UPDATED GEOTECHNICAL AND INFILTRATION EVALUATION
PROPOSED SINGLE-FAMILY RESIDENTIAL DEVELOPMENT
TRACT NO. 31304 – PACIFIC EMERALD PROJECT
CITY OF PERRIS, RIVERSIDE COUNTY, CALIFORNIA

PREPARED FOR

PACIFIC COMMUNITIES BUILDER, INC.
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PREPARED BY

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May 6, 2020
Project No. 2359-CR

Pacific Communities Builder, Inc.
1000 Dove Street, Suite 300
Irvine, California 92660

Attention: Mr. Tony Arnest

Subject: Updated Geotechnical and Infiltration Evaluation
Tract No. 31304 – Pacific Emerald Project
Northeast Corner of McPherson Road and Mountain Avenue
City of Perris, Riverside County, California

Dear Mr. Arnest:

We are pleased to provide the results of our updated geotechnical and infiltration evaluation for the subject project located along the north side of Mountain Avenue and east side of McPherson Road in the city of Perris, Riverside County, California. This report presents the results of our evaluation and discussion of our findings.

In our opinion, site development appears feasible from a geotechnical viewpoint. Final site development and grading plans should be reviewed by this firm as they become available, as it will be necessary to provide appropriate recommendations for intended specific site development as those plans become refined.

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

Respectfully submitted,
GeoTek, Inc.

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1. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the general geotechnical conditions on the site and provide updated geotechnical recommendations as deemed appropriate. Services for this study included the following:

- Research and review of available geologic and geotechnical data, and general information pertinent to the site,
- Review of the referenced *Rippability Study*, prepared by Robert Prater Associates, Inc (2002) and *Geotechnical Investigation* report, prepared by Sladden Engineering, Inc (2003),
- Perform a reconnaissance of the site,
- Excavation of sixteen exploratory trenches to assess general subsurface soil conditions of the property,
- Site evaluation of rock hardness via a seismic refraction survey, performed by a subconsultant,
- Excavation of one exploratory boring and four borings for infiltration testing within the area of the currently planned catch basin,
- Collection of relatively undisturbed and bulk samples of the onsite materials including samples for corrosion evaluation,
- Laboratory testing of selected soil samples,
- A corrosion study for the property,
- Review and evaluation of site seismicity, and
- Compilation of this updated geotechnical and infiltration evaluation report which presents our findings, conclusions, and recommendations for the site development.

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

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The square-shaped site is located adjacent to the north side of Mountain Avenue and east side of McPherson Road in the city of Perris, Riverside County, California. The site is comprised of four parcels of land identified with Riverside County Assessor's Parcel Numbers (APNs) 342-080-039, -040, -041, and -042 and is approximately 40.4 acres. The general location of the site is shown in Figure 1.

Based on a review of available maps, information provided within the referenced reports, and observations at the time of our recent site reconnaissance, the site consists of vacant land with a light to moderate growth of dry weeds and brush and some dispersed trees and bushes. Numerous granitic boulders (corestones) up to approximately 10 to 15 feet in diameter were also observed scattered across the site. The site also has some visible trash and litter.

The site has a gently sloping terrain, with the highest ground elevation of approximately 1,572 feet above mean sea level (amsl) located in the western edge of the site and lowest ground elevation of 1,495 feet amsl towards the southeastern corner. Surface drainage is to the east-southeast. A drainage course is located within the northeastern portion of the site.

The site is bounded by Mountain Avenue (a paved roadway) and scattered residences to the south; McPherson Road (a dirt roadway) and dispersed residences to the west; David Jones Road (a dirt roadway) with scattered residences to the north; and vacant land with scattered residences to the east.

2.2 PROPOSED DEVELOPMENT

According to the referenced *Conceptual Site Plan,* prepared by KWC Engineers, site development includes the grading and construction of 199 single-family residential lots, a catch basin, a park site, two recreation areas, underground utilities and street improvements. An undeveloped, open space is planned to remain at the northeastern edge of the property. Cuts and fills up to 17 and 12 feet, respectively, are anticipated to be required to reach design grades. Also, slopes to maximum heights of about 25 feet in cut and 10 feet in fill at 2:1 (h:v) maximum gradients as well as retaining walls are expected. Plans for utility construction were not available at the time of this review. However, based on discussions with Victor Elia of

KWC Engineers, the deepest utility proposed will be the sewer line at a depth of approximately 12 feet below existing ground surface.

A stormwater detention/catch basin is also proposed within the southeastern portion of the property. Cuts on the order of 10 feet are expected to be required to reach the proposed basin bottom.

If site development differs from the assumptions made herein, the recommendations included in this report should be subject to further review and evaluation. Final site development plans should be reviewed by GeoTek when they become available. Additional geotechnical field exploration, analyses, and recommendations may be necessary upon review of site development plans.

3. REPORT REVIEW

On December 19, 2002, Robert Prater Associates, Inc., (RPA) issued a report entitled *Rippability Study, Mountain Avenue Subdivision, Perris, California*. The purpose of the study was to evaluate the hardness on-site bedrock and presence of compressible soils at the subject property. The study assumed that the site grading would involve cuts of about 5 feet or less and trenching for utility construction would be about 15 feet deep or less. The study included 16 exploratory borings to maximum depths of about 20 feet below grade. RPA stated that the borings encountered a surficial layer of topsoil atop granitic bedrock. This stratum appears to be mostly comprised of loose silty sand with an average thickness of about 1.5 feet or less. However, in localized areas within the northeastern region of the site, the topsoil was observed to consist of very loose to loose clayey to sandy silt and clayey sand and extended to 7 feet below grade. Beneath the topsoil, decomposed granitic bedrock was encountered and was recovered as medium dense to very dense silty sand. RPA also noted that scattered corestones of mildly decomposed rock were locally encountered within more weathered granitic rock. Practical refusal due to underlying bedrock was experienced in the majority of the site borings at depths between 6 and 18 feet, as reported by RPA.

In addition to the boring exploration, RPA conducted 12 seismic refraction traverses across the property. RPA indicated that the site subsurface materials can generally be divided into three layers. The upper layer consists of loose to medium dense soils with thicknesses ranging between about 1.5 and 12 feet. This layer generally comprises topsoil and highly weathered bedrock, with compressional wave velocities ranging between 1,240 and 2,370 feet per second (fps). The intermediate layer was noted to comprise mildly to moderately decomposed granitic bedrock with velocities ranging from 2,520 to 4,550 fps and extends to depths of about

16 to 33 feet. The third layer was stated to be comprised of slightly decomposed to massive bedrock with velocities greater than 5,900 fps and detected at depths ranging from 5 to 44 feet. RPA mentioned that high velocity materials were encountered at depths of 8 feet in Traverse 4NE, 12 feet in 4SW, 5 feet in 8N, and 6 feet in 11SE.

The study stated that while a Caterpillar D-9 tractor with a single ripper can reportedly excavate bedrock materials with velocities near 7,000 fps, local experience indicates that such high velocities usually require blasting. The study pointed out that a more reasonable rippable velocity would be on the order of 5,500 fps. Velocities on the order of 4,500 to 5,500 fps are considered marginal and involve difficult ripping conditions.

For trench excavation, the study stated that velocities as low as 3,500 fps may indicate difficult ripping depending on the degree of fracturing or weathering of the rock. It also pointed out that most materials with velocities of about 3,800 fps or less are rippable, velocities between 3,800 and 4,300 fps are marginally rippable, and above 4,300 fps are non-rippable based on the use of an excavator Kohring 505 or similar.

The study concluded that cuts up to 5 feet deep for the site grading can be achieved utilizing standard heavy earthmoving equipment. Materials generated by site excavations will likely consist of coarse-grained silty sand with significant amounts of large corestones/boulders. RPA noted that granitic outcrops with individual boulders up to 12 feet in diameter exist across the property. RPA also stated that their seismic refraction data indicates the presence of numerous subsurface corestones/boulders within the intermediate velocity layer beneath the locations of Traverses 2, 4, 5, 7, 8, and 11, with some localized blasting or chipping required to dislodge and remove larger corestones.

RPA also mentioned that some difficult trenching for utility installation should be anticipated below depths of 5 feet in the areas of Traverses 8 and 11 feet and below 10 feet in the areas of Traverses 2, 3, 7, 10 and Boring B-10. Trenching below the said depths may require localized blasting and/or heavy chipping due to hard rock.

On December 1, 2003, Sladden Engineering, Inc. (Sladden) issued a report entitled *Geotechnical Investigation, Tentative Tract 31304, NEC McPherson Road and Mountain Avenue, Perris, California*. The subject investigation included the excavation of 14 exploratory borings to depths ranging from 12 to 50 feet below grade. Sladden stated that the site contained a thin layer of native alluvial materials covering bedrock. The older alluvium reportedly consisted of silty sandy soils and the underlying granitic bedrock was reportedly weathered to varying degrees. While some of the borings experienced early refusal at depths of about 12 to 14 feet, most of the borings were effectively excavated to depths of 10 to 20 feet into the underlying bedrock.

Sladden noted the lack of groundwater under the site. However, Sladden mentioned that groundwater seepage was observed within the underlying bedrock in some borings (B-2, B-6, and B-8) at 15 to 35 feet below grade. Because of the lack of groundwater and the presence of shallow bedrock, the potential for liquefaction was considered negligible.

Sladden recommended that the native soils and underlying bedrock within the proposed foundation zones be removed and recompacted to a depth of at least 3 feet below existing grade or 2 feet below the bottom of footings, whichever is deeper. Removals were recommended to be extended at least five feet beyond the footing lines.

The evaluation by Sladden stated that the presence of shallow bedrock at the property may require the utilization of specialized grading equipment to perform planned cuts. Sladden also mentioned that the on-site materials are "very low" expansive and have negligible sulfate concentrations.

4. FIELD EXPLORATION, LABORATORY TESTING, AND CORROSION TESTING

4.1 FIELD EXPLORATION

GeoTek investigated the project site via exploratory trenches and borings which were performed between April 2, 2020 and April 28, 2020. The trenching exploration consisted of sixteen trenches to depths ranging from 10 to 20 feet and were excavated to log the subsurface materials and examine the rippability and/or hardness of localized areas throughout the site. The boring exploration consisted of drilling one exploratory boring to approximately 20 feet below grade and four borings for infiltration testing to depths of about 10 feet below grade within the currently proposed catch basin area. The trenches were excavated utilizing a Western SK500 excavator, and the borings were drilled with a track-mounted hollow-stem auger drill rig.

Also, a seismic refraction survey was conducted on April 21, 2020 by a subconsultant (Subsurface Surveys & Associates, Inc.). The seismic refraction survey involved the recording and measuring of man-made energy waves from seven seismic refraction lines placed in site areas where deep excavations are proposed. The seismic survey summary report is included in Appendix C.

The approximate locations of our site explorations along with the locations of the exploratory borings and seismic refraction lines performed by RPA (2002) and Sladden (2003) are shown on the Exploration Location Map, Figure 2. Logs of the borings by Robert Prater Associates and Sladden, in addition to the trenches and seismic refraction lines by GeoTek are provided in Appendices A and B, respectively.

4.2 LABORATORY TESTING

Laboratory testing was performed on selected relatively bulk soil and bedrock samples collected during the field exploration. The purpose of the laboratory testing was to confirm the field classification of the subsurface materials encountered and to evaluate the soil/bedrock physical properties for use in the engineering design and analysis. Our test results along with a brief description and relevant information regarding testing procedures are included in Appendix D.

4.3 CORROSION TESTING

GeoTek collected a total of 10 samples across the site from the upper one foot. The samples were taken to the laboratory to be evaluated for their corrosion potential. The locations of the samples obtained for the site are shown on the Exploration Location Map, Figure 2. The results of corrosion tests are presented in Appendix E.

5. INFILTRATION TESTING

As part of our field investigation, four infiltration test borings were drilled to a depth of 10 feet below ground surface and one exploratory boring to 20 feet below grade within the proposed basin area. The exploratory boring was excavated to verify that a minimum of 5 feet of permeable materials exists below the bottom of the future infiltration basin and a minimum of 10 feet between the bottom of the basin and a seasonal high groundwater level.

Groundwater was encountered in all our borings at approximate depths ranging from 2 to 4 feet below existing ground surface. The high groundwater table encountered is most likely a perched water condition between the older alluvium and the granitic bedrock and is likely the result of seasonal heavy rains that had occurred within the previous weeks. Due to the high groundwater situation, we were unable to perform the infiltration testing. A layer of older alluvium approximately 4 to 8 feet in thickness covering weathered bedrock was encountered at the basin location.

6. GEOLOGIC AND SOILS CONDITIONS

6.1 REGIONAL SETTING

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

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

More specific to the subject property, the site is located in an area geologically mapped by others to be underlain by tonalite bedrock (Dibblee, T.W. and Minch, J.A., 2003). The regional geologic maps noted the general trend of foliations in the bedrock had a northwest-southeast orientation and a 30-degree to 70-degree inclination to the northeast.

No active faults are shown in the immediate site vicinity on the maps reviewed for the area. The site is not located within an Earthquake Fault Zone (Alquist-Priolo) as designated by the State of California. The Riverside County website (https://gis.countyofriverside.us/) has designated the site as “not in a fault zone”, “not in a fault line”, “not in a liquefaction area”, and “not in a subsidence area”.

6.2 EARTH MATERIALS

A brief description of the earth materials reported to be on the site by RPA (2002) and Sladden (2003) and encountered in our explorations is presented in the following sections.

6.2.1 Colluvium

Colluvium was encountered in the majority of our exploratory trenches and previous borings by RPA and Sladden. These materials consist of silty sand and extended from the ground surface to depths of about 1 to 3 feet. The colluvium was brown in color, slightly moist to moist, and generally loose to medium dense, based on our field observations.

6.2.2 Older alluvium

Older alluvium was observed in our exploratory borings placed within the southeastern corner of the site (basin area) and in some our exploratory trenches excavated near the eastern site region which is adjacent to a seasonal drainage course. The older alluvium mostly consists of silty sand with some clayey sand and extended from the ground surface to depths of about 1 to 4 feet. In localized areas, such as the areas of trench T-4 and future basin, the alluvial materials extended to 8 feet. The older alluvium was brown in color, dry to moist, and generally medium dense, based on our field observations.

6.2.3 Granitic Bedrock

Granitic bedrock was observed at the property as rock outcrops or encountered in site explorations at typical depths of 1 to 3 feet and in some areas as deep as approximately 8 feet. Also, bedrock materials were found at or near the ground surface in the seismic refraction lines placed at the site by our firm. The regional geologic map shows the bedrock is foliated, generally in a northwest/southeast orientation with inclinations ranging from 35 degrees to 75 degrees to the northeast.

The on-site bedrock consists of tonalite which is moderately to highly weathered within its upper portions and is recovered as gray fine to coarse sand when excavated. The bedrock becomes less weathered with depth. While all the trenches were dug to the planned depths, particularly slow/difficult excavations were noted in Trenches T-7, T-8, and T-11 within the western portion of the site where deeper cuts are proposed. Trenches T-8 and T-11 experienced especially slow excavation starting at 15 and 11 feet, respectively. Trench T-7 encountered a corestone at about 6 feet below grade, and the trench was relocated.

The seismic refraction survey generally identified three zones of subsurface materials. The uppermost zone comprises mostly colluvial and alluvial soils and is estimated to extend up to 5 feet below grade mostly, with exception of Line 4 where soils extend to 10 feet. The middle zone was noted to correspond to highly weathered bedrock to depths ranging from 5 to 23 feet with velocities ranging from 2,685 to 3,251 fps. The bottom zone was noted to comprise less weathered bedrock with velocities ranging from 3,437 to 6,083 fps. Particularly hard un-weathered bedrock was estimated to exist under the area of Line 6 starting at depths of 21 feet. Also, high velocity corestones were estimated to be present beneath Line 3 at 7 feet below grade and beneath Line 7 at depths of 12 to 15 feet.

To estimate the approximate depth to non-rippable bedrock and non-rippable trenching (utility construction) using the seismic refraction data collected at the site, we have utilized cut-off velocities of 5,500 fps and 4,300 fps, respectively. We have also used our field observations during the excavation of the recent site trenches. Based on the above and per the proposed grades shown on the referenced *Conceptual Site Plan* (KWC, 2020) and maximum utility depth of 12 feet, we estimate that much on-site bedrock is rippable with a Caterpillar D-9R Ripper. As stated previously, some areas within the western region of the site, such as Trench T-8 at about 15 feet and T-11 at about 11 feet, may experience very slow excavation and blasting or other excavation techniques could be more cost-effective. Cuts in the vicinity of Traverse 8 by RPA (2002) may also encounter non-rippable bedrock at about 5 feet below grade.

Very difficult trenching may be encountered near the areas of Trench T-7 at about 6 feet, Line 2 at about 8 feet, Line 3 at 7 feet, and Line 7 at 12 feet. RPA (2002) identified additional areas with non-rippable trenching such as near Traverses 8 and 11 at about 5 feet and near Traverses 2, 3, 10, and Boring B-10 at 10 feet.

Results of the seismic refraction survey are provided in Appendix C.

The surficial soils and bedrock materials were tested and found to have a “very low” expansion potential.

Detailed logs of the subsurface conditions of the site are presented in Appendices A and B.

6.3 SURFACE WATER AND GROUNDWATER

6.3.1 Surface Water

Surface water was not noted during our field work. If encountered during earthwork construction, surface water on this site is the result of precipitation or possibly some minor surface run-off from immediately surrounding properties. Overall site area drainage is generally to the east-southeast, as directed by site topography. Provisions for surface drainage will need to be accounted for by the project civil engineer.

6.3.2 Groundwater

Groundwater was not encountered in any of the borings by RPA (2002), majority of borings by Sladden (2003), and recent trenches by GeoTek. Sladden (2003) reported a bedrock groundwater seepage observed in their borings B-2, B-6, and B-8 at 25, 15, and 35 feet below grade, respectively. Our exploratory borings placed within the planned site basin encountered groundwater at 2 to 4 feet below grade. This high groundwater table is most likely a perched water condition between the older alluvium and the granitic bedrock and is probably associated with the heavy rains that had occurred within the previous weeks and close location to an existing drainage course.

California Department of Water Resources, Water Data Library, indicates that the groundwater depth for a well (State Well No. 05S03W04M001S) is approximately 46 feet below ground surface as of 2020. The well is located approximately 2 miles east-southeast of the site. Based on the above, groundwater is not anticipated to be a factor during the majority of the site grading. However, seasonal perched groundwater may be encountered during grading within the lower elevations on the southeast portion of the site.

GeoTek should review grading plans once available to determine if groundwater is anticipated to adversely affect the proposed developments.

6.4 FAULTING AND SEISMICITY

The geologic structure of the entire southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is in a seismically active region. No active or potentially active fault is known to exist at this site nor is the site situated within a State of California designated *"Alquist-Priolo"* Earthquake Fault Zone (Bryant and Hart, 2007; CGS, 1986).

The County of Riverside has designated the site as "not in a fault zone" and "not in a fault line."

6.4.1 Seismic Design Parameters

The site is located at approximately 33.7667 Latitude and -117.2474 Longitude. Site spectral accelerations (S_a and S_1), for 0.2 and 1.0 second periods for a Class "C" site, were 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. Due to the presence of shallow bedrock, a Site Class C is considered appropriate. The results are presented in the following table:

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_S	1.455g
Mapped 1.0 sec Period Spectral Acceleration, S_1	0.534g
Site Coefficient for Site Class "C", F_a	1.2
Site Coefficient for Site Class "C", F_v	1.466
Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, S_{MS}	1.747g
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, S_{M1}	0.783g
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	1.164g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	0.522g
Site Modified Peak Ground Acceleration, PGA_M	0.6g

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.

6.4.2 Surface Fault Rupture

The site is in a seismically active region; however, no active or potentially active fault is known to exist at this site nor is the site situated within an *"Alquist-Priolo"* Earthquake Fault Zone (Bryant and Hart, 2007). No faults are identified on geologic maps readily available and reviewed by this firm for the immediate study area. The nearest known active fault zone is the Elsinore Fault - Glen Ivy Section located approximately 8.5 miles southwest of the site. Therefore, the potential for surface rupture at the site is considered negligible.

6.4.3 Liquefaction and Seismically Induced Settlement

The County of Riverside has designated the site as "not in a liquefaction area", and "not in a subsidence area".

Liquefaction is not considered to be a hazard at the subject site due the presence of shallow bedrock materials. Also, the potential for seismically induced settlement at the property is considered to be nil because of the minimal thickness of soil atop bedrock.

6.4.4 Other Seismic Hazards

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

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

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 GENERAL

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

7.2 EARTHWORK CONSIDERATIONS

7.2.1 General

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the City of Perris, the 2019 California Building Code (CBC), and recommendations contained in this report. The General Grading Guidelines included in Appendix F 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 F.

Final site grading plans should be reviewed by this office when they become available. Additional recommendations will likely be offered subsequent to review of these plans.

7.2.2 Site Clearing

Site preparation should start with removal of any existing improvements, deleterious materials, and vegetation within the planned development areas of the site. These materials should be properly disposed of off-site.

7.2.3 Remedial Grading

All topsoil, older alluvium/colluvium, and highly weathered bedrock should be removed to expose competent bedrock. Competent bedrock is defined as firm, unyielding materials. A representative of this firm should observe and approve the bottom of all excavations.

Based on the data available, removals/over-excavations generally on the order of two feet (and up to eight feet locally) from existing grade or to a minimum of three feet below proposed grades, whichever is greater, should be performed below structural areas. Actual depths of removal/over-excavation should be determined in the field based on observation and in-place density testing. As a minimum, removals/overexcavations should extend down and away from foundation elements at a 1:1 (h:v) projection to the recommended removal depth, or a minimum of five feet laterally, whichever is greater. The bottom of the removals/overexcavations should be graded to drain toward the front of the lot at a gradient of at least two percent.

In order to facilitate footing excavation and installation of house services, consideration should be given to overexcavate cut lots to a minimum depth of five feet below proposed grades. We also recommend that utility alignments be overexcavated to at least one foot below the depth of the lowest underground utility.

To prevent potential differential settlement, the cut portions of transition (i.e. cut/fill) lots should be overexcavated a minimum of five feet below proposed grades or to a depth of one-half of the maximum fill thickness on the lot, whichever is greater. The horizontal extent of over-excavation could comprise the entire lot or extend at least five feet outside the structural area, or a distance equal to the depth of overexcavation below the bottom of the structural elements, whichever is greater. Overexcavation bottoms should be graded to drain toward the front of the lot (two percent minimum).

The approved removal/over-excavation bottom exposed should then be scarified to a depth of about six 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, per ASTM D 1557.

7.2.4 Engineered Fill

The onsite materials are considered suitable for reuse as engineered fill provided they are free from vegetation, roots, and rock/hard lumps greater than six inches in maximum dimension.

The undercut areas should be brought to final subgrade elevations with fill materials that are placed and compacted in general accordance with minimum project standards. Engineered fill should be placed in six- to eight-inch loose lifts, moisture conditioned to the optimum moisture content, and compacted to a minimum relative compaction of 90 percent as determined by ASTM D 1557. Placement of engineered fill should be observed and tested on a full-time basis by a GeoTek representative during grading activities.

If oversized materials (greater than six inches) are generated from cuts into bedrock, the oversized rock should be disposed of offsite or stockpiled on site and crushed for future use.

7.2.5 Excavation Characteristics

Based on the results of the seismic refraction survey (Appendix C) and our trenching exploration, most of on-site bedrock materials is considered rippable with a Caterpillar D9R Ripper to general depths of about 11 to 25 feet. However, some areas within the western region of the site, such as Trench T-8 at about 15 feet and T-11 at 11 feet, may experience very slow excavation and blasting or other excavation techniques could be more cost-effective. Cuts in the vicinity of Traverse 8 by RPA (2002) may also encountered non-rippable bedrock at 5 feet. Scattered, non-rippable corestones such as noted during this investigation and the exploration by RPA (2002) may also exist at shallow depths that could require special excavation techniques or blasting.

