# GEOTECHNICAL AND INFILTRATION EVALUATION
# PROPOSED SINGLE-FAMILY RESIDENTIAL DEVELOPMENT
# ASSESSOR'S PARCEL NUMBERS (APNS) 1007-061-08-0000 AND 1007-061-23-0000
# 1812 AND 1816 WEST FOOTHILL BOULEVARD
# UPLAND, SAN BERNARDINO COUNTY, CALIFORNIA

**PREPARED FOR**

**CENTURY COMMUNITIES**
**4395 MACARTHUR COURT, SUITE 300**
**NEWPORT BEACH, CALIFORNIA 92660**

**PREPARED BY**

**GEOTEK, INC.**
**1548 NORTH MAPLE STREET**
**CORONA, CALIFORNIA 92878**

**PROJECT NO. 4056-CR** **FEBRUARY 5, 2025**

GEOTEK

GeoTek, Inc.
1548 North Maple Street, Corona, California 92878
(951) 710-1160 Office (951) 710-1167 Fax www.geotekusa.com

February 5, 2025
Project No. 4056-CR

**Century Communities**
4395 MacArthur Court, Suite 300
Newport Beach, California 92660

Attention: Mr. Brian Taylor

Subject: **Geotechnical and Infiltration Evaluation**
Proposed Single-Family Residential Development
Assessor's Parcel Numbers (APNs) 1007-061-08-0000 and 1007-061-23-0000
1812 and 1816 West Foothill Boulevard
Upland, San Bernardino County, California

Dear Mr. Taylor:

GeoTek, Inc. (GeoTek) is pleased to provide the results of this Geotechnical and Infiltration Evaluation for a proposed single-family residential development that will be constructed at 1812 and 1816 West Foothill Boulevard, in the City of Upland, San Bernardino County, California. This report presents a discussion of GeoTek's evaluation and provides preliminary geotechnical recommendations for site preparation, foundation design, preliminary infiltration rates and construction of the proposed site improvements.

Based upon review and evaluation, site development appears feasible from a geotechnical viewpoint provided that the recommendations included in this report are incorporated into the design and construction phases of site development.

The opportunity to be of service is sincerely appreciated. If you have any questions, please do not hesitate to contact GeoTek.

Respectfully submitted,
**GeoTek, Inc.**

REGISTERED PROFESSIONAL ENGINEER BRUCE A. HICK GE 2284 GEOTECHNICAL STATE OF CALIFORNIA

CERTIFIED ENGINEERING GEOLOGIST EDWARD H. LaMONT No. 1892 STATE OF CALIFORNIA

Bruce A. Hick
GE 2284, Exp. 12/31/26
Geotechnical Engineer

Edward H. LaMont
CEG 1892, Exp. 07/31/26
Principal Geologist

Anna M. Scott
Project Geologist

Distribution: (1) Addressee via email (one PDF file)

*https://geotekusa.sharepoint.com/teams/Corona_Branch/Shared Documents/Projects/GeoTek Inc/4000/4056/GEO/Working Files/Geotechnical and Infiltration Evaluation/4056CR GEO INFILT UPLAND 02-05-2025.docx*

# TABLE OF CONTENTS

## TABLE OF CONTENTS

# 1. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the site geotechnical conditions for a proposed single-family residential development to be constructed at 1812 and 1816 West Foothill Boulevard, in the City of Upland, San Bernardino County, California, as outlined in GeoTek's proposal P-0801724-CR dated August 1, 2024. Services provided for this study included the following:

- Research and review of available geologic and geotechnical data and general information pertinent to the site,
- A site reconnaissance,
- Excavation of five (5) exploratory borings for the geotechnical portion of the evaluation to depths ranging between about eight (8) to 25.5 feet below existing grades,
- Infiltration testing of two (2) additional test borings at a depth of about five (5) feet deep in anticipated stormwater management areas,
- Collection of soil samples in the test borings,
- Laboratory testing of selected soil samples,
- Review and evaluation of site seismicity, and
- Compilation of this geotechnical report which presents preliminary recommendations for site development.

The intent of this report is to aid in the evaluation of the site for future proposed development from a geotechnical perspective. The professional opinions and geotechnical information contained in this report may need to be updated based upon review of the final site development plans. These plans should be provided to GeoTek Inc. for review when available.

# 2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

## 2.1 SITE DESCRIPTION

The rectangular-shaped project site is comprised of two (2) parcels of land totaling approximately 4.42-acres in size, located at 1812 and 1816 West Foothill Boulevard, in the City of Upland, San Bernardino County, California (see Figure 1). Access to the site is generally available from West Foothill Boulevard, a paved, improved street located adjacent to the northern boundary of the site. The parcels are identified as San Bernardino County Assessor's Parcel Numbers (APNs) 1007-061-08-0000 and 1007-061-23-0000.

The site can be considered as having a relatively flat topography (see Figure 1). The elevation of the site ranges from approximately 1,330 to 1,350 feet above mean sea level (amsl). Site drainage is generally directed in a southerly direction by sheetflow.

The site is currently occupied by abandoned structures and a parking lot in the northern portion of the site. It is anticipated that foundations, slabs, underground utilities and possible septic tank/seepage pits are present on the site.

## 2.2 PROPOSED DEVELOPMENT

Based on review of a *Concept Design Site Plan*, prepared by KTGY and dated December 20, 2024, the proposed residential development will consist of 70, one- to two-story single-family homes, as well as stormwater disposal facilities, open space, perimeter/retaining walls, associated interior streets/driveways, underground utilities and other typical development improvements (see Figure 2).

It is anticipated that the residential structures will be of wood frame construction, supported by shallow spread foundations (continuous and pad), and most likely will include conventional slab-on-grade floors. Although structural loading information was not provided, GeoTek has assumed the structures will exert relatively light to moderate foundation loads. Maximum column and wall loads on the order of 50 kips and 2.5 kips per lineal foot, respectively, are estimated for the proposed structures. Once actual loads are known, that information should be provided to GeoTek to determine if modifications to the recommendations presented in this report are warranted.

On-site stormwater disposal facilities are proposed for the project; however, the type and specific locations of the facilities are unknown at this time.

Cut and fills of less than approximately 5 feet in height, not including any recommended remedial grading are anticipated for site development. Retaining and perimeter walls are anticipated. Sewage disposal is anticipated to be be provided by a public sewer system. If site development differs from the assumptions made herein, the recommendations included in this report should be subject to further review and evaluation.

# 3. FIELD EXPLORATION AND LABORATORY TESTING

## 3.1 FIELD EXPLORATION

The field exploration for this evaluation was conducted on January 30, 2025. For the geotechnical portion of the investigation, five (5) exploratory borings (Borings B-1 through B-5) were excavated with a hollow-stem auger drill rig to depths ranging from about eight (8) to 25.5 feet below the existing ground surface at the boring locations. All of the test borings were terminated at a depth shallower than planned due to auger refusal on cobbles and boulders.

For the infiltration part of the study, two (2) test borings were excavated to depths of approximately five (5) feet, below the existing ground location in the southern portion of the site, as requested by the project civil engineer.

A hollow-stem auger with an outside diameter of approximately 8.0 inches was utilized to conduct the borings. The inside diameter of the auger was approximately 4.5 inches. A geologist from GeoTek, Inc. logged the exploratory borings and obtained soil samples from within the borings. The boring locations are presented on Figure 2, Exploration Location Map. The logs of the exploratory borings are included in Appendix A.

The exploration logs in Appendix A show subsurface conditions at the dates and locations indicated and may not be representative of other locations and times. The stratification lines presented on the logs represent the approximate boundaries between soil types, and the transitions may be gradual.

In the geotechnical borings, relatively undisturbed soil samples were recovered at various intervals with a California sampler. The California sampler is a 2.9-inch outside diameter, 2.5-inch inside diameter, split barrel sampler lined with brass rings. The sampler is approximately 18 inches in length. The sampler conformed to the requirements of ASTM D 3550. A 140-pound automatic trip hammer was utilized, dropping approximately 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.

## Infiltration Testing

Two (2) borings (Borings I-1 and I-2) were excavated on the project site to evaluate preliminary infiltration rates for the proposed stormwater management facilities. Infiltration testing was conducted in these borings in general accordance County of San Bernardino guidelines.

The infiltration tests consisted of drilling eight-inch diameter test holes to the desired depth and installing approximately two (2) inches of gravel in the bottom of the holes. A three-inch diameter perforated PVC pipe, wrapped in a filter sock, was placed in the excavations and the annular space was filled with gravel to prevent caving within the borings. Water was then placed in the borings to presoak the holes and percolation testing was performed following the pre-soak period. Following presoaking, the percolation tests were performed which consisted of adding water to each test hole and measuring the water drop over a 10-minute period. The water drop was recorded and six (6) 10-minute test intervals were completed. Water was added to the test holes after each test interval. The field percolation rates were then converted to an infiltration rate using the Porchet Method. The infiltration rates calculated using the Porchet Method are presented in the following table:

| SUMMARY OF PRELIMINARY INFILTRATION RATES | | |
|---|---|---|
| Boring | Depth of Test (Feet) | Preliminary Infiltration Rate* (Inches per hour) |
| I-1 | 5.0 | 3.48 |
| I-2 | 5.0 | 4.61 |

*Porchet Method converted infiltration rate from field measured rate.

Copies of the percolation data sheets and the Porchet infiltration rate conversion calculations are presented in Appendix C. No factors of safety were applied to the rates provided. Over the lifetime of the infiltration areas, the infiltration rates may be affected by sediment 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 rate in designing the infiltration system.

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

Representatives of GeoTek should observe the soils exposed at the bottom of the stormwater management facilities during construction/earthwork operations to confirm suitability and that the conditions exposed are as anticipated for the proposed stormwater disposal basin.

### 3.2 LABORATORY TESTING

Laboratory testing was performed on selected soil samples obtained during the field exploration. 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 the laboratory testing were moisture-density determinations on relatively undisturbed samples. The optimum moisture content-maximum dry density relationships were established for typical soil types so that the relative compaction of the subsoils could be determined. Expansion index testing was performed on selected samples to evaluate the expansion potential of the on-site soils. Direct shear testing was conducted to determine the shear strength parameters of the site soils. Chemical testing comprised of pH, soluble sulfate, chloride and resistivity testing was conducted on selected samples. The moisture-density test data are presented on the exploration boring logs in Appendix A. The maximum density, expansion index, direct shear and chemical test data are presented in Appendix B.

## 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 approximately 975 miles south of the Transverse Ranges geomorphic province 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 found near the middle of the province. The San Andreas Fault zone borders the northeasterly margin of the province.

More specific to the subject property, the site is located in an area geologically mapped to be underlain by alluvium (Dibblee, T.W. and Minch, J.A., 2002).

## 4.2 GENERAL SOIL/GEOLOGIC CONDITIONS

A brief description of the lithologic units encountered on the site is presented in the following sections. Based on the field exploration and observations, the area investigated is locally underlain by undocumented fill materials or disturbed topsoil, overlying alluvial materials.

### 4.2.1 Undocumented Fill

Asphalt concrete pavement (asphalt concrete) was encountered at the surface of Boring B-1.

Undocumented fill materials were encountered in Borings B-1 and B-5 to depths of up to approximately 2.5 feet below the ground surface. These materials were found to generally consist of gravel and gravelly sand (GP and SP soil types based upon the Unified Soil Classification System). These fill soils were most likely placed during the grading for the existing site improvements.

Based on the laboratory test results, the near surface soils exhibit a "Very Low" ($0 \leq EI \leq 20$) Expansion Index when tested in accordance with ASTM D 4829. Based on the laboratory test results, the near surface soils have a soluble sulfate content of less than 0.1 percent (ASTM D 4327). The laboratory test results are provided in Appendix B.

### 4.2.2 Alluvium

Alluvial materials were encountered in all of the borings performed beneath the undocumented fill soils. The alluvial materials were found to generally consist of interbedded dense sand and gravel with varying amounts of cobbles (SP and GP soil types). Although boulders were not observed during the drilling, it is anticipated that various amounts of boulders are also present in the alluvial materials. The gravel and cobbles most likely affected the sampler blow counts obtained. Alluvial materials were encountered to the maximum depths explored of approximately 25.5 feet in Boring B-5. As previously discussed, all borings were terminated due to refusal on cobbles and boulders.

