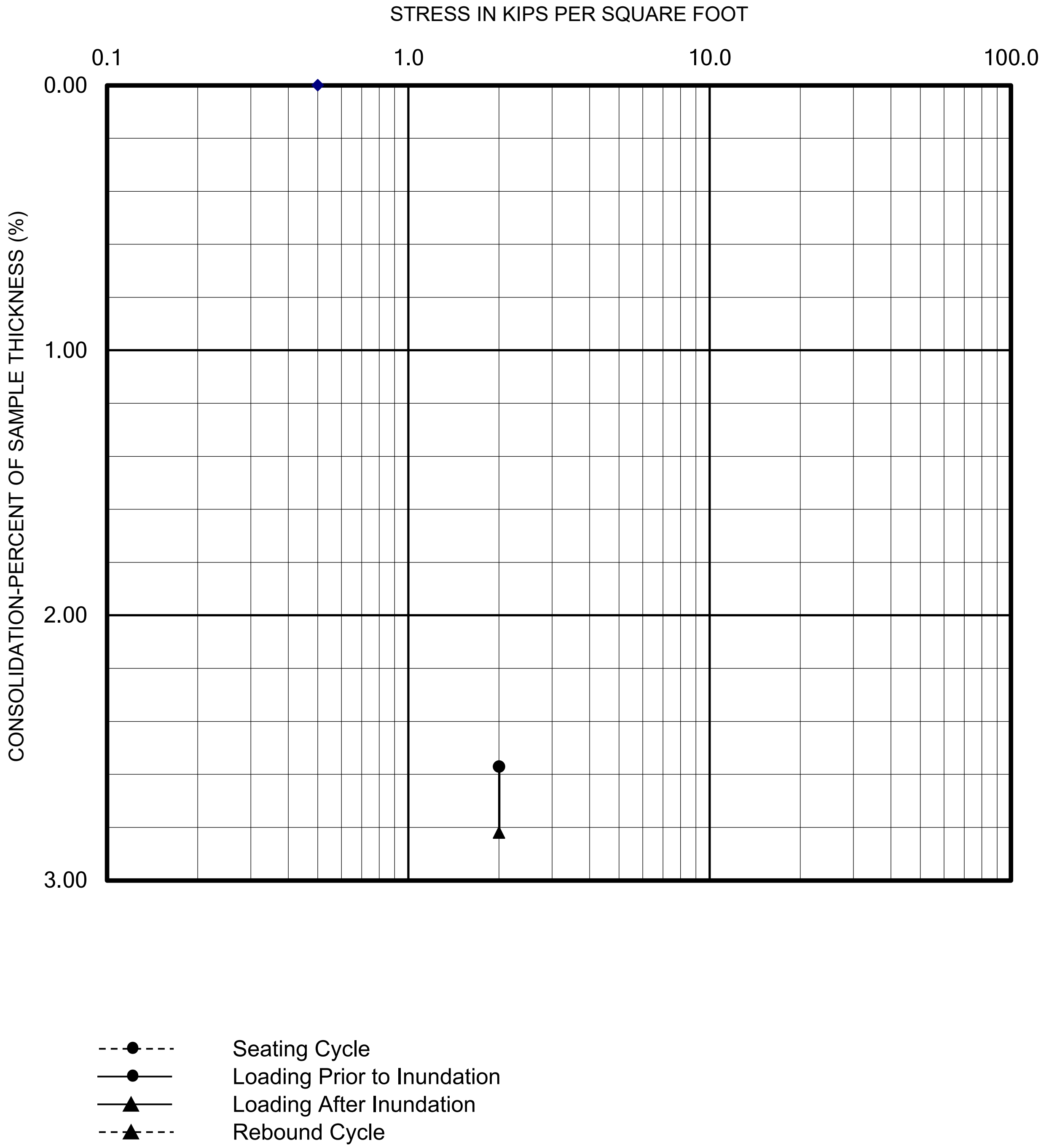
CHECKED BY: RJ	Lab: Corona
PROJECT NO.: 2654-CR	Date: 3-4-21