The data also suggests that trenching for utility construction may be feasible across much of the site utilizing a large excavator such as Western SK500 or equivalent. However, very difficult trenching conditions may be experienced in the near surface areas of Trench T-7 at 6 feet, Line 2 at 8 feet, Line 3 at 7 feet, and Line 7 at 12 feet due to either existing corestones or hard unweathered bedrock. RPA (2002) identified additional areas with non-rippable trenching such as near Traverses 8 and 11 at about 5 feet and near Traverses 2, 3, 10, and Boring B-10 at 10 feet. Localized blasting, chipping to dislocate and remove the corestones, or other special techniques may be warranted.

Excavation of alluvial deposits and most granitic bedrock to the design elevations is expected to be feasible with heavy-duty grading equipment in good operating condition. All temporary excavations for grading purposes and installation of underground utilities should be constructed in accordance with local and Cal-OSHA guidelines. Temporary excavations within the on-site materials should be stable at 1:1 (h:v) inclinations for cuts less than ten feet in height.

7.2.6 Slope Construction

An engineering geologist should observe all cut slopes. Cut slopes should expose competent bedrock. If adverse structure or incompetent materials are exposed and identified in the cut slopes, stabilization fills may be recommended.

Fill slopes constructed at maximum gradients of 2:1 (h:v), in accordance to industry standards, are anticipated to be both grossly and surficially stable. Where fill is to be placed against sloping terrain with gradients of 5:1 (h:v) or steeper, the sloping ground surface should be benched to remove loose and disturbed surface soil to assure that the new fill is placed in direct contact with competent bedrock and to provide horizontal surfaces for fill placement. A 10- to 15-foot wide keyway should be constructed at the toe of the fill slope areas extending at least 2 to 3 feet vertically into competent natural material.

The base of the keyways and benches should be sloped back into the hillside at a gradient of at least two percent. The base of the benches should be evaluated by a representative of GeoTek prior to processing. Upon approval, the exposed materials should be moistened to at least the optimum moisture content and densified to a relative compaction of at least 90 percent (ASTM D 1557).

Fill slopes should be overfilled during construction and then cut back to expose fully compacted soil. A suitable alternative would be to compact the slopes during construction and then roll the final slope to provide a dense, erosion resistant surface.

7.2.7 Trench Excavations and Backfill

Temporary trench excavations within the on-site materials should be stable at 1:1 (h:v) inclinations for short durations during construction and where cuts do not exceed ten feet in height. We anticipate that temporary cuts to a maximum height of four feet can be excavated vertically.

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

Utility trench backfill should be compacted to at least 90 percent relative compaction (as determined per ASTM D 1557). Under-slab trenches should also be compacted to project specifications. 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 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 thoroughly moisture conditioned prior to placement in trenches.

7.2.8 Shrinkage and Bulking

Several factors will impact earthwork balancing on the site, including shrinkage, subsidence, trench spoil from utilities and footing excavations, as well as the accuracy of topography. Shrinkage is primarily dependent upon the degree of compactive effort achieved during construction. For planning purposes, a shrinkage factor of five to ten percent may be considered for the surficial soils. Bedrock materials may bulk up to ten percent. Site balance areas should be available in order to adjust project grades, depending on actual field conditions at the conclusion of site earthwork construction.

Subsidence is not considered to be a factor with the underlying site materials.

7.3 DESIGN RECOMMENDATIONS

7.3.1 Foundation Design Criteria

Foundation design criteria for a conventional foundation system, in general conformance with the 2019 CBC, are presented herein. These are typical design criteria and are not intended to supersede the design by the structural engineer.

Based on the results of laboratory testing, the on-site materials are classified as having "very low" ($0 \le EI \le 20$) expansion potential per ASTM D 4829. Additional laboratory testing should be performed at the completion of site grading to verify the expansion potential of the near-surface soils.

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

MINIMUM DESIGN REQUIREMENTS FOR CONVENTIONALY REINFORCED SHALLOW FOUNDATIONS	
Design Parameter	"Very Low" Expansion Potential (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- and Two-Story – 12
Minimum Slab Thickness (actual)	4 inches
Sand Blanket and Moisture Retardant Membrane below On-Grade Building Slabs	2 inches of sand** overlying moisture vapor retardant membrane overlying 2 inches of sand**
Minimum Slab Reinforcing	6" x 6" – W1.4/W1.4 welded wire fabric placed in middle of slab
Minimum Footing Reinforcement	Two No. 4 Reinforcing bars, one top and one bottom
Presaturation of Subgrade Soil (Percent of Optimum)	Minimum 100% to a depth of 12 inches

*Code minimums per Table 1809.7 of the 2019 CBC.

** Sand should have a sand equivalent of at least 30

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.

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 value may be increased by 400 psf for each additional 12 inches in depth and by 400 psf for each additional 12 inches in width to a maximum value of 3,000 psf. Additionally, an increase of one-third may be applied when considering short-term live loads (e.g. seismic and wind loads).

Based on the recommended site grading, we estimate a total static settlement of less than 1 inch. A differential static settlement of about ½ inch over a 30-foot span is also estimated. Seismically induced total and differential settlement are considered to be negligible.

The passive earth pressure may be computed as an equivalent fluid having a density of 300 psf per foot of depth, to a maximum earth pressure of 2,500 psf for footings founded on engineered fill. A coefficient of friction between soil and concrete of 0.40 may be used with dead load forces. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

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.

A moisture and vapor retarding system should be placed below slabs-on-grade where moisture migration through the slab is undesirable. Guidelines for these are provided in the 2019 California Green Building Standards Code (CALGreen) Section 4.505.2, the 2019 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.

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

Ultimately, the vapor retarding system should be comprised of suitable elements to limit migration of water and reduce transmission of water vapor through the slab to acceptable levels. The selected elements should have suitable properties (i.e. thickness, composition, strength, and permeance) to achieve the desired performance level. Consideration should be given to consulting with an individual possessing specific expertise in this area for additional evaluation.

We recommend 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.

7.3.2 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.

7.3.3 Foundation Set Backs

Where applicable, the following setbacks should apply to all foundations. Any improvements not conforming to these setbacks may be subject to lateral movements and/or differential settlements:

- The outside bottom edge of all footings should be set back a minimum of H/3 (where H is the slope height) from the face of any descending slope. The setback should be at least 5 feet and need not exceed 40 feet.
- The outside bottom edge of all footings should be set back a minimum of H/2 (where H is the slope height) from the face of any ascending slope. The setback should be at least 5 feet and need not to exceed 15 feet. Where a retaining wall is constructed at the toe of the slope, the height of the slope should be measured from top of the wall to the top of the slope.
- The bottom of all footings for structures near retaining walls should be deepened so as to extend below a 1:1 (h:v) projection upward from the bottom inside edge of the wall footing.
- The bottom of any proposed foundations for structures should be deepened so as to extend below a 1:1 (h:v) projection upward from the bottom of the nearest excavation.

7.4 RETAINING WALL DESIGN AND CONSTRUCTION

7.4.1 General Design Criteria

Recommendations presented herein may apply to typical masonry or concrete vertical walls retaining up to six feet of soil. Additional review and recommendations should be requested for higher walls.

Retaining wall foundations embedded a minimum of 12 inches below the lowest adjacent grade and should rest on either 24 inches of compacted fill placed on competent bedrock or on competent bedrock. Wall footings should be designed using an allowable bearing capacity of 2,000 psf. An increase of one-third may be applied when considering short-term live loads (e.g. seismic and wind loads). The passive earth pressure may be computed as an equivalent fluid having a density of 300 psf per foot of depth, to a maximum earth pressure of 2,500 psf. A coefficient of friction between soil and concrete of 0.40 may be used with dead load forces. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

An equivalent fluid pressure approach may be used to compute the horizontal active pressure against the wall. The appropriate fluid unit weights are given in the table below for specific slope gradients of retained materials.

ACTIVE EARTH PRESSURES	
Surface Slope of Retained Materials (H:V)	Equivalent Fluid Pressure (PCF) Native Materials*
Level	37
2:1	53

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

The above equivalent fluid weights do not include superimposed loading conditions such as expansive soils, vehicular traffic, structures, seismic conditions or adverse geologic conditions.

7.4.2 Restrained Retaining Walls

Any retaining wall that will be restrained prior to placing backfill or walls that have male or reentrant corners should be designed for at-rest soil conditions using an equivalent fluid pressure of 57 pcf, plus any applicable surcharge loading. For areas having male or reentrant corners, the restrained wall design should extend a minimum distance equal to twice the height of the wall laterally from the corner, or as otherwise determined by the structural engineer.

7.4.3 Wall Backfill and Drainage

Retaining wall backfill should be free of deleterious and/or oversized materials and should have and expansion index of less than 20. Retaining walls should be provided with an adequate pipe and gravel back drain system to help prevent buildup of hydrostatic pressures. Backdrains should consist of a four-inch diameter perforated collector pipe (Schedule 40, SDR 35, or approved equivalent) embedded in a minimum of one-cubic foot per linear foot of ¾- to 1-inch clean crushed rock or an approved equivalent, wrapped in filter fabric (Mirafi 140N or an approved equivalent). The drain system should be connected to a suitable outlet. Waterproofing of site walls should be performed where moisture migration through the wall is undesirable.

Retaining wall backfill should be placed in lifts no greater than eight inches in thickness and compacted to a minimum of 90 percent relative compaction in accordance with ASTM Test Method D 1557. The wall backfill should also include a minimum one-foot wide section of ¾- to 1-inch clean crushed rock (or an approved equivalent). The rock should be placed immediately adjacent to the back of the wall and extend up from a back drain to within approximately 24 inches of the finish grade. The rock should be separated from the earth with filter fabric. The upper 24 inches should consist of compacted on-site soil.

As an alternative to the drain rock and fabric, Miradrain 2000, or approved equivalent, may be used behind the retaining wall. The Miradrain 2000 should extend from the base of the wall to within two feet of the ground surface. The subdrain should be placed at the base of the wall in direct contact with the Miradrain 2000.

The presence of other materials might necessitate revision to the parameters provided and modification of the wall designs. Proper surface drainage needs to be provided and maintained. Walls from two to four feet in height may be drained using localized gravel packs behind weep holes at eight feet maximum spacing (e.g. approximately 1.5 cubic feet of gravel in a woven plastic bag). 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.

7.4.3.1 Other Design Considerations

- 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 garden walls at horizontal distances not exceeding 20 feet.

7.4.4 Pavement Design Considerations

Pavement design for proposed on-site and off-site street improvements was conducted per Caltrans *Highway Design Manual* guidelines for flexible pavements. Based on traffic indices (TIs) of 5.0 to 7.0 generally associated with these types of projects and using an assumed design R-value of 50, the following preliminary sections were calculated:

PRELIMINARY PAVEMENT SECTIONS			
TI	R-Value	Thickness of Asphalt Concrete (inches)	Thickness of Aggregate Base (inches)
5.0	50	3	4
6.0		3	5
7.0		4	5

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

The recommended pavement sections provided are intended as a minimum guideline and final selection of pavement cross section parameters should be made by the project civil engineer, based upon the local laws and ordinates, expected subgrade and pavement response, and desired level of conservatism. If thinner or highly variable pavement sections are constructed, increased maintenance and repair could be expected. Final pavement design should be checked by testing of soils exposed at subgrade (the upper 12 inches) after final grading has been completed.

Asphalt concrete and aggregate base should conform to current Caltrans Standard Specifications Section 39 and 26-1.02, respectively. As an alternative, asphalt concrete can conform to Section 203-6 of the current Standard Specifications for Public Work (Green

Book). Crushed aggregate base or crushed miscellaneous base can conform to Section 200-2.2 and 200-2.4 of the Green Book, respectively. Pavement base should be compacted to at least 95 percent of the ASTM D1557 laboratory maximum dry density (modified proctor).

All pavement installation, including preparation and compaction of subgrade, compaction of base material, placement and rolling of asphaltic concrete, should be done in accordance with the City of Perris specifications, and under the observation and testing of GeoTek and a City Inspector where required. Jurisdictional minimum compaction requirements in excess of the aforementioned minimums may govern.

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

7.4.5 Soil Corrosivity

A corrosion report was prepared for the site by our sub-consultant HDR based on various samples recently obtained across the site. The site corrosion report is included in Appendix E. In general, the report concluded that the on-site materials are "severely corrosive" to ferrous metals and "aggressive" to copper.

7.4.6 Soil Sulfate Content

The corrosion evaluation performed by HDR, Inc. states that the site soils have negligible sulfate concentrations. Based upon the test results, no special concrete mix design is required by Code for sulfate attack resistance. Additional recommendations for mitigation of soil corrosion are provided in Appendix E.

7.4.7 Import Soils

Import soils should have expansion characteristics similar to the on-site soils. GeoTek also recommends that the proposed import soils be tested for expansion and sulfate potential. GeoTek should be notified a minimum of 72 hours prior to importing so that appropriate sampling and laboratory testing can be performed.

7.4.8 Concrete Flatwork

7.4.8.1 Exterior Concrete Slabs, Sidewalks, and Driveways

Exterior concrete slabs, sidewalks and driveways should be designed using a four-inch minimum thickness. No specific reinforcement is required from a geotechnical perspective. However, some shrinkage and cracking of the concrete should be anticipated as a result of typical mix designs and curing practices commonly utilized in industrial construction.

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

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

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

7.4.8.2 Concrete Performance

Concrete cracks should be expected. These cracks can vary from sizes that are essentially unnoticeable to more than 0.125-inch in width. Most cracks in concrete, while unsightly, do not significantly impact long-term performance. While it is possible to take measures (proper concrete mix, placement, curing, control joints, etc.) to reduce the extent and size of cracks that occur, some cracking will occur despite the best efforts to minimize it. Concrete can also undergo chemical processes that are dependent upon 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 suggests that control joints be placed in two orthogonal directions and located a distance apart approximately equal to 24 to 36 times the slab thickness.

7.5 POST CONSTRUCTION CONSIDERATIONS

7.5.1 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. Care should be taken when adding soil amendments to avoid excessive watering. Leaching as a method of soil preparation prior to planting is not recommended. An abatement program to control ground-burrowing rodents should be implemented and maintained. This is critical as burrowing rodents can decreased the long-term performance of slopes.

It is common for planting to be placed adjacent to structures in planter or lawn areas. This will result in the introduction of water into the ground adjacent to the foundations. This type of landscaping should be avoided. Due to the presence of high expansive soils, irrigation should be minimized adjacent to the buildings. Planters within 30 feet of the buildings should be above ground and underlain by a concrete slab. Waterproofing of the foundation and/or subdrains may be warranted and advisable. We could discuss these issues, if desired, when plans are made available.

7.5.2 Drainage

The need to maintain proper surface drainage and subsurface systems cannot be overly emphasized. Positive site drainage should be maintained at all times, as directed by the project civil engineer. 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.

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

7.6 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

We recommend that site grading, specifications, retaining wall/shoring plans and foundation plans be reviewed by this office prior to construction to check for conformance with the recommendations of this report. Additional recommendations may be necessary based on these reviews. We also recommend that GeoTek representatives be present during site grading and foundation construction to check for proper implementation of the geotechnical recommendations. The owner/developer should have GeoTek's representative 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 when necessary.
- Observe the fill for uniformity during placement including utility trenches.
- Test the fill for field density and relative compaction.
- Test the near-surface soils to verify proper moisture content.
- Observe and probe foundation excavations to confirm suitability of bearing materials.

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

8. LIMITATIONS

This evaluation does not and should in no way be construed to encompass any areas beyond the specific area of proposed construction as indicated to us by the client. Further, no evaluation of any existing site improvements is included. The scope is based on our understanding of the project and the client's needs, our proposal (Proposal No. P-0302620-

CR) dated April 7, 2020 and geotechnical engineering standards normally used on similar projects in this region.

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

Since our recommendations are based on the site conditions observed and encountered, and laboratory testing, our 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 is expressed or implied. Standards of practice are subject to change with time.

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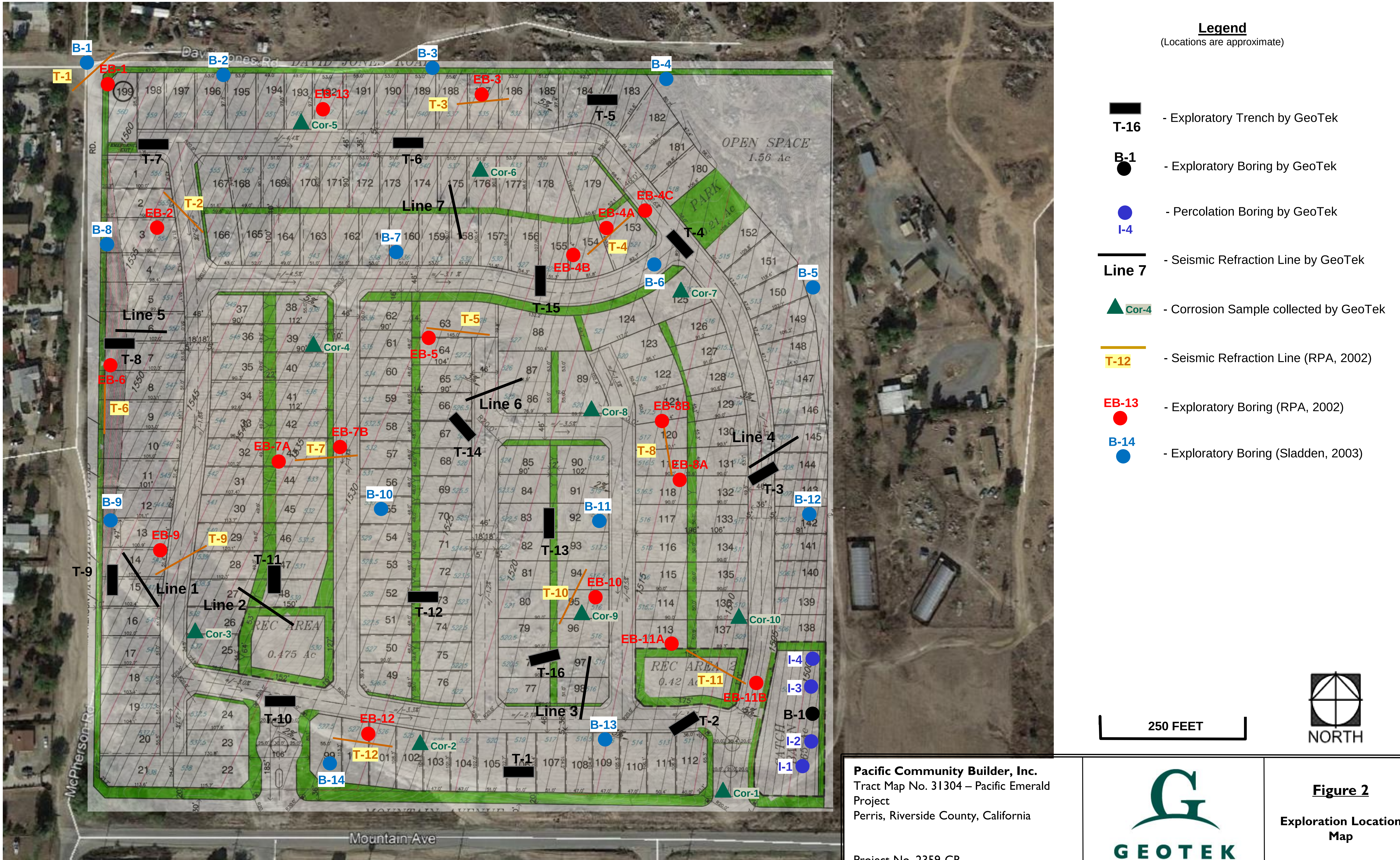
Pacific Communities Builder, Inc. Proposed Residential Development Tract No. 31304 Perris, Riverside County, California GeoTek Project No. 2359-CR	NORTH	**Figure 1** **Site Location Map**	GEOTEK



Pacific Community Builder, Inc.
Tract Map No. 31304 – Pacific Emerald Project
Perris, Riverside County, California

Project No. 2359-CR

GEOTEK

Figure 2

Exploration Location Map

APPENDIX A

LOGS OF EXPLORATORY BORINGS BY ROBERT PRATER ASSOCIATES (2002) AND SLADDEN (2003)

Updated Geotechnical and Infiltration Evaluation

Tract No. 31304, Perris, Riverside County, California

Project No. 2359-CR

GEOTEK

DRILL RIG Continuous Flight Auger	SURFACE ELEVATION 1557' (approx.)	LOGGED BY CW
DEPTH TO GROUNDWATER None	BORING DIAMETER 6 Inches	DATE DRILLED 12/13/2002

DESCRIPTION AND CLASSIFICATION					DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
DESCRIPTION AND REMARKS	SYM-BOL	COLOR	CONSIST.	SOIL TYPE						
SILTY SAND (decomposed granitic rock)		olive and grayish brown	medium dense	SM						
					1					
			dense		2	X				
					3					
			very dense		4					
					5					
					6					
					7					
		olive			8	X				
					9					
					10					
					11					
					12					
					13					
					14					
					15	X				
					16					
					17					
					18					
					19					
Bottom of Boring @ 20 feet Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.					20					

ROBERT PRATER ASSOCIATES
Consulting Geotechnical Engineers & Geologists

EXPLORATORY BORING LOG

MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO.
442-4	December 2002	1

DRILL RIG Continuous Flight Auger	SURFACE ELEVATION 1554' (approx.)	LOGGED BY CW	
DEPTH TO GROUNDWATER None	BORING DIAMETER 6 Inches	DATE DRILLED 12/13/2002	

DESCRIPTION AND CLASSIFICATION										
DESCRIPTION AND REMARKS	SYMBOL	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
SILTY SAND (topsoil)		yellowish brown	loose	SM						
					1	X				
SILTY SAND (decomposed granitic rock)		light yellowish brown	medium dense	SM	2					
					3					
			dense		4					
					5	X				
					6					
			very dense		7					
Core-stone(s) from 8' to 10'					8	X				
					9					
					10					
					11					
					12					
Core-stone(s) from 13' to 15'					13					
					14	X				
					15					
					16					
					17					
					18					
					19					
Bottom of Boring @ 20 feet Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.					20					

ROBERT PRATER ASSOCIATES
Consulting Geotechnical Engineers & Geologists

EXPLORATORY BORING LOG

MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO. 2
442-4	December 2002	

DRILL RIG	Continuous Flight Auger	SURFACE ELEVATION	1530' (approx.)	LOGGED BY	CW
DEPTH TO GROUNDWATER	None	BORING DIAMETER	6 Inches	DATE DRILLED	12/13/2002

DESCRIPTION AND REMARKS	SYMBOL	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
CLAYEY-SANDY SILT and CLAYEY SAND (topsoil)		olive brown	loose	ML/SC	1	S				
CLAYEY SAND (decomposed granitic rock)		olive brown	dense	SC	2					
					3					
					4					
			very dense		5	X				
					6					
					7					
SILTY SAND (decomposed granitic rock)		olive	very dense	SM	8					
					9					
					10	X				
Core-stone at 11'					11					
Bottom of Boring @ 12 feet Met refusal on granitic rock					12					
Bottom of Boring @ 20 feet Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.										