## 4.3 SURFACE AND GROUNDWATER

### 4.3.1 Surface Water

Surface water was not observed during the site exploration. If encountered during earthwork construction, surface water on this site is the result of precipitation or possibly some minor surface run-off from surrounding areas. Overall site drainage is generally in a southerly direction, as directed by site topography. Provisions for surface drainage will need to be accounted for by the project civil engineer.

### 4.3.2 Groundwater

Groundwater was not encountered to a maximum depth of about 25.5 feet within Boring B-5 at the time of drilling. Based on review of the California's Groundwater Live: Groundwater Levels website (California's Groundwater Live: Groundwater Levels), the depth to groundwater in the proximity of the site is approximately 128 feet below existing grades for a reading from October 1, 2024.

Based on the above, groundwater is not anticipated to be a factor during the site grading. However, seasonal perched groundwater may be encountered during grading within portions of the site.

## 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.

The site is not 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 liquefaction nor within an area designated for earthquake induced landslides.

### 4.4.1 Seismic Design Parameters

The site is located at approximately 34.1058 Latitude and -117.6880 West Longitude. Based on the relatively dense soil conditions encountered across the site, a Site Class "D" is considered appropriate for this project. Site spectral accelerations (Sa and S1), 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.

The following seismic design parameters, based on the 2015 National Earthquake Hazards Reduction Program (NEHRP)/ASCE 7-16/2022 CBC, are presented below:

| SITE SEISMIC PARAMETERS | |
|---|---|
| Mapped 0.2 sec Period Spectral Acceleration, $S_S$ | 1.695g |
| Mapped 1.0 sec Period Spectral Acceleration, $S_1$ | 0.638g |
| Site Coefficient for Site Class "D", $F_a$ | 1.0 |
| Site Coefficient for Site Class "D", $F_v$ | 1.7** |
| Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, $S_{MS}$ | 1.695g |
| Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, $S_{M1}$ | 1.626g* |
| 5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, $S_{DS}$ | 1.13g |
| 5% Damped Design Spectral Response Acceleration Parameter at 1 second, $S_{D1}$ | 1.085g* |
| Site Modified Peak Ground Acceleration, $PGA_M$ | 0.792g |
| Seismic Design Category | D |

*ASCE 7-16 Supplement 3 Section 11.4.8 requires a ground motion hazard analysis for structures on Site Class "D" for values of S1 greater than or equal to 0.2g. However, a ground motion hazard analysis is not required where the values of SM1 and SD1 are increased by 50%. The SM1 and SD1 values shown above already include the 50% increase, so that exception can be obtained.
**ASCE 7-16 Supplement 3 Section 11.4.8 indicates that the value of Fv should only be used for calculation of Ts, determination of Seismic Design Category, linear interpolation for intermediate values of S1, and when taking the exceptions under Items 1 and 2 of Section 11.4.8 for the calculation of SD1.

Final selection of the appropriate seismic design coefficients should be made by the project structural engineer based upon the local practices and ordinances, expected building response and desired level of conservatism.

### 4.5 LIQUEFACTION

Liquefaction describes a phenomenon in which cyclic stresses, produced by earthquake-induced ground motion, create excess pore pressures in relatively cohesionless soils. These soils may acquire a high degree of mobility which can lead to lateral movement, sliding, settlement of loose sediments, sand boils and other damaging deformations. This phenomenon occurs only below the water table, but, after liquefaction has developed, the effects can propagate upward into overlying non-saturated soil as excess pore water dissipates.

The factors known to influence liquefaction potential include soil type and grain size, relative density, groundwater level, confining pressures, and both intensity and duration of ground shaking. In general, materials that are susceptible to liquefaction are loose, saturated granular soils having low fines content under low confining pressures.

The project site is not located within an area mapped by the State of California for liquefaction potential.

Based on the relatively dense nature of the subsurface soils encountered, along with the relatively deep groundwater depth, the liquefaction potential at the subject site is considered to be very low.

### 4.6 OTHER SEISMIC HAZARDS

Due to the relatively dense nature of the subsurface alluvial soils and proposed remedial grading, the "dry sand" (unsaturated) settlements at the site are estimated to be negligible.

Evidence of ancient landslides or slope instability at this site was not observed during the field investigation. Due to the relatively flat site topography, the potential for seismic-induced lateral displacements (i.e., "lateral spread") and slope instability hazards are considered negligible.

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

## 5. CONCLUSIONS AND RECOMMENDATIONS

### 5.1 GENERAL

The anticipated site development appears feasible from a geotechnical viewpoint provided that the following recommendations, and those provided by this firm at a later date are incorporated into the design and construction phases of development. Site development, grading and foundation plans should be reviewed by GeoTek, Inc. when they become available so the recommendations contained in this report can be confirmed.

The near-surface upper site soils were found to consist of undocumented fill soils. In addition, the upper site soils are anticipated to be further disturbed from the demolition of the existing site structures and utility lines. Therefore, the upper site soils are not considered suitable for foundation loading in their current condition. Remedial grading, consisting of overexcavation and recompaction of the upper site soils, is recommended to provide a uniform bearing for any proposed structures.

## 5.2 EARTHWORK CONSIDERATIONS

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the City of Upland, the 2022 California Building Code (CBC) and recommendations contained in this report. The Grading Guidelines included in Appendix D 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 D.

### 5.2.1 Site Clearing and Demolition

Initial site preparation should commence with removal of debris, existing structures, pavements, underground utilities, foundations, slabs-on-grade, deleterious materials and vegetation within the limits of the planned improvements. Demolition of the existing buildings/structures should include removal of all shallow foundations, floor slabs, on-site wastewater disposal systems and any below-grade construction.

In areas of planned grading and improvements, the locations of existing utilities should be determined. Existing utilities should be relocated or abandoned. Debris should be properly disposed of off-site. Voids resulting from site clearing should be backfilled with engineered fill.

Portland Cement Concrete (PCC) generated from the demolition of existing site improvements may be incorporated into site fills provided the following guidelines are implemented: 1) concrete should be free of rebar or other deleterious materials and should be broken down to a maximum dimension of six (6) inches; 2) concrete should not be placed within three (3) feet of finish grade in the building pad areas or within one (1) foot of subgrade elevations in the street/drive areas; 3) concrete should be distributed in the fill and should not be "nested" or placed in concentrated pockets.

Asphalt concrete (AC) should not be used in fill for building pads or landscape areas. This material may be used in pavement areas of the project or should be removed from the site.

Alternatively, existing PCC concrete, AC and aggregate base may be pulverized and reused as Crushed Miscellaneous Base (CMB) in new pavement sections. These pulverized materials should not contain any detrimental or deleterious materials (reinforcing steel, nails, metal, glass, plastic rubber, wood, organic matter, friable materials, elongated or laminated pieces, etc.). Any materials to be used as CMB should be tested to confirm conformance with appropriate Standard Specifications for Public Works Construction ("Greenbook") specifications (Section 200-2.4).

### 5.2.2 Site Preparation

Due to the presence of undocumented fill and anticipated disturbance of the upper site soils due to site demolition operations, it is recommended that the soils be removed beneath the planned building footprints to a depth of at least four (4) feet below existing grades, or two (2) feet below the base of the proposed foundations, whichever is greater. All disturbed soils and any undocumented fill soils shall be removed as part of remedial grading. The lateral extent of this recommended over-excavation should extend at least five (5) feet beyond the building limits, where obtainable. Removal bottoms should be relatively uniform in soil type and not adversely porous and having an in-place density of at least 85 percent of the soil's maximum dry density as determined by ASTM D 1557 test procedures. Deeper removals may be required and should be determined during site grading by a GeoTek representative.

Following site clearing operations, over-excavation and lowering of site grades, where necessary, it is recommended that the exposed subgrade soils beneath all surface improvements be proof rolled with a heavy rubber-tired piece of construction equipment approved by and in the presence of the geotechnical engineering representative. All soil that ruts or excessively deflects during proof rolling should be removed as recommended by the GeoTek representative.

Following proof rolling and removal of any unsuitable bearing soil, the exposed subgrade should be scarified to a depth of about 12 inches, be moisture conditioned to slightly above the soil's optimum moisture content and then be compacted to at least 90 percent of the soil's maximum dry density as determined by ASTM D-1557 test procedures.

### 5.2.3 Pavement Areas

Undocumented fill should be removed below proposed pavement areas. If no undocumented fill is encountered or is relatively shallow, the natural soils should be overexcavated to a depth of 12 inches below existing grade or 12 inches below proposed finished grade, whichever is deeper. Finished grade is defined as the top of the subgrade. The exposed soils in these areas and in cut areas should be scarified to a depth of approximately eight inches, moistened to at least the optimum moisture content and compacted to a minimum relative compaction of at least 95 percent of maximum dry density as determined by ASTM D 1557 test procedures.

### 5.2.4 Hardscape Areas

Undocumented fill should be removed below hardscape areas. The exposed soils in these areas and in cut areas should be scarified to a depth of approximately eight inches, moistened to at least the optimum moisture content and compacted to a minimum relative compaction of at least 90 percent of maximum dry density as determined by ASTM D 1557 test procedures.

### 5.2.5 Preparation of Excavation Bottoms

A representative of this firm should observe the bottom of all excavations. Upon approval, the exposed soils should be scarified to a depth of approximately eight inches, moistened to at least the optimum moisture content and compacted to a minimum relative compaction of at least 95 percent of maximum dry density as determined by ASTM D 1557 test procedures.

### 5.2.6 Engineered Fill

The on-site soils are generally considered suitable for reuse as engineered fill provided they are free from vegetation, oversize materials, debris and other deleterious material. Engineered fill should be placed in loose lifts with a thickness of eight inches or less and moisture conditioned to at least the optimum moisture content.

The alluvial materials are anticipated to contain significant quantities of oversize materials (i.e., particles greater than six inches maximum size). Special excavation and grading techniques will be required to perform site excavations (including utility lines) and grading. The project budget should include contingencies for possible crushing or removal of the oversized materials.

Below and within the proposed building area, engineered fill should be moisture conditioned to at least optimum moisture content and be compacted to at least 90 percent of maximum dry density as determined by ASTM D 1557 test procedures if a shallow foundation system is used. Below other structural elements, such as hardscape areas and walls independent of the building, engineered fill should be moisture conditioned to at least optimum moisture content and be compacted to at least 90 percent of maximum dry density as determined by ASTM D 1557 test procedures.

### 5.2.7 Excavation Characteristics

Excavation of the on-site soils is expected to be feasible utilizing heavy-duty grading equipment in good operating condition. Some excavation difficulties should be anticipated due to the presence of cobbles and/or boulders. Oversized rocks (>6 inches) should be anticipated on this site. The alluvial materials are anticipated to contain significant quantities of oversize (i.e., greater than six inches maximum size). Special excavation techniques and/or equipment (screens) may be required to create acceptable fill.

All temporary excavations for grading purposes and installation of underground utilities should be constructed in accordance with local and Cal-OSHA guidelines. Temporary excavations within the on-site materials should be stable at 1.5:1 (horizontal: vertical) inclinations for cuts less than five feet in height.

### 5.2.8 Trench Excavations and Backfill

Temporary trench excavations within the on-site materials should be stable at 1.5:1 inclinations for short durations during construction and where cuts do not exceed 8 feet in height. It is anticipated that temporary cuts to a maximum height of four (4) feet can be excavated vertically, but local sloughing and/or failure could occur due to the granular nature of the soils at this site. Increased caution should be applied when working near or within any excavations at this site. "Popouts" and/or sloughing of oversize cobbles and boulders should be anticipated during utility trench operations.

The alluvial materials are anticipated to contain significant quantities of oversize (i.e., greater than six inches maximum size). Special excavation techniques and/or equipment (screens) may be required to create acceptable fill.

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 by ASTM D 1557 test procedures). Under-slab trenches should also be compacted to project specifications. Where applicable, based on jurisdictional requirements, the top 12 inches of backfill below subgrade for road pavements should be compacted to at least 95 percent relative compaction. On-site materials may not be suitable for use as bedding material but should be suitable as backfill provided particles larger than six (6) inches are removed.

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 properly moisture conditioned prior to placement in trenches.