COLLAPSE REPORT

Sample: B-4 @ 4 feet

Vernola Marketplace Project
Jurupa Valley, CA

Plate B-2



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4546

GEOTEK

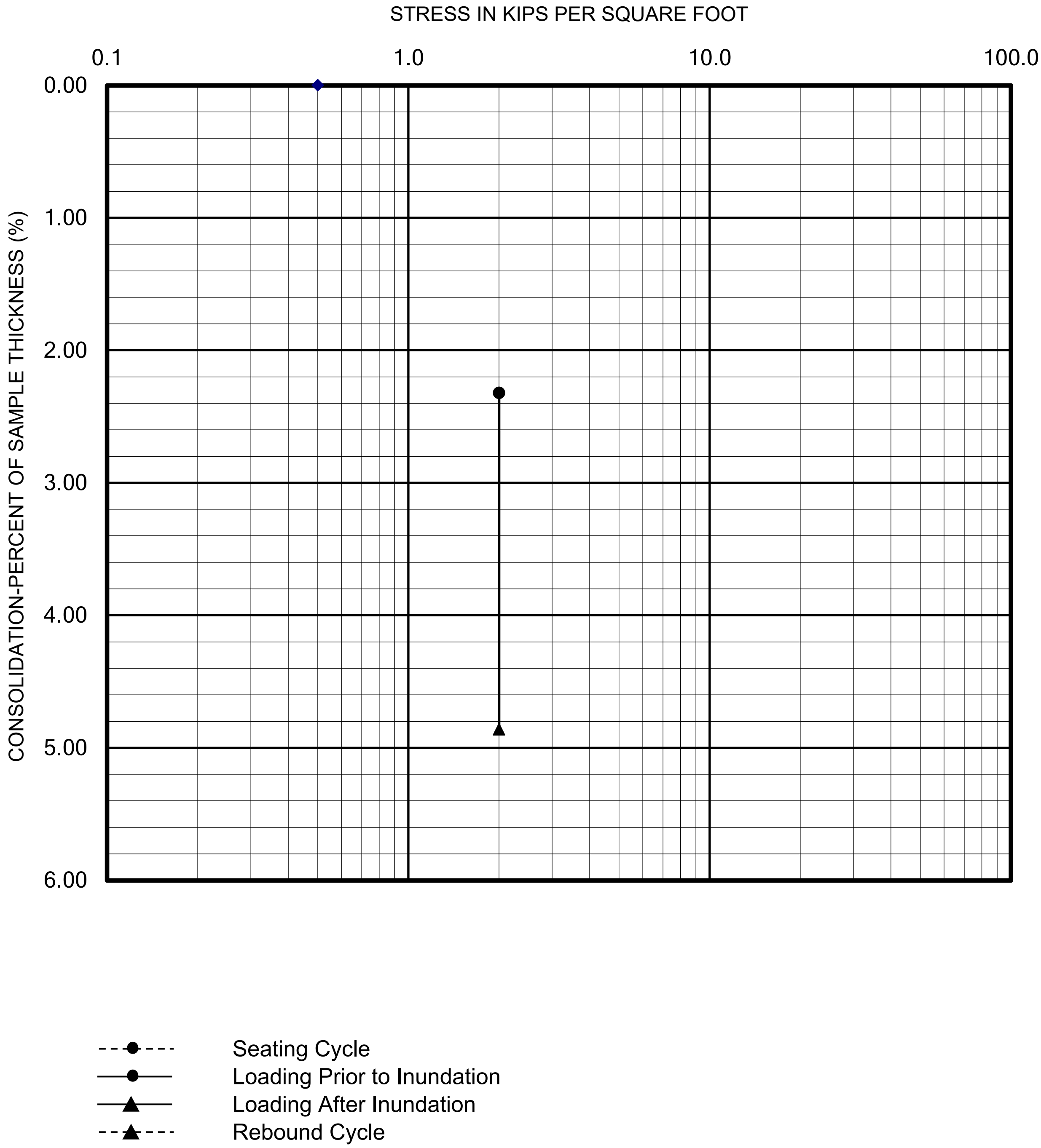
COLLAPSE REPORT

Sample: B-4 @ 6 feet

Vernola Marketplace Project
Jurupa Valley, CA

Plate B-3

CHECKED BY: RJ	Lab: Corona
PROJECT NO.: 2654-CR	Date: 3-4-21



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4546

GEOTEK

COLLAPSE REPORT

Sample: B-6 @ 4 feet

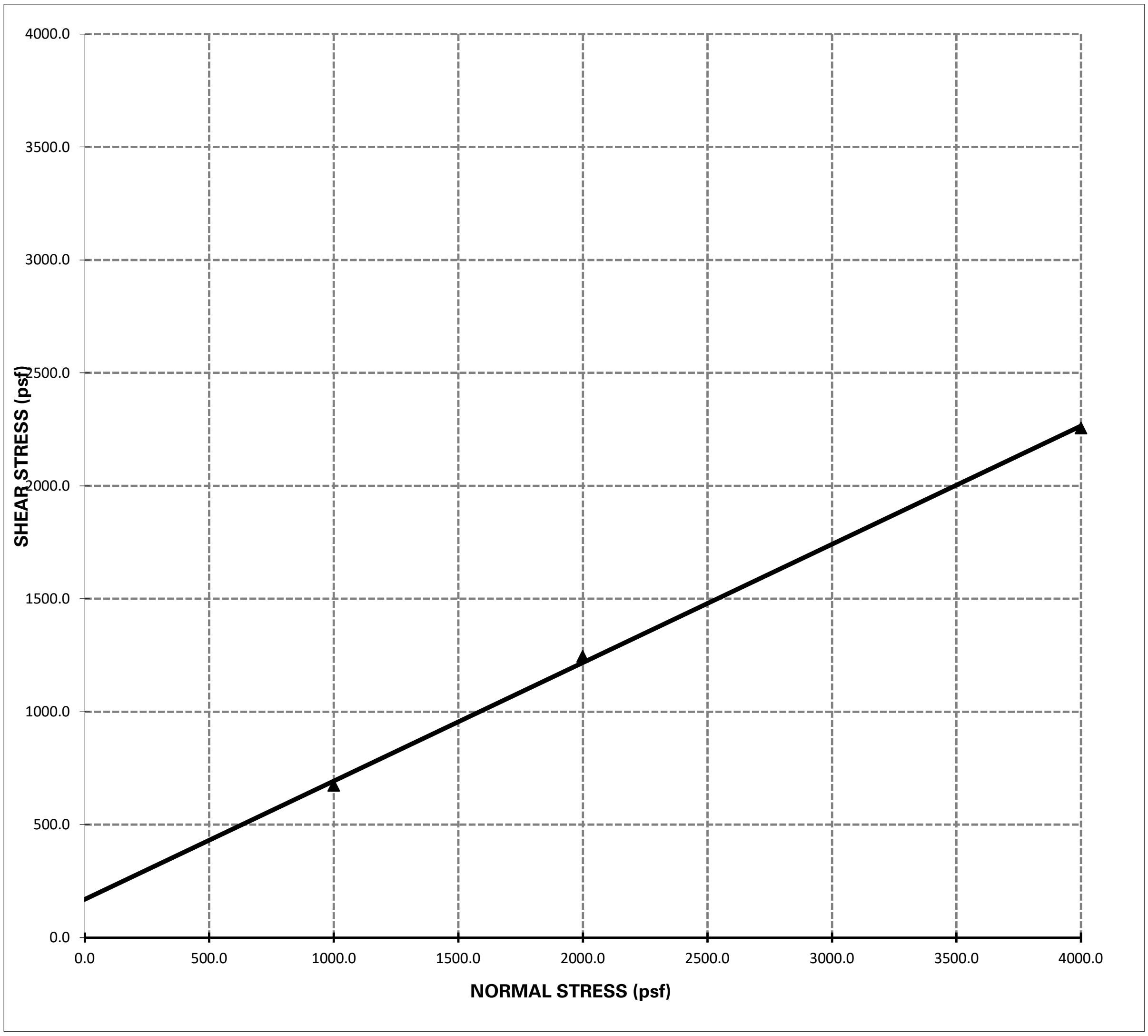
Vernola Marketplace Project
Jurupa, CA

Plate B-4

CHECKED BY: RJ	Lab: Corona
PROJECT NO.: 2654-CR	Date: 3-4-21

DIRECT SHEAR TEST

Project Name:	Vernola Trust	***Sample Location:***	B-3 @ 0-5 feet
Project Number:	2654-CR	***Date Tested:***	3/8/2021



Shear Strength: $\Phi =$ **28°** , **C = 169 psf**

Notes: 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.

2 - The above reflect direct shear strength at saturated conditions.

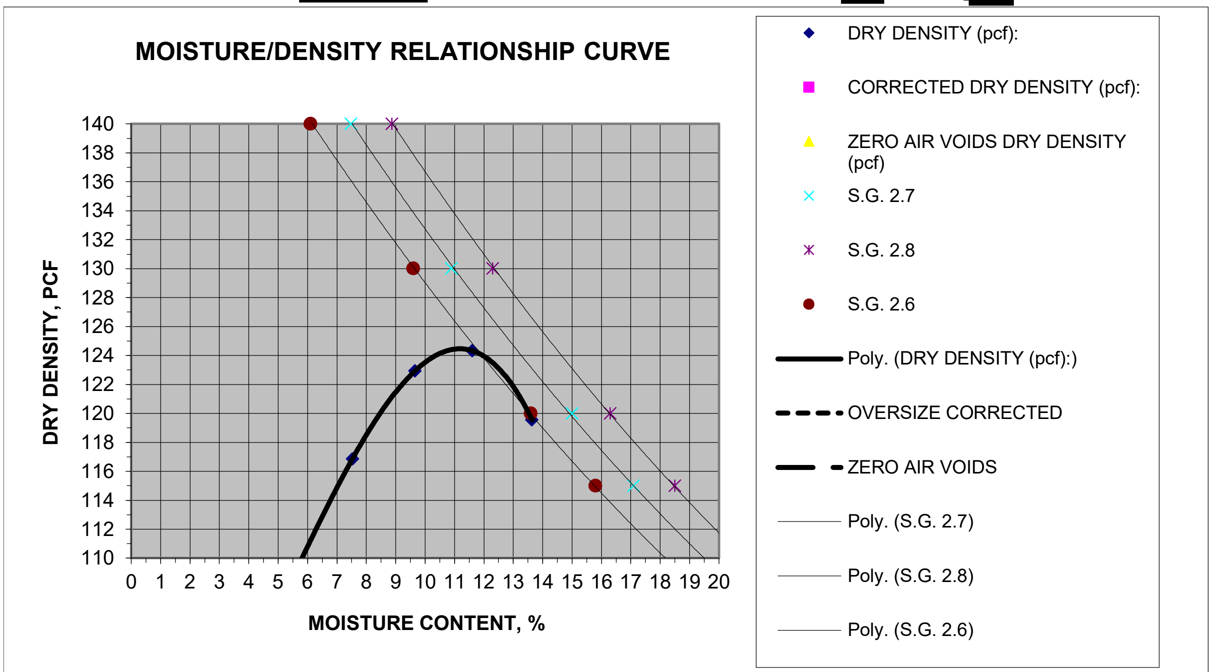
3 - The tests were run at a shear rate of 0.035 in/min.

