GEOTECHNICAL EXPLORATION
PROPOSED RESIDENTIAL DEVELOPMENT
TTM 33200
PERRIS, CALIFORNIA

Prepared for

J & C INTERNATIONAL GROUP
17700 Castleton Street, Suite 128
City of Industry, California 91748

Project No. 12223.001

December 14, 2018

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Attention: Mr. Michael Chu

Subject: **Geotechnical Exploration**
Proposed Residential Development - TTM 33200
Perris, California

In accordance with your request, we are pleased to present herewith the results of our geotechnical exploration for the subject project. This report presents our findings, conclusions and recommendations pertaining to the geotechnical aspects of the proposed development. It is our opinion that the overall site appears suitable for the intended use provided our recommendations included herein are properly incorporated during design and construction phases of development. However, one of the major geotechnical concerns on this site is the presence of shallow bedrock and scattered rock outcrops. As such, blasting and generation of oversize rock should be anticipated during grading, especially in deep excavations. Please note that this is a stand-alone geotechnical report and supersedes previous reports prepared for this site.

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

Respectfully submitted,

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1.0 INTRODUCTION

1.1 Purpose and Scope

This geotechnical exploration report is for a Proposed Residential Development (TTM 33200), located southwest of North A Street and Metz Road in the City of Perris, California. Our scope of services for this geotechnical exploration included the following:

- Review of available site-specific information, including various publications and site-specific geotechnical report listed in the references at the end of this report.
- A review of the provided site Tentative Tract Map (Hunsaker, 2006) and Cut/fill analysis plan (Qtative, 2018).
- Site reconnaissance, geologic mapping and visual observations of surface conditions.
- Excavation of eleven (11) exploratory borings within the site. Approximate locations of these borings are depicted on the accompanying geotechnical Map (Plate 1). The logs of borings are presented in Appendix A.
- Geotechnical laboratory testing of selected soil samples collected during this exploration. Test results are presented in Appendix B.
- Geotechnical engineering analyses performed or as directed by a California registered Geotechnical Engineer (GE). A California Certified Engineering Geologist (CEG) performed engineering geology review of site geologic hazards.
- Preparation of this report which presents our geotechnical conclusions and recommendations regarding the grading and design of the proposed structures.

This report is not intended to be used as an environmental assessment (Phase I ESA or others), or foundation and/or a rough grading plan review.

1.2 Site Location and Description

The approximately 53-acre site is located southwest of the intersection of North A Street and Metz Road, in the City of Perris, California (*see Figure 1, Site Location Map*). The site is bounded to the east by North A Street and existing residential developments, to the north by Metz Road, to the west by undeveloped land, and to the south by San Jacinto Avenue. Topographically, the property contains low rolling terrain with moderately steep hills along the northwestern boundary with an elevation of approximately 1,580 feet MSL. The lowest portion of the site with an elevation of approximately 1,493 feet MSL is located in the northeastern corner of the site. The site is currently undeveloped, with elevated rock outcroppings noted throughout the site. Surface vegetation is generally sparse to locally moderate with native shrubs and grasses.

1.3 Proposed Development

Based on the provided Tentative Tract Map (Hunsaker & Associates, 2006), we understand that Tract 33200 will consist of 124 residential lots with associated site improvements (still subject to changes). The residential lots will host a typical one- or two-story single-family residential home consisting of wood-frame structure with conventional or post-tensioned slab-on-grade foundations. The foundation loads are not expected to exceed 2,500 pounds per lineal foot (plf) for continuous footings. Grading will require cuts and fills typically on the order of 20 feet and 12 feet, respectively. Based on a cut/fill analysis map (QTative, 2018), the maximum fill depth (before remedial removal) will be on the order of 10 to 13 feet and maximum excavation will be on the order of 18 to 20 feet. The maximum excavation will be locally deeper to provide rock clearance for underground utility construction.

1.4 Previous Site Investigations

A previous geotechnical investigation for this site was conducted by Global Geo-Engineering, Inc, (GGI, 2004). This investigation included a preliminary subsurface investigation consisting of eight (8) hollow stem auger borings and seven seismic refraction lines. The results of this previous investigation have been reviewed and incorporated into this study where appropriate.

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 Field Exploration

Our field exploration consisted of the excavation of eleven (11) borings within accessible areas of the site. During exploration, in-situ undisturbed (Cal Ring) and disturbed/bulk samples were collected from the borings for further laboratory testing and evaluation. Approximate locations of the borings are depicted on the *Geotechnical Map* (Plate 1). Sampling was conducted by a staff engineer from our firm. After logging and sampling, the excavations were loosely backfilled with spoils generated during excavation. Additionally, the property was traversed by a geologist from our firm to look for indications of surface distress, ground settlement (ground cracking), landslides or other possible ground surface deficiencies.

The exploration logs included within Appendix A and related information depicts subsurface conditions only at the locations indicated and at the particular date designated on the logs. Subsurface conditions at other locations may differ from conditions occurring at these borings locations. The passage of time may result in altered subsurface conditions due to environmental changes. In addition, any stratification lines on the logs represent the approximate boundary between soil types and the transition may be gradual.

2.2 Laboratory Testing

Laboratory tests were performed on representative bulk samples to provide a basis for development of remedial earthwork and geotechnical design parameters. Selected samples were tested to determine the following parameters: maximum dry density and optimum moisture, expansion index, collapse/settlement potential, R-value and soluble sulfate content. The results of our laboratory testing are presented in Appendix B.

3.0 GEOTECHNICAL AND GEOLOGIC FINDINGS

3.1 Regional Geology

The site is located within a prominent natural geomorphic province in southwestern California known as the Peninsular Ranges. It is characterized by steep, elongated ranges and valleys that