### 5.2.9 Slot-Cut Excavations

Assuming that any existing block walls along existing site boundaries are screen walls (imparting minimal loads), GeoTek evaluated the use of slot-cut excavations adjacent to these improvements in order to facilitate the required remedial grading for construction of proposed site walls and other improvements. Preliminary analyses by GeoTek using a soil cohesion of zero psf along a friction angle of approximately 34 degrees, an assumed slot-cut height of about five feet, and an assumed footing surcharge of approximately 1,000 psf yielded an approximate slot-cut width of five feet. Wider slot cuts may be feasible if favorable conditions (i.e. denser soils with significant cohesion) are exposed in the site excavations.

Slot-cut excavations should follow an A-B-C sequence. Each "A" section should be excavated to the required depth and then backfilled with compacted soil (or wall section constructed). Following completion of the "A" sections, the "B" sections are then excavated and backfilled/constructed and then all "C" sections are completed in a similar manner. A GeoTek representative should observe that the slot-cuts are being performed in conformance with these recommendations.

#### 5.2.10 Shrinkage and Subsidence

Several factors will impact earthwork balancing on the site, including shrinkage, subsidence, removal of oversize material, trench spoil from utilities and footing excavations, as well as the accuracy of topography. Shrinkage and subsidence are primarily dependent upon the degree of compactive effort achieved during construction. For planning purposes, a shrinkage factor of 10 to 15 percent may be considered for the materials requiring removal and/or recompaction. Site balance areas should be available in order to adjust project grades, depending on actual field conditions at the conclusion of earthwork. Subsidence on the order of up to 0.2 foot may be anticipated for the underlying soils. Additional loss should be anticipated for removal and offsite disposal of oversized materials.

#### 5.2.11 Import Soils

Import soils should have a "Very Low" (0-20) Expansion Index. GeoTek, Inc. also recommends that the proposed import soils be tested for expansion and corrosivity potential. GeoTek, Inc. should be notified a minimum of 72 hours prior to importing so that appropriate sampling and laboratory testing can be performed.

## 5.3 DESIGN RECOMMENDATIONS

### 5.3.1 Foundation Design

The tested surficial site soils generally exhibit a "Very Low" ($0 \leq EI \leq 20$) Expansion Index (EI) when tested in accordance with ASTM D 4829. Additionally, the site soils tested generally have soil soluble sulfate contents of less than 0.1 percent. Laboratory testing should be performed at the completion of site grading to verify the Expansion Index (EI) and soluble sulfate content of the near-surface soils.

Foundation design criteria, in general conformance with the 2022 *CBC*, are presented below. The recommendations provided are minimal and are not intended to supersede the design by the project structural engineer. It should be noted that the criteria provided are based on soil support characteristics only. The structural engineer should design the slab and beam reinforcement based on actual loading conditions.

The foundation elements for the proposed structures should bear entirely in engineered fill soils as recommended in this report. Foundations should be designed in accordance with the *2022 California Building Code* (CBC) and City of Upland requirements. A summary of the foundation design recommendations is presented in the following table:

| **MINIMUM DESIGN REQUIREMENTS FOR CONVENTIONALLY REINFORCED FOUNDATIONS** | |
|---|---|
| Design Parameter | "Very Low" Expansion Index (0≤EI≤20) |
| Foundation Depth or Minimum Perimeter Beam Depth (inches below lowest adjacent grade) | One- and two-story – 12 |
| Minimum Foundation Width (Inches)* | One-story – 12<br>Two-story – 12 |
| Minimum Slab Thickness (Inches) | 4 – Actual |
| Minimum Slab Reinforcing | 6" x 6" – W1.4 x W1.4 welded wire fabric or No. 3 reinforcing bars placed at 18 on center each way placed in middle of slab |
| Minimum Reinforcement for Continuous Footings, Grade Beams, and Retailing Wall Footings | Two No. 4 reinforcing bars, one placed near the top and one near the bottom |
| Presaturation of Subgrade Soil (Percent of Optimum/Depth in Inches) | Minimum 100% 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 2022 CBC should be complied with.

The following criteria for design of foundations are preliminary and should be re-evaluated based on the results of additional laboratory testing of samples obtained near finish pad grade. An allowable bearing capacity of 2,000 pounds per square foot (psf) may be used for design of continuous and perimeter footings 12 inches deep and 12 inches wide, and pad footings 24 inches square and 12 inches deep. This allowable soil bearing capacity may be increased by 400 psf for each additional foot of footing depth and 250 psf for each additional foot of footing width to a maximum value of 3,500 psf. An increase of one-third may be applied when considering short-term live loads (e.g., seismic and wind loads). These bearing values contain a minimum factor of safety of three (3).

The recommended allowable bearing capacity is based on an estimated maximum post-construction settlement of 1-inch. Differential settlement of about one-half of the total settlement over a horizontal distance of 40 feet could result. The project structural engineer, foundation engineer, and earth retention structure designer should incorporate these settlement estimates into the design, as appropriate.

The passive earth pressure may be computed as an equivalent fluid having a density of 400 psf per foot of depth, to a maximum earth pressure of 4,000 psf for footings founded on engineered fill or competent native soil. The allowable passive earth pressure contains a factor of safety of 1.5. A coefficient of friction between soil and concrete of 0.35 may be used with dead load forces. Passive pressure and frictional resistance may be combined without reduction. The upper one foot of soil should be ignored in the passive pressure calculations unless the surface is covered with pavements or slabs.

A grade beam, a minimum of 12 inches wide and 12 inches deep, should be utilized across large entrances. The base of the grade beam should be at the same elevation as the bottom of the adjoining footings.

It is recommended that control joints be placed in two directions spaced approximately 24 to 36 times the thickness of the slab in inches. These joints are a widely accepted means to control cracks and should be reviewed by the project structural engineer.

### 5.3.2 Moisture Vapor and Retarding System

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 2022 California Green Building Standards Code (CALGreen) Section 4.505.2, the 2022 CBC Section 1907.1 and ACI 360R-10. The vapor retarder design and construction should also meet the requirements of ASTM E 1643. A portion of the vapor retarder design should be the implementation of a moisture vapor retardant membrane.

The effectiveness of the vapor retarding membrane can be adversely impacted as a result of construction related punctures. 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 6-mil vapor retarder membrane, 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 such as thickness, composition, strength, and permeability to achieve the desired performance level. Moisture retarders can reduce, but not eliminate, moisture vapor rise from the underlying soils up through the slab. Moisture retarder systems 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 a flooring contractor, structural engineer, architect, and/or other experts specializing in moisture control within buildings be consulted to evaluate the general and specific moisture and vapor transmission paths and associated potential impact on the proposed construction. That person should provide recommendations relative to the slab moisture and vapor retarder systems and for migration of potential adverse impact of moisture vapor transmission on various components of the structures, as deemed appropriate.

In addition, the recommendations in this report and GeoTek's services in general are not intended to address mold prevention, since GeoTek, along with geotechnical consultants in general, do not practice in the area of mold prevention. If specific recommendations addressing potential mold issues are desired, then a professional mold prevention consultant should be contacted.

### 5.3.3 Miscellaneous Foundation Recommendations

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.

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.

### 5.3.4 Foundation Setbacks

Minimum setbacks for all foundations should comply with the 2022 CBC or City of Upland requirements, whichever is more stringent. Improvements not conforming to these setbacks are subject to the increased likelihood of excessive lateral movement and/or differential settlement. If large enough, these movements can compromise the integrity of the improvements.

- The outside top 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 five feet and need not exceed 40 feet.
- The bottom of any proposed foundations should be deepened so as to extend below a 1:1 upward projection from the bottom edge of the nearest excavation and the bottom edge of the closest footing.

### 5.3.5 Soil Corrosivity

Based on the chemical test results presented in Appendix B, the corrosivity test results indicate that the on-site soils are "mildly corrosive" to "moderately corrosive" (8,040 to 13,400 ohm-cm) to buried ferrous metal. This corrosion classification is obtained from "Corrosion Basics: An Introduction," by Pierre R. Roberge, 2nd Edition, 2005. Recommendations for protection of buried ferrous metal should be provided by a corrosion engineer. Laboratory testing should be performed at the completion of site grading to verify the soil corrosivity of the near-surface soils.

### 5.3.6 Soil Sulfate Content

Based on the chemical test results presented in Appendix B, the sulfate test results on samples obtained from the project site indicate a soluble sulfate content of less than 0.1% by weight. Soluble sulfate contents of this level would be in the range of "negligible" (i.e., "S0" exposure classification) in accordance with ACI 318-19. Based on the test results and Table 19.3.1.1 of ACI 318-19, no special recommendations for concrete are required for this project due to soil sulfate exposure. Laboratory testing should be performed at the completion of site grading to verify the soil sulfate content of the near-surface soils

## 5.4 RETAINING AND SCREEN WALL DESIGN AND CONSTRUCTION

### 5.4.1 General Design Criteria

Retaining wall foundations independent of the building should be embedded a minimum of 18 inches into engineered fill. Retaining wall foundations should be designed in accordance with Section 5.3.1 of this report. Structural requirements may govern and should be evaluated by the project structural engineer. All earth retention structure plans should be reviewed by this office prior to finalization.

Site clearing and remedial earthwork for all earth retention structures should meet the requirements of this report, unless specifically provided otherwise, or more stringent requirements or recommendations are made by the wall designer. The soil used as backfill behind retaining walls should have a "Very Low" (0-20) Expansion Index and should be compacted to at least 90 percent relative compaction (ASTM D 1557).

In general, cantilever retaining walls 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 the 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 structure, should be considered in the design of the retaining walls. Loads applied within a 1:1 (h:v) projection from the surcharging structure on the stem of the retaining wall should be considered in the design.

Final selection of the appropriate design parameters should be made by the retaining wall designer based upon the local practices and ordinances, expected structure response, and desired level of conservatism.

### 5.4.2 Cantilevered Walls

The recommendations presented below are for cantilevered retaining walls up to six (6) feet high. Active earth pressure may be used for retaining wall design, provided the top of the wall is not restrained from minor deflections. 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.

| ACTIVE EARTH PRESSURES | |
|---|---|
| Surface Slope of Retained Materials (h:v) | Equivalent Fluid Pressure* (pcf) |
| Level | 38 |
| 2:1 | 54 |

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

For walls with a retained height greater than six (6) feet, an incremental seismic pressure should be included into the wall design. Where needed, it is recommended that an incremental seismic load for unrestrained walls with level backfill of $14H^2$ [Units: pounds per lineal foot of wall] should be included into the wall design to account for seismic loading conditions, where H is the retained height of the wall. For unrestrained walls with a retained height greater than six (6) feet with backfill of a 2:1 [horizontal: vertical] gradient, a dynamic load increment of $20H^2$ should be included in the wall design. These incremental seismic loads may be assumed to be applied at a point 1/3H above the base of the wall.

### 5.4.3 Retaining Wall Backfill and Drainage

Wall backfill should include a minimum one foot wide section of ¾- to one-inch clean crushed rock or approved equivalent. The rock should be placed immediately adjacent to the back of the wall and extend up from a backdrain to within approximately 12 inches of finish grade. The portion of the rock opposite the back of the wall adjacent to the soil backfill should be covered with a layer of filter fabric comprised of Mirafi 140N or the equivalent. The upper 12 inches of backfill should consist of compacted on-site soil. Backfill placed within the active zone as defined by a 1:1 (H:V) projection from the back of the retaining wall footing up to the retained surface behind the wall should consist of very low expansive soil. The presence of other soils placed within the 1:1 projection will necessitate revision to the parameters provided and modification of wall designs.

The backfill soil should be placed in lifts no greater than eight inches in thickness, moisture conditioned to at least optimum moisture content and compacted to at least 90 percent of maximum dry density as determined by ASTM D 1557 test procedures. 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 walls is undesirable.

Retaining walls should be provided with an adequate pipe and gravel back drain system to reduce the potential for hydrostatic pressures to develop. A 4-inch diameter perforated collector pipe (Schedule 40 PVC or approved equivalent) in a minimum of one cubic foot per linear foot of ¾-inch or one inch clean crushed rock or equivalent, wrapped in filter fabric should be placed near the bottom of the backfill and the water should be directed to an appropriate disposal area.