MOISTURE/DENSITY RELATIONSHIP

Client:	Vernola Trust	**Job No.:**	2654CR
Project:	Vernola Marketplace	**Lab No.:**	Corona
Location:	Jurupa Valley		
Material Type:	Light Brown Silty Sand		
Material Supplier:	-		
Material Source:	-		
Sample Location:	B3 @ 0-5'		
	-		
Sampled By:	JD	**Date Sampled:**	2/26/2021
Received By:	RJ	**Date Received:**	2/26/2021
Tested By:	RL	**Date Tested:**	3/1/2021
Reviewed By:	RJ	**Date Reviewed:**	3/2/2021

Test Procedure: ASTM D1557 **Method:** A

Oversized Material (%): 13.3 **Correction Required:** yes no



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	124.5	**@ Optimum Moisture, %**	11.0
Corrected Maximum Dry Density, pcf	128.8	**@ Optimum Moisture, %**	9.6

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

Classification:

Unified Soils Classification:

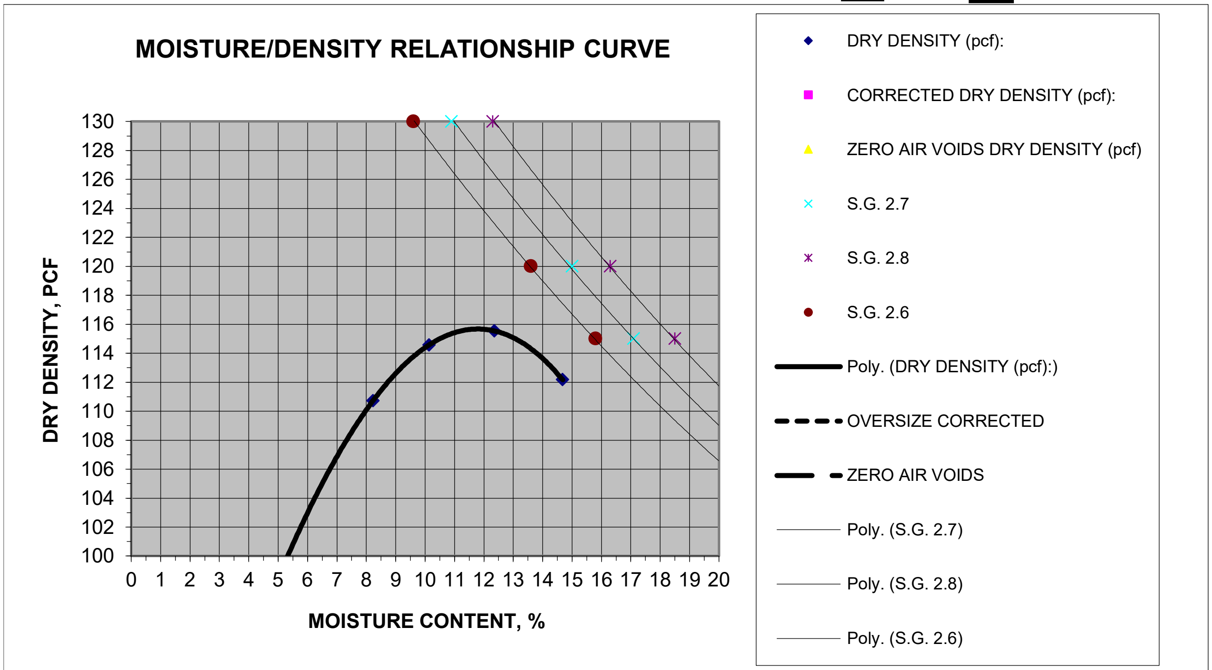
AASHTO Soils Classification:

MOISTURE/DENSITY RELATIONSHIP

Client:	Vernola Trust	**Job No.:**	2654CR
Project:	Vernola Marketplace	**Lab No.:**	Corona
Location:	Jurupa Valley		
Material Type:	Brown Sandy Silt/ Silty Sand		
Material Supplier:	-		
Material Source:	-		
Sample Location:	'B-5@5'		
	-		
Sampled By:	JD	**Date Sampled:**	2/26/2021
Received By:	RJ	**Date Received:**	2/26/2021
Tested By:	RL	**Date Tested:**	3/3/2021
Reviewed By:	RJ	**Date Reviewed:**	3/8/2021

Test Procedure: ASTM D1557 **Method:** A

Oversized Material (%): 3.0 **Correction Required:** ☐ yes ☒ no



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	116.0	**@ Optimum Moisture, %**	12.0
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

Classification:

Unified Soils Classification: ________

AASHTO Soils Classification: ________

Results Only Soil Testing for Vernola Marketplace Neighborhood, Jurupa Valley

March 4, 2021

Prepared for:
Anna Scott
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Project X Job#: S210302C
Client Job or PO#: 2654-CR

Respectfully Submitted,

Eduardo Hernandez, M.Sc., P.E.
Sr. Corrosion Consultant
NACE Corrosion Technologist #16592
Professional Engineer
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Soil Analysis Lab Results

Client: GeoTek, Inc.
Job Name: Vernola Markteplac Neighborhood, Jurupa Valley
Client Job Number: 2654-CR
Project X Job Number: S210302C
March 4, 2021

	Method	ASTM D4327		ASTM D4327		ASTM G187		ASTM D4972	ASTM G200	SM 4500-S2-D	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D4327	ASTM D4327
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-		**Resistivity** As Rec'd | Minimum		**pH**	**Redox**	**Sulfide** S^{2-}	**Nitrate** NO_3^-	**Ammonium** NH_4^+	**Lithium** Li^+	**Sodium** Na^+	**Potassium** K^+	**Magnesium** Mg^{2+}	**Calcium** Ca^{2+}	**Fluoride** F_2^{--}	**Phosphate** PO_4^{3-}
	(ft)	(mg/kg)	(wt%)	(mg/kg)	(wt%)	(Ohm-cm)	(Ohm-cm)		(mV)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
2654-CR B-2	0-5	139.4	0.0139	81.2	0.0081	6,633	1,139	8.0	147	<0.01	328.4	40.6	ND	207.4	5.5	38.7	88.4	2.0	7.3

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

Results Only Soil Testing for Vernola Marketplace Neighborhood, Surupa Valley

March 5, 2021

Prepared for:
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Project X Job#: S210303C
Client Job or PO#: 2654-CR

Respectfully Submitted,

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Sr. Corrosion Consultant
NACE Corrosion Technologist #16592
Professional Engineer
California No. M37102
ehernandez@projectxcorrosion.com

Soil Analysis Lab Results

Client: GeoTek, Inc.
Job Name: Vernola Marketplace Neighborhood, Surupa Valley
Client Job Number: 2654-CR
Project X Job Number: S210303C
March 5, 2021

	Method	ASTM D4327		ASTM D4327		ASTM G187		ASTM D4972	ASTM G200	SM 4500-S2-D	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D4327	ASTM D4327
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-		**Resistivity** As Rec'd | Minimum		**pH**	**Redox**	**Sulfide** S^{2-}	**Nitrate** NO_3^-	**Ammonium** NH_4^+	**Lithium** Li^+	**Sodium** Na^+	**Potassium** K^+	**Magnesium** Mg^{2+}	**Calcium** Ca^{2+}	**Fluoride** F_2^{--}	**Phosphate** PO_4^{3-}
	(ft)	(mg/kg)	(wt%)	(mg/kg)	(wt%)	(Ohm-cm)	(Ohm-cm)		(mV)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
2654-CR B-5 @	0-5	266.9	0.0267	113.7	0.0114	18,760	2,680	8.2	178	<0.01	237.9	49.0	0.03	111.3	40.7	53.0	143.4	2.5	15.6

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

APPENDIX C

INFILTRATION TEST DATA

Vernola Marketplace Apartments
Jurupa Valley, Riverside County, California
Project No. 2654-CR

GEOTEK

PERCOLATION DATA SHEET

Project: VERNOLA MARKET PLACE, **Job No.:** 2654-CR.