ROBERT PRATER ASSOCIATES
Consulting Geotechnical Engineers & Geologists

EXPLORATORY BORING LOG

MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO.
442-4	December 2002	3

DRILL RIG Continuous Flight Auger	SURFACE ELEVATION 1515' (approx.)	LOGGED BY CW
DEPTH TO GROUNDWATER None	BORING DIAMETER 8 Inches	DATE DRILLED 12/13/2002

DESCRIPTION AND CLASSIFICATION					DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT(%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
DESCRIPTION AND REMARKS	SYM-BOL	COLOR	CONSIST.	SOIL TYPE						
CLAYEY-SANDY SILT (topsoil)		olive brown to brown	very loose	ML	0–7					
					2–3.5	sample	2			
					5–6.5	sample	4			
			loose		6					
CLAYEY-SILTY SAND (decomposed granitic rock)		dark brown	medium dense	SC-SM	7–8.5					
SILTY SAND (decomposed granitic rock)		dark olive brown	very dense	SM	8.5–17					
					9	sample	50/5"			
		olive			14					
					15	X				
Bottom of Boring @ 17 feet Met refusal on granitic rock					17					

Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.

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EXPLORATORY BORING LOG

MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO.
442-4	December 2002	4A

DRILL RIG Continuous Flight Auger	SURFACE ELEVATION 1516' (approx.)	LOGGED BY CW	
DEPTH TO GROUNDWATER None	BORING DIAMETER 6 Inches	DATE DRILLED 12/13/2002	

DESCRIPTION AND CLASSIFICATION					DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT(%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
DESCRIPTION AND REMARKS	SYMBOL	COLOR	CONSIST.	SOIL TYPE						
SILTY SAND (topsoil)		light yellowish brown	loose	SM	1	X				
SILTY SAND (decomposed granitic rock)		olive brown	medium dense	SM	2					
					3					
			dense		4	X				
					5					
					6					
					7					
			very dense		8					
					9					
					10					
					11	X				
Core-stone(s) at 12' to 13-1/2'					12					
					13					
					14					
Core-stone(s) at 15' to 16-1/2'					15					
					16					
Bottom of Boring @ 17 feet Met refusal on granitic rock					17					

Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual

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EXPLORATORY BORING LOG

MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO.
442-4	December 2002	4B

DRILL RIG Continuous Flight Auger	SURFACE ELEVATION 1514' (approx.)	LOGGED BY CW
DEPTH TO GROUNDWATER None	BORING DIAMETER 6 Inches	DATE DRILLED 12/13/2002

DESCRIPTION AND REMARKS	SYMBOL	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
CLAYEY-SANDY SILT and CLAYEY SAND (topsoil)		olive brown	loose	ML/SC	1					
					2					
					3	X	-			
					4					
					5					
					6					
					7					
SILTY SAND (decomposed granitic rock)		olive brown	medium dense	SM						
					8	X				
					9					
					10					
			dense		11					
		dark olive	very dense		12					
					13					
					14	X				
Core-stone at 15'					15					
Bottom of Boring @16 feet Met refusal on granitic rock					16					

Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual

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EXPLORATORY BORING LOG

MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO.
442-4	December 2002	4C

DRILL RIG: Continuous Flight Auger	SURFACE ELEVATION: 1526' (approx.)	LOGGED BY: CW
DEPTH TO GROUNDWATER: None	BORING DIAMETER: 6 Inches	DATE DRILLED: 12/13/2002

DESCRIPTION AND REMARKS	SYMBOL	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT(%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
SILTY SAND (topsoil)		brown	loose	SM						
SILTY SAND (decomposed granitic rock)		light olive brown	medium dense	SM	1					
					2	X				
					3					
			dense		4					
		olive			5					
			very dense		6	X				
					7					
					8					
					9					
					10					
					11					
					12					
					13	X				
					14					
Bottom of Boring @ 15 feet Met refusal on granitic rock					15					

Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.

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EXPLORATORY BORING LOG

MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO.
442-4	December 2002	5

DRILL RIG Continuous Flight Auger	SURFACE ELEVATION 1560' (approx.)	LOGGED BY CW
DEPTH TO GROUNDWATER None	BORING DIAMETER 6 Inches	DATE DRILLED 12/13/2002

DESCRIPTION AND CLASSIFICATION					DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT(%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
DESCRIPTION AND REMARKS	SYM-BOL	COLOR	CONSIST.	SOIL TYPE						
SILTY SAND (decomposed granitic rock)		light yellowish brown	medium dense	SM	0–5	S				
			dense		3					
			very dense		6					
					10	X				
		light olive brown			11					
					15	X				
					19.5	X				
Bottom of Boring @ 20 feet Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.					20					

ROBERT PRATER ASSOCIATES Consulting Geotechnical Engineers & Geologists	EXPLORATORY BORING LOG MOUNTAIN AVENUE SUBDIVISION Perris, California		
	PROJECT NO. 442-4	DATE December 2002	BORING NO. 6

DRILL RIG Continuous Flight Auger	SURFACE ELEVATION 1537' (approx.)	LOGGED BY CW
DEPTH TO GROUNDWATER None	BORING DIAMETER 6 Inches	DATE DRILLED 12/13/2002

DESCRIPTION AND CLASSIFICATION					DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT(%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
DESCRIPTION AND REMARKS	SYM-BOL	COLOR	CONSIST.	SOIL TYPE						
SILTY SAND (topsoil)		brown	loose	SM						
					1	X				
SILTY SAND (decomposed granitic rock)		light yellowish brown	medium dense	SM	2					
					3					
			dense							
					4					
			very dense		5	X				
					6					
		light olive brown			7					
					8					
					9	X				
Core-stone at 10'					10					
					11					
Bottom of Boring @ 11 feet Met refusal on granitic rock										

Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.

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EXPLORATORY BORING LOG

MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO.
442-4	December 2002	7A

DRILL RIG: Continuous Flight Auger	SURFACE ELEVATION: 1536' (approx.)	LOGGED BY: CW
DEPTH TO GROUNDWATER: None	BORING DIAMETER: 6 Inches	DATE DRILLED: 12/13/2002

DESCRIPTION AND REMARKS	SYMBOL	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
SILTY SAND (topsoil)		brown	loose	SM	1					
SILTY SAND (decomposed granitic rock)		light yellowish brown	medium dense	SM	2					
			dense		3–4					
			very dense		5–7					
		light olive brown			8–14					
Core-stone at 15'					15	x				
Bottom of Boring @ 16 feet Met refusal on granitic rock					16					

Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.

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EXPLORATORY BORING LOG

MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO.
442-4	December 2002	7B

DRILL RIG Continuous Flight Auger	SURFACE ELEVATION 1513' (approx.)	LOGGED BY CW
DEPTH TO GROUNDWATER None	BORING DIAMETER 6 Inches	DATE DRILLED 12/13/2002

DESCRIPTION AND CLASSIFICATION

DESCRIPTION AND REMARKS	SYM-BOL	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
SILTY SAND (topsoil)		light brown	loose	SM						
SILTY SAND (decomposed granitic rock)		light yellowish brown	medium dense	SM	1					
					2					
					3	X				
			dense		4					
			very dense		5					
					6	X				
Bottom of Boring @ 7 feet Met refusal on granitic rock					7					

Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.

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EXPLORATORY BORING LOG

MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO. 8A
442-4	December 2002	

DRILL RIG Continuous Flight Auger	SURFACE ELEVATION 1514' (approx.)	LOGGED BY CW	
DEPTH TO GROUNDWATER None	BORING DIAMETER 6 Inches	DATE DRILLED 12/13/2002	

DESCRIPTION AND REMARKS	SYMBOL	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
SILTY SAND (topsoil)		light brown	loose	SM						
SILTY SAND (decomposed granitic rock)		light yellowish brown	medium dense	SM	1					
					2					
					3					
			dense		4					
			very dense		5					
					6					
					7					
					8					
					9					
					10	X				
					11					
					12					
					13					
					14					
					15					
					16					
					17	X				
Bottom of Boring @ 18 feet Met refusal on granitic rock					18					

Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.

EXPLORATORY BORING LOG

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MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO.
442-4	December 2002	8B

DRILL RIG	Continuous Flight Auger	SURFACE ELEVATION	1548' (approx.)	LOGGED BY	CW
DEPTH TO GROUNDWATER	None	BORING DIAMETER	6 Inches	DATE DRILLED	12/13/2002

DESCRIPTION AND REMARKS	SYMBOL	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT(%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
SILTY SAND (topsoil)		light yellowish brown	loose	SM	1					
SILTY SAND (decomposed granitic rock)		light yellowish brown	medium dense	SM	2					
					3					
					4					
		light olive brown	dense		5	X				
					6					
		olive gray	very dense		7					
					8					
					9					
					10					
					11					
		olive			12					
					13					
					14					
					15	X				
					16					
					17					
					18					
					19					
Bottom of Boring @ 20 feet Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.					20					

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EXPLORATORY BORING LOG

MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO.
442-4	December 2002	9

DRILL RIG Continuous Flight Auger	SURFACE ELEVATION 1514' (approx.)	LOGGED BY CW
DEPTH TO GROUNDWATER None	BORING DIAMETER 6 Inches	DATE DRILLED 12/13/2002

DESCRIPTION AND REMARKS	SYMBOL	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
SILTY SAND (topsoil)			loose	SM	1					
SILTY SAND (decomposed granitic rock)		light olive brown	medium dense	SM	2	X				
					3					
			dense		4					
		olive	very dense		5					
					6					
					7					
					8					
					9	X				
					10					
					11					
Small core-stones from 12' to 13'					12					
					13					
					14					
					15	X				
Bottom of Boring @ 16 feet Met refusal on granitic rock					16					

Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.

EXPLORATORY BORING LOG

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MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO.
442-4	December 2002	10

DRILL RIG Continuous Flight Auger	SURFACE ELEVATION 1507' (approx.)	LOGGED BY CW
DEPTH TO GROUNDWATER None	BORING DIAMETER 6 Inches	DATE DRILLED 12/13/2002

DESCRIPTION AND REMARKS	SYMBOL	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
CLAYEY-SILTY SAND (topsoil)		light brown	loose	SC-SM		X				
SILTY SAND (decomposed granitic rock)		light olive brown	medium dense	SM	1					
					2					
			dense		3					
			very dense		4					
					5	X				
Bottom of Boring @ 6 feet Met refusal on granitic rock					6					

Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.

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EXPLORATORY BORING LOG

MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO.
442-4	December 2002	11A

DRILL RIG Continuous Flight Auger	SURFACE ELEVATION 1506' (approx.)	LOGGED BY CW
DEPTH TO GROUNDWATER None	BORING DIAMETER 6 Inches	DATE DRILLED 12/13/2002

DESCRIPTION AND CLASSIFICATION

DESCRIPTION AND REMARKS	SYMBOL	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
CLAYEY-SILTY SAND (topsoil)		light brown	loose	SC-SM						
					1					
SILTY SAND (decomposed granitic rock)		light olive brown	medium dense	SM						
					2					
			dense		3					
			very dense		4					
					5					
					6					
					7					
		olive			8					
					9					
					10					
					11					
		dark olive			12					
					13					
					14					
					15	X				
					16					
					17					
					18					
Very moist below 19'					19					
Bottom of Boring @ 20 feet Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual						X				
					20					

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EXPLORATORY BORING LOG

MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO.
442-4	December 2002	11B

DRILL RIG Continuous Flight Auger	SURFACE ELEVATION 1525' (approx.)	LOGGED BY CW
DEPTH TO GROUNDWATER None	BORING DIAMETER 6 Inches	DATE DRILLED 12/13/2002

DESCRIPTION AND CLASSIFICATION										
DESCRIPTION AND REMARKS	SYM-BOL	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT (%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
SILTY SAND (topsoil)		light olive brown	loose	SM						
SILTY SAND (decomposed granitic rock)		olive brown	medium dense	SM	1					
					2					
			dense		3					
					4					
			very dense		5	X				
					6					
					7					
					8					
					9					
					10					
					11					
					12					
					13					
					14					
					15					
					16					
					17					
					18					
					19					
Bottom of Boring @ 20 feet Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.					20					

ROBERT PRATER ASSOCIATES Consulting Geotechnical Engineers & Geologists	EXPLORATORY BORING LOG MOUNTAIN AVENUE SUBDIVISION Perris, California

PROJECT NO.	DATE	BORING NO. 12
442-4	December 2002	

DRILL RIG	Continuous Flight Auger	SURFACE ELEVATION	1544' (approx.)	LOGGED BY	CW
DEPTH TO GROUNDWATER	None	BORING DIAMETER	6 Inches	DATE DRILLED	12/13/2002

DESCRIPTION AND CLASSIFICATION

DESCRIPTION AND REMARKS	SYMBOL	COLOR	CONSIST.	SOIL TYPE	DEPTH (FEET)	SAMPLER	PENETRATION RESISTANCE (BLOWS/FT.)	WATER CONTENT(%)	SHEAR STRENGTH BY TORVANE (KSF)	DRY UNIT WEIGHT (PCF)
SILTY SAND (decomposed granitic rock)		light olive brown	dense	SM						
					1					
			very dense		2	X				
		light gray			3					
					4					
					5	X				
					6					
					7					
					8					
Core-stone @ 9'					9					
					10					
Bottom of Boring @ 10 feet Met refusal on grantic rock										

Note: The stratification lines represent the approximate boundary between material types and the transition may be gradual.

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EXPLORATORY BORING LOG

MOUNTAIN AVENUE SUBDIVISION
Perris, California

PROJECT NO.	DATE	BORING NO.
442-4	December 2002	13

TABLE A-1 (cont.)

SEISMIC TRAVERSE RESULTS

Traverse	Seismic Velocity (feet per second)	Depth Interpretation (feet)
T-11NW	1,600	0 - 2
	2,810	2 - 17
	12,200	>17
T-11SE	1,520	0 - 6
	6,050	6 - 29½
	14,500	>29½
T-12E	1,470	0 - 2
	3,760	2 - 31½
	14,500	>31½
T-12W	1,570	0 - 3
	3,510	3 - 30
	16,350	>30

Notes:

1) Traverses denoted by line number corresponding to designation on Figure 1. Seismic measurements for each traverse were run in opposite directions. The letters following each traverse number indicates the general compass heading of the run.

2) The results presented for each traverse direction are indicative of the conditions near the beginning of the run (i.e. T-1NE results are indicative of the conditions at the southwest end of the traverse).

TABLE A-1 (cont.)

SEISMIC TRAVERSE RESULTS

Traverse	Seismic Velocity (feet per second)	Depth Interpretation (feet)
T-6N	1,570	0 - 4½
	3,580	4½ - 31½
	7,800	>31½
T-6S	1,780	0 - 3½
	3,470	3½ - 33
	7,800	>33
T-7E	1,980	0 - 2
	3,210	2 - 30½
	14,000	>30½
T-7W	2,300	0 - 4½
	3,460	4½ - 28
	13,000	>28
T-8N	1,460	0 - 5
	5,910	5 - 26½
	14,400	>26½
T-8S	1,960	0 - 3
	2,960	3 - 22½
	20,000	>22½
T-9E	2,060	0 - 2
	3,150	2 - 16
	4,550	>16
T-9W	2,050	0 - 1½
	2,660	1½ - 16
	5,120	>16
T-10N	2,060	0 - 2½
	4,040	2½ - 26½
	20,000	>26½
T-10S	1,280	0 - 3½
	4,300	3½ - 18
	14,300	>18

TABLE A-1 (cont.)

SEISMIC TRAVERSE RESULTS

Traverse	Seismic Velocity (feet per second)	Depth Interpretation (feet)
T-6N	1,570	0 - 4½
	3,580	4½ - 31½
	7,800	>31½
T-6S	1,780	0 - 3½
	3,470	3½ - 33
	7,800	>33
T-7E	1,980	0 - 2
	3,210	2 - 30½
	14,000	>30½
T-7W	2,300	0 - 4½
	3,460	4½ - 28
	13,000	>28
T-8N	1,460	0 - 5
	5,910	5 - 26½
	14,400	>26½
T-8S	1,960	0 - 3
	2,960	3 - 22½
	20,000	>22½
T-9E	2,060	0 - 2
	3,150	2 - 16
	4,550	>16
T-9W	2,050	0 - 1½
	2,660	1½ - 16
	5,120	>16
T-10N	2,060	0 - 2½
	4,040	2½ - 26½
	20,000	>26½
T-10S	1,280	0 - 3½
	4,300	3½ - 18
	14,300	>18

Riverside Land Development
Mountain Ave., Perris

Date: 10/16/03 | **Boring No. 1** | **Job Number:** 644-3209

Depth, ft	Symbol	Core	Blows/6"	Description	Soil type	Unit Wt, pcf	Moisture, %	% Minus #200	Remarks
0			---	Silty Sand with D.G.: Brown	SM	--	---	---	Native Soils
5			50-2"	Silty Sand with D.G.: Brown	SM		3.1		
10			50-6"	D.G.: Grey	SM		1.5		
				Refusal @ 14'					
15									Total Depth = 14' No Bedrock No Groundwater
20									
25									
30									
35									
40									
45									
50									

Recovered Sample

Unrecovered Sample

Standard Penetration Sample

Note: The stratification lines represent the approximate boundaries between the soil types; the transition may be gradual.

Riverside Land Development
Mountain Ave., Perris

Date: 10/16/03 | Boring No. 2 | Job Number: 644-3209

Depth, ft	Symbol	Core	Blows/6"	Description	Soil type	Unit Wt, pcf	Moisture, %	% Minus #200	Remarks
0			---	Silty Sand with Decomposed Granite: Grey	SM	---	---	---	Native Soils
5			---	Silty Sand with Decomposed Granite: Grey	SM	---	---	---	
10									
15									
20									
25			---	Groundwater @ 25' - Seeping Layer	---				
30			---	Less Decomposed Granite @ 32'	---				
35									
40									Note: The stratification lines represent the approximate boundaries between the soil types; the transition may be gradual.
45									Total Depth = 50.5' No Bedrock
50									

Riverside Land Development
Mountain Ave., Perris

Date: 10/16/03

Boring No. 3

Job Number: 644-3209

Depth, ft	Symbol	Core	Blows/6"	Description	Soil type	Unit Wt, pcf	Moisture, %	% Minus #200	Remarks
0			---	Silty Sand: Light Brown	SM				Native Soils
			---	Decomposed Granite: Grey	SM				
5									
10									
15									
20									Total Depth = 20' No Groundwater
25									
30									
35									
40									
45									
50									

Recovered Sample

Unrecovered Sample

Standard Penetration Sample

Note: The stratification lines represent the approximate boundaries between the soil types; the transition may be gradual.

Riverside Land Development
Mountain Ave., Perris

Date: 10/16/03

Boring No. 4

Job Number: 644-3209

Depth, ft	Symbol	Core	Blows/6"	Description	Soil type	Unit Wt, pcf	Moisture, %	% Minus #200	Remarks
0			---	Silty Sand: Light Brown	SM				Native Soils
			---	Decomposed Granite: Grey	---				
20									Total Depth = 20' No Groundwater

Recovered Sample

Unrecovered Sample

Standard Penetration Sample

Note: The stratification lines represent the approximate boundaries between the soil types; the transition may be gradual.

Riverside Land Development
Mountain Ave., Perris

Date: 10/16/03 **Boring No. 5** **Job Number:** 644-3209

Depth, ft	Symbol	Core	Blows/6"	Description	Soil type	Unit Wt, pcf	Moisture, %	% Minus #200	Remarks
0			--	Silty Sand: Reddish Brown	SM				Native Soils Alluvium
5									
10				Refusal @ 13'					
15									Total Depth = 13' No Groundwater
20									
25									
30									
35									
40									
45									
50									

Recovered Sample

Unrecovered Sample

Standard Penetration Sample

Note: The stratification lines represent the approximate boundaries between the soil types; the transition may be gradual.

Riverside Land Development
Mountain Ave., Perris

Date: 10/16/03 **Boring No. 6** **Job Number:** 644-3209

Depth, ft	Symbol	Core	Blows/6"	Description	Soil type	Unit Wt, pcf	Moisture, %	% Minus #200	Remarks
0			--	Decomposed Granite: Grey	--				Native Soils
5									
10									
15									Groundwater @ 15'
									Total Depth = 16'
20									
25									
30									
35									
40									
45									
50									

Recovered Sample

Unrecovered Sample

Standard Penetration Sample

Note: The stratification lines represent the approximate boundaries between the soil types; the transition may be gradual.

Riverside Land Development
Mountain Ave., Perris

Date: 10/16/03

Boring No. 7

Job Number: 644-3209

Depth, ft	Symbol	Core	Blows/6"	Description	Soil type	Unit Wt, pcf	Moisture, %	% Minus #200	Remarks
0			--	Decomposed Granite: Grey	--				Native Soils
16									Total Depth = 16' No Groundwater

Recovered Sample

Unrecovered Sample

Standard Penetration Sample

Note: The stratification lines represent the approximate boundaries between the soil types; the transition may be gradual.

Riverside Land Development
Mountain Ave., Perris

Date: 10/16/03 | **Boring No. 8** | **Job Number:** 644-3209

Depth, ft	Symbol	Core	Blows/6"	Description	Soil type	Unit Wt, pcf	Moisture, %	% Minus #200	Remarks
0			--	Decomposed Granite: Grey	--				Native Soils
5									
10									
15									
20									
25									
30									
35				Groundwater @ 35'					
40				Refusal @ 40'					Note: The stratification lines represent the approximate boundaries between the soil types; the transition may be gradual.
45									Total Depth = 40' No Bedrock
50									

Riverside Land Development
Mountain Ave., Perris

Date: 10/16/03

Boring No. 9

Job Number: 644-3209

Depth, ft	Symbol	Core	Blows/6"	Description	Soil type	Unit Wt, pcf	Moisture, %	% Minus #200	Remarks
0			---	Silty Sand: Light Brown	SM				Native Soils
			---	Decomposed Granite: Grey Brown	DG				
5									
10									
15									
20									Total Depth = 16' No Groundwater
25									
30									
35									
40									
45									
50									

Recovered Sample

Unrecovered Sample

Standard Penetration Sample

Note: The stratification lines represent the approximate boundaries between the soil types; the transition may be gradual.

Riverside Land Development
Mountain Ave., Perris

Date: 10/16/03 | **Boring No. 10** | **Job Number:** 644-3209

Depth, ft	Symbol	Core	Blows/6"	Description	Soil type	Unit Wt, pcf	Moisture, %	% Minus #200	Remarks
0			---	Silty Sand: Light Brown	SM				Native Soils
5			---	Decomposed Granite: Grey	DG				
10									
15									
20									Total Depth = 20' No Groundwater
25									
30									
35									
40									
45									
50									

Recovered Sample

Unrecovered Sample

Standard Penetration Sample

Note: The stratification lines represent the approximate boundaries between the soil types; the transition may be gradual.

Riverside Land Development

Mountain Ave., Perris

Date: 10/16/03

Boring No. 11

Job Number: 644-3209

Depth, ft	Symbol	Core	Blows/6"	Description	Soil type	Unit Wt, pcf	Moisture, %	% Minus #200	Remarks
0			---	Silty Sand: Light Brown	SM				Native Soils
5			---	Decomposed Granite: Grey	DG				
10				Refusal @ 12'					
15									Total Depth = 12' No Groundwater
20									
25									
30									
35									
40									
45									
50									

Recovered Sample

Unrecovered Sample

Standard Penetration Sample

Note: The stratification lines represent the approximate boundaries between the soil types; the transition may be gradual.

Riverside Land Development
Mountain Ave., Perris

Date: 10/16/03

Boring No. 12

Job Number: 644-3209

Depth, ft	Symbol	Core	Blows/6"	Description	Soil type	Unit Wt, pcf	Moisture, %	% Minus #200	Remarks
0			---	Silty Sand: Light Brown	SM				Native Soils
			---	Decomposed Granite: Grey	DG				
5									
10									
				Refusal @ 13'					
15									Total Depth = 13' No Groundwater
20									
25									
30									
35									
40									
45									
50									

Recovered Sample

Unrecovered Sample

Standard Penetration Sample

Note: The stratification lines represent the approximate boundaries between the soil types; the transition may be gradual.