As an alternative to the drain, rock and fabric, a pre-manufactured wall drainage product (example: Mira Drain 6000 or approved equivalent) may be used behind the retaining wall. The wall drainage product should extend from the base of the wall to within two (2) feet of the ground surface. The subdrain should be placed in direct contact with the wall drainage product.

Walls less than two (2) feet in height do not require backdrains. Walls from two to four feet in height may be drained using localized gravel packs (e.g., approximately 1.5 cubic feet of gravel in a woven plastic bag) behind weep holes at 10 feet maximum spacing. Weep holes should be provided or the head joints omitted in the first course of block extended above the ground surface. However, nuisance water may still collect in front of the wall.

Drain outlets should be maintained over the life of the project and should not be obstructed or plugged by adjacent improvements.

#### 5.4.4 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 64 pcf, plus any applicable surcharge loading. 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.

#### 5.4.5 Additional Retaining Wall Design Considerations

- Retaining and screen wall foundation elements should be designed in accordance with building code setback requirements. A minimum horizontal setback distance of five feet as measured from the top outside edge of the footing to an adjacent slope face is recommended.
- Wall design should consider the additional surcharge loads from superjacent slopes and/or footings, where appropriate.
- No backfill should be placed against concrete until minimum design strengths are evident by compression tests of cylinders.
- The retaining wall footing excavations, backcuts, and backfill materials should be approved by the project geotechnical engineer or their authorized representative.
- Positive separations should be provided in screen walls at horizontal distances not exceeding 20 feet.

## 5.5 CONCRETE FLATWORK

### 5.5.1 Exterior Concrete Slabs, Sidewalks and Driveways

Exterior concrete slabs, sidewalks and driveways should be designed using a four-inch minimum thickness. Some shrinkage and cracking of the concrete should be anticipated as a result of typical mix designs and curing practices utilized in construction.

Sidewalks may be under the jurisdiction of the governing agency. If so, jurisdictional design and construction criteria will apply, if more restrictive than the recommendations presented in this report.

Subgrade soils should be pre-moistened prior to placing concrete. The subgrade soils below exterior slabs and sidewalks should be pre-saturated to a minimum of 100 percent of the optimum moisture content to a depth of 12 inches.

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

### 5.5.2 Concrete Performance

Concrete cracks should be expected. These cracks can vary from sizes that are hairline 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 undergoes 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 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, Inc. suggests that control joints be placed in two directions and located a distance approximately equal to 24 to 36 times the slab thickness.

## 5.6 PRELIMINARY PAVEMENT DESIGN

### 5.6.1 Asphaltic Concrete Pavement

Although planned final grades beneath the proposed streets and drive aisles within the site are not yet known, the following preliminary pavement design recommendations are based on an assumed Traffic Index of 5.5.

Preliminary pavement thickness design is based on the Caltrans Highway Design Manual (2018). An R-value of 50 was assumed for the determination of preliminary pavement sections for this report. Once the traffic loading information becomes more defined, revision to the pavement design recommendations may be warranted. It is recommended that the final pavement design be based on R-value testing of the as-graded subgrade soils within the pavement areas.

Based on the assumptions noted above, the following preliminary pavement section recommendations are provided for the site:

| PRELIMINARY MINIMUM PAVEMENT SECTION | | |
|---|---|---|
| Traffic Index | Thickness of Asphalt Concrete (inches) | Thickness of Aggregate Base (inches) |
| 5.5 (Interior Streets and Drive Aisles) | 3.0 | 4.0 |

Traffic Indices (TIs) used in the pavement design are designated by the City of Upland 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.

All base material and the upper 12 inches of subgrade should be compacted to at least 95 percent of the material's maximum dry density as determined by ASTM D1557 test procedures. All materials and methods of construction should conform to the requirements of the City of Upland.

### 5.6.2 Permeable Interlocking Concrete Pavers

Interlocking concrete pavers can be used for this project. The pavers are assumed to be approximately 3.2 inches (80 millimeters) in thickness. Concrete pavers should be underlain by 1.0 inch to 1.5 inches of bedding sand overlying four inches of aggregate base founded on compacted subgrade soils. The aggregate base should be compacted to at least 95 percent of maximum dry density as determined by ASTM D 1557 test procedures.

Where possible, the aggregate base should extend beyond the perimeter of the pavers a minimum distance of four inches.

The bedding sand should be placed and lightly moistened and compacted. Since this compaction cannot be tested it should be observed by a representative of this firm.

Historically, paver systems have experienced failures in areas where water has degraded the support characteristics of the underlying base and/or subgrade soils. Since paver systems are permeable and allow transmission of water into the underlying materials, it may be prudent to discuss with the paver designer/manufacturer what methods may be employed to address the issue of potential water introduction into the underlying materials. Underdrain systems, local subgrade reinforcement, tilting the pavement subgrade to drain away from paver areas and not pond, or additional structural elements such as geotextiles can be considered, particularly in high traffic areas and/or low areas where water will tend to collect. The recommendations of the designer/manufacturer should then be implemented in the design and construction of the paver system.

### 5.6.3 Portland Cement Concrete (PCC) Pavement

For the proposed vehicle parking areas, it is recommended that a minimum of five (5.0) inches of PCC pavement over 12 inches subgrade compacted to at least 95 percent of maximum dry density as determined by ASTM D 1557 test procedures be utilized. For vehicle service and access lanes, it is recommended that a minimum of six (6.0) inches of PCC pavement over 12 inches subgrade compacted to at least 95 percent of maximum dry density be utilized. This section should also be used in heavy truck traffic areas such as fire lanes, trash dumpster pads and approaches.

Requirements of Section 90 of Caltrans Standard Specifications, and various ACI and ASTM standards regarding mixing and placing concrete should be followed. The PCC pavement should have a minimum modulus of rupture of 500 pounds per square inch, and a minimum 28-day compressive strength of 4,000 pounds per square inch. Concrete should incorporate 1-inch maximum size aggregate and should be proportioned to achieve a maximum slump of four inches. Instead of increasing the water content, a plasticizing admixture may be utilized to increase the workability of the concrete. The concrete should be properly cured after placement. Concrete should not be placed during hot and windy weather.

Crack control joints should be provided in the transverse direction spaced at horizontal intervals ranging from 24 to 36 times the thickness of the concrete.

### 5.6.4 Pavement Construction

All pavement installation, including preparation and compaction of subgrade and base material, placement and rolling of asphaltic concrete and placement of concrete pavement, should be done in accordance with the City of Upland guidelines, and under the observation and testing of GeoTek and a City inspector, where required.

Any aggregate base used should consist of crushed rock with an R-Value and gradation in accordance with Crushed Aggregate Base (Section 400-2.4 of the "Greenbook" Regional Supplement Amendments). Any Crushed Miscellaneous Base used shall conform to Section 200-2.4 of the Green Book.

Minimum compaction requirements for aggregate base should be 95 percent of maximum dry density as determined by ASTM D 1557 test procedures for both soil subgrade and aggregate base. Jurisdictional minimum compaction requirements in excess of the aforementioned minimums may govern. The upper 12 inches of subgrade should be moisture-conditioned to at least optimum moisture. The top of the subgrade and aggregate base should be graded to drain to the perimeter of the pavement.

## 5.7 POST CONSTRUCTION CONSIDERATIONS

### 5.7.1 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. An abatement program to control ground-burrowing rodents should be implemented and maintained. Burrowing rodents can decrease 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 foundations. This type of landscaping should be avoided.

### 5.7.2 Drainage

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 adjacent to the footings and floor-slabs. Pad drainage should be directed toward approved areas and not be blocked by other improvements. Roof gutters should be installed that will direct the collected water at least 20 feet from the buildings.

## 5.8 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

It is recommended that specifications and foundation and grading plans be reviewed by GeoTek prior to construction to check for conformance with the recommendations of this report. It is also recommended that GeoTek, Inc. representatives be present during site grading and foundation construction to observe and document proper implementation of the geotechnical recommendations. The owner/developer should verify that GeoTek, Inc. 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 on-site and import materials for fill placement and collect soil samples for laboratory testing where necessary.
- Observe the fill for uniformity during placement, including utility trench backfill. Perform field density testing of the fill materials.
- Observe and probe foundation excavations to confirm suitability of bearing materials with respect to density.

If requested, a construction observation and compaction report can be provided by GeoTek, Inc., which can comply with the requirements of the governmental agencies having jurisdiction over the project. It is recommended 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 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 this evaluation is limited to the boundaries of the subject property. 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 of this evaluation is based on GeoTek's understanding of the project and geotechnical engineering standards normally used on similar projects in this locality.

## 7. LIMITATIONS

GeoTek's findings are based on site conditions observed and the stated sources. Thus, GeoTek's comments are professional opinions that are limited to the extent of the available data.

GeoTek has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report.

Since GeoTek's recommendations are based on the site conditions observed and encountered, and laboratory testing, GeoTek's conclusions 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 of any kind is expressed or implied. Standards of care/practice are subject to change with time.

## 8. SELECTED REFERENCES

American Concrete Institute (ACI), 2006, Publication 302.2R-06, Guide for Concrete Slabs That Receive Moisture Sensitive Flooring Materials.

______, 2010, Publications 360R-10, Guide to Design of Slabs-On-Ground.

______, 2018, Publications 318-19, Building Code Requirements for Structural Concrete.

American Society of Civil Engineers (ASCE), 2017, "Minimum Design Loads for Buildings and Other Structures," ASCE/SEI 7-16, Third Printing, Errata Incorporated through March 15.

Bray, J.D., Sancio, R.B., 2006, "Assessment of the Liquefaction Susceptibility of Fine-Grained Soils," Journal of Geotechnical and Geoenvironmental Engineering, Volume 132, Issue 9, dated September 1.

Bryant, W.A., and Hart, E.W., 2007, "Fault Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps," California Geological Survey: Special Publication 42.

California Code of Regulations, Title 24, 2022, "California Building Code," 2 volumes.

California Department of Transportation, 2020, "Highway Design Manual," 7th Edition.

California Geological Survey (CGS, formerly referred to as the California Division of Mines and Geology), 1977, "Geologic Map of California."

_____, 2008, "Guidelines for Evaluating and Mitigating Seismic Hazards in California," Special Publication 117A.

_____, 2018, "Earthquake Fault Zones, A Guide for Government Agencies, Property Owners/Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California, Special Publication 42 (Revised), California Geological Survey (CGS), 1980, "State of California, Special Studies Zone, Elsinore Quadrangle," dated January 1.

Dibblee, T.W. and Minch, J.A., 2002, "Geologic Map of the San Dimas and Ontario Quadrangles, Los Angeles and San Bernardino Counties, California," Dibblee Geological Foundation, Dibblee Foundation Map DF-91, 1:24,000.

GeoTek, Inc., In-house proprietary information.