Test Hole No.: I-1 **Tested By:** DVG, **Date:** 3/1/2021.

Depth of Hole As Drilled: 204" **Before Test:** 204" **After Test:** 204".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
	—	—	—	—	—	—		PRESOAK 5 GAL
	749	—	204	20	—	—		BEGIN
	814	25			9	11		1ST 25 MIN
	816		204	20				
	841	25			9 3/4	10 1/4		2ND 25 MIN.
	843		204	20				
	913	30			8	12		1ST 30 MIN.
	915		204	20				
	945	30			8 1/2	11 1/2		2ND 30 MIN.
	947		204	20				
	1017	30			9 1/4	10 3/4		3RD 30 MIN.
	1019		204	20				
	1049	30			9 1/2	10 1/2		4TH 30 MIN.
	1051		204	20				
	1121	30			10 1/4	9 3/4		5TH 30 MIN.
	1123		204	20				
	1153	30			11 1/4	8 3/4		6TH 30 MIN.
	1155		204	20				
	1225	30			12	8		7TH 30 MIN.

PERCOLATION DATA SHEET

Project: VERNOLA MARKET PLACE, Job No.: 2654-CR

Test Hole No.: I-1 Tested By: DVG, Date: 3/1/2021.

Depth of Hole As Drilled: 204" Before Test: 204" After Test: 204".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
	1227		204	20				
	1257	30			12 ½	7 ½		8TH 30 MIN.
	1259		204	20				
	129	30			13 ¼	6 ¾		9TH 30 MIN.
	131		204	20				
	201	30			14	6		10TH 30 MIN.
	203		204	20				
	233	30			14 ½	5 ½		11TH 30 MIN.
	235		204	20				
	305	30			15	5		12TH 30 MIN.

PERCOLATION DATA SHEET

Project: VERNOLA MARKET PLACE, **Job No.:** 2654-CR.

Test Hole No.: I-2 **Tested By:** JD, **Date:** 3/1/2021.

Depth of Hole As Drilled: 228" **Before Test:** 228" **After Test:** 228".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
								PRESOAK 5 GAL
	756		228	20				BEGIN
	821	25			10 1/2	9 1/2		1ST 25 MIN.
	823		228	20				
	848	25			10 3/4	9 1/4		2ND 25 MIN.
	850		228	20				
	920	30			9	11		1ST 30 MIN.
	922		228	20				
	952	30			10 1/2	9 1/2		2ND 30 MIN.
	954		228	20				
	1024	30			12 1/2	7 1/2		3RD 30 MIN.
	1026		228	20				
	1056	30			14	6		4TH 30 MIN.
	1058		228	20				
	1128	30			15	5		5TH 30 MIN.
	1130		228	20				
	1200	30			15 1/2	4 1/2		6TH 30 MIN.
	1202		228	20				
	1232	30			16 1/4	3 3/4		7TH 30 MIN.

PERCOLATION DATA SHEET

Project: VERNOLA MARKET PLACE, Job No.: 2654-CR.

Test Hole No.: I-2 Tested By: JD, Date: 3/1/2021.

Depth of Hole As Drilled: 228" Before Test: 228" After Test: 228".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
	1234 104	30	228	20	16 3/4	3 1/4		8TH 30 MIN.
	106 136	30	228	20	17	3		9TH 30 MIN.
	138 208	30	228	20	17 1/2	2 1/2		10TH 30 MIN.
	210 240	30	228	20	17 3/4	2 1/4		11TH 30 MIN.
	242 312	30	228	20	18	2		12TH 30 MIN.

PERCOLATION DATA SHEET

Project: VERNOLA MARKET PLACE, **Job No.:** 2654-CR.

Test Hole No.: I-3 **Tested By:** DVG, **Date:** 3/1/2021.

Depth of Hole As Drilled: 36" **Before Test:** 36" **After Test:** 36".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
								PRESOAK 5 GAL
	742 807	25	36	20	17 1/4	2 3/4		BEGIN 1ST 25 MIN.
	809 834	25	36	20	17 1/2	2 1/2		2ND 25 MIN.
	836 906	30	36	20	17	3		1ST 30 MIN.
	908 938	30	36	20	17 1/4	2 3/4		2ND 30 MIN.
	940 1010	30	36	20	17 1/2	2 1/2		3RD 30 MIN.
	1012 1042	30	36	20	17 3/4	2 1/4		4TH 30 MIN.
	1044 1114	30	36	20	18	2		5TH 30 MIN.
	1116 1146	30	36	20	18 1/4	1. 3/4		6TH 30 MIN.
	1148 1218	30	36	20	18 1/2	1 1/2		7TH 30 MIN.

PERCOLATION DATA SHEET

Project: VERNOLA MARKET PLACE, Job No.: 2654-CR

Test Hole No.: I-3 Tested By: DVG, Date: 3/1/2021.

Depth of Hole As Drilled: 36" Before Test: 36" After Test: 36".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
	1220		36	20				
	1250	30			18 3/4	1 1/4		8TH 30 MIN.
	1252		36	20				
	122	30			18 3/4	1 1/4		9TH 30 MIN.
	124		36	20				
	154	30			19	1		10TH 30 MIN.
	156		36	20				
	226	30			19	1		11TH 30 MIN.
	228		36	20				
	258	30			19	1		12TH 30 MIN.

PERCOLATION DATA SHEET

Project: VERNOLA MARKET PLACE, **Job No.:** 2654-CR

Test Hole No.: I-4 **Tested By:** DVG, **Date:** 3/1/2021.

Depth of Hole As Drilled: 72 **Before Test:** 72" **After Test:** 72".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
								PRESOAK 5 GAL
	735 800	25	72	20	17 1/4	2 3/4		BEGIN 1ST 25 MIN.
	802 827	25	72	20	17 1/2	2 1/2		2ND 25 MIN.
	829 859	30	72	20	16 3/4	3 1/4		1ST 30 MIN.
	901 931	30	72	20	17 1/4	2 3/4		2ND 30 MIN.
	933 1003	30	72	20	17 1/2	2 1/2		3RD 30 MIN.
	1005 1035	30	72	20	17 3/4	2 1/4		4TH 30 MIN.
	1037 1107	30	72	20	18	2		5TH 30 MIN.
	1109 1139	30	72	20	18 1/4	1 3/4		6TH 30 MIN.
	1141 1211	30	72	20	18 1/4	1 3/4		7TH 30 MIN.