Riverside Land Development
Mountain Ave., Perris

Date: 10/16/03

Boring No. 13

Job Number: 644-3209

Depth, ft	Symbol	Core	Blows/6"	Description	Soil type	Unit Wt, pcf	Moisture, %	% Minus #200	Remarks
0			---	Silty Sand: Light Brown	SM				Native Soils
3			---	Decomposed Granite: Grey	DG				
20									Total Depth = 20' No Groundwater

Recovered Sample

Unrecovered Sample

Standard Penetration Sample

Note: The stratification lines represent the approximate boundaries between the soil types; the transition may be gradual.

Riverside Land Development
Mountain Ave., Perris

Date: 10/16/03 **Boring No. 14** **Job Number:** 644-3209

Depth, ft	Symbol	Core	Blows/6"	Description	Soil type	Unit Wt, pcf	Moisture, %	% Minus #200	Remarks
0			---	Decomposed Granite: Grey	DG				Native Soils
5									
10									
15									
20									Total Depth = 20' No Groundwater
25									
30									
35									
40									
45									
50									

Recovered Sample

Unrecovered Sample

Standard Penetration Sample

Note: The stratification lines represent the approximate boundaries between the soil types; the transition may be gradual.

APPENDIX B

LOGS OF EXPLORATORY TRENCHES AND BORINGS
BY GEOTEK

Updated Geotechnical and Infiltration Evaluation
Tract No. 31304, Perris, Riverside County, California
Project No. 2359-CR

GEOTEK

A - FIELD TESTING AND SAMPLING PROCEDURES

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 – TRENCH/BORING LOG LEGEND

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

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 the trench/boring

(Additional denotations and symbols are provided on the log of trench/boring)

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

TRENCH NO.: T-1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				Colluvium/Topsoil:			
			SM	Silty f-m SAND, brown, slightly moist to moist, medium dense			
				Granitic Bedrock			
				TONALITE, gray, moist, moderately hard, weathered			
5							
				Hard			
				Little to no difficulty excavating			
10				**TRENCH TERMINATED AT 10 FEET**			
				No groundwater encountered			
				Trench backfilled with excavated soils			
15							

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

Lab testing:

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

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

TRENCH NO.: T-2

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				<u>Older Alluvium:</u>			
			SM	Silty f-m SAND, dark brown, moist, medium dense			
				<u>Granitic Bedrock</u>			
				TONALITE, gray, moist, moderately hard, weathered			
5							
				Little to no weathering			
				Excavation slowed, becoming difficult to excavate			
10							
				2-3 scrapes to get 1/8 bucket full			
				TRENCH TERMINATED AT 10 FEET			
				No groundwater encountered			
				Trench backfilled with excavated soils			
15							

LEGEND

<u>Sample type</u>: ---Ring ---Large Bulk ---Water Table

<u>Lab testing:</u>

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

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

TRENCH NO.: T-3

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				Colluvium/Topsoil:			
			SM-ML	Silty SAND/Sandy SILT, brown, slightly moist to moist, moderately hard/stiff, roots			
				Granitic Bedrock			
				TONALITE, gray, slightly moist to moist, moderately hard, weathered			
5							
				Some fracturing			
10							
				Excavation slowed			
				Little to no difficulty excavating			
15				**TRENCH TERMINATED AT 15 FEET**			
				No groundwater encountered			
				Trench Backfilled with excavated soils			

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

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

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

TRENCH NO.: T-4

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				Older Alluvium:			
			SM	Silty f SAND, dark brown, moist, medium dense, roots			
5							
				Granitic Bedrock			
				TONALITE, gray, moist, moderately hard, weathered in upper 3-5 feet			
				Breaks down to f-c SAND			
10							
				Hard			
				Little to no difficulty excavating			
15				**TRENCH TERMINATED AT 15 FEET**			
				No groundwater encountered			
				Trench backfilled with excavated soils			

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

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

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

TRENCH NO.: T-5

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				Colluvium/Topsoil:			
			SM	Silty f-m SAND, brown, slightly moist, loose			
				Granitic Bedrock			
				TONALITE, yellowish gray, moist, moderately hard, weathered			
5							
				Excavation slowed slightly			
				Moderately difficult excavation from 9 feet to 10 feet			
10				**TRENCH TERMINATED AT 10 FEET**			
				No groundwater encountered			
				Trench backfilled with excavated soils			
15							

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

TRENCH NO.: T-6

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				Colluvium/Topsoil:			
			SM	Silty f-m SAND, brown, slightly moist, loose			
				Granitic Bedrock			
				TONALITE, dark gray, moist, moderately hard, weathered in upper 3 feet			
5							
				Hard			
				Excavation slowed			
10							
				2-3 scrapes to get 1/2 bucket full			
				5 minutes of excavation time from 13 feet to 15 feet			
				Moderately difficult excavation			
15				**TRENCH TERMINATED AT 15 FEET**			
				No groundwater encountered			
				Trench backfilled with excavated soils			

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

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

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

TRENCH NO.: T-7

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
	Large Bulk			**Colluvium/Topsoil:**			MD, EI
			SM	Silty f-m SAND, brown, slightly moist, loose			
				Granitic Bedrock			
				TONALITE, dark gray, moist, moderately hard, weathered in upper 3 feet			
5							
				Very hard locally due to quartz dike, stepped back to continue excavation adjacent to dike			
10							
				Excavation slowed			
				2-3 scrapes to get 1/2 bucket full			
				Light to moderate difficulty excavating			
15				**TRENCH TERMINATED AT 15 FEET**			
				No groundwater encountered			
				Trench backfilled with excavated soils			

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

TRENCH NO.: T-8 Sheet 1 of 2

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				Colluvium/Topsoil:			
			SM	Silty f-m SAND, reddish brown, slightly moist, medium dense, roots			
				Granitic Bedrock			
				TONALITE, dark gray, slightly moist, moderately hard, weathered in upper 4 feet			
5							
10							
15				Excavation slowed			

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	**TRENCH NO.: T-8 Sheet 2 of 2** / **MATERIAL DESCRIPTION AND COMMENTS**	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				2-3 scrapes to get 1/4 bucket full			
20				8 minutes to excavate from 18 feet to 20 feet			
				TRENCH TERMINATED AT 20 FEET			
				No groundwater encountered			
				Trench backfilled with excavated soils			
25							
30							
35							

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

TRENCH NO.: T-9 Sheet 1 of 2

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
			SM	**Colluvium/Topsoil:** Silty f-c SAND, reddish brown, slightly moist, medium dense, roots			
				Granitic Bedrock TONALITE, dark gray, slightly moist, moderately hard, weathered in upper 6 feet			
5							
				Little to no difficulty excavating			
10							
				Excavation slowed			
15							
				2-3 scrapes to get 1/4-1/2 bucket			

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

TRENCH NO.: T-9 Sheet 2 of 2

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				13 minutes to excavate from 18 feet to 20 feet Difficult excavation from 19 feet to 20 feet			
20				**TRENCH TERMINATED AT 20 FEET** No groundwater encountered Trench backfilled with excavated soils			
25							
30							
35							

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	TRENCH NO.: T-10 — MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				Colluvium/Topsoil:			
			SM	Silty f SAND, brown, slightly moist, loose			
				Granitic Bedrock			
				TONALITE, dark gray, moist, moderately hard, weathered in upper 3 feet			
				Little to no weathering			
5				Hard			
				Some fracturing			
10							
				2-3 scrapes to get 1/4 to 1/2 bucket full			
				Moderately difficult excavation			
15				**TRENCH TERMINATED AT 15 FEET**			
				No groundwater encountered			
				Trench backfilled with excavated soils			

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

Lab testing:

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

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

TRENCH NO.: T-11

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				Colluvium/Topsoil:			
			SM	Silty f-m SAND, dark brown, slightly moist, loose, roots			
				Granitic Bedrock			
				TONALITE, gray, moist, moderately hard, weathered in upper 2 feet			
				Little to no weathering			
5				Hard			
				Excavation slowed			
10							
				2-3 scrapes for 1/4 bucket			
				14 minutes to excavate from 13 feet to 15 feet			
15							
				Only teeth scraping			
				TRENCH TERMINATED DUE TO REFUSAL AT 16 FEET			
				No groundwater encountered			
				Trench backfilled with excavated soils			

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

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

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

TRENCH NO.: T-12

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
			SM	**Colluvium/Topsoil:** Silty f SAND, brown, dry to slightly moist, loose, roots			
				Granitic Bedrock TONALITE, dark gray, slightly moist, moderately hard, weathered in upper 3 feet			
5							
				Little to no weathering			
10							
				Excavation slowed			
				2-3 scrapes to get 1/4 to 1/2 bucket full			
				Little to no difficulty excavating			
15				**TRENCH TERMINATED AT 15 FEET**			
				No groundwater encountered Trench backfilled with excavated soils			

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

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

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

TRENCH NO.: T-13

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				Colluvium/Topsoil:			
			SM	Silty f-m SAND, brown, dry to slightly moist, medium dense, roots			
				Granitic Bedrock			
				TONALITE, gray, slightly moist, moderately hard, weathered in upper 3 feet			
				Breaks down to f-c SAND			
5							
				Little to no weathering			
10							
				excavation slowed			
				2-3 scrapes to get 1/4 to 1/2 bucket full			
				Little to moderate difficulty excavating			
15				**TRENCH TERMINATED AT 15 FEET**			
				No groundwater encountered			
				Trench backfilled with excavated soils			

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

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

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	**TRENCH NO.: T-14** — **MATERIAL DESCRIPTION AND COMMENTS**	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				Older Alluvium:			
			SM	Silty f-m SAND, brown, dry to slightly moist, medium dense, roots			
				Granitic Bedrock			
5				TONALITE, gray, slightly moist, moderately hard, weathered in upper 3 feet			
				Excavation slowed			
10							
				Little to moderate difficulty excavating			
15				**TRENCH TERMINATED AT 15 FEET**			
				No groundwater encountered			
				Trench backfilled with excavated soils			

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

TRENCH NO.: T-15

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				Older Alluvium:			
			SM	Silty f-m SAND, brown, dry to slightly moist, medium dense, roots			
				Granitic Bedrock			
				TONALITE, gray, slightly moist, moderately hard, weathered in upper 3 feet			
5							
				Excavation slowed			
				Little to no weathering			
				Very hard locally due to quartz dike, stepped back from dike to continue excavation			
10							
				Excavation slowed			
				Little to no difficulty excavating			
15				**TRENCH TERMINATED AT 15 FEET**			
				No groundwater encountered			
				Trench backfilled with excavated soils			

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

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

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	Pacific Communities Builder, Inc.	**LOGGED BY:**	KRM
PROJECT NAME:	Tract 31304	**EQUIPMENT**	Western SK500
PROJECT NO.:	2359-CR	**DATE:**	4/2/2020
LOCATION:	See Exploration Location Map		

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	**TRENCH NO.: T-16** / **MATERIAL DESCRIPTION AND COMMENTS**	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				Older Alluvium:			
			SM	Silty f-m SAND, brown, dry to slightly moist, medium dense, roots			
				Granitic Bedrock			
				TONALITE, gray, slightly moist, moderately hard, weathered in upper 3 feet			
5							
				Excavation slowed			
				Hard			
				2-3 scrapes to get 1/4 bucket full			
				Only teeth scraping			
10				**TRENCH TERMINATED DUE TO REFUSAL AT 10 FEET**			
				No groundwater encountered			
				Trench backfilled with excavated soils			
15							

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

Lab testing:

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

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Pacific Communities Builder, Inc.	**DRILLER:**	2R Drilling Inc.	**LOGGED BY:**	DRW
PROJECT NAME:	Tract 31304	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Jeff
PROJECT NO.:	2359-CR	**HAMMER:**	140lbs/30in.	**RIG TYPE:**	CME 75
LOCATION:	See Exploration Location Map			**DATE:**	4/28/2020

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
0	Large Bulk			SM-SC	**Older Alluvium:** Silty clayey f-c SAND, dark brown, moist to very moist Perched groundwater at 2 feet			MD, EI, SH
4					**Granitic Bedrock:** TONALITE, gray, moist to very moist, indurated			
5	Ring	40 50/3"						
10	Ring	50/6"			Same as above			
15					Same as above, becomes light gray, slightly moist			
20					**BORING TERMINATED AT 20 FEET** Perched groundwater encountered at 2 feet below ground surface Boring backfilled with soil cuttings			
25								
30								

LEGEND

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

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

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Pacific Communities Builder, Inc.	**DRILLER:**	2R Drilling Inc.	**LOGGED BY:**	DRW
PROJECT NAME:	Tract 31304	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Jeff
PROJECT NO.:	2359-CR	**HAMMER:**	140lbs/30in.	**RIG TYPE:**	CME 75
LOCATION:	See Exploration Location Map			**DATE:**	4/28/2020

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
				SM	**Older Alluvium:** Silty clayey f-c SAND, dark brown, moist to very moist			
					Perched groundwater at 3.75 feet			
5	SPT	15 22 25		SC	Clayey silty f-c SAND, dark brown, very moist, medium dense			
	SPT	10 24 29			**Granitic Bedrock:** TONALITE, gray, moist to very moist, very weathered			
10					**BORING TERMINATED AT 10 FEET** Perched groundwater encountered at 3.75 feet below ground surface 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:	Pacific Communities Builder, Inc.	**DRILLER:**	2R Drilling Inc.	**LOGGED BY:**	DRW
PROJECT NAME:	Tract 31304	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Jeff
PROJECT NO.:	2359-CR	**HAMMER:**	140lbs/30in.	**RIG TYPE:**	CME 75
LOCATION:	See Exploration Location Map			**DATE:**	4/28/2020

BORING NO.: I-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
					Older Alluvium:			
				SC	Clayey f-c SAND, dark brown to brown, very moist			
					Perched groundwater at 3.75 feet			
5	Ring	7 26			Same as above			
	Ring	50/4"			**Granitic Bedrock:** TONALITE, gray, moist to very moist, very weathered			
	Ring	50/6"						
10					**BORING TERMINATED AT 10 FEET**			
					Perched groundwater encountered at 3.75 feet below ground surface 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:	Pacific Communities Builder, Inc.	**DRILLER:**	2R Drilling Inc.	**LOGGED BY:**	DRW
PROJECT NAME:	Tract 31304	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Jeff
PROJECT NO.:	2359-CR	**HAMMER:**	140lbs/30in.	**RIG TYPE:**	CME 75
LOCATION:	See Exploration Location Map			**DATE:**	4/28/2020

BORING NO.: I-3

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				SM	**Older Alluvium:** Silty f-c SAND, brown, moist to very moist			
					Perched groundwater at 3.5 feet			
					Granitic Bedrock: TONALITE, gray, moist to very moist, very weathered			
5	SPT	40 50/3"			Becomes indurated			
	No Recovery	50/3"			Same as above			
10					**BORING TERMINATED AT 10 FEET**			
					Perched groundwater encountered at 3.5 feet below ground surface 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:	Pacific Communities Builder, Inc.	**DRILLER:**	2R Drilling Inc.	**LOGGED BY:**	DRW
PROJECT NAME:	Tract 31304	**DRILL METHOD:**	Hollow Stem Auger	**OPERATOR:**	Jeff
PROJECT NO.:	2359-CR	**HAMMER:**	140lbs/30in.	**RIG TYPE:**	CME 75
LOCATION:	See Exploration Location Map			**DATE:**	4/28/2020

BORING NO.: I-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
				SC	**Older Alluvium:** Clayey f-c SAND, dark brown to brown, very moist			
					Perched groundwater at 3.75 feet			
					Granitic Bedrock: TONALITE, gray, moist to very moist, very weathered			
5	SPT	30 50/3"			Becomes indurated			
		50/4"			Same as above			
10					**BORING TERMINATED AT 10 FEET**			
					Perched groundwater encountered at 3.75 feet below ground surface 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

APPENDIX C

SEISMIC REFRACTION SURVEY RESULTS

Updated Geotechnical and Infiltration Evaluation
Tract No. 31304, Perris, Riverside County, California
Project No. 2359-CR

GEOTEK

Subsurface Surveys & Associates, Inc.
2075 Corte Del Nogal, Suite W   Carlsbad, CA 92011
Phone: (760) 476-0492   Fax: (760) 476-0493

Geotek, Inc.
1548 N. Maple Street
Corona, California

May 5, 2020

Attn: Gaby Bogdanoff

Re: Seismic Survey Summary Report
Project No. 2359-CR

This report covers the results of a seismic refraction survey performed at the Pacific Community Builder development site in Perris, California. The purpose of the survey was to measure the compressional wave velocity of bedrock for rippability assessment and to provide cross sections showing thickness of the weathered zone and depth to the unweathered interface. This should be useful for planning cuts and other earthwork.

The field work was conducted on April 21, 2020. Seven seismic lines were recorded at locations selected by Geotek. A survey location map is provided on Figure 1 that shows the position and orientation of the traverses.

GEOLOGIC SETTING

A review of the "Geologic Map of the San Bernardino and Santa Ana 30' x 60' quadrangles, California ", (USGS Open File Report 2006-1217, 2006) indicates the survey area is underlain by Val Verde tonalite (Kvt) of Cretaceous age. Surface deposits are mapped as old alluvium (Qvoa).

DATA ACQUISITION AND FIELD METHODS

Seismic refraction data were recorded with a Bison 9024 signal enhancement seismograph and 30 Hz geophones. The standard spread layout used 24 geophones with a 5-foot spacing. Each spread used five shotpoints, one off each end (5-foot offset) and three within the interior of the spread. Depth of investigation was approximately 30 feet.

Compressional wave energy was created by sledge hammer impacts on a metal plate. The signal enhancement feature of the seismograph allowed returns from repeated hits to be stacked, thus improving the signal. Each record was stored digitally on an internal hard disk and printed copies of each seismogram were made in the field on thermal paper. Example seismic records from this survey are shown on Figure 2.

Relative elevations of all shotpoints and geophones were determined by differential leveling with a hand level. Geophone 1 (distance = 0 ft.) at the beginning of each line was assigned a elevation value of 0.0 feet. This datum point served as the reference elevation for all other measurements.

Labeled wooden stakes were placed at the beginning and end of each traverse and a Garmin handheld GPS receiver was used to record the latitude and longitude coordinates of the stakes. The coordinates were used to make the location map shown on Figure 1.

SEISMIC REFRACTION METHOD

The refraction method involves measuring the total time for compressional waves to travel from a shotpoint through the subsurface to a set of geophones placed linearly along the ground. Based on Snell's Law, when two or more layers are present with increasingly higher acoustic velocity, waves become critically refracted across the layer boundaries and begin traveling at the speed of the underlying layer. The advancing waves then generate new wavefronts back to the ground surface. The first surge of energy hitting the geophone is termed the "first arrival" and is depicted on the seismogram as a high angle deflection along each trace. Example field records from this survey that show the first arriving energy are provided on Figure 2.

Recognition of direct wave arrivals (non-refracted) verses refracted waves is a key element of refraction interpretation. To assist this process, the first arrival times measured from the seismic records are plotted on graphs of time verses distance called Time-Distance graphs. An example T-D graph from Line 6 is shown on Figure 3. Based on changes in slope on the graphs, a preliminary layer number (i.e. 1, 2, 3) is assigned to each segment of the graph. The layer assignments together with time, distance and elevation data are input to a computer for additional processing.

DATA REDUCTION AND VELOCITY DETERMINATION

Processing and interpretation of this data set was accomplished with “SIPT2", an interactive inversion modeling program developed by James Scott for the U.S. Bureau of Mines. The inversion algorithm uses the delay time method to construct a first pass depth model. The model is then adjusted by an iterative ray tracing process that attempts to minimize the discrepancies between the total travel times calculated along ray paths and the observed travel times measured in the field.

This program calculates refractor velocity in two ways. First, apparent velocities from each shot are determined by the inverse slope of a best fit (least squares) line through datum-corrected travel times. True velocity is estimated from the apparent velocities by using the following equation:

$$Vt = 2(Vu \times Vd)/(Vu + Vd)$$

where
Vt = true velocity
Vu = apparent up dip velocity
Vd = apparent down dip velocity

The second method uses a more sophisticated set of equations (the Hobson-Overton formula) developed by the Canadian Geological Survey. The final velocity assigned to the refractor is a weighted average of the results of the two methods. The weighting is based on the number of arrival times used in the computations.

SUMMARY OF RESULTS

Results from refraction analysis show a three layer solution beneath all lines (see Figures 5-11). Velocities posted on the cross sections represent averages as described in the previous section. Therefore, minor localized changes in velocity may occur along any profile. A description of the layers is provided below and a cross section summary is shown in Table 1.

Layer 1 - is mostly older alluvium. Thickness is generally less than 5 feet, except for Line 4, where the maximum thickness is 10 feet.

Layer 2 - is interpreted to be highly weathered and decomposed bedrock. The velocity range is 2685-3251 ft/sec and is considered easily rippable with a D-9 Cat.

Layer 3 - represents weathered bedrock. Note: the velocity of layer 3 beneath Line 6 is 8677 ft/s and is interpreted as hard unweathered rock.

Table 1. Cross Section Summary Velocity in (ft/sec), Depth in (feet)

Line	Velocity Layer 1	Velocity Layer 2	Velocity Layer 3	Depth Range Layer 2/3 Interface
1	1117	2780	3699	6 - 9
2	1144	3251	4644	8 - 13
3	1163	2685	5676	11 - 18
4	1112	2721	5679	13 - 23
5	1180	2470	3437	5 - 11
6	1297	2942	8677	21 - 25
7	1226	2918	6083	16 - 20

Weathering tends to be gradational for most granitic rock types and usually produces a gradual increase in velocity with depth. Consequently, variation of $\pm$ 15% from the posted averages may occur between the top and bottom of weathered layers.

Clusters of large boulders were observed across the ground surface at various locations. Core stones and boulders are fairly common in granitic terrain where chemical and mechanical processes produce spheroidal weathering and exfoliation of the granitic basement rock. The result is remnant large dense spheroids surrounded by a matrix of weathered bedrock. An example photo of core stones exposed in a road cut in the Escondido area is shown on Figure 12.

Evidence of suspected buried core stones, at depths of 15 feet or less, was found beneath Lines 3 and 7. The modeling software used to prepare the layered models tends to flatten and smooth structures with high dip angles and steep sides. The interpreted edges of the core stones are annotated on the cross sections to better define the width of these features.

Figure 4 presents a rippability chart (courtesy of Caterpillar Tractor Co.) for a D9R Ripper. Bar graphs show the relationship between seismic compressional wave velocity and ripper performance for various rock types in three categories: rippable, marginal, and non-rippable. Granite is listed as marginally rippable at approximately 6700 ft/sec and is considered non-rippable above 8000 ft/sec. This chart is provided only as a guide and should not be considered absolute. Other geologic factors that may influence bedrock rippability at this site include changes in composition of the bedrock and the presence of fractures and joints.

All data acquired during this survey is considered confidential and is available for review by your staff at any time. We appreciate the opportunity to participate in this project.

Please call if there are any questions.