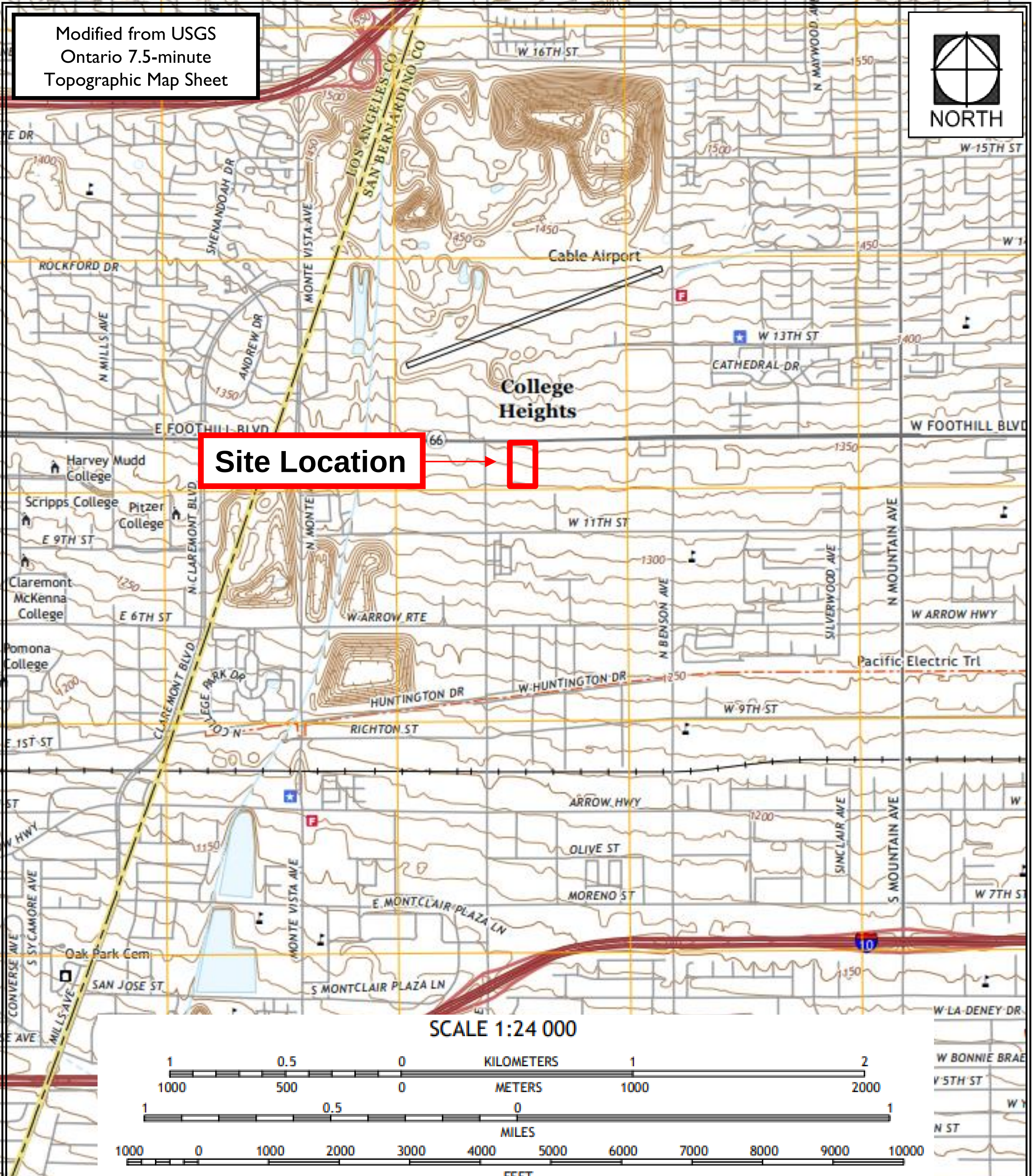
KTGY, 2024, "Conceptual Site Plan, Upland-Foothills," dated December 20.

OSHPD Seismic Design Maps (https://seismic maps.org/).

Roberge, P. R., 2005, "Handbook of Corrosion Engineering," 2nd Edition.

Seismic Design Values for Buildings (http://geohazards.usgs.gov/designmaps/us/application.php).

Southern California Earthquake Center (SCEC), 1999, Martin, G. R., and Lew, M., ed. "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction Hazards in California,", dated March 1999.




**Century Communities**
APNs 1007-061-08-0000 and 107-061-23-0000
1812 and 1816 West Foothill Boulevard
Upland, San Bernardino County, California

Project No. 4056-CR

**Figure 1**

**Site Location and Topography Map**

GEOTEK


**LEGEND**
**(Locations are Approximate)**

Site Boundary

B-5 Geotechnical Boring

I-2 Infiltration Test

**Century Communities**
APNs 1007-061-08-0000 and 107-061-23-0000
1812 and 1816 West Foothill Boulevard
Upland, San Bernardino County, California

Project No. 4056-CR

GEOTEK

**Figure 2**

**Exploration Location Map**

# APPENDIX A

## LOGS OF EXPLORATORY BORINGS

**Geotechnical and Infiltration Evaluation**
**Proposed Single-Family Residential Development**
**APNs 1007-061-08-0000 and 1007-061-23-0000**
**1812 and 1816 West Foothill Boulevard**
**Upland, San Bernardino County, California**
**Project No. 4056-CR**

GEOTEK

## A - FIELD TESTING AND SAMPLING PROCEDURES

The Modified Split-Barrel Sampler (Ring)
The Ring sampler is driven into the ground at various depths in accordance with ASTM D 3550 test procedures. 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.

The Standard Penetration Test (SPT) Sampler
Standard penetration tests (SPT) were performed with a 2.0-inch outside diameter, 1.5-inch inside diameter, split-barrel sampler. The sampler was 18 inches long. The inside diameter of the sampler shoe was 1.4 inches. The sampler was unlined. The sampler conformed to the requirements of ASTM D 1586. A 140-pound automatic trip hammer was utilized, dropping 30 inches for each blow. Blow counts are recorded for every 6 inches of penetration as indicated on the log of boring. Disturbed samples are removed from the sample barrel, sealed in a plastic bag, 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.

Bulk Samples (Small)
These are plastic bag samples which are normally airtight and contain less than 5 pounds in weight of earth materials collected from the field by means of hand digging or exploratory cuttings. These samples are primarily used for determining natural moisture content and classification indices.

## 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

GeoTek, Inc.

# LOG OF EXPLORATORY BORING

| | | | | | |
|---|---|---|---|---|---|
| **CLIENT:** | Century Communities SoCal | **DRILLER:** | 2R Drilling Inc. | **LOGGED BY:** | JR |
| **PROJECT NAME:** | 1812 and 1816 W Foothill Blvd | **DRILL METHOD:** | Hollow Stem Auger | **OPERATOR:** | Miguel |
| **PROJECT NO.:** | 4056-CR | **HAMMER:** | 140lbs/30in. | **RIG TYPE:** | CME-75 |
| **LOCATION:** | See Boring Location Map | | | **DATE:** | 1/30/2025 |

**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 |
|---|---|---|---|---|---|---|---|---|
| | Large Bulk / Ring | 50/6" | R1 | GP | **3" Asphalt concrete/No base:** **Undocumented Fill:** Cobble and gravel in sampler | 0.6 | | EI, SH, SR, MD EI=5 |
| | Ring | 26 40 50/4" | R2 | GP | **Alluvium:** F-c sandy GRAVEL, brown, slightly moist, very dense, trace cobble | 1.0 | | |
| 5 | Ring | 35 50/5" | R3 | | | 0.7 | | |
| | Ring | 50/3" | R4 | | | | | |
| 10 | | | | | **BORING TERMINATED AT 8 FEET DUE TO PRACTICAL REFUSAL** No groundwater encountered Boring backfilled with soil cuttings | | | |
| 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:** | Century Communities SoCal | **DRILLER:** | 2R Drilling Inc. | **LOGGED BY:** | JR |
| **PROJECT NAME:** | 1812 and 1816 W Foothill Blvd | **DRILL METHOD:** | Hollow Stem Auger | **OPERATOR:** | Miguel |
| **PROJECT NO.:** | 4056-CR | **HAMMER:** | 140lbs/30in. | **RIG TYPE:** | CME-75 |
| **LOCATION:** | See Boring Location Map | | | **DATE:** | 1/30/2025 |

**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 |
|---|---|---|---|---|---|---|---|---|
| | | | | | **Vegetation/Disturbed Topsoil:** | | | |
| | | | | | **Alluvium:** | | | |
| | Ring | 20<br>24<br>30 | R1 | SP | Gravelly f-c SAND, gray brown, slightly moist, dense | 1.3 | | |
| 5 | Ring | 30<br>31<br>33 | R2 | SP/GP | Gravelly f-c SAND to f-c sandy GRAVEL, gray brown, slightly moist, dense | 0.9 | | |
| | Ring | 50/4" | R3 | GP | F-c sandy GRAVEL, gray brown, slightly moist, very dense, trace cobble | | | |
| | Ring | 37<br>50/6" | R4 | | Cobble in sampler | 0.6 | | |
| 10 | | | | | | | | |
| | Ring | 50/6" | R5 | SP | Gravelly f-c SAND, brown, slightly moist, very dense, trace cobble | 0.9 | | |
| 15 | | | | | | | | |
| | Ring | 50/4" | R6 | | | | | |
| | | | | | **BORING TERMINATED AT 16.5 FEET DUE TO PRACTICAL REFUSAL** | | | |
| | | | | | No groundwater encountered<br>Boring backfilled with soil cuttings | | | |
| 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:** | Century Communities SoCal | **DRILLER:** | 2R Drilling Inc. | **LOGGED BY:** | JR |
| **PROJECT NAME:** | 1812 and 1816 W Foothill Blvd | **DRILL METHOD:** | Hollow Stem Auger | **OPERATOR:** | Miguel |
| **PROJECT NO.:** | 4056-CR | **HAMMER:** | 140lbs/30in. | **RIG TYPE:** | CME-75 |
| **LOCATION:** | See Boring Location Map | | | **DATE:** | 1/30/2025 |

## 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 |
|---|---|---|---|---|---|---|---|---|
| | | | | | **Vegetation/Disturbed Topsoil:** | | | SR |
| | | 22<br>26<br>29 | R1 | SP/GP | F-c SAND to f-c sandy GRAVEL, brown to gray brown, slightly moist, dense | 0.8 | | |
| | | | | | **Alluvium:** | | | |
| | | 26<br>27<br>50 | R2 | GP | F-c sandy GRAVEL, gray brown, slightly moist, very dense | 0.7 | | |
| 5 | | 25<br>50/6" | R3 | | | 0.8 | | |
| | | 40<br>50/3" | R4 | SP | Gravelly f-c SAND, gray brown, slightly moist, very dense | 1.2 | 123.9 | |
| 10 | | 50/6" | R5 | GP | (Cobble in sampler) F-c sandy GRAVEL, gray brown, slightly moist, very dense, trace cobble | 0.7 | | |
| | | | | | **BORING TERMINATED AT 11 FEET DUE TO PRACTICAL REFUSAL** | | | |
| | | | | | No groundwater encountered<br>Boring backfilled with soil cuttings | | | |
| 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:** | Century Communities SoCal | **DRILLER:** | 2R Drilling Inc. | **LOGGED BY:** | JR |
| **PROJECT NAME:** | 1812 and 1816 W Foothill Blvd | **DRILL METHOD:** | Hollow Stem Auger | **OPERATOR:** | Miguel |
| **PROJECT NO.:** | 4056-CR | **HAMMER:** | 140lbs/30in. | **RIG TYPE:** | CME-75 |
| **LOCATION:** | See Boring Location Map | | | **DATE:** | 1/30/2025 |

**BORING NO.: B-4**

| 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 |
|---|---|---|---|---|---|---|---|---|
| | | | | | **Vegetation/Disturbed Topsoil:** | | | |
| | | | | | **Alluvium:** | | | |
| | Ring | 21<br>30<br>25 | R1 | GP | F-c sandy GRAVEL, brown, slightly moist, dense | 0.8 | | |
| | | | | | | 0.6 | | |
| 5 | Ring | 35<br>35<br>25 | R2 | | | | | |
| | | | | | | 0.2 | | |
| | Ring | 50/4" | R3 | | Cobble in sampler | | | |
| | Ring | 27<br>50/4" | R4 | | F-c sandy GRAVEL, gray, slightly moist, very dense | 0.7 | | |
| 10 | | | | | | | | |
| | No Recovery | 50/1" | R5 | | | | | |
| 15 | | | | | **BORING TERMINATED AT 14.5 FEET DUE TO PRACTICAL REFUSAL** | | | |
| | | | | | No groundwater encountered<br>Boring backfilled with soil cuttings | | | |
| 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:** | Century Communities SoCal | **DRILLER:** | 2R Drilling Inc. | **LOGGED BY:** | JR |
| **PROJECT NAME:** | 1812 and 1816 W Foothill Blvd | **DRILL METHOD:** | Hollow Stem Auger | **OPERATOR:** | Miguel |
| **PROJECT NO.:** | 4056-CR | **HAMMER:** | 140lbs/30in. | **RIG TYPE:** | CME-75 |
| **LOCATION:** | See Boring Location Map | | | **DATE:** | 1/30/2025 |