PERCOLATION DATA SHEET

Project: VERNOLA MARKET PLACE, **Job No.:** 2654-CR

Test Hole No.: I-4 **Tested By:** DVG, **Date:** 3/1/2021.

Depth of Hole As Drilled: 72" **Before Test:** 72 **After Test:** 72".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)	Rate (minutes per inch)	Comments
	1213 1243	30	72	20	18½	1½		8TH 30 MIN.
	1245 115	30	72	20	18½	1½		9TH 30 MIN.
	117 147	30	72	20	18¾	1¼		10TH 30 MIN.
	149 219	30	72	20	18¾	1¼		11TH 30 MIN.
	221 251	30	72	20	18¾	1¼		12TH 30 MIN.

Client:	**Vernola Trust**
Project:	**Vernola Market Place**
Project No:	**2654-CR**
Date:	**3/1/2021**

Boring No. **I-1 (18' deep)**

Percolation Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	189
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	184
Total Test Hole Depth, D_T =	216

Equation - $I_t = \dfrac{\Delta H\,(60r)}{\Delta t\,(r+2H_{avg})}$

$H_O = D_T - D_O =$	32
$H_F = D_T - D_F =$	27
$\Delta H = \Delta D = H_O - H_F =$	5
$H_{avg} = (H_O+H_F)/2 =$	29.5

I_t = 0.63 **Inches per Hour**

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Client:	**Vernola Trust**
Project:	**Vernola Market Place**
Project No:	**2654-CR**
Date:	**3/1/2021**

Boring No.	**I-2 (19' deep)**

Percolation Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	210
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	208
Total Test Hole Depth, D_T =	228

Equation - $$I_t = \frac{\Delta H\,(60r)}{\Delta t\,(r+2H_{avg})}$$

$H_O = D_T - D_O$ =	20
$H_F = D_T - D_F$ =	18
$\Delta H = \Delta D = H_O - H_F$ =	2
$Havg = (H_O+H_F)/2$ =	19

I_t = 0.38 **Inches per Hour**

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Client:	**Vernola Trust**
Project:	**Vernola Market Place**
Project No:	**2654-CR**
Date:	**3/1/2021**

Boring No. **I-3 (3' deep)**

Percolation Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	17
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	16
Total Test Hole Depth, D_T =	36

Equation - $I_t = \dfrac{\Delta H\ (60r)}{\Delta t\ (r+2H_{avg})}$

$H_O = D_T - D_O$ =	20
$H_F = D_T - D_F$ =	19
$\Delta H = \Delta D = H_O - H_F$ =	1
Havg = $(H_O+H_F)/2$ =	19.5

I_t = 0.19 **Inches per Hour**

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Client:	**Vernola Trust**
Project:	**Vernola Market Place**
Project No:	**2654-CR**
Date:	**3/1/2021**

Boring No. **I-4 (6' deep)**

Percolation Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	53.25
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	52
Total Test Hole Depth, D_T =	72

Equation - $$I_t = \frac{\Delta H\ (60r)}{\Delta t\ (r+2H_{avg})}$$

$H_O = D_T - D_O$ =	20
$H_F = D_T - D_F$ =	18.75
$\Delta H = \Delta D = H_O - H_F$ =	1.25
$Havg = (H_O+H_F)/2$ =	19.375

I_t = 0.23 **Inches per Hour**

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APPENDIX D

LIQUEFACTION ANALYSIS

Vernola Marketplace Apartments
Jurupa Valley, Riverside County, California
Project No. 2654-CR

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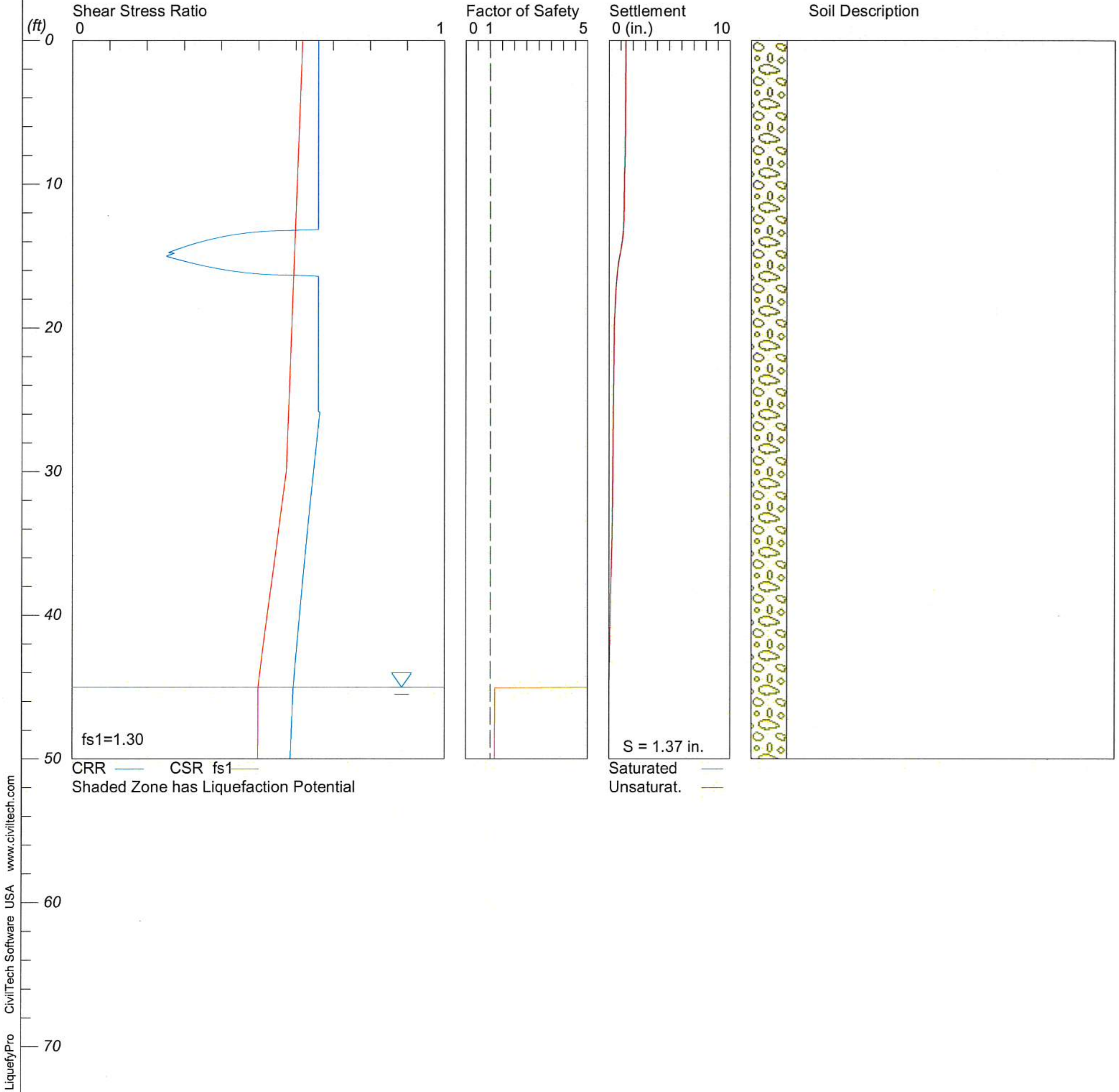
LIQUEFACTION ANALYSIS