PAWalen

Phillip A. Walen
Senior Geophysicist
CA Registration No. GP917

Seismic Survey Location Map

Tract Map No. 31304 -- Perris, Riverside County, California

N

Figure 1

Example Seismic Field Records

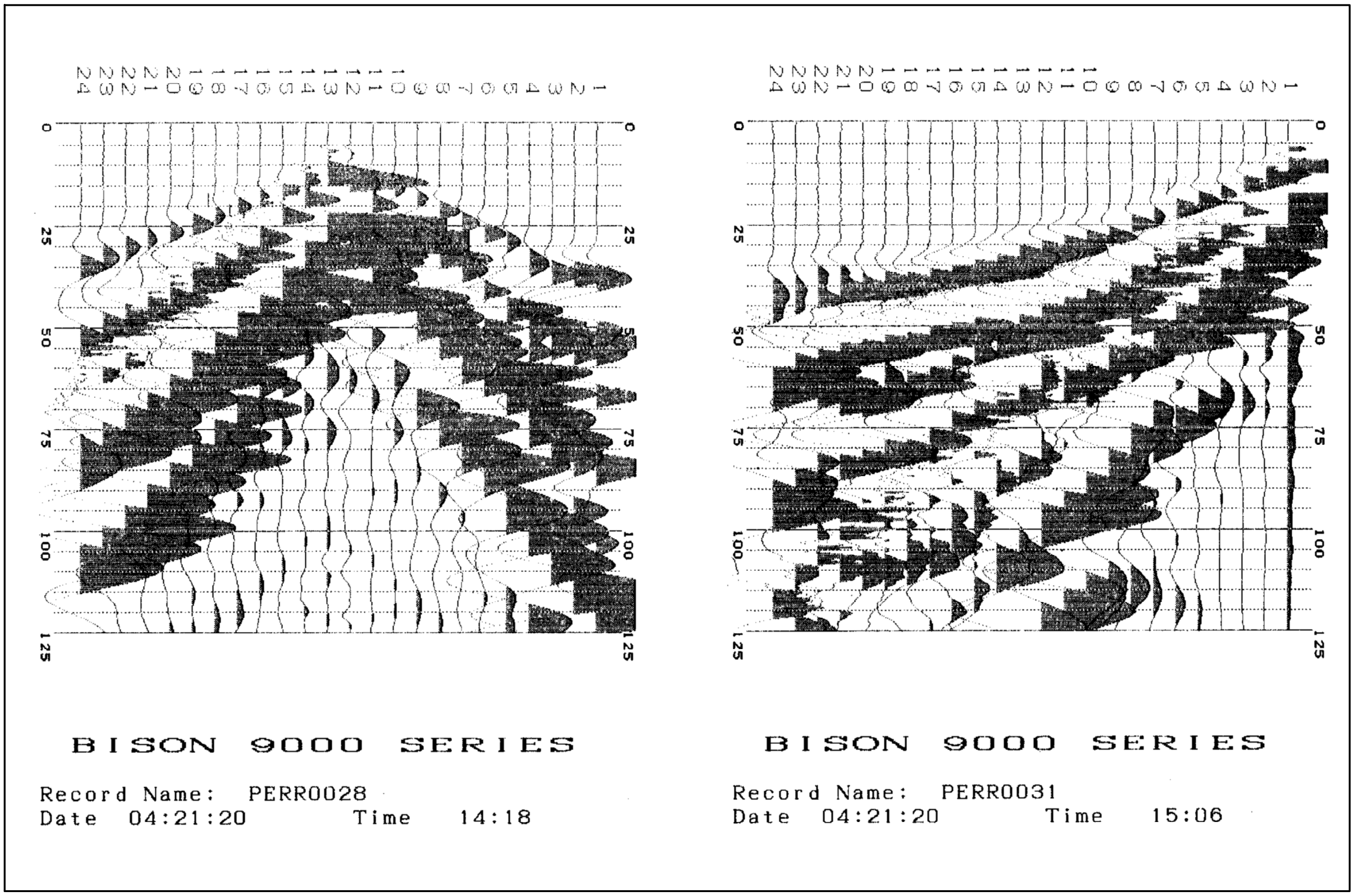
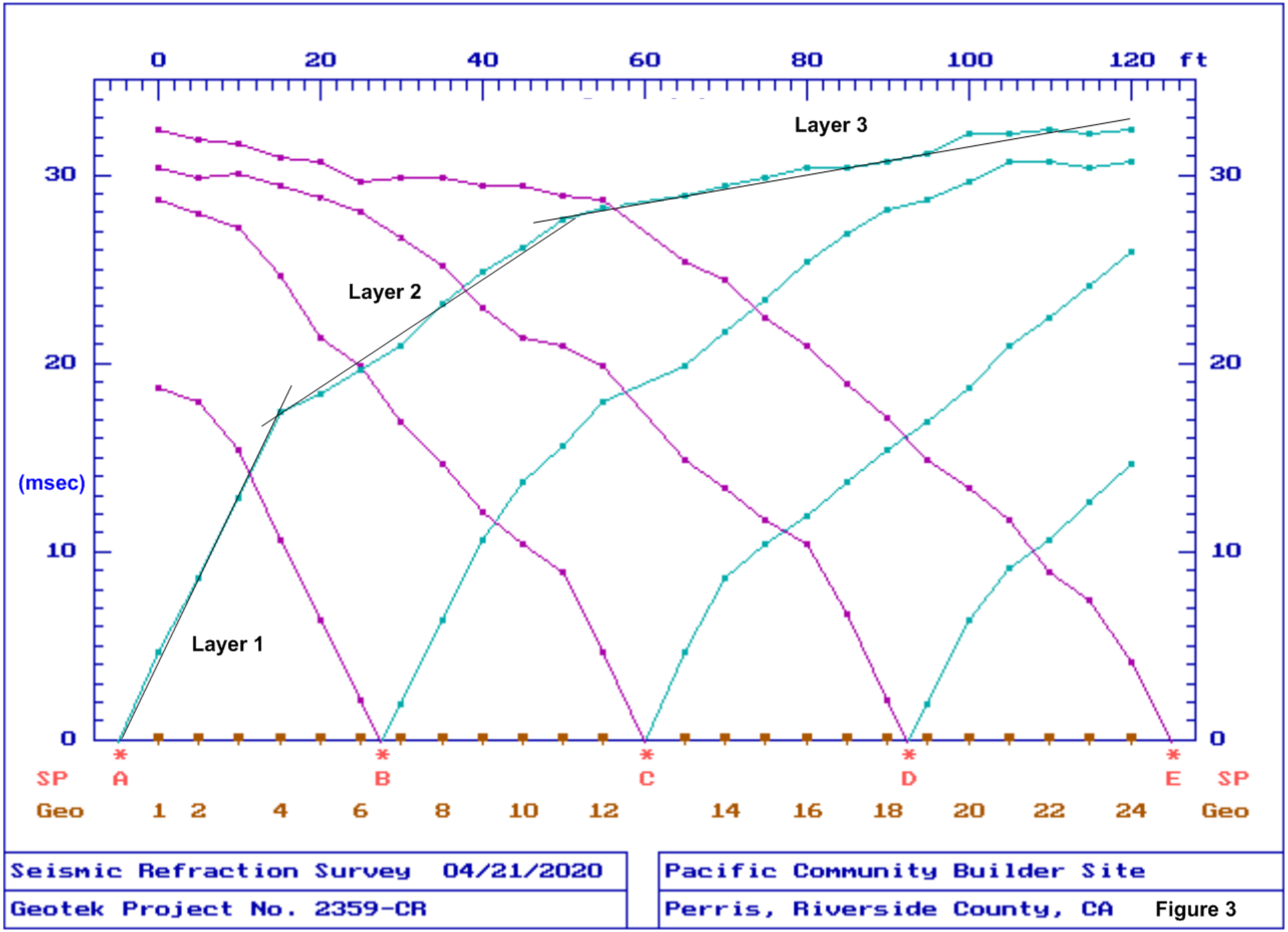


Figure 2

Example Time-Distance Graph -- Line 6



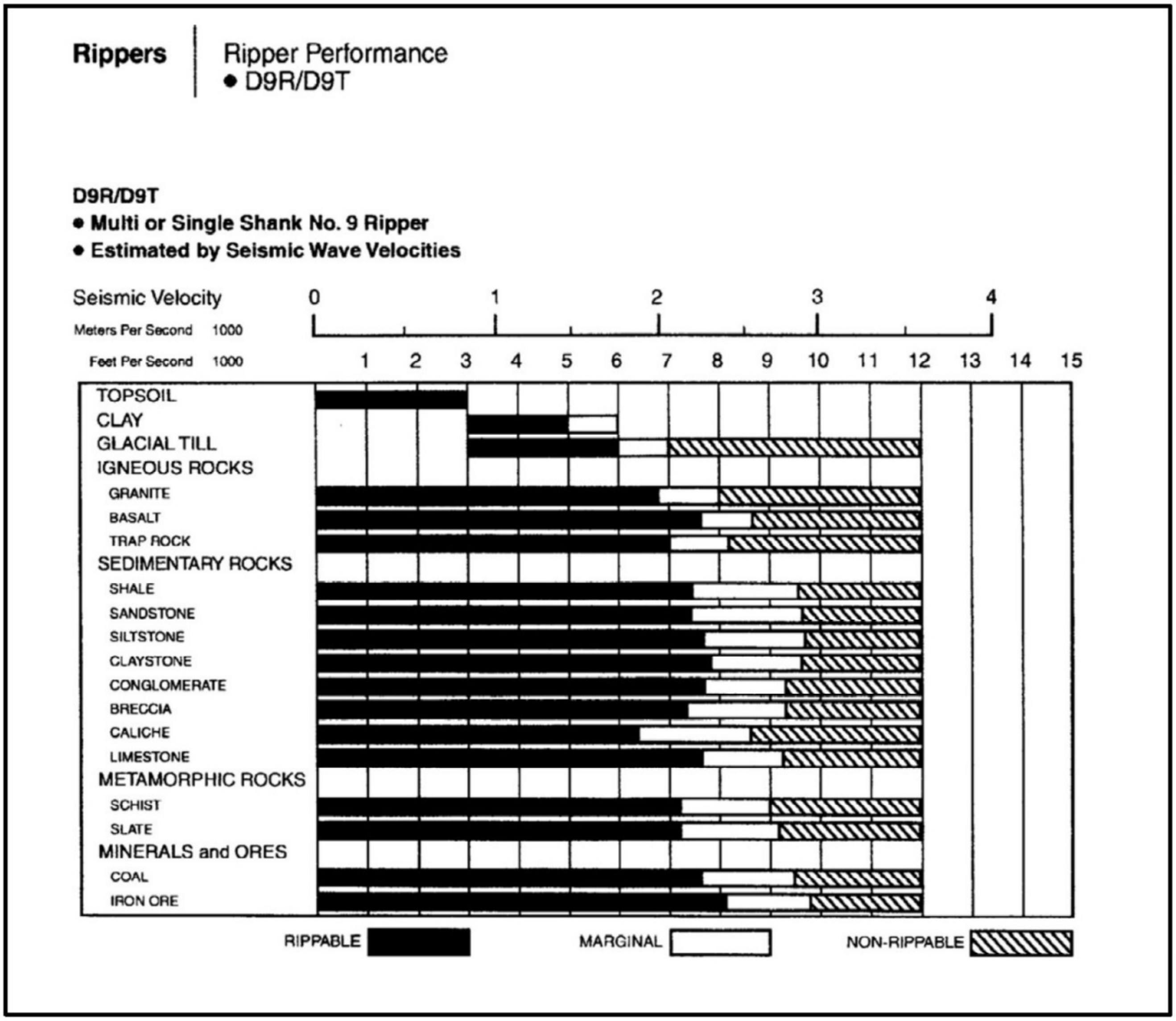
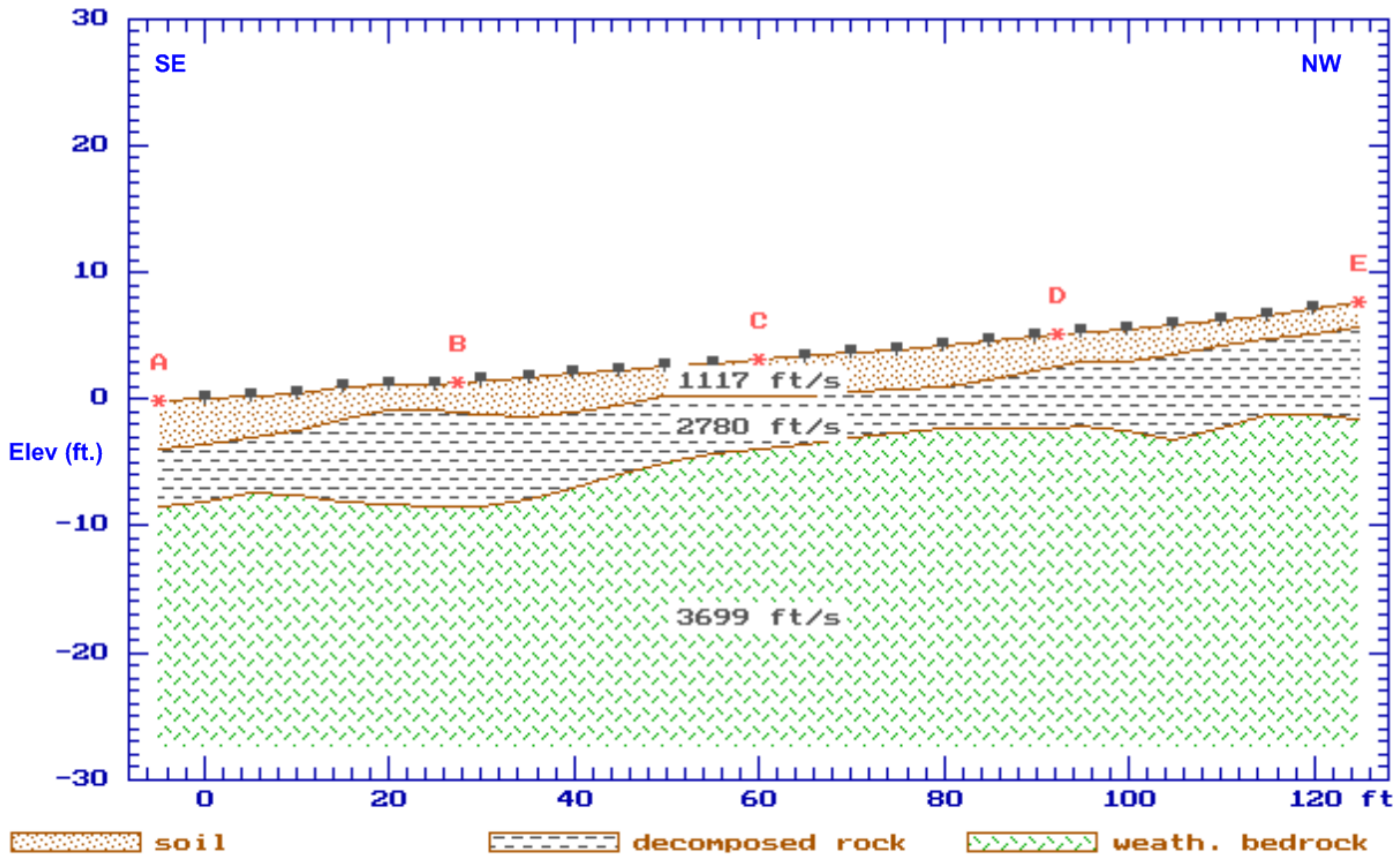
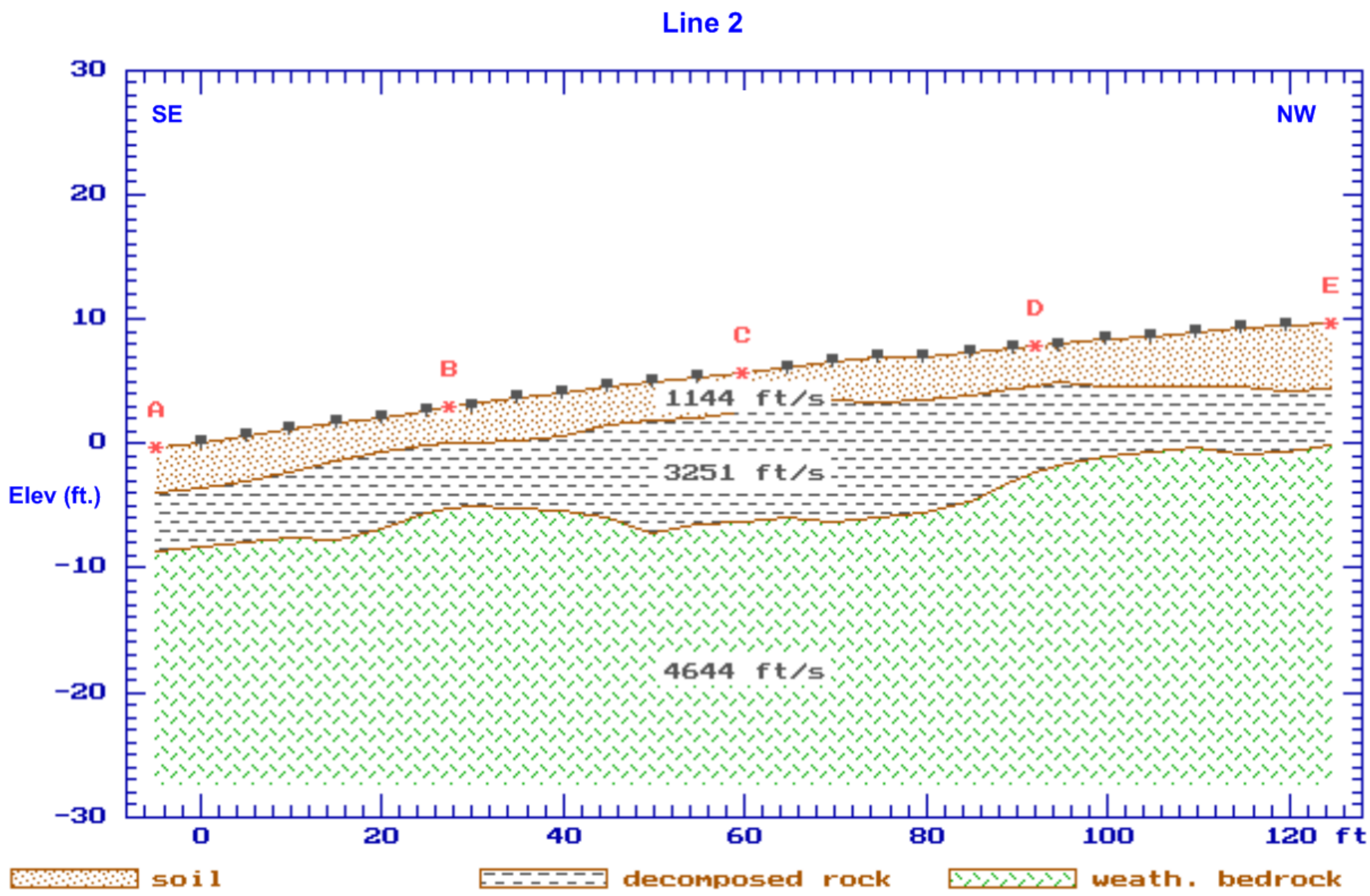

Rippers
Ripper Performance
• D9R/D9T
D9R/D9T
• Multi or Single Shank No. 9 Ripper
• Estimated by Seismic Wave Velocities
Seismic Velocity
Meters Per Second 1000
Feet Per Second 1000
0 1 2 3 4
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TOPSOIL
CLAY
GLACIAL TILL
IGNEOUS ROCKS
GRANITE
BASALT
TRAP ROCK
SEDIMENTARY ROCKS
SHALE
SANDSTONE
SILTSTONE
CLAYSTONE
CONGLOMERATE
BRECCIA
CALICHE
LIMESTONE
METAMORPHIC ROCKS
SCHIST
SLATE
MINERALS and ORES
COAL
IRON ORE
RIPPABLE
MARGINAL
NON-RIPPABLE

Figure 4

Line 1

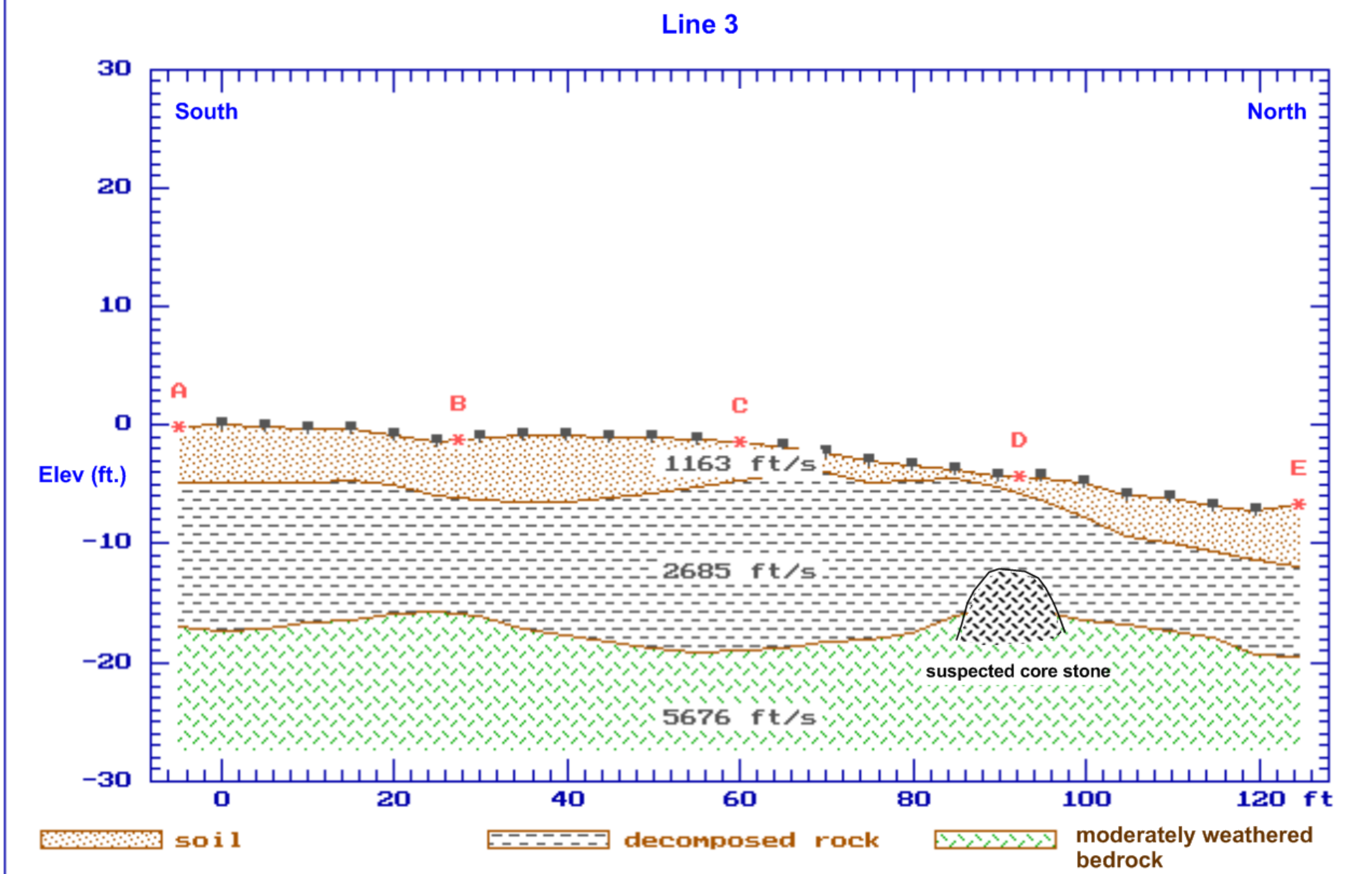


Seismic Refraction Survey 04/21/2020	Pacific Community Builder Site
Geotek Project No. 2359-CR	Perris, Riverside County, CA Figure 5