**BORING NO.: B-5**

| Depth (ft) | SAMPLES: Sample Type | Blows/ 6 in | Sample Number | USCS Symbol | MATERIAL DESCRIPTION AND COMMENTS | Laboratory Testing: Water Content (%) | Dry Density (pcf) | Others |
|---|---|---|---|---|---|---|---|---|
| | | | | | **Undocumented Fill:** | | | EI, SH, MD EI=0 |
| | | 22 13 20 | R1 | SP | Gravelly f-c SAND (Coarse Aggregate Base) to f SAND, black to brown, slightly moist, medium dense | 1.4 | 110.3 | |
| | | | | | **Alluvium:** | | | |
| | | 13 26 26 | R2 | GP | F sandy GRAVEL, brown, slightly moist, dense | 0.9 | | |
| 5 | | 23 33 50/6" | R3 | | F-c sandy GRAVEL, brown, slightly moist, very dense | 1.0 | 128.9 | |
| | | 37 41 50/3" | R4 | | | 1.3 | | |
| 10 | | 40 50/5" | R5 | | F-c sandy GRAVEL, brown, slightly moist, very dense, trace cobble | 2.1 | 108.8 | |
| 15 | | 41 50/5" | R6 | SP | F-c SAND, brown, slightly moist, very dense, few gravel, trace cobble | 4.9 | 119.6 | |
| 20 | | 50/2" | R7 | GP | | | | |
| 25 | | 50/1" | S1 | | | | | |
| | | | | | **BORING TERMINATED AT 25.5 FEET DUE TO PRACTICAL REFUSAL** | | | |
| | | | | | No groundwater encountered<br>Boring backfilled with soil cuttings | | | |
| 30 | | | | | | | | |

LEGEND

**Sample type**: ---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:** | Century Communities SoCal | **DRILLER:** | 2R Drilling Inc. | **LOGGED BY:** | JR |
| **PROJECT NAME:** | 1812 and 1816 W Foothill Blvd | **DRILL METHOD:** | Hollow Stem Auger | **OPERATOR:** | Miguel |
| **PROJECT NO.:** | 4056-CR | **HAMMER:** | 140lbs/30in. | **RIG TYPE:** | CME-75 |
| **LOCATION:** | See Boring Location Map | | | **DATE:** | 1/30/2025 |

**BORING NO.: I-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 |
|---|---|---|---|---|---|---|---|---|
| | | | | SP | **Vegetation/Disturbed Topsoil:**<br>Gravelly f-c SAND, brown, slightly moist, trace cobble | | | |
| | | | | GP | **Alluvium:**<br>F-c sandy GRAVEL, brown, slightly moist, dense, trace cobble | | | |
| 5 | | | | | **BORING TERMINATED AT 5 FEET**<br>No groundwater encountered<br>Boring set up with perforated pipe and gravel | | | |
| 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:** | Century Communities SoCal | **DRILLER:** | 2R Drilling Inc. | **LOGGED BY:** | JR |
| **PROJECT NAME:** | 1812 and 1816 W Foothill Blvd | **DRILL METHOD:** | Hollow Stem Auger | **OPERATOR:** | Miguel |
| **PROJECT NO.:** | 4056-CR | **HAMMER:** | 140lbs/30in. | **RIG TYPE:** | CME-75 |
| **LOCATION:** | See Boring Location Map | | | **DATE:** | 1/30/2025 |

| Depth (ft) | SAMPLES: Sample Type | Blows/ 6 in | Sample Number | USCS Symbol | BORING NO.: I-2<br>MATERIAL DESCRIPTION AND COMMENTS | Laboratory Testing: Water Content (%) | Dry Density (pcf) | Others |
|---|---|---|---|---|---|---|---|---|
| | | | | SP | **Vegetation/Disturbed Topsoil:**<br>Gravelly f-c SAND, brown, slightly moist, trace cobble | | | |
| | | | | GP | **Alluvium:**<br>F-c sandy GRAVEL, brown, slightly moist, dense, trace cobble | | | |
| 5 | | | | | **BORING TERMINATED AT 5 FEET**<br>No groundwater encountered<br>Boring set up with perforated pipe and gravel | | | |
| 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

# APPENDIX B

## LABORATORY TEST RESULTS

**Geotechnical and Infiltration Evaluation**
**Proposed Single-Family Residential Development**
**APNs 1007-061-08-0000 and 1007-061-23-0000**
**1812 and 1816 West Foothill Boulevard**
**Upland, San Bernardino County, California**
**Project No. 4056-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 are shown on the boring logs in Appendix A.

**Direct Shear**
Shear testing was performed on remolded samples 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 graphically in Appendix B.

**Expansion Index**
The expansion potential of the site soil was estimated by performing Expansion Index testing on selected samples in general accordance with ASTM D 4829. The results of the testing are presented graphically in Appendix B.

**In-Situ Moisture and Density**
The natural water content was determined (ASTM D 2216) on samples of the materials recovered from the subsurface exploration. In addition, in-place dry density determinations (ASTM D 2937) were performed on relatively undisturbed samples to measure the unit weight of the subsurface soils. Results of these tests are shown on the logs at the appropriate sample depths in Appendix A.

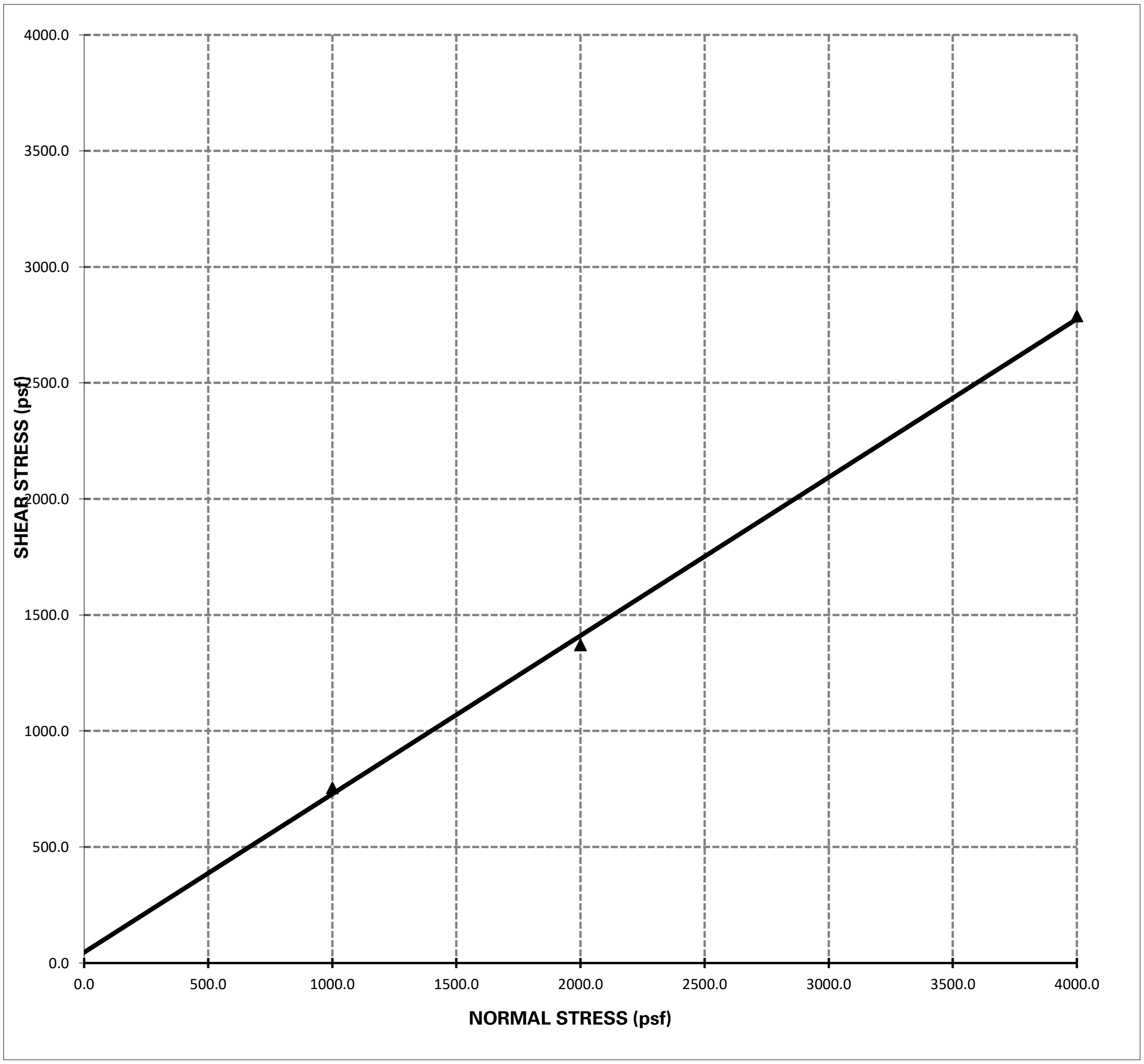
**Moisture-Density Relationship**
Laboratory testing consisting of a moisture-density relationship was performed on samples obtained during the subsurface exploration. The laboratory maximum dry density and optimum moisture content was determined in general accordance with ASTM D 1557 test procedures. The results of the testing are presented graphically in Appendix B.

**Sulfate Content, Resistivity and Chloride Content**
Laboratory testing was performed by Project X Corrosion Engineering in general accordance with ASTM procedures. The testing included pH and water-soluble sulfate content determinations, and resistivity and chloride content testing. The results of the testing are presented in Appendix B.

GEOTEK

# DIRECT SHEAR TEST

| | | | |
|---|---|---|---|
| ***Project Name:*** | 1812 & 1816 West Foothill Blvd. | ***Sample Location:*** | B-1 @ 0-5 Feet |
| ***Project Number:*** | 4056-CR | ***Date Tested:*** | 2/4/2025 |




**<u>Shear Strength:</u>** **Φ = 34 °** **C = 46 psf**

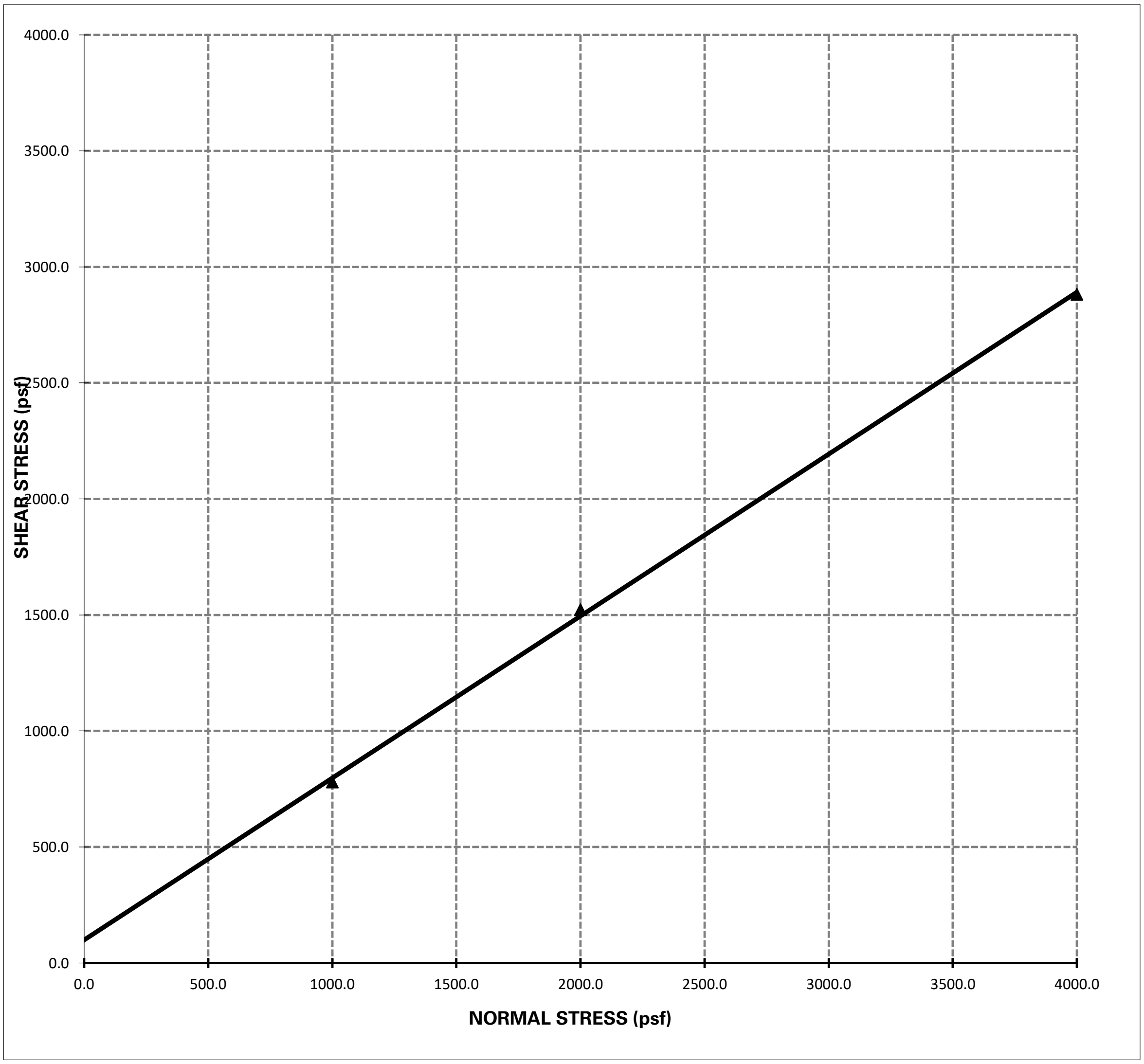
**Notes:** 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.