Vernola Apts

Hole No.=B-3   Water Depth=45 ft

Magnitude=6.73
Acceleration=0.73g



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****************************************************************************************************
                              LIQUEFACTION ANALYSIS SUMMARY

                              Copyright by CivilTech Software
                                  www.civiltech.com

****************************************************************************************************
        Font: Courier New, Regular, Size 8 is recommended for this report.
        Licensed to ,   3/10/2021      7:54:03 AM

        Input File Name: UNTITLED
        Title:  Vernola Apts
        Subtitle:  2654-CR

        Surface Elev.=
        Hole No.=B-3
        Depth of Hole= 50.00 ft
        Water Table during Earthquake= 45.00 ft
        Water Table during In-Situ Testing= 45.00 ft
        Max. Acceleration= 0.73 g
        Earthquake Magnitude= 6.73

 Input Data:
        Surface Elev.=
        Hole No.=B-3
        Depth of Hole=50.00 ft
        Water Table during Earthquake= 45.00 ft
        Water Table during In-Situ Testing= 45.00 ft
        Max. Acceleration=0.73 g
        Earthquake Magnitude=6.73
        No-Liquefiable Soils:   CL, OL are Non-Liq. Soil

        1. SPT or BPT Calculation.
        2. Settlement Analysis Method: Ishihara / Yoshimine
        3. Fines Correction for Liquefaction: Idriss/Seed
        4. Fine Correction for Settlement: During Liquefaction*
        5. Settlement Calculation in: All zones*
        6. Hammer Energy Ratio,                             Ce = 1.25
        7. Borehole Diameter,                                   Cb= 1.15
        8. Sampling Method,                                    Cs= 1.2
        9. User request factor of safety (apply to CSR) ,   User= 1.3
           Plot one CSR curve (fs1=User)
        10. Use Curve Smoothing: Yes*
        * Recommended Options