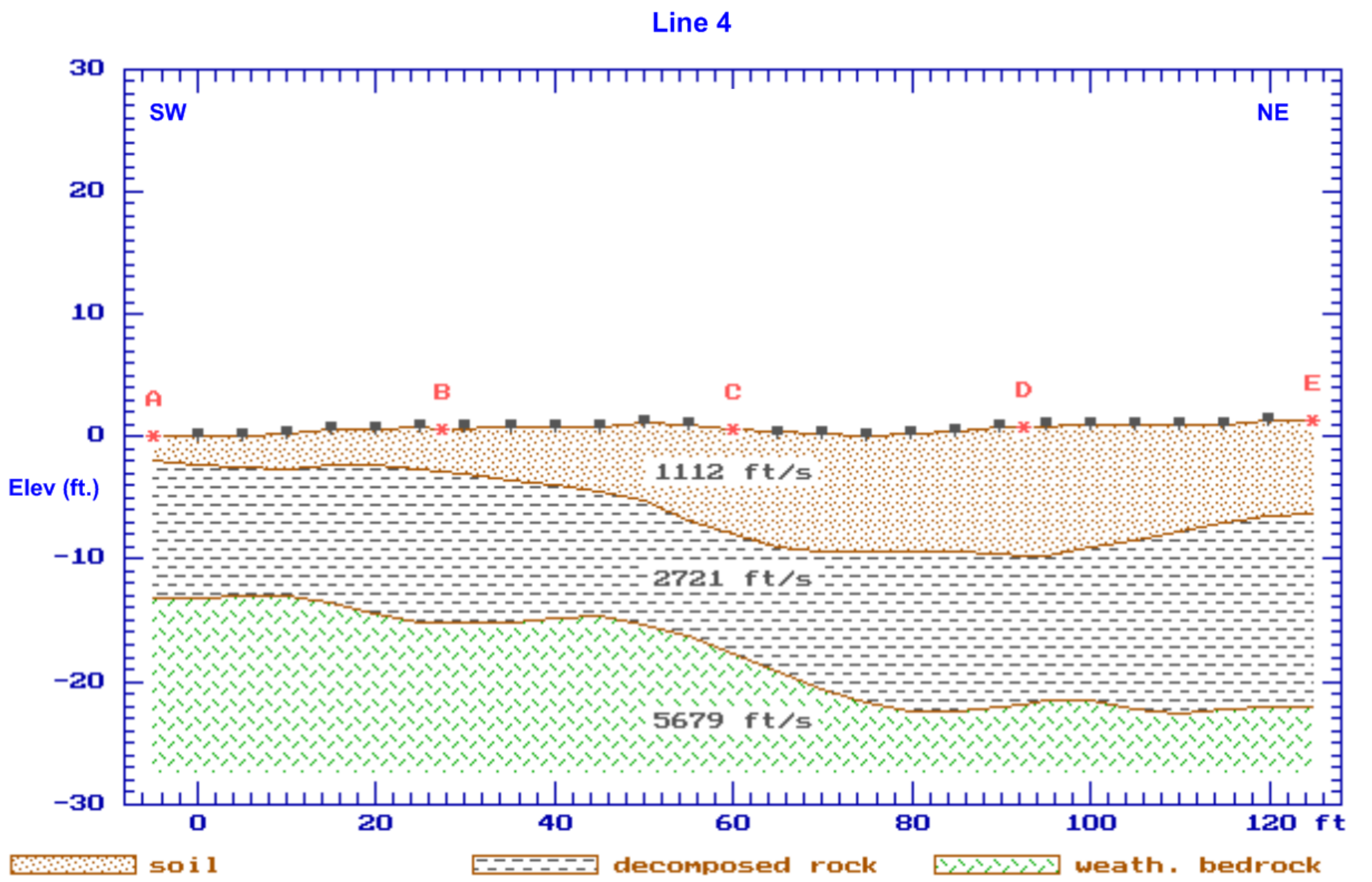


Seismic Refraction Survey 04/21/2020	Pacific Community Builder Site
Geotek Project No. 2359-CR	Perris, Riverside County, CA

Figure 6

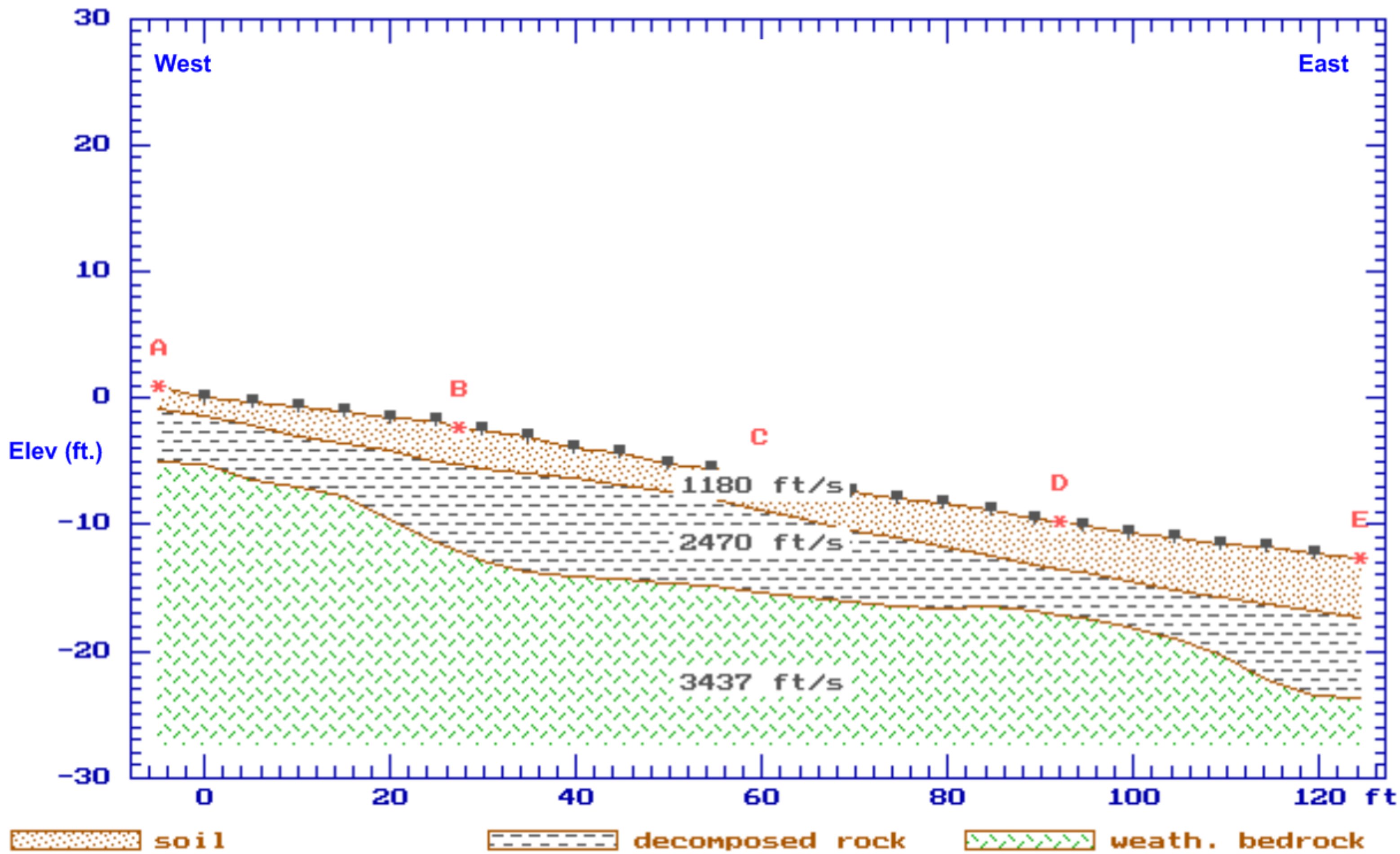


Seismic Refraction Survey 04/21/2020	Pacific Community Builder Site
Geotek Project No. 2359-CR	Perris, Riverside County, CA Figure 7

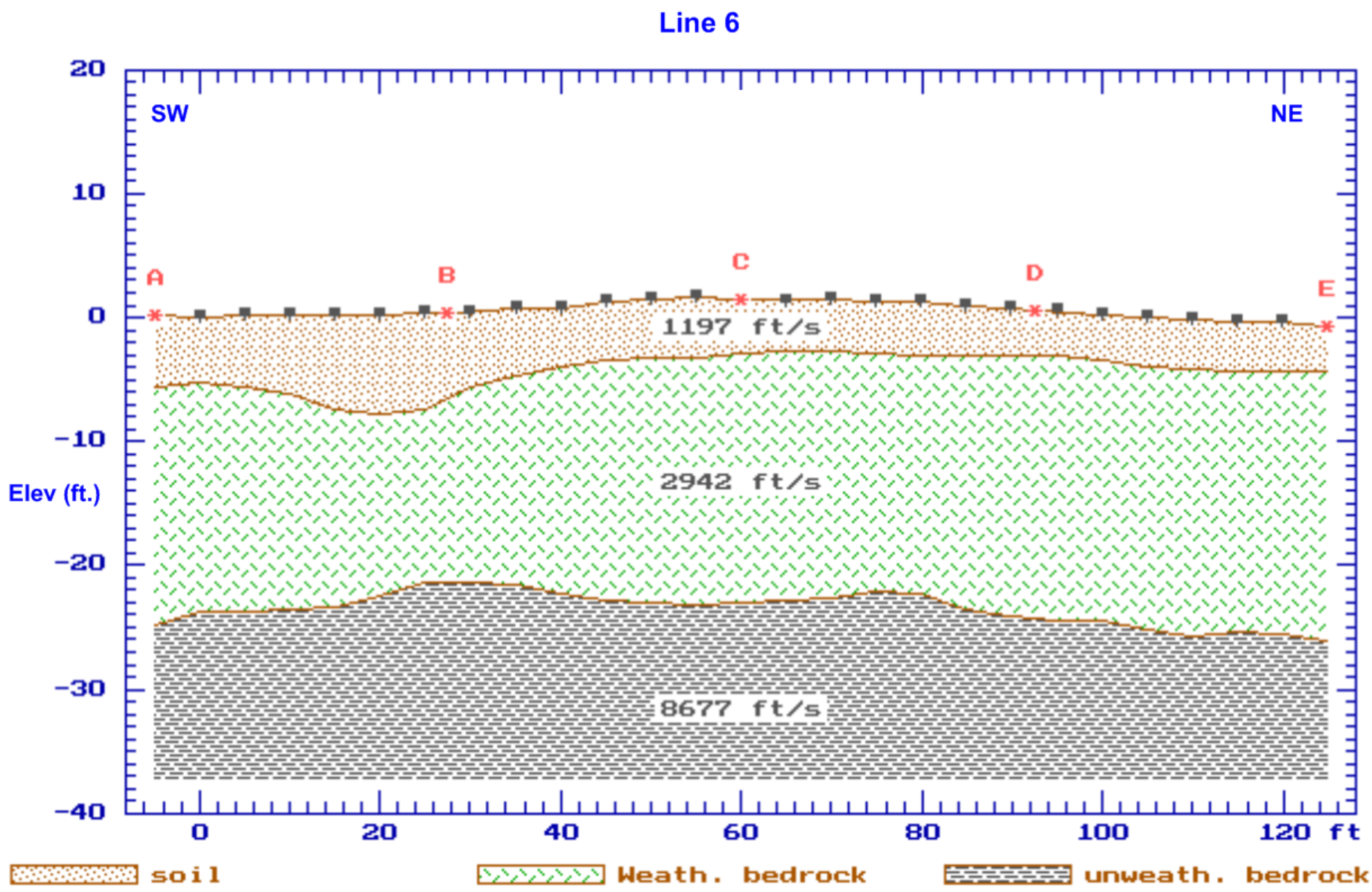


Seismic Refraction Survey 04/21/2020	Pacific Community Builder Site
Geotek Project No. 2359-CR	Perris, Riverside County, CA — Figure 8

Line 5

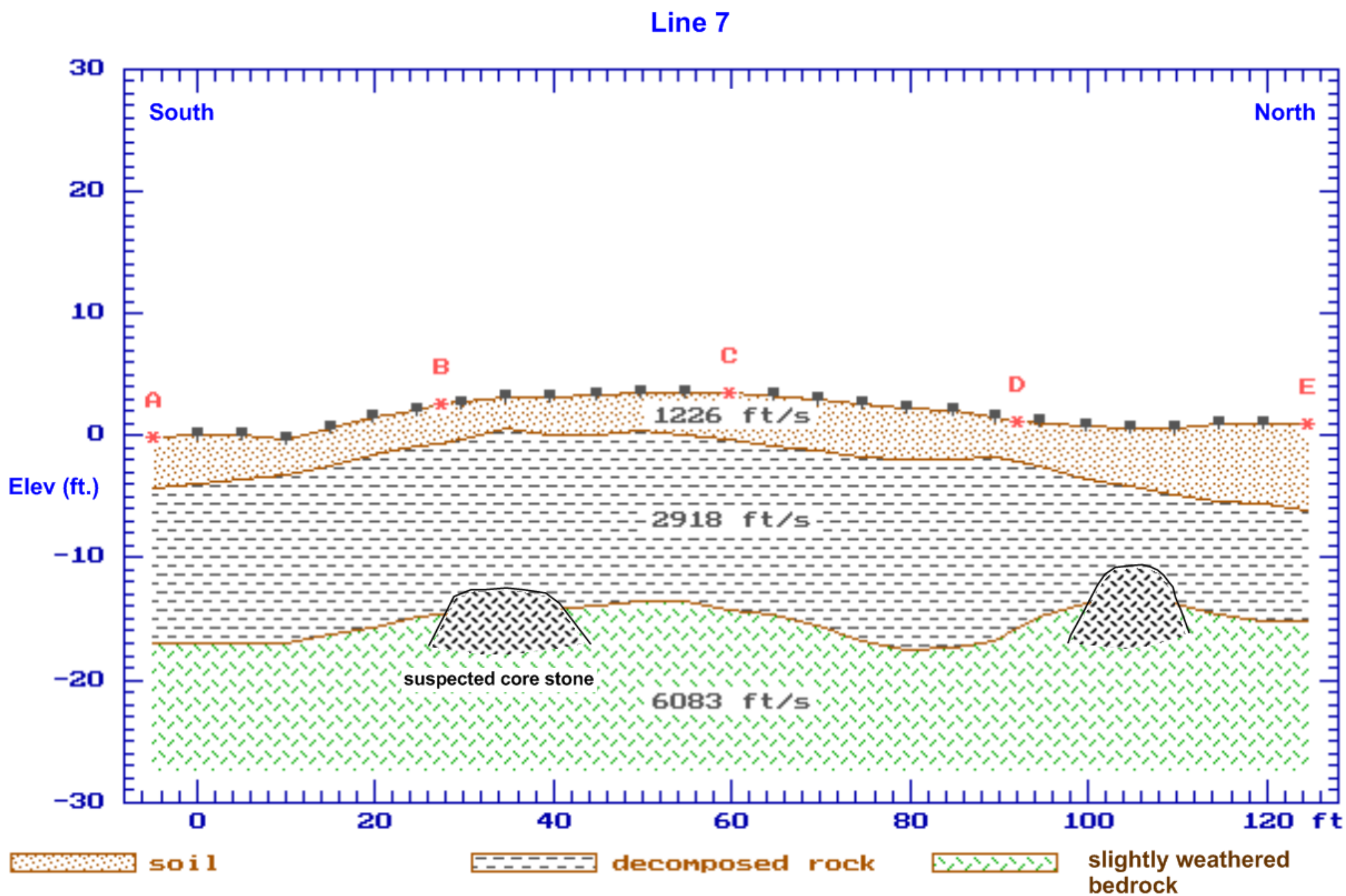


Seismic Refraction Survey 04/21/2020	Pacific Community Builder Site
Geotek Project No. 2359-CR	Perris, Riverside County, CA Figure 9



Seismic Refraction Survey 04/21/2020	Pacific Community Builder Site
Geotek Project No. 2359-CR	Perris, Riverside County, CA

Figure 10



Seismic Refraction Survey 04/21/2020	Pacific Community Builder Site
Geotek Project No. 2359-CR	Perris, Riverside County, CA Figure 11

Core stones in weathered bedrock

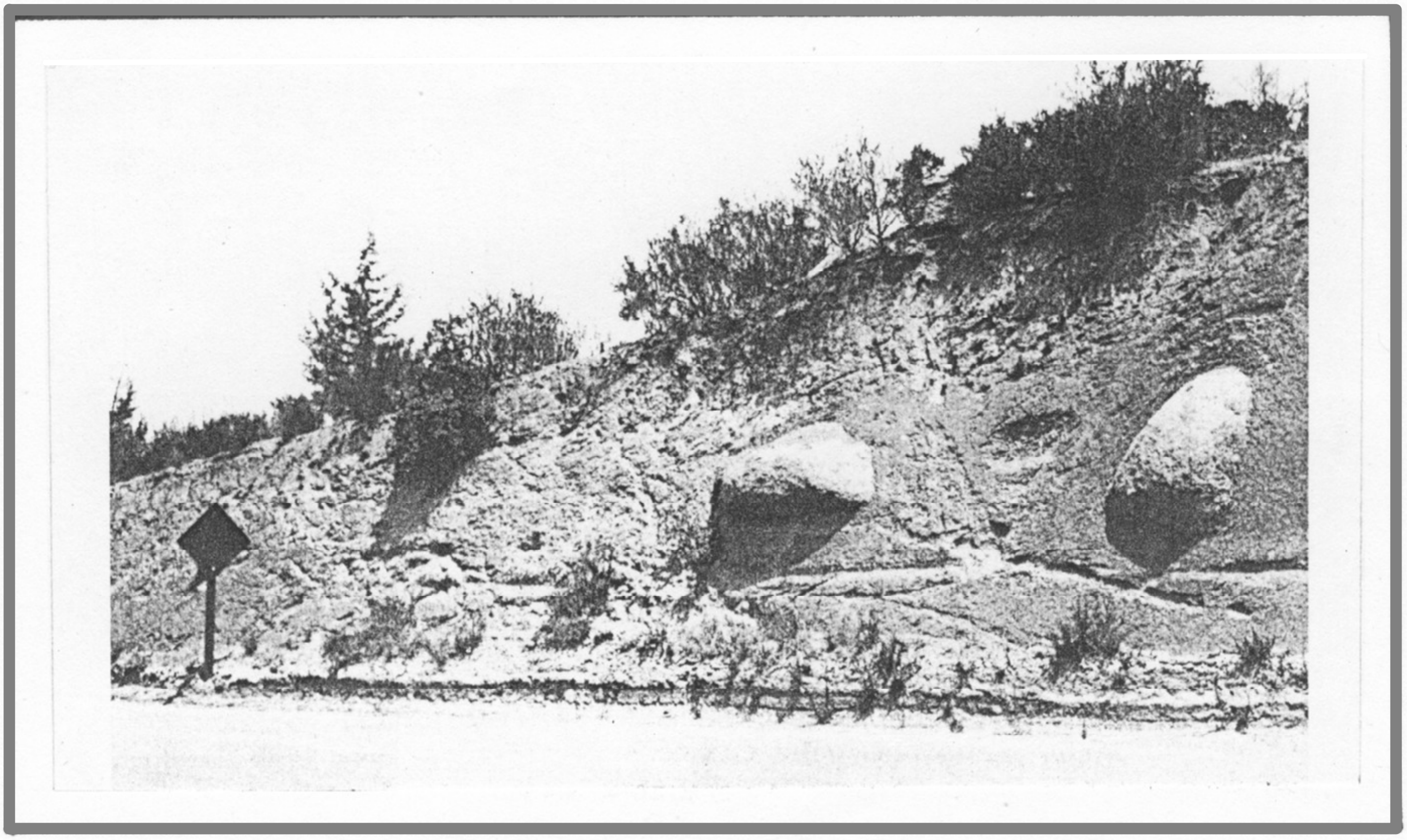


Figure 12

APPENDIX D

RESULTS OF LABORATORY TESTING BY GEOTEK

Updated Geotechnical and Infiltration Evaluation
Tract No. 31304, Perris, Riverside County, California
Project No. 2359-CR

SUMMARY OF LABORATORY TESTING

Classification
Soils were classified visually in general accordance to the Unified Soil Classification System (ASTM Test Method D 2487). The soil classifications are shown on the logs of trenches and borings in Appendix B.

Moisture-Density Relationship
Laboratory testing was performed on two samples obtained during the subsurface exploration. The laboratory maximum dry density and optimum moisture content was determined in general accordance with ASTM D 1557. The results of the testing are provided herein.

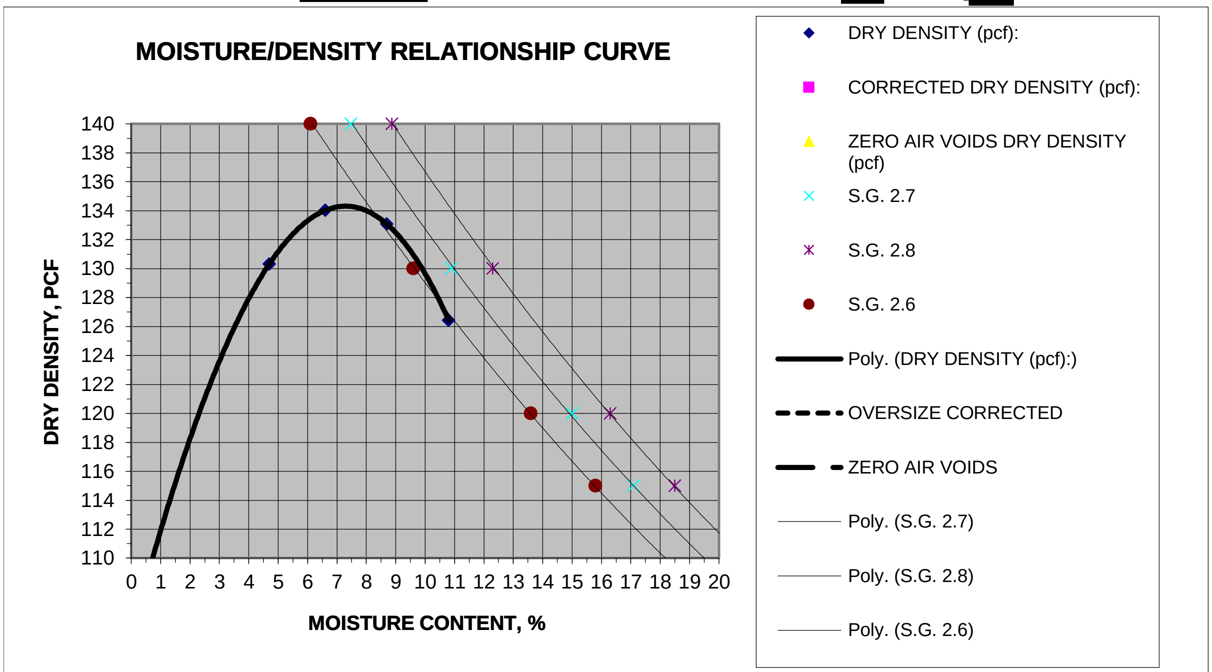
Direct Shear
Shear testing was performed in a direct shear machine of the strain-control type in general accordance with ASTM Test Method D 3080. The rate of deformation was approximately 0.035 inch per minute. The samples were sheared under varying confining loads in order to determine the coulomb shear strength parameters, angle of internal friction and cohesion. Testing was performed on remolded soil samples (90% of the maximum dry density per ASTM D 1557). The shear test results are presented herein.

Expansion Index
Expansion Index testing was performed on two soil samples. Testing was performed in general accordance with ASTM Test Method D 4829. The results of the testing are provided herein.