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

3 - The tests were run at a shear rate of 0.01 in/min.

# DIRECT SHEAR TEST

| | | | |
|---|---|---|---|
| ***Project Name:*** | 1812 & 1816 West Foothill Blvd. | ***Sample Location:*** | B-5 @ 0-5 Feet |
| ***Project Number:*** | 4056-CR | ***Date Tested:*** | 2/4/2025 |




**Shear Strength:** $\Phi$ = 35 ° C = 100 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 0.01 in/min.

GEOTEK

# EXPANSION INDEX TEST

**(ASTM D4829)**

| | | | |
|---|---|---|---|
| ***Client:*** | Century Communities | ***Tested/ Checked By:*** | KLP Lab No Corona |
| ***Project Number:*** | 4056-CR | ***Date Tested:*** | 2/3/2025 |
| ***Project Location:*** | 1812 and 1816 West Foothill Boulevard | ***Sample Source:*** | B-1 @ 0-5 Feet |
| | | ***Sample Description:*** | |

Ring #:______ Ring Dia. : 4.01" Ring Ht.:1"

**DENSITY DETERMINATION**

| | |
|---|---|
| Weight of compacted sample & ring (gm) | 801.2 |
| Weight of ring (gm) | 372.9 |
| Net weight of sample (gm) | **428.3** |
| Wet Density, lb / ft3 (C*0.3016) | **129.2** |
| Dry Density, lb / ft3 (D/1.F) | **120.5** |

**SATURATION DETERMINATION**

| | |
|---|---|
| Moisture Content, % | 7.2 |
| Specific Gravity, assumed | **2.70** |
| Unit Wt. of Water @ 20°C, (pcf) | **62.4** |
| % Saturation | **48.8** |

| READINGS | | | |
|---|---|---|---|
| DATE | TIME | READING | |
| 2/3/2025 | | 0.4040 | Initial |
| 2/3/2025 | | 0.4040 | 10 min/Dry |
| | | | |
| | | | |
| | | | |
| 2/4/2025 | | 0.4090 | Final |

| FINAL MOISTURE | |
|---|---|
| Final Weight of wet sample & tare | % Moisture |
| 819.3 | **11.4** |

**EXPANSION INDEX = 5**

GEOTEK

# EXPANSION INDEX TEST

**(ASTM D4829)**

| | | | |
|---|---|---|---|
| ***Client:*** | Century Communities | ***Tested/ Checked By:*** | KLP Lab No Corona |
| ***Project Number:*** | 4056-CR | ***Date Tested:*** | 2/3/2025 |
| ***Project Location:*** | 1812 and 1816 West Foothill Boulevard | ***Sample Source:*** | B-5 @ 0-5 Feet |
| | | ***Sample Description:*** | |

Ring #:______ Ring Dia. : 4.01" Ring Ht.:1"

**DENSITY DETERMINATION**

| | |
|---|---|
| Weight of compacted sample & ring (gm) | 782.8 |
| Weight of ring (gm) | 363.4 |
| Net weight of sample (gm) | **419.4** |
| Wet Density, lb / ft3 (C*0.3016) | **126.5** |
| Dry Density, lb / ft3 (D/1.F) | **116.6** |

**SATURATION DETERMINATION**

| | |
|---|---|
| Moisture Content, % | 8.5 |
| Specific Gravity, assumed | **2.70** |
| Unit Wt. of Water @ 20°C, (pcf) | **62.4** |
| % Saturation | **51.6** |

**READINGS**

| DATE | TIME | READING | |
|---|---|---|---|
| 2/3/2025 | | 0.6540 | Initial |
| 2/3/2025 | | 0.6540 | 10 min/Dry |
| | | | |
| | | | |
| | | | |
| 2/4/2025 | | 0.6540 | Final |

**FINAL MOISTURE**

| Final Weight of wet sample & tare | % Moisture |
|---|---|
| 805.5 | **13.9** |

**EXPANSION INDEX = 0**

**GeoTek - Corona**
1548 N. Maple St.
Corona, CA 92880
Phone: (951) 710-1160
Fax: (951) 710-1167

**Report No: PTR:25-00022-S01**

# Proctor Report

**Client:** Century Communities SoCal
4695 MacArthur Court,
Newport Beach CA 92660

**CC:**

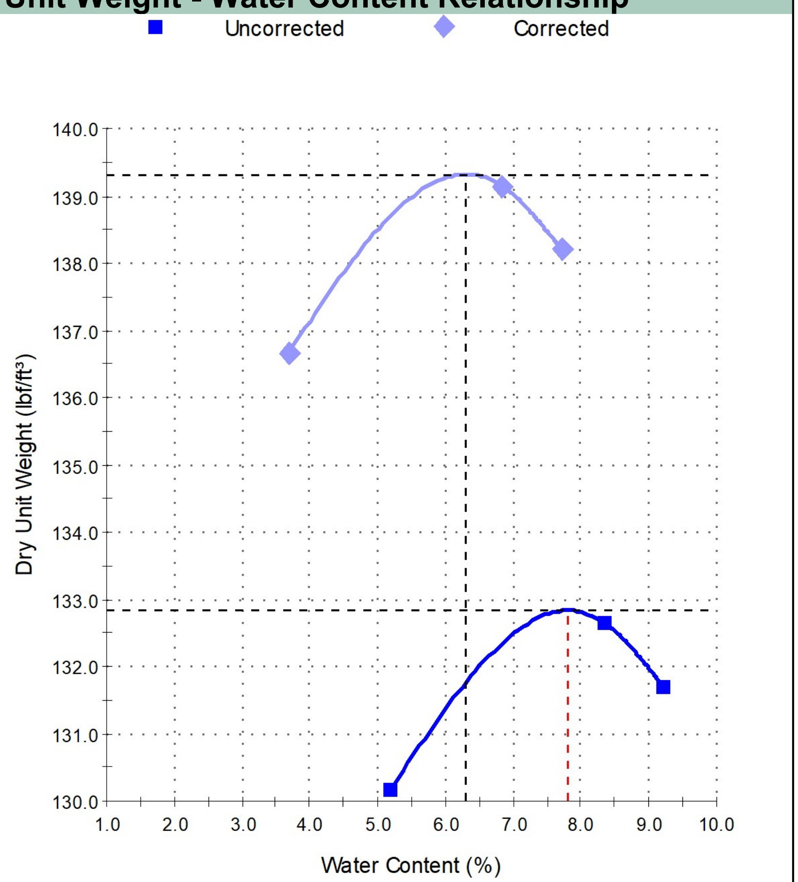
**Project:** 4056-CR
1812 and 1816 West Foothill Boulevard



## Sample Details

**Sample ID:** 25-00022-S01 **Date Sampled:** 2/3/2025
**Sampled By:**
**Material:** FIne to Coarse Sandy GRAVEL
**Location:** B-1 @ 0-5 Feet

## Dry Unit Weight - Water Content Relationship




## Test Results

ASTM D 1557

| | |
|---|---|
| **Maximum Dry Unit Weight (lbf/ft³):** | **132.8** |
| **Optimum Water Content (%):** | **7.8** |
| Method: | C |
| Preparation Method: | Moist |
| Retained Sieve 3/4" (19mm) (%): | 22 |
| Passing Sieve 3/4" (19mm) (%): | 78 |
| Tested By: | Eduardo Cuevas |
| Date Tested: | 1/31/2025 |

ASTM D 4718

| | |
|---|---|
| **Corrected Maximum Dry Unit Weight (lbf/ft³):** | **139.3** |
| **Corrected Optimum Water Content (%):** | **6.3** |
| Specific Gravity (Oversize): | 2.70 |
| Sieve Size (Oversize): | 3/4 |
| Oversize Particles (%): | 22 |

## Comments

**GeoTek - Corona**
1548 N. Maple St.
Corona, CA 92880
Phone: (951) 710-1160
Fax: (951) 710-1167

**Report No: PTR:25-00022-S02**

# Proctor Report

**Client:** Century Communities SoCal
4695 MacArthur Court,
Newport Beach CA 92660

**CC:**

**Project:** 4056-CR
1812 and 1816 West Foothill Boulevard



## Sample Details

**Sample ID:** 25-00022-S02

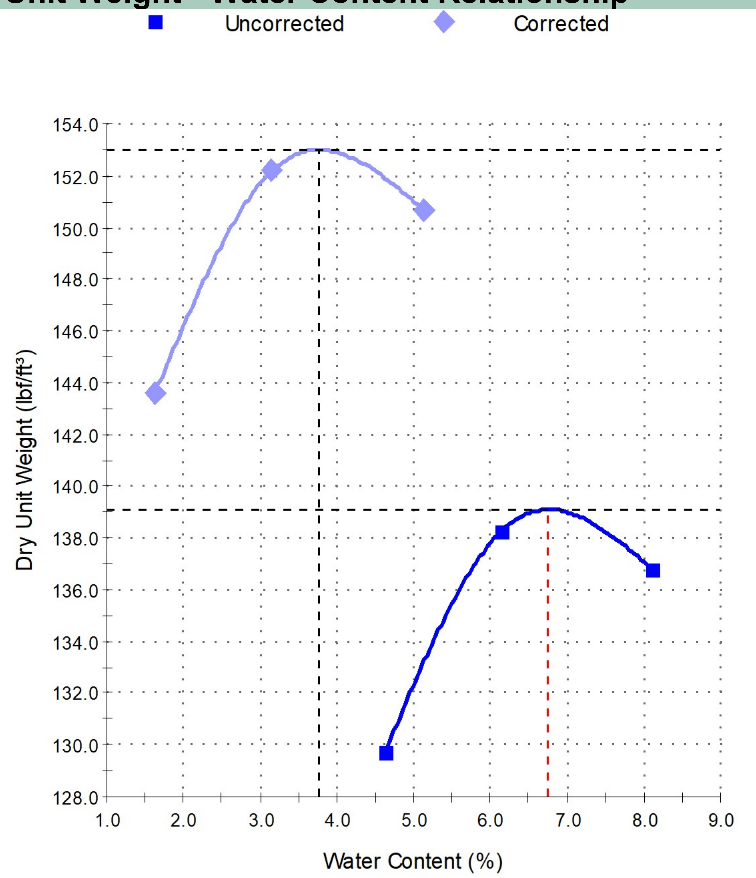
**Date Sampled:**

**Sampled By:**

**Material:** FIne to Coarse Sandy GRAVEL

**Location:** B-5 @ 0-5 Feet

## Dry Unit Weight - Water Content Relationship




## Test Results

ASTM D 1557

| | |
|---|---|
| **Maximum Dry Unit Weight ($lbf/ft^3$):** | **139.1** |
| **Optimum Water Content (%):** | **6.8** |
| Method: | C |
| Preparation Method: | Moist |
| Retained Sieve 3/4" (19mm) (%): | 52 |
| Passing Sieve 3/4" (19mm) (%): | 48 |
| Tested By: | Eduardo Cuevas |
| Date Tested: | 1/31/2025 |

ASTM D 4718

| | |
|---|---|
| **Corrected Maximum Dry Unit Weight ($lbf/ft^3$):** | **153.0** |
| **Corrected Optimum Water Content (%):** | **3.8** |
| Specific Gravity (Oversize): | 2.70 |
| Sieve Size (Oversize): | 3/4 |
| Oversize Particles (%): | 52 |

## Comments

# Results Only Soil Testing
# for
# 1812 & 1816 W.Foothill Blvd.

## February 3, 2025

## Prepared for:

**Eddy Cuevas**
**GeoTek USA**
**1548 N. Maple Avenue**
**Corona, CA 92878**
**Ecuevas@geotekusa.com, jbrucelas@geotekusa.com**

**Project X Job#: S250131F**
**Client Job or PO#: 4056-CR**

Prepared by:
M. Williams

Respectfully Submitted,

Eduardo Hernandez, M.Sc., P.E.
Sr. Corrosion Consultant
NACE Corrosion Technologist #16592
Professional Engineer
California No. M37102
ehernandez@projectxcorrosion.com

# Soil Analysis Lab Results

Client: GeoTek USA
Job Name: 1812 & 1816 W.Foothill Blvd.
Client Job Number: 4056-CR
Project X Job Number: S250131F
February 3, 2025

| | Method | ASTM D4327 | | ASTM D4327 | | ASTM G187 | | ASTM G51 | ASTM G200 | SM 4500-D | ASTM D4327 | ASTM D6919 | ASTM D6919 | ASTM D6919 | ASTM D6919 | ASTM D6919 | ASTM D6919 | ASTM D4327 | ASTM D4327 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bore# / Description** | **Depth** | **Sulfates** $SO_4^{2-}$ | | **Chlorides** $Cl^-$ | | **Resistivity** As Rec'd | Minimum | **pH** | **Redox** | **Sulfide** $S^{2-}$ | **Nitrate** $NO_3^-$ | **Ammonium** $NH_4^+$ | **Lithium** $Li^+$ | **Sodium** $Na^+$ | **Potassium** $K^+$ | **Magnesium** $Mg^{2+}$ | **Calcium** $Ca^{2+}$ | **Fluoride** $F_2^{2-}$ | **Phosphate** $PO_4^{3-}$ |
| | (ft) | (mg/kg) | (wt%) | (mg/kg) | (wt%) | (Ω-cm) | (Ω-cm) | | (mV) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| B-1 | 0-5 | 45.5 | 0.0045 | 55.5 | 0.0056 | 44,890 | 13,400 | 8.8 | 126 | 2.01 | 1.4 | 4.8 | ND | 70.4 | 12.2 | 65.2 | 251.1 | 1.5 | 0.5 |
| B-3 | 0-5 | 17.6 | 0.0018 | 22.6 | 0.0023 | 26,130 | 8,040 | 8.5 | 128 | 0.48 | 19.3 | 2.5 | ND | 20.0 | 14.2 | 53.0 | 207.1 | 0.8 | 0.7 |

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

For AWWA 105C: 0-3mg/kg sulfide = Negative; 3-6mg/kg = trace; >6mg/kg = Positive

**Note**: Sometimes a bad sulfate hit is a contaminated spot. Typical fertilizers are Potassium chloride, ammonium sulfate or ammonium sulfate nitrate (ASN). So this is another reason why testing full corrosion series is good because we then have the data to see if those other ingredients are present meaning the soil sample is just fertilizer-contaminated soil. This can happen often when the soil samples collected are simply surface scoops. This is why it's best to dig in a foot, throw away the top and test the deeper stuff. Dairy farms are also notorious for these items.

If one sample pops up much more corrosive than all others, we would recommend collecting more samples surrounding the problem sample location to determine if the peak is isolated to it. This allows us to conclude it was a contaminated sample and able to declare it an outlier.

Try out our new online forms: SOIL CORROSIVITY & THERMAL RESISTIVITY LAB REQUEST FORM & IN-SITU WENNER 4 PIN QUOTE REQUEST FORM

# APPENDIX C

## INFILTRATION TEST DATA
## AND PORCHET CALCULATIONS

**Geotechnical and Infiltration Evaluation**
**Proposed Single-Family Residential Development**
**APNs 1007-061-08-0000 and 1007-061-23-0000**
**1812 and 1816 West Foothill Boulevard**
**Upland, San Bernardino County, California**
**Project No. 4056-CR**

GEOTEK

## PERCOLATION DATA SHEET

**Project:** 1812 and 1816 W Foothill Blvd **Job No.:** 4056-CR

**Test Hole No.:** I-1 **Tested By:** JR **Date:** 1/30/2025

**Depth of Hole As Drilled:** 60" **Before Test:** 60" **After Test:** 60"

| 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 |
|---|---|---|---|---|---|---|---|---|
| 1 | 1:45 PM | | 60 | 36 | | | | presoaked |
| | 2:10 PM | 25 | | | 0 | 36 | 0.7 | |
| 2 | 2:11 PM | | 60 | 36 | | | | |
| | 2:36 PM | 25 | | | 0 | 36 | 0.7 | |
| 1 | 2:37 PM | | 60 | 36 | | | | |
| | 2:47 PM | 10 | | | 7 | 29 | 0.3 | |
| 2 | 2:48 PM | | 60 | 36 | | | | |
| | 2:58 PM | 10 | | | 7 7/8 | 28 1/8 | 0.4 | |
| 3 | 2:59 PM | | 60 | 36 | | | | |
| | 3:09 PM | 10 | | | 8 3/8 | 27 5/8 | 0.4 | |
| 4 | 3:10 PM | | 60 | 36 | | | | |
| | 3:20 PM | 10 | | | 9 | 27 | 0.4 | |
| 5 | 3:21 PM | | 60 | 36 | | | | |
| | 3:31 PM | 10 | | | 9 1/4 | 26 3/4 | 0.4 | |
| 6 | 3:32 PM | | 60 | 36 | | | | |
| | 3:42 PM | 10 | | | 9 5/8 | 26 3/8 | 0.4 | |

## PERCOLATION DATA SHEET

**Project:** 1812 and 1816 W Foothill Blvd **Job No.:** 4056-CR

**Test Hole No.:** I-2 **Tested By:** JR **Date:** 1/30/2025

**Depth of Hole As Drilled:** 60" **Before Test:** 60" **After Test:** 60"

| 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 |
|---|---|---|---|---|---|---|---|---|
| 1 | 1:33 PM | | 60 | 36 | | | | presoaked |
| | 1:58 PM | 25 | | | 0 | 36 | 0.7 | |
| 2 | 1:59 PM | | 60 | 36 | | | | |
| | 2:24 PM | 25 | | | 0 | 36 | 0.7 | |
| 1 | 2:25 PM | | 60 | 36 | | | | |
| | 2:35 PM | 10 | | | 10 | 26 | 0.4 | |
| 2 | 2:36 PM | | 60 | 36 | | | | |
| | 2:46 PM | 10 | | | 10 5/8 | 25 3/8 | 0.4 | |
| 3 | 2:47 PM | | 60 | 36 | | | | |
| | 2:57 PM | 10 | | | 11 1/8 | 24 7/8 | 0.4 | |
| 4 | 2:58 PM | | 60 | 36 | | | | |
| | 3:08 PM | 10 | | | 11 1/2 | 24 1/2 | 0.4 | |
| 5 | 3:09 PM | | 60 | 36 | | | | |
| | 3:19 PM | 10 | | | 11 7/8 | 24 1/8 | 0.4 | |
| 6 | 3:20 PM | | 60 | 36 | | | | |
| | 3:30 PM | 10 | | | 12 1/4 | 23 3/4 | 0.4 | |

| | |
|---|---|
| **Client:** | **Century Communities SoCal** |
| **Project:** | **1812 and 1816 W Foothill Blvd** |
| **Project No:** | **4056-CR** |
| **Date:** | **1/30/2025** |

**Boring No.** **I-1**

**Percolation to Infiltration Rate (Porchet Method)**

| | |
|---|---|
| Time Interval, $\Delta t$ = | 10 |
| Final Depth to Water, $D_F$ = | 33.625 |
| Test Hole Radius, r = | 4 |
| Initial Depth to Water, $D_O$ = | 36 |
| Total Test Hole Depth, $D_T$ = | 60 |

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

| | |
|---|---|
| $H_O = D_T - D_O$ = | 36 |
| $H_F = D_T - D_F$ = | 26.375 |
| $\Delta H = \Delta D = H_O - H_F$ = | 9.625 |
| $Havg = (H_O+H_F)/2$ = | 31.1875 |

**$I_t$ =** 3.48 **Inches per Hour**

GEOTEK

| | |
|---|---|
| **Client:** | **Century Communities SoCal** |
| **Project:** | **1812 and 1816 W Foothill Blvd** |
| **Project No:** | **4056-CR** |
| **Date:** | **1/30/2025** |

**Boring No.** **I-2**

**Percolation to Infiltration Rate (Porchet Method)**

| | |
|---|---|
| Time Interval, $\Delta t$ = | 10 |
| Final Depth to Water, $D_F$ = | 36.25 |
| Test Hole Radius, r = | 4 |
| Initial Depth to Water, $D_O$ = | 24 |
| Total Test Hole Depth, $D_T$ = | 60 |

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

| | |
|---|---|
| $H_O = D_T - D_O$ = | 36 |
| $H_F = D_T - D_F$ = | 23.75 |
| $\Delta H = \Delta D = H_O - H_F$ = | 12.25 |
| $Havg = (H_O+H_F)/2$ = | 29.875 |

**$I_t$ =** 4.61 **Inches per Hour**

GEOTEK

# APPENDIX D

## GENERAL GRADING GUIDELINES

**Geotechnical and Infiltration Evaluation**

**Proposed Single-Family Residential Development**

**APNs 1007-061-08-0000 and 1007-061-23-0000**

**1812 and 1816 West Foothill Boulevard**

**Upland, San Bernardino County, California**

**Project No. 4056-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 (2022) 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 aspects 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 done 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 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 backhoe 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) The 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 contractor's 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 should be brought to the contractor's 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 the 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.

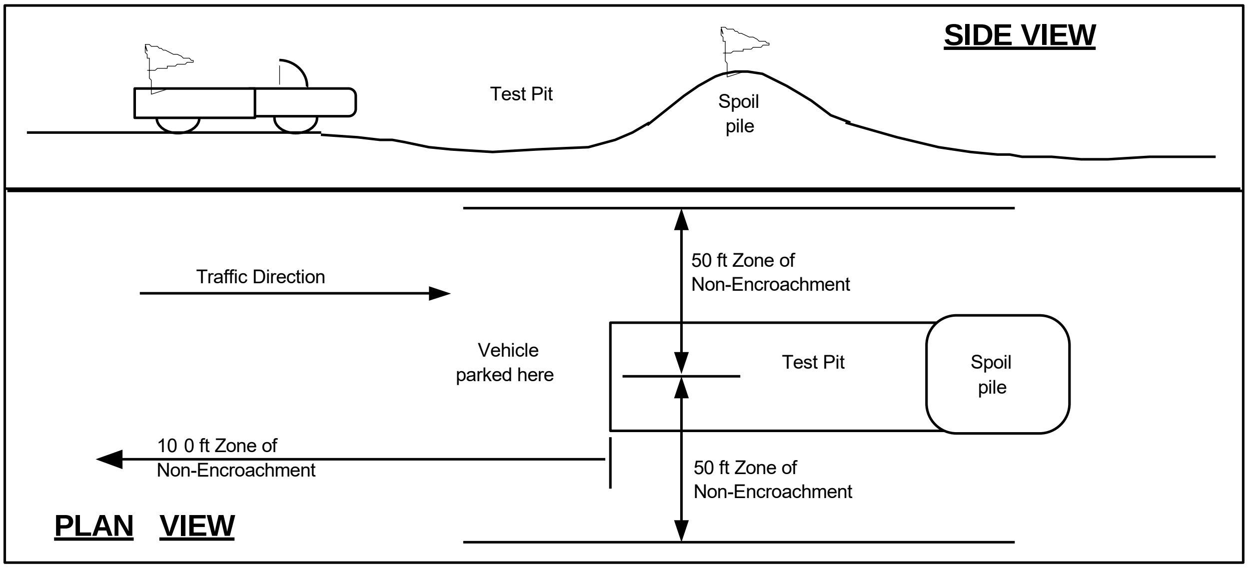
**Test Pits Location, Orientation and Clearance**

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 contractor's 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 affect 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 the technician's 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.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures, particularly the zone of non-encroachment.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures, particularly the zone of non-encroachment.