        In-Situ Test Data:
        Depth   SPT    gamma   Fines
```

ft		pcf	%
0.00	22.00	115.00	15.00
3.00	20.00	127.00	15.00
5.00	14.00	108.00	15.00
7.00	26.00	130.00	15.00
10.00	24.00	130.00	15.00
15.00	6.00	125.00	60.00
20.00	30.00	130.00	4.00
25.00	45.00	130.00	4.00
30.00	100.00	130.00	4.00
35.00	39.00	130.00	15.00
40.00	34.00	130.00	15.00
45.00	38.00	130.00	15.00
50.00	75.00	130.00	15.00

Output Results:

Settlement of Saturated Sands=0.00 in.
Settlement of Unsaturated Sands=1.37 in.
Total Settlement of Saturated and Unsaturated Sands=1.37 in.
Differential Settlement=0.683 to 0.901 in.

Depth ft	CRRm	CSRfs	F.S.	S_sat. in.	S_dry in.	S_all in.
0.00	0.66	0.62	5.00	0.00	1.37	1.37
1.00	0.66	0.62	5.00	0.00	1.36	1.36
2.00	0.66	0.61	5.00	0.00	1.36	1.36
3.00	0.66	0.61	5.00	0.00	1.36	1.36
4.00	0.66	0.61	5.00	0.00	1.35	1.35
5.00	0.66	0.61	5.00	0.00	1.34	1.34
6.00	0.66	0.61	5.00	0.00	1.33	1.33
7.00	0.66	0.61	5.00	0.00	1.32	1.32
8.00	0.66	0.61	5.00	0.00	1.31	1.31
9.00	0.66	0.60	5.00	0.00	1.28	1.28
10.00	0.66	0.60	5.00	0.00	1.25	1.25
11.00	0.66	0.60	5.00	0.00	1.24	1.24
12.00	0.66	0.60	5.00	0.00	1.22	1.22
13.00	0.66	0.60	5.00	0.00	1.19	1.19
14.00	0.35	0.60	5.00	0.00	1.07	1.07
15.00	0.25	0.60	5.00	0.00	0.88	0.88
16.00	0.42	0.59	5.00	0.00	0.70	0.70
17.00	0.66	0.59	5.00	0.00	0.59	0.59
18.00	0.66	0.59	5.00	0.00	0.52	0.52
19.00	0.66	0.59	5.00	0.00	0.46	0.46
20.00	0.66	0.59	5.00	0.00	0.42	0.42
21.00	0.66	0.59	5.00	0.00	0.40	0.40
22.00	0.66	0.59	5.00	0.00	0.39	0.39
23.00	0.66	0.58	5.00	0.00	0.38	0.38

24.00	0.66	0.58	5.00	0.00	0.36	0.36
25.00	0.66	0.58	5.00	0.00	0.35	0.35
26.00	0.66	0.58	5.00	0.00	0.34	0.34
27.00	0.66	0.58	5.00	0.00	0.32	0.32
28.00	0.65	0.58	5.00	0.00	0.31	0.31
29.00	0.65	0.58	5.00	0.00	0.30	0.30
30.00	0.65	0.57	5.00	0.00	0.29	0.29
31.00	0.64	0.57	5.00	0.00	0.28	0.28
32.00	0.64	0.56	5.00	0.00	0.27	0.27
33.00	0.63	0.56	5.00	0.00	0.26	0.26
34.00	0.63	0.55	5.00	0.00	0.24	0.24
35.00	0.63	0.55	5.00	0.00	0.22	0.22
36.00	0.62	0.54	5.00	0.00	0.19	0.19
37.00	0.62	0.54	5.00	0.00	0.16	0.16
38.00	0.62	0.53	5.00	0.00	0.12	0.12
39.00	0.61	0.53	5.00	0.00	0.10	0.10
40.00	0.61	0.52	5.00	0.00	0.08	0.08
41.00	0.61	0.52	5.00	0.00	0.07	0.07
42.00	0.60	0.51	5.00	0.00	0.05	0.05
43.00	0.60	0.51	5.00	0.00	0.03	0.03
44.00	0.60	0.50	5.00	0.00	0.02	0.02
45.00	0.59	0.50	5.00	0.00	0.00	0.00
46.00	0.59	0.50	1.19	0.00	0.00	0.00
47.00	0.59	0.50	1.18	0.00	0.00	0.00
48.00	0.59	0.50	1.18	0.00	0.00	0.00
49.00	0.59	0.50	1.18	0.00	0.00	0.00
50.00	0.58	0.50	1.18	0.00	0.00	0.00

* F.S.<1, Liquefaction Potential Zone
(F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

Units: Unit: qc, fs, Stress or Pressure = atm (1.0581tsf); Unit Weight = pcf; Depth = ft; Settlement = in.

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1 atm (atmosphere) = 1 tsf (ton/ft2)

CRRm	Cyclic resistance ratio from soils
CSRsf	Cyclic stress ratio induced by a given earthquake (with user request factor of safety)
F.S.	Factor of Safety against liquefaction, F.S.=CRRm/CSRsf
S_sat	Settlement from saturated sands
S_dry	Settlement from Unsaturated Sands
S_all	Total Settlement from Saturated and Unsaturated Sands
NoLiq	No-Liquefy Soils

APPENDIX E

GENERAL GRADING GUIDELINES

Vernola Marketplace Apartments
Jurupa Valley, Riverside County, California
Project No. 2654-CR

GEOTEK

GENERAL GRADING GUIDELINES

Guidelines presented herein are intended to address general construction procedures for earthwork construction. Specific situations and conditions often arise which cannot reasonably be discussed in general guidelines, when anticipated these are discussed in the text of the report. Often unanticipated conditions are encountered which may necessitate modification or changes to these guidelines. It is our hope that these will assist the contractor to more efficiently complete the project by providing a reasonable understanding of the procedures that would be expected during earthwork and the testing and observation used to evaluate those procedures.

General

Grading should be performed to at least the minimum requirements of governing agencies, Chapters 18 and 33 of the Uniform Building Code, CBC (2019) and the guidelines presented below.

Preconstruction Meeting

A preconstruction meeting should be held prior to site earthwork. Any questions the contractor has regarding our recommendations, general site conditions, apparent discrepancies between reported and actual conditions and/or differences in procedures the contractor intends to use should be brought up at that meeting. The contractor (including the main onsite representative) should review our report and these guidelines in advance of the meeting. Any comments the contractor may have regarding these guidelines should be brought up at that meeting.

Grading Observation and Testing

1. Observation of the fill placement should be provided by our representative during grading. Verbal communication during the course of each day will be used to inform the contractor of test results. The contractor should receive a copy of the "Daily Field Report" indicating results of field density tests that day. If our representative does not provide the contractor with these reports, our office should be notified.
2. Testing and observation procedures are, by their nature, specific to the work or area observed and location of the tests taken, variability may occur in other locations. The contractor is responsible for the uniformity of the grading operations; our observations and test results are intended to evaluate the contractor’s overall level of efforts during grading. The contractor’s personnel are the only individuals participating in all aspect of site work. Compaction testing and observation should not be considered as relieving the contractor’s responsibility to properly compact the fill.
3. Cleanouts, processed ground to receive fill, key excavations, and subdrains should be observed by our representative prior to placing any fill. It will be the contractor's responsibility to notify our representative or office when such areas are ready for observation.

4. Density tests may be made on the surface material to receive fill, as considered warranted by this firm.
5. In general, density tests would be made at maximum intervals of two feet of fill height or every 1,000 cubic yards of fill placed. Criteria will vary depending on soil conditions and size of the fill. More frequent testing may be performed. In any case, an adequate number of field density tests should be made to evaluate the required compaction and moisture content is generally being obtained.
6. Laboratory testing to support field test procedures will be performed, as considered warranted, based on conditions encountered (e.g. change of material sources, types, etc.) Every effort will be made to process samples in the laboratory as quickly as possible and in progress construction projects are our first priority. However, laboratory workloads may cause in delays and some soils may require a **minimum of 48 to 72 hours to complete test procedures**. Whenever possible, our representative(s) should be informed in advance of operational changes that might result in different source areas for materials.
7. Procedures for testing of fill slopes are as follows:
   a) Density tests should be taken periodically during grading on the flat surface of the fill, three to five feet horizontally from the face of the slope.
   b) If a method other than over building and cutting back to the compacted core is to be employed, slope compaction testing during construction should include testing the outer six inches to three feet in the slope face to determine if the required compaction is being achieved.
8. Finish grade testing of slopes and pad surfaces should be performed after construction is complete.

Site Clearing

1. All vegetation, and other deleterious materials, should be removed from the site. If material is not immediately removed from the site it should be stockpiled in a designated area(s) well outside of all current work areas and delineated with flagging or other means. Site clearing should be performed in advance of any grading in a specific area.
2. Efforts should be made by the contractor to remove all organic or other deleterious material from the fill, as even the most diligent efforts may result in the incorporation of some materials. This is especially important when grading is occurring near the natural grade. All equipment operators should be aware of these efforts. Laborers may be required as root pickers.
3. Nonorganic debris or concrete may be placed in deeper fill areas provided the procedures used are observed and found acceptable by our representative.

Treatment of Existing Ground

1. Following site clearing, all surficial deposits of alluvium and colluvium as well as weathered or creep effected bedrock, should be removed unless otherwise specifically indicated in the text of this report.
2. In some cases, removal may be recommended to a specified depth (e.g. flat sites where partial alluvial removals may be sufficient). The contractor should not exceed these depths unless directed otherwise by our representative.
3. Groundwater existing in alluvial areas may make excavation difficult. Deeper removals than indicated in the text of the report may be necessary due to saturation during winter months.
4. Subsequent to removals, the natural ground should be processed to a depth of six inches, moistened to near optimum moisture conditions and compacted to fill standards.
5. Exploratory back hoe or dozer trenches still remaining after site removal should be excavated and filled with compacted fill if they can be located.

Fill Placement

1. Unless otherwise indicated, all site soil and bedrock may be reused for compacted fill; however, some special processing or handling may be required (see text of report).
2. Material used in the compacting process should be evenly spread, moisture conditioned, processed, and compacted in thin lifts six (6) to eight (8) inches in compacted thickness to obtain a uniformly dense layer. The fill should be placed and compacted on a nearly horizontal plane, unless otherwise found acceptable by our representative.
3. If the moisture content or relative density varies from that recommended by this firm, the contractor should rework the fill until it is in accordance with the following:
    a) Moisture content of the fill should be at or above optimum moisture. Moisture should be evenly distributed without wet and dry pockets. Pre-watering of cut or removal areas should be considered in addition to watering during fill placement, particularly in clay or dry surficial soils. The ability of the contractor to obtain the proper moisture content will control production rates.
    b) Each six-inch layer should be compacted to at least 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency. In most cases, the testing method is ASTM Test Designation D 1557.
4. Rock fragments less than eight inches in diameter may be utilized in the fill, provided:
    a) They are not placed in concentrated pockets;
    b) There is a sufficient percentage of fine-grained material to surround the rocks;
    c) The distribution of the rocks is observed by, and acceptable to, our representative.

5. Rocks exceeding eight (8) inches in diameter should be taken off site, broken into smaller fragments, or placed in accordance with recommendations of this firm in areas designated suitable for rock disposal. On projects where significant large quantities of oversized materials are anticipated, alternate guidelines for placement may be included. If significant oversize materials are encountered during construction, these guidelines should be requested.
6. In clay soil, dry or large chunks or blocks are common. If in excess of eight (8) inches minimum dimension, then they are considered as oversized. Sheepsfoot compactors or other suitable methods should be used to break up blocks. When dry, they should be moisture conditioned to provide a uniform condition with the surrounding fill.

Slope Construction

1. The contractor should obtain a minimum relative compaction of 90 percent out to the finished slope face of fill slopes. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment.
2. Slopes trimmed to the compacted core should be overbuilt by at least three (3) feet with compaction efforts out to the edge of the false slope. Failure to properly compact the outer edge results in trimming not exposing the compacted core and additional compaction after trimming may be necessary.
3. If fill slopes are built "at grade" using direct compaction methods, then the slope construction should be performed so that a constant gradient is maintained throughout construction. Soil should not be "spilled" over the slope face nor should slopes be "pushed out" to obtain grades. Compaction equipment should compact each lift along the immediate top of slope. Slopes should be back rolled or otherwise compacted at approximately every 4 feet vertically as the slope is built.
4. Corners and bends in slopes should have special attention during construction as these are the most difficult areas to obtain proper compaction.
5. Cut slopes should be cut to the finished surface. Excessive undercutting and smoothing of the face with fill may necessitate stabilization.

UTILITY TRENCH CONSTRUCTION AND BACKFILL

Utility trench excavation and backfill is the contractors responsibility. The geotechnical consultant typically provides periodic observation and testing of these operations. While efforts are made to make sufficient observations and tests to verify that the contractors' methods and procedures are adequate to achieve proper compaction, it is typically impractical to observe all backfill procedures. As such, it is critical that the contractor use consistent backfill procedures.

Compaction methods vary for trench compaction and experience indicates many methods can be successful. However, procedures that "worked" on previous projects may or may not prove effective on a given site. The contractor(s) should outline the procedures proposed, so that we may discuss them **prior** to construction. We will offer comments based on our knowledge of site conditions and experience.

1. Utility trench backfill in slopes, structural areas, in streets and beneath flat work or hardscape should be brought to at least optimum moisture and compacted to at least 90 percent of the laboratory standard. Soil should be moisture conditioned prior to placing in the trench.
2. Flooding and jetting are not typically recommended or acceptable for native soils. Flooding or jetting may be used with select sand having a Sand Equivalent (SE) of 30 or higher. This is typically limited to the following uses:
    a) shallow (12 + inches) under slab interior trenches and,
    b) as bedding in pipe zone.

    The water should be allowed to dissipate prior to pouring slabs or completing trench compaction.
3. Care should be taken not to place soils at high moisture content within the upper three feet of the trench backfill in street areas, as overly wet soils may impact subgrade preparation. Moisture may be reduced to 2% below optimum moisture in areas to be paved within the upper three feet below sub grade.
4. Sand backfill should not be allowed in exterior trenches adjacent to and within an area extending below a 1:1 projection from the outside bottom edge of a footing, unless it is similar to the surrounding soil.
5. Trench compaction testing is generally at the discretion of the geotechnical consultant. Testing frequency will be based on trench depth and the contractors procedures. A probing rod would be used to assess the consistency of compaction between tested areas and untested areas. If zones are found that are considered less compact than other areas, this would be brought to the contractors attention.

JOB SAFETY

General

Personnel safety is a primary concern on all job sites. The following summaries are safety considerations for use by all our employees on multi-employer construction sites. On ground personnel are at highest risk of injury and possible fatality on grading construction projects. The company recognizes that construction activities will vary on each site and that job site safety is the contractor's responsibility. However, it is, imperative that all personnel be safety conscious to avoid accidents and potential injury.

In an effort to minimize risks associated with geotechnical testing and observation, the following precautions are to be implemented for the safety of our field personnel on grading and construction projects.

1. Safety Meetings: Our field personnel are directed to attend the contractor's regularly scheduled safety meetings.
2. Safety Vests: Safety vests are provided for and are to be worn by our personnel while on the job site.
3. Safety Flags: Safety flags are provided to our field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

In the event that the contractor's representative observes any of our personnel not following the above, we request that it be brought to the attention of our office.

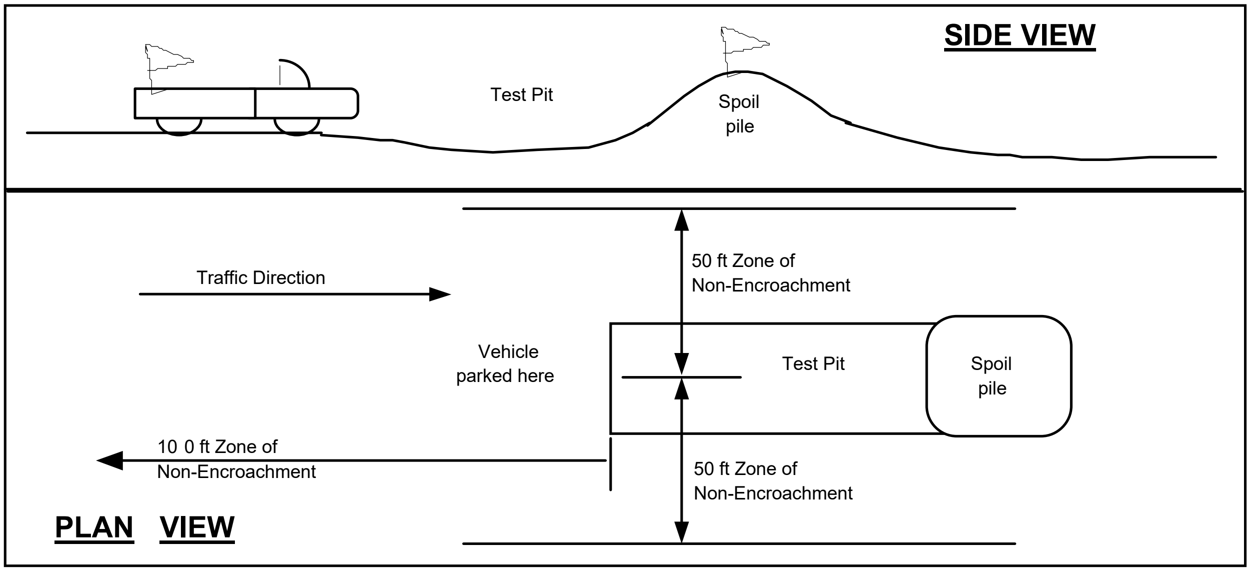
Test Pits Location, Orientation and Clearance

The technician is responsible for selecting test pit locations. The primary concern is the technician's safety. However, it is necessary to take sufficient tests at various locations to obtain a representative sampling of the fill. As such, efforts will be made to coordinate locations with the grading contractors authorized representatives (e.g. dump man, operator, supervisor, grade checker, etc.), and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractors authorized representative should direct excavation of the pit and safety during the test period. Again, safety is the paramount concern.

Test pits should be excavated so that the spoil pile is placed away from oncoming traffic. The technician's vehicle is to be placed next to the test pit, opposite the spoil pile. This necessitates that the fill be maintained in a drivable condition. Alternatively, the contractor may opt to park a piece of equipment in front of test pits, particularly in small fill areas or those with limited access.

A zone of non-encroachment should be established for all test pits (see diagram below). No grading equipment should enter this zone during the test procedure. The zone should extend outward to the sides approximately 50 feet from the center of the test pit and 100 feet in the direction of traffic flow. This zone is established both for safety and to avoid excessive ground vibration, which typically decreases test results.

TEST PIT SAFETY PLAN



Slope Tests

When taking slope tests, the technician should park their vehicle directly above or below the test location on the slope. The contractor's representative should effectively keep all equipment at a safe operation distance (e.g. 50 feet) away from the slope during testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location.

Trench Safety

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Trenches for all utilities should be excavated in accordance with CAL-OSHA and any other applicable safety standards. Safe conditions will be required to enable compaction testing of the trench backfill.

All utility trench excavations in excess of 5 feet deep, which a person enters, are to be shored or laid back. Trench access should be provided in accordance with OSHA standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

Our personnel are directed not to enter any excavation which;

1. is 5 feet or deeper unless shored or laid back,
2. exit points or ladders are not provided,
3. displays any evidence of instability, has any loose rock or other debris which could fall into the trench, or

4. displays any other evidence of any unsafe conditions regardless of depth.

If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraws and notifies their supervisor. The contractors representative will then be contacted in an effort to effect a solution. All backfill not tested due to safety concerns or other reasons is subject to reprocessing and/or removal.

Procedures

In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is directed to inform both the developer's and contractor's representatives. If the condition is not rectified, the technician is required, by company policy, to immediately withdraw and notify their supervisor. The contractor's representative will then be contacted in an effort to effect a solution. No further testing will be performed until the situation is rectified. Any fill placed in the interim can be considered unacceptable and subject to reprocessing, recompaction or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to technicians attention and notify our project manager or office. Effective communication and coordination between the contractors' representative and the field technician(s) is strongly encouraged in order to implement the above safety program and safety in general.

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