MOISTURE/DENSITY RELATIONSHIP

Client: Pacific Communities Builder
Job No.: 2359-CR
Project: TR 31304
Lab No.: Corona
Location: Perris
Material Type: Dark Brown Silty F - C Sand
Material Supplier: -
Material Source: -
Sample Location: B-1 @ 0 - 1 ft
-
Sampled By: KM
Date Sampled: 4/13/2020
Received By: DLI
Date Received: 4/14/2020
Tested By: DLI
Date Tested: 4/20/2020
Reviewed By: -
Date Reviewed: -

Test Procedure: ASTM D1557
Method: A
Oversized Material (%): 0.8
Correction Required: ☐ yes ☒ no



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	134.5	**@ Optimum Moisture, %**	7.0
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

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

Atterberg Limits:

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

Classification:

Unified Soils Classification: ________

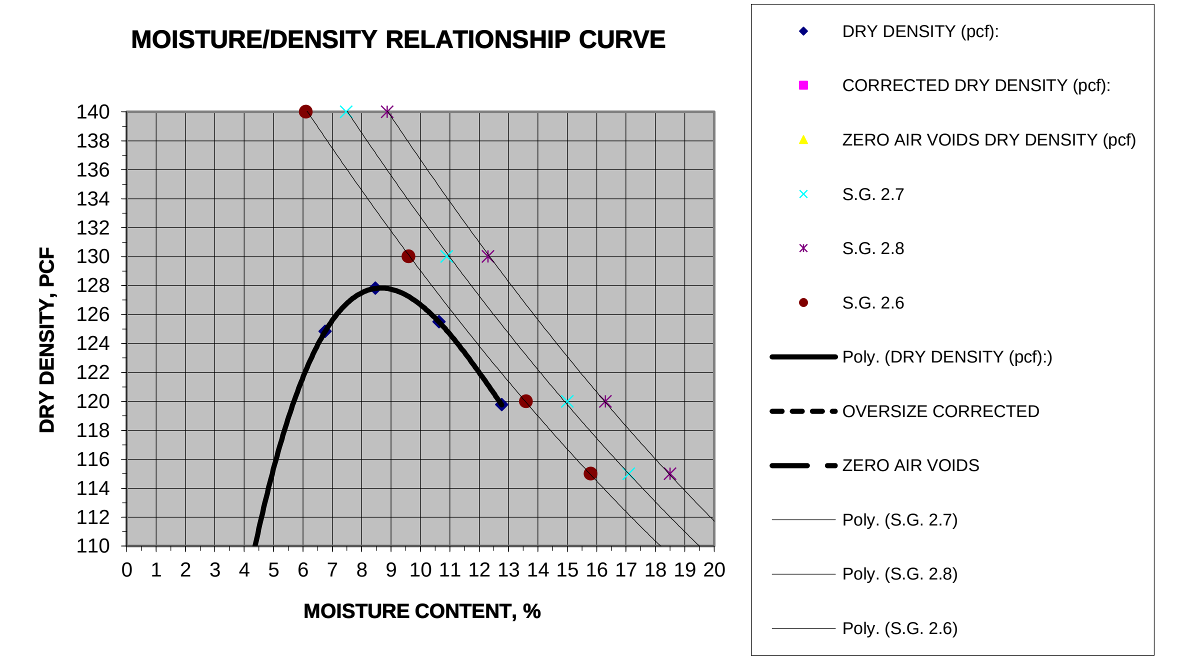
AASHTO Soils Classification: ________

GEOTEK

MOISTURE/DENSITY RELATIONSHIP

Client: Pacific Communities Builder
Job No.: 2359-CR
Project: TR 31304
Lab No.: Corona
Location: Perris
Material Type: Dark Brown Silty F - C Sand
Material Supplier: -
Material Source: -
Sample Location: T-7 @ 0 - 1 ft
-
Sampled By: KM
Date Sampled: 4/13/2020
Received By: DLI
Date Received: 4/14/2020
Tested By: DLI
Date Tested: 4/20/2020
Reviewed By: -
Date Reviewed: -

Test Procedure: ASTM D1557
Method: A
Oversized Material (%): 1.0
Correction Required: ☐ yes ☒ no



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	128.0	**@ Optimum Moisture, %**	9.0
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

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

Atterberg Limits:

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

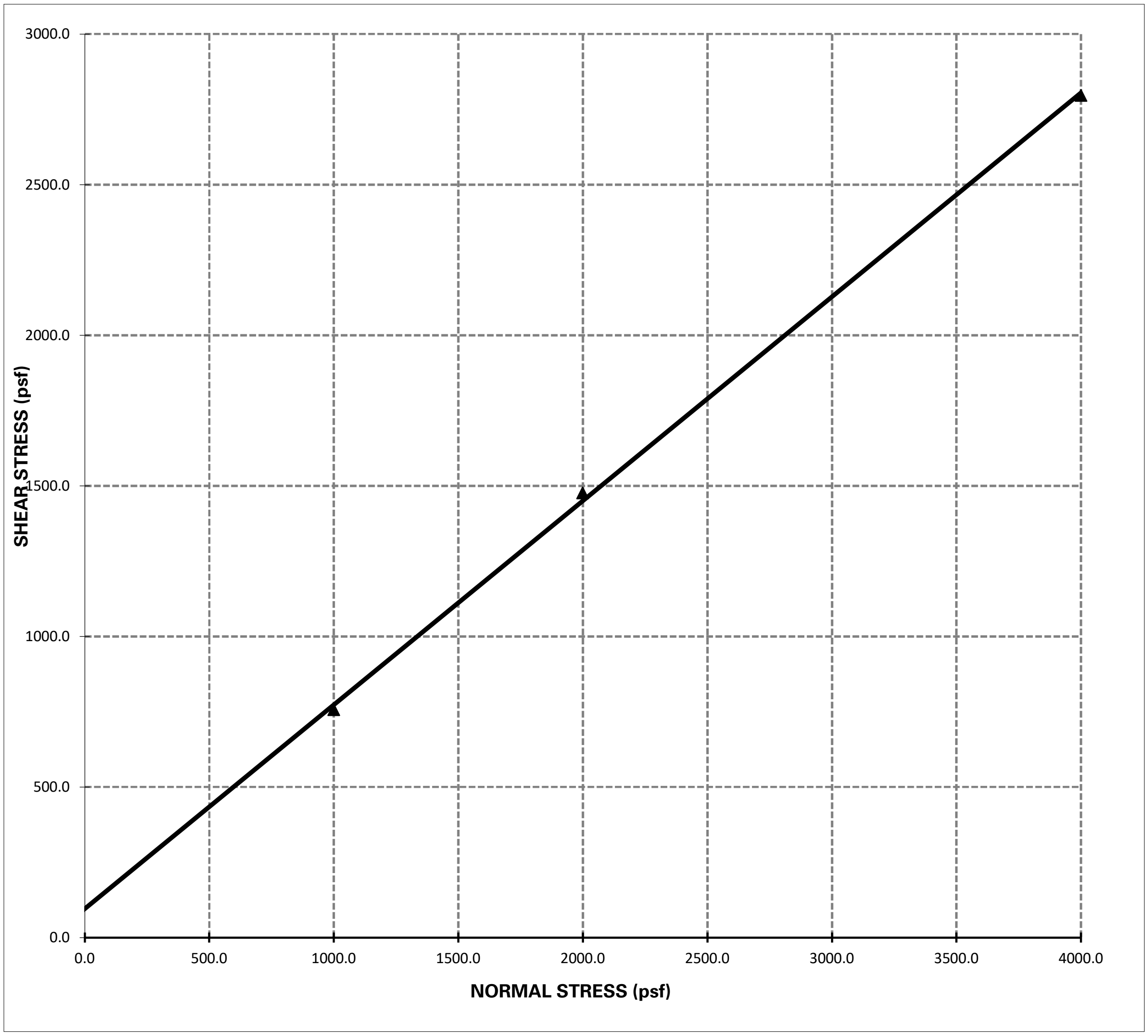
Classification:

Unified Soils Classification: ____________

AASHTO Soils Classification: ____________

DIRECT SHEAR TEST

Project Name:	TR 31304, Perris	***Sample Location:***	B-1 @ 0 - 1 ft
Project Number:	2359-CR	***Date Tested:***	4/28/2020



Shear Strength: Φ = **34.1 °** , **C = 96.00 psf**

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

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

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

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Client: Pacific Communities Builder
Project Number: 2359-CR
Project Location: TR 31304, Perris

Tested/ Checked By: DA Lab No Corona
Date Tested: 4/22/2020
Sample Source: B-1 @ 0 - 1 ft
Sample Description:

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

DENSITY DETERMINATION

A	Weight of compacted sample & ring (gm)	791.0
B	Weight of ring (gm)	366.7
C	Net weight of sample (gm)	**424.3**
D	Wet Density, lb / ft3 (C*0.3016)	**128.0**
E	Dry Density, lb / ft3 (D/1.F)	**119.0**

SATURATION DETERMINATION

F	Moisture Content, %	7.5
G	Specific Gravity, assumed	**2.70**
H	Unit Wt. of Water @ 20 °C, (pcf)	**62.4**
I	% Saturation	**48.8**

READINGS

DATE	TIME	READING	
4/22/2020	12:26	0.4800	Initial
	12:36	0.4800	10 min/Dry
4/23/2020	12:36	0.4810	Final

FINAL MOISTURE

Final Weight of wet sample & tare	% Moisture
811.4	**12.3**

EXPANSION INDEX = 1

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Client:	Pacific Communities Builder	***Tested/ Checked By:***	DI Lab No Corona
Project Number:	2359-CR	***Date Tested:***	4/21/2020
Project Location:	TR 31304, Perris	***Sample Source:***	T-7 @ 0 - 1 ft
		Sample Description:	

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

DENSITY DETERMINATION

A	Weight of compacted sample & ring (gm)	771.8
B	Weight of ring (gm)	363.1
C	Net weight of sample (gm)	**408.7**
D	Wet Density, lb / ft3 (C*0.3016)	**123.3**
E	Dry Density, lb / ft3 (D/1.F)	**113.3**

SATURATION DETERMINATION

F	Moisture Content, %	8.8
G	Specific Gravity, assumed	**2.70**
H	Unit Wt. of Water @ 20 °C, (pcf)	**62.4**
I	% Saturation	**48.8**

READINGS

DATE	TIME	READING	
4/21/2020	4:08	0.2220	Initial
	4:18	0.2210	10 min/Dry
4/22/2020	4:18	0.2260	Final

FINAL MOISTURE

Final Weight of wet sample & tare	% Moisture
797.0	**15.0**

EXPANSION INDEX = 5

APPENDIX E

SOIL CORROSIVITY STUDY

Updated Geotechnical and Infiltration Evaluation
Tract No. 31304, Perris, Riverside County, California
Project No. 2359-CR

GEOTEK

April 27, 2020 via email: gbogdanoff@geotekusa.com

GEOTEK, INC.
1548 N. Maple St.
Corona, CA 92880

Attention: Ms. Gaby Bogdanoff, PE, GE

Re: Soil Corrosivity Study
PCB-Tr. 31304
Perris, CA
HDR #20-0223SCS, GI# 2359.CR

Introduction

Laboratory tests have been completed on 10 soil samples provided for the referenced project. The purpose of these tests was to determine if the soils might have deleterious effects on underground utility piping and concrete structures. HDR Engineering, Inc. (HDR) assumes that the samples provided are representative of the most corrosive soils at the site.

The proposed project consists of a single-family residential development with one to two stories and no subterranean levels. The site is located northeast of McPherson Road and Mountain Avenue in Perris, California, and the water table is reportedly greater than 15 feet deep.

The scope of this study is limited to a determination of soil corrosivity and general corrosion control recommendations for materials likely to be used for construction. HDR's recommendations do not constitute, and are not meant as a substitute for, design documents for the purpose of construction. If the architects and/or engineers desire more specific information, designs, specifications, or review of design, HDR will be happy to work with them as a separate phase of this project.

431 W. Baseline Road, Claremont, CA 91711-1608
(909) 626-0967

Laboratory Soil Corrosivity Tests

The electrical resistivity of each sample was measured in a soil box per ASTM G187 in its as-received condition and again after saturation with distilled water. Resistivities are at about their lowest value when the soil is saturated. The pH of the saturated samples was measured per ASTM G51. A 5:1 water:soil extract from each sample was chemically analyzed for the major soluble salts commonly found in soil per ASTM D4327, ASTM D6919, and Standard Method 2320-B. Total acidity was performed per NBS Circular 579 on two samples where the pH was found to 5.5 or lower. Laboratory test results are shown in the attached Table 1.

Soil Corrosivity

A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. Corrosion currents, following Ohm's Law, are inversely proportional to soil resistivity. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil.

A correlation between electrical resistivity and corrosivity toward ferrous metals is:[1]

Soil Resistivity in ohm-centimeters	Corrosivity Category
Greater than 10,000	Mildly Corrosive
2,001 to 10,000	Moderately Corrosive
1,001 to 2,000	Corrosive
0 to 1,000	Severely Corrosive

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

[1] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, pp. 166–167.*

Electrical resistivities were in the mildly to moderately corrosive categories with as-received moisture. When saturated, the resistivities were in the mildly to severely corrosive categories. Variation in soil resistivity of an order of magnitude or more can create differential-concentration corrosion cells that would increase corrosion rates for all metals above what would be expected from the chemical characteristics alone.

Soil pH values varied from 4.9 to 7.1. This range is very strongly acidic to neutral.[2] Total acidity was performed on sample COR-4 and COR-8. The results, 28 and 33 mmol H^{1+}/kg, is not high enough to warrant concern of acid attack to concrete. Soil with a pH less than 5.5 is considered aggressive to copper.

The soluble salt content of the samples ranged from low to moderate. Chloride and sulfate were found at low concentrations.

Some nitrate concentrations were high enough to be aggressive to copper. Ammonium was detected in low concentrations.

Tests were not made for sulfide and oxidation-reduction (redox) potential because these samples did not exhibit characteristics typically associated with anaerobic conditions.

Variation in soil resistivity of an order of magnitude or more can create differential-concentration corrosion cells that would affect all metals.

This soil is classified as severely corrosive to ferrous metals and aggressive to copper.

Corrosion Control Recommendations

The life of buried materials depends on thickness, strength, loads, construction details, soil moisture, etc., in addition to soil corrosivity, and is, therefore, difficult to predict. Of more practical value are corrosion control methods that will increase the life of materials that would be subject to significant corrosion.

The following recommendations are based on the soil conditions discussed in the Soil Corrosivity section above. Unless otherwise indicated, these recommendations apply to the entire site or alignment.

---

[2] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, p. 8.*

Steel Pipe

1. Underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints should be bonded for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.

2. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:

   a. At each end of the pipeline.

   b. At each end of all casings.

   c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

3. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically isolate each buried steel pipeline per NACE SP0286 from:

   a. Dissimilar metals.

   b. Dissimilarly coated piping (cement-mortar vs. dielectric).

   c. Above ground steel pipe.

   d. All existing piping.

4. Choose one of the following corrosion control options:

   OPTION 1

   a. Apply a suitable dielectric coating intended for underground use such as:

      i. Polyurethane per AWWA C222 *or*

      ii. Extruded polyethylene per AWWA C215 *or*

      iii. A tape coating system per AWWA C214 *or*

      iv. Hot applied coal tar enamel per AWWA C203 *or*

      v. Fusion bonded epoxy per AWWA C213.

b. Apply cathodic protection to steel piping as per NACE SP0169.

OPTION 2

As an alternative to dielectric coating and cathodic protection, apply a ¾-inch cement mortar coating per AWWA C205 or encase in concrete three inches thick, using any type of ASTM C150 cement. Joint bonds, test stations, and insulated joints are still recommended for this alternative.

NOTE: Some steel piping systems, such as for oil, gas, and high-pressure piping systems, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Ductile Iron Pipe

1. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE SP0286.

2. Bond all nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.

3. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:

   a. At each end of the pipeline.

   b. At each end of any casings.

   c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

4. Choose one of the following corrosion control options:

   OPTION 1

   a. Apply a suitable coating intended for underground use such as:

      i. Polyethylene encasement per AWWA C105; *or*

      ii. Epoxy coating; *or*

iii. Polyurethane; *or*

iv. Wax tape.

NOTE: The thin factory-applied asphaltic coating applied to ductile iron pipe for transportation and aesthetic purposes does not constitute a corrosion control coating.

b. Apply cathodic protection to cast and ductile iron piping as per NACE SP0169.

OPTION 2

As an alternative to the coating systems described in Option 1 and cathodic protection, concrete encase all buried portions of metallic piping so that there is a minimum of three inches of concrete cover provided over and around surfaces of pipe, fittings, and valves using any type of ASTM C150 cement.

NOTE: Some iron piping systems, such as for fire water piping, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Cast Iron Soil Pipe

1. Protect cast iron soil pipe with either a double wrap 4-mil or single wrap 8-mil polyethylene encasement per AWWA C105.

2. It is not necessary to bond the pipe joints or apply cathodic protection.

3. Provide six inches of clean sand backfill all around the pipe.

Clean Sand Backfill

1. Clean sand backfill must have the following parameters:

   a. Minimum saturated resistivity of no less than 3,000 ohm-cm; *and*

   b. pH between 6.0 and 8.0.

2. All backfill testing should be performed by a corrosion engineering laboratory.

Copper Tubing

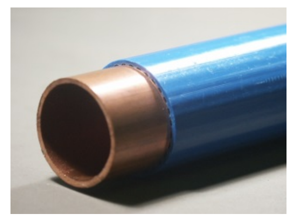
1. Electrically insulate underground copper pipe from dissimilar metals and from above ground copper pipe with insulating devices per NACE SP0286.

2. Electrically insulate cold water piping from hot water piping systems.

3. Protect buried copper tubing by one of the following measures:

    a. Prevention of soil contact. Soil contact may be prevented by placing the tubing above ground or encasing the tubing using PVC pipe with solvent-welded joints.

    b. Installation of a factory-coated copper pipe with a minimum 25-mil thickness such as Kamco's Aqua Shield™, Mueller's Streamline Protec™, or equal. The coating must be continuous with no cuts or defects.



    c. Installation of 12-mil polyethylene pipe wrapping tape with butyl rubber mastic over a suitable primer. Protect wrapped copper tubing by applying cathodic protection per NACE SP0169.

Plastic and Vitrified Clay Pipe

1. No special corrosion control measures are required for plastic and vitrified clay piping placed underground.

2. Protect all metallic fittings and valves with wax tape per AWWA C217, or with epoxy and appropriately sized cathodic protection per NACE SP0169.

All Pipe

1. On all pipes, appurtenances, and fittings not protected by cathodic protection, coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA C217 after assembly.

2. Where metallic pipelines penetrate concrete structures such as building floors, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

Concrete Structures and Pipe

1. From a corrosion standpoint, any type of ASTM C150 cement may be used for concrete structures and pipe because the sulfate concentration is negligible, from 0 to 0.10 percent.[3,4,5]

2. Standard concrete cover over reinforcing steel may be used for concrete structures and pipe in contact with these soils due to the low chloride concentrations[6] found onsite. Limit the water-soluble chloride ion content in the concrete mix design to less than 0.3 percent by weight of cement.

Post-Tensioned Slabs: Unbonded Single-Stranded Tendons and Anchors

Soil is considered an aggressive environment for post-tensioning strands and anchors. Protect post-tensioning strands and anchors against corrosion by implementing all the following measures:[7,8,9]

1. Limit the water-soluble chloride ion content in the concrete mix design to less than 0.06 percent by weight of cement.

2. All tendons should be designed to prevent ingress of moisture. A corrosion-inhibiting coating should be incorporated into the tendon sheaths.

3. Use non-shrink grout mixes for all post-tensioning pockets.

---

[3] *2015 International Building Code (IBC) which refers to American Concrete Institute (ACI) 318-14 Table 19.3.2.1*

[4] *2015 International Residential Code (IRC) which refers to American Concrete Institute (ACI) 318-14 Table 19.3.2.1*

[5] *2016 California Building Code (CBC) which refers to American Concrete Institute (ACI) 318-14 Table 19.3.2.1*

[6] *Design Manual 303: Concrete Cylinder Pipe. Ameron. p.65*

[7] *Post-Tensioning Manual, sixth edition. Post-Tensioning Institute (PTI), Phoenix, AZ, 2006.*

[8] *PTI M10.2-00: Specification for Unbonded Single Strand Tendons. Post-Tensioning Institute (PTI), Phoenix, AZ, 2000.*

[9] *ACI 423.6-01: Specification for Unbonded Single Strand Tendons. American Concrete Institute (ACI), 2001*

4. Prior to grouting the pocket, apply a corrosion protection cap filled with corrosion protection material that provides a watertight seal for the strand end and wedge cavity, such as Tiger Industries' PocketCap or equal. Ensure the cap fully seats against the face of the standard anchor at the live end.
5. All components exposed to the job site should be protected within one working day after their exposure during installation.
6. Ensure the minimum concrete cover over the tendon tail is 1 inch, or greater if required by the applicable building code.
7. Caps should be installed within one working day after the cutting of the tendon tails and acceptance of the elongation records by the engineer.
8. Limit the access of direct runoff onto the anchorage area by designing proper drainage. Do not allow water to pond against anchors.
9. Provide at least two inches of space between finish grade and the anchorage area, or more if required by applicable building codes.

Expanded Analysis

1. Because a limited number of samples were submitted for soil corrosivity analysis, recommendations are based on a worst-case scenario. However, only 2 of the 10 submitted samples (COR-4 and COR-8) indicate low pH and corrosive conditions that require additional corrosion control. The owner may find it advantageous to consider retesting the site more extensively in order to allow for the appropriate scaling of mitigative measures to match the corrosivity of the various regions of the site, thereby removing the alternate need of applying the worst-case corrosivity to the entire site.

Closure

The analysis and recommendations presented in this report are based upon data obtained from the laboratory samples. This report does not reflect variations that may occur across the site or due to the modifying effects of construction. If variations appear, HDR should be notified immediately so that further evaluation and supplemental recommendations can be provided.

HDR's services have been performed with the usual thoroughness and competence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

Please call if you have any questions.

Respectfully Submitted,
HDR Engineering, Inc.

REGISTERED PROFESSIONAL ENGINEER
SEAN O'CASEY HOSS
79964
CIVIL
STATE OF CALIFORNIA

James Keegan Sean O. Hoss, PE

Enc: Table 1

Table 1 - Laboratory Tests on Soil Samples

Geotek, Inc.
PCB-Tr. 31304
Your #2359.CR, HDR Lab #20-0223SCS
24-Apr-20

Sample ID			COR-1 @ 0-1'	COR-2 @ 0-1'	COR-3 @ 0-1'	COR-4 @ 0-1'	COR-5 @ 0-1'
Resistivity		**Units**					
as-received		ohm-cm	13,200	19,200	10,400	2,800	11,200
saturated		ohm-cm	5,200	8,400	4,800	880	7,200
pH			7.1	5.8	6.6	5.5	6.4
Electrical Conductivity		mS/cm	0.10	0.09	0.16	0.48	0.14
Chemical Analyses							
Cations							
calcium	Ca^{2+}	mg/kg	30	38	43	176	52
magnesium	Mg^{2+}	mg/kg	13	15	16	48	18
sodium	Na^{1+}	mg/kg	28	17	57	66	11
potassium	K^{1+}	mg/kg	91	88	128	295	142
Anions							
carbonate	CO_3^{2-}	mg/kg	ND	ND	ND	ND	ND
bicarbonate	HCO_3^{1-}	mg/kg	131	180	195	122	174
fluoride	F^{1-}	mg/kg	7.7	15	11	12	7.6
chloride	Cl^{1-}	mg/kg	14	10	21	174	29
sulfate	SO_4^{2-}	mg/kg	52	19	109	145	20
phosphate	PO_4^{3-}	mg/kg	27	30	40	29	22
Other Tests							
ammonium	NH_4^{1+}	mg/kg	2.3	2.4	3.2	6.4	5.9
nitrate	NO_3^{1-}	mg/kg	37	38	59	781	40
total acidity	H^{1+}	mmol/kg	na	na	na	28	na
Redox		mV	na	na	na	na	na

Resistivity per ASTM G187, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B.
Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

Table 1 - Laboratory Tests on Soil Samples

Geotek, Inc.
PCB-Tr. 31304
Your #2359.CR, HDR Lab #20-0223SCS
24-Apr-20

Sample ID

			COR-6 @ 0-1'	COR-7 @ 0-1'	COR-8 @ 0-1'	COR-9 @ 0-1'	COR-10 @ 0-1'
Resistivity		**Units**					
as-received		ohm-cm	88,000	29,600	4,800	17,600	33,200
saturated		ohm-cm	19,200	12,400	1,680	10,000	17,200
pH			6.5	6.3	4.9	6.4	6.4
Electrical Conductivity		mS/cm	0.03	0.05	0.30	0.06	0.05
Chemical Analyses							
Cations							
calcium	Ca^{2+}	mg/kg	18	29	110	19	23
magnesium	Mg^{2+}	mg/kg	11	13	28	12	13
sodium	Na^{1+}	mg/kg	12	21	41	21	13
potassium	K^{1+}	mg/kg	20	28	203	61	41
Anions							
carbonate	CO_3^{2-}	mg/kg	ND	ND	ND	ND	ND
bicarbonate	HCO_3^{1-}	mg/kg	104	159	134	125	119
fluoride	F^{1-}	mg/kg	5.8	4.3	14	2.7	4.0
chloride	Cl^{1-}	mg/kg	9.6	6.8	42	6.9	6.2
sulfate	SO_4^{2-}	mg/kg	7.1	2.1	80	13	7.0
phosphate	PO_4^{3-}	mg/kg	8.5	10	35	22	14
Other Tests							
ammonium	NH_4^{1+}	mg/kg	1.1	2.8	5.0	2.1	1.1
nitrate	NO_3^{1-}	mg/kg	9.5	8.8	511	25	12
total acidity	H^{1+}	mmol/kg	na	na	33	na	na
Redox		mV	na	na	na	na	na

Resistivity per ASTM G187, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B.
Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

APPENDIX F

GENERAL GRADING GUIDELINES

Updated Geotechnical and Infiltration Evaluation
Tract No. 31304, Perris, Riverside County, California
Project No. 2359-CR

GEOTEK

GENERAL GRADING GUIDELINES

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

General

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

Preconstruction Meeting

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

Grading Observation and Testing

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

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

Site Clearing

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

Treatment of Existing Ground

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

Fill Placement

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

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

Slope Construction

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

UTILITY TRENCH CONSTRUCTION AND BACKFILL

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

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

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

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

JOB SAFETY

General

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

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

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

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

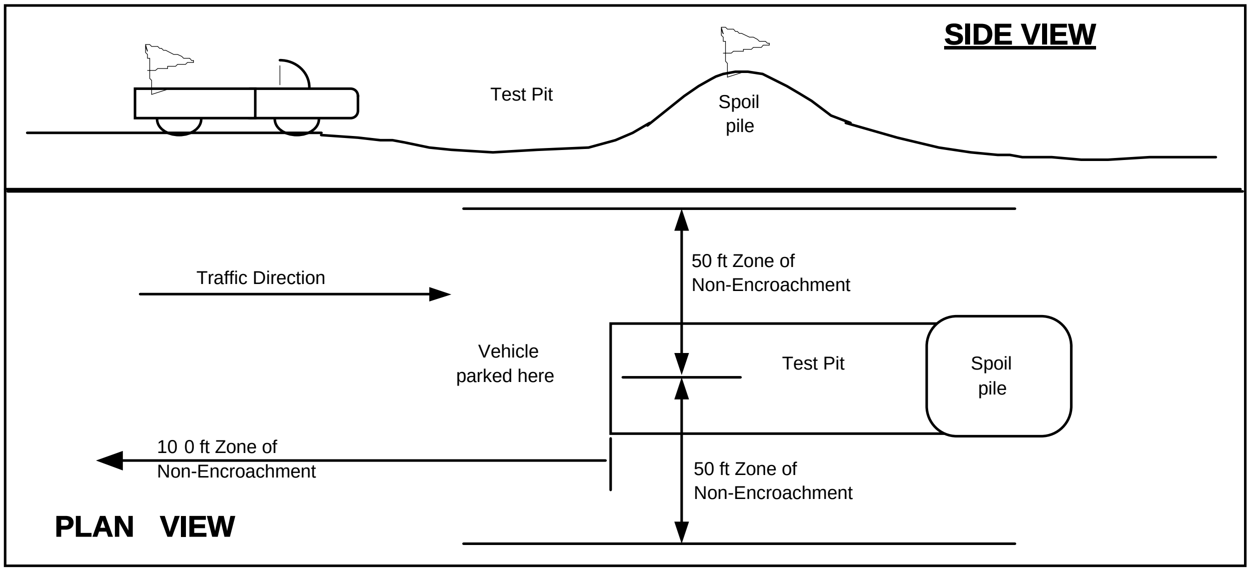
Test Pits Location, Orientation and Clearance

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

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

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

TEST PIT SAFETY PLAN



Slope Tests

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

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

Trench Safety

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

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

Our personnel are directed not to enter any excavation which;

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

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

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

Procedures

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

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

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.

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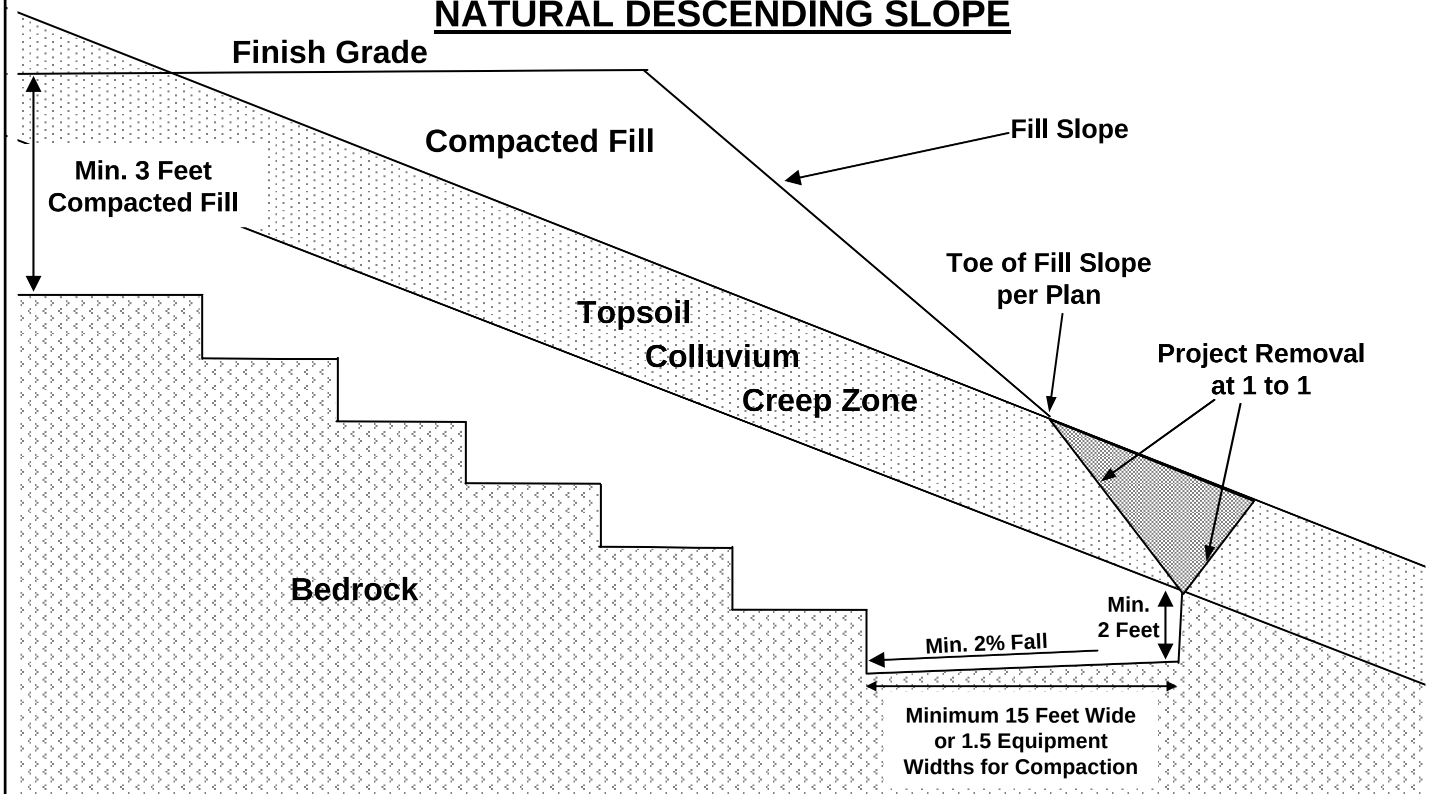
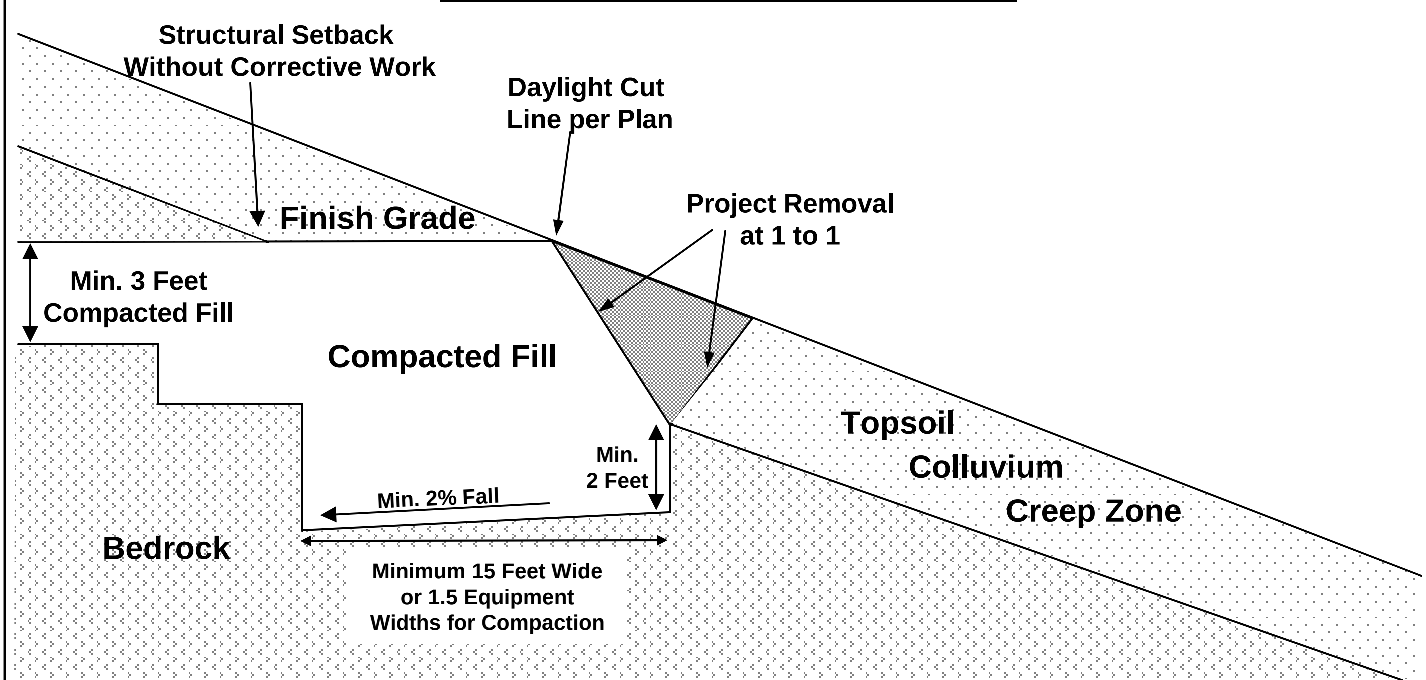
TYPICAL FILL SLOPE OVER NATURAL DESCENDING SLOPE



DAYLIGHT CUT AREA OVER NATURAL DESCENDING SLOPE



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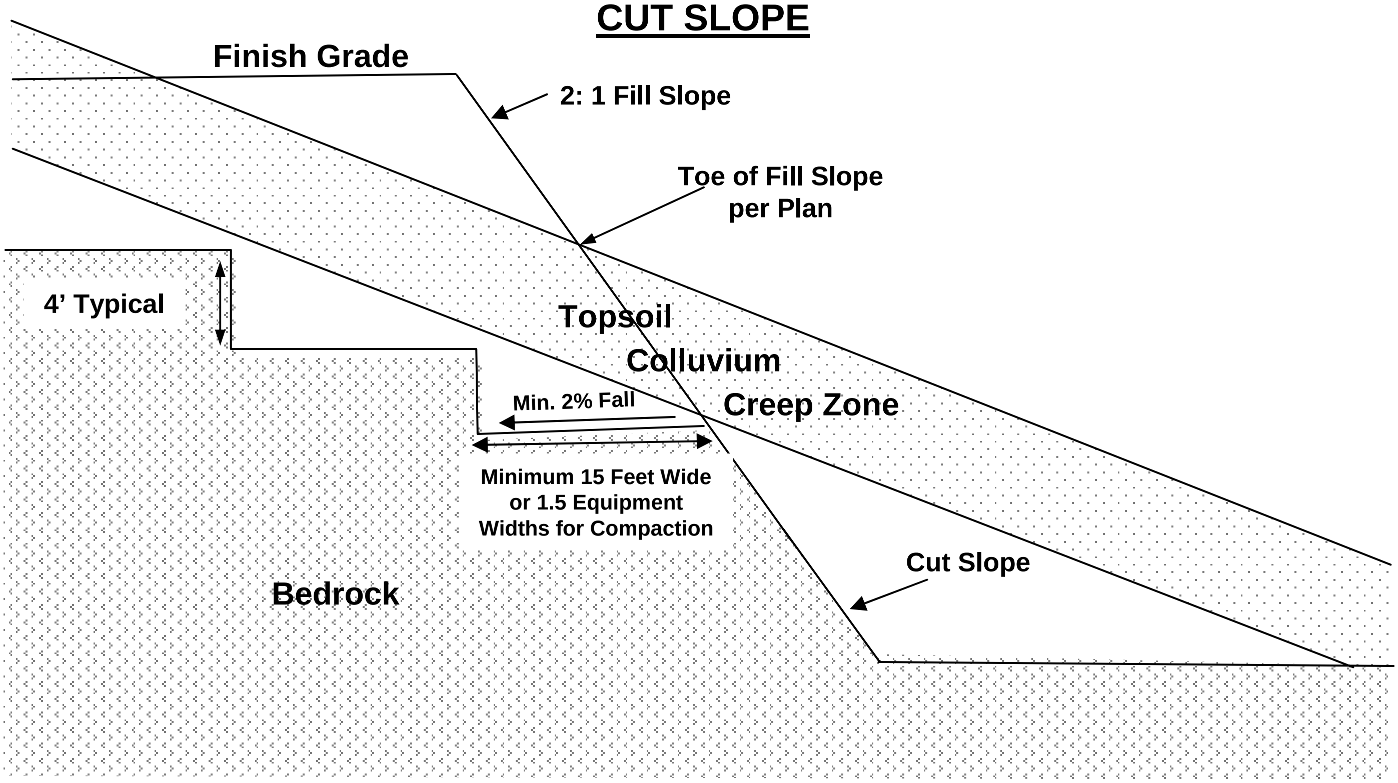
TREATMENT ABOVE NATURAL SLOPES

STANDARD GRADING GUIDELINES

PLATE F-1

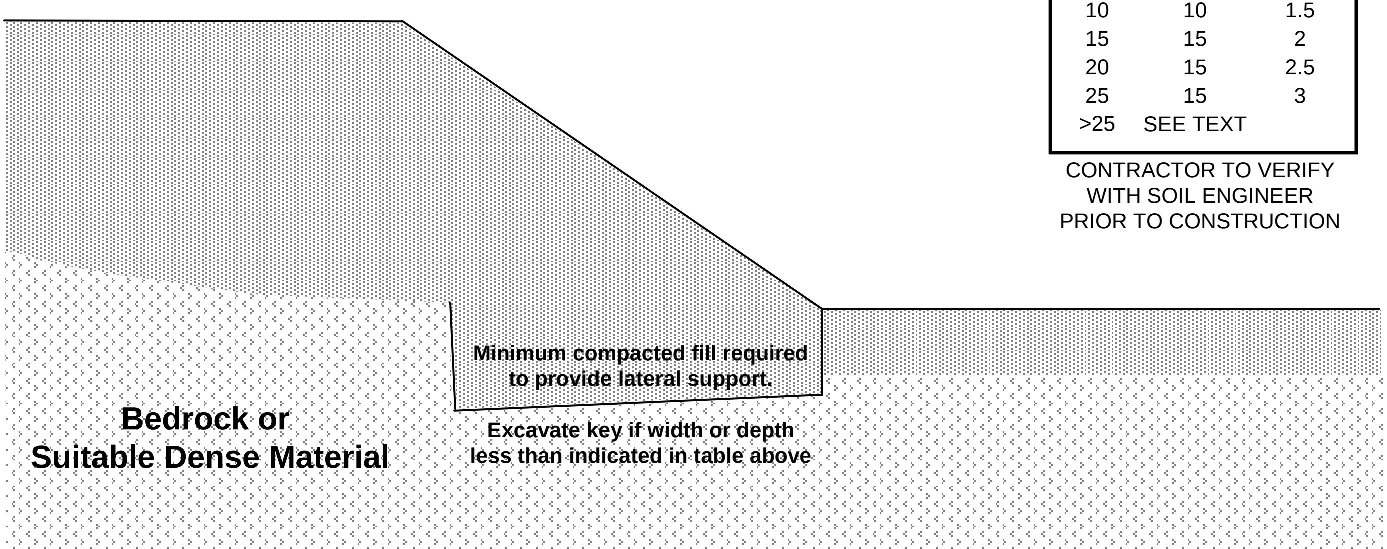
TYPICAL FILL SLOPE OVER CUT SLOPE



TYPICAL FILL SLOPE

SLOPE HEIGHT	MIN. KEY WIDTH	MIN. KEY DEPTH
5	7	1
10	10	1.5
15	15	2
20	15	2.5
25	15	3
>25	SEE TEXT	

CONTRACTOR TO VERIFY WITH SOIL ENGINEER PRIOR TO CONSTRUCTION



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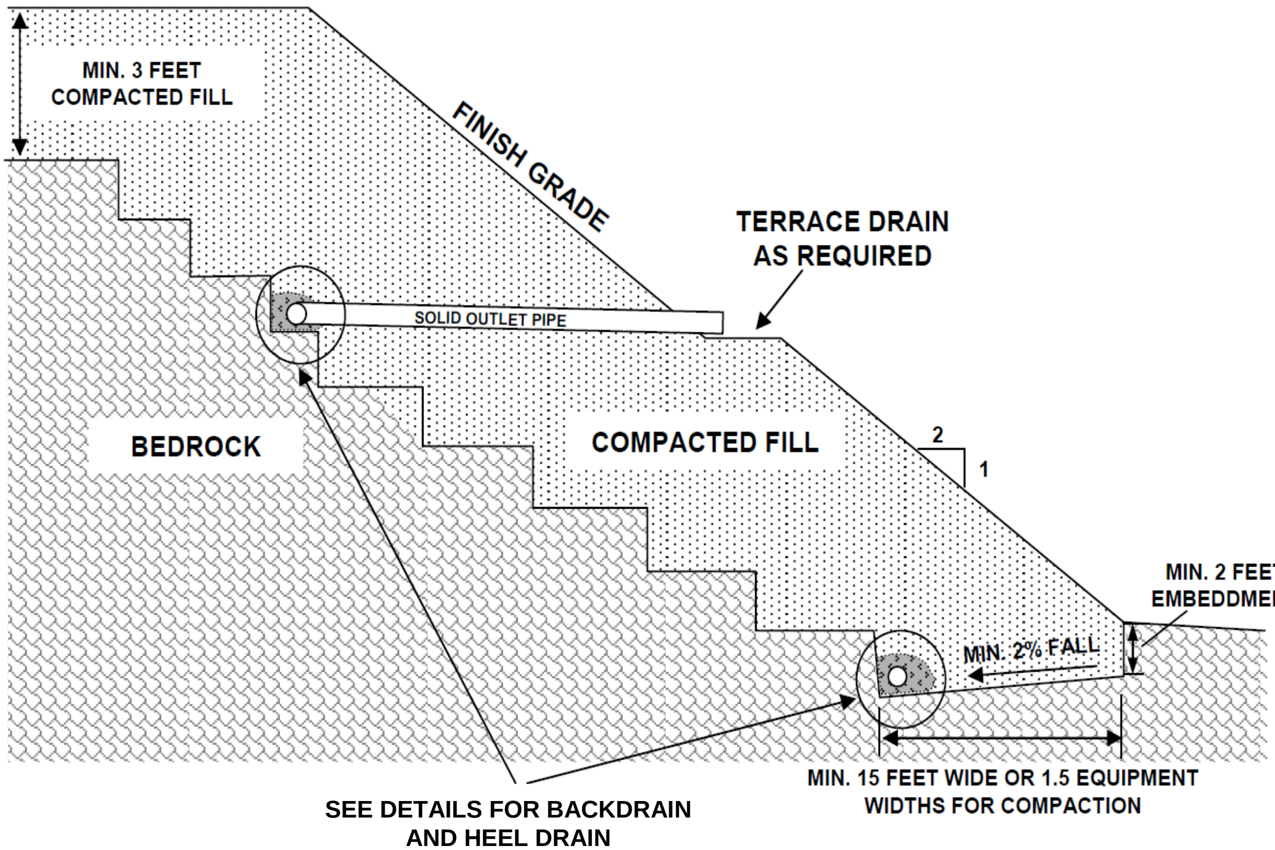
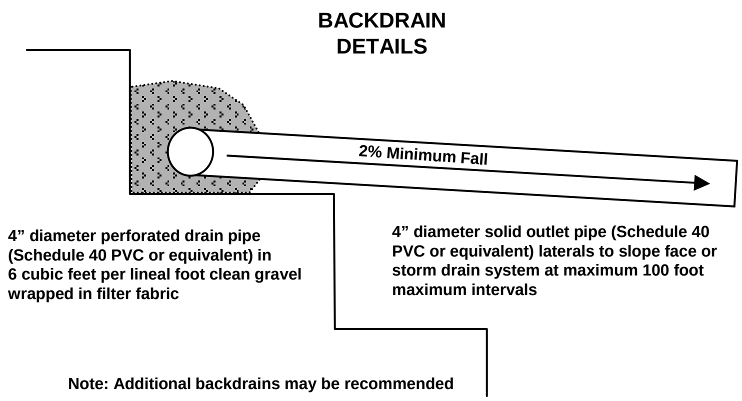
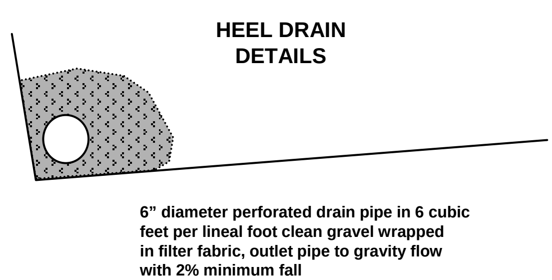
COMMON FILL SLOPE KEYS

STANDARD GRADING GUIDELINES

PLATE F-2







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TYPICAL BUTTRESS AND STABILIZATION FILL

STANDARD GRADING GUIDELINES

PLATE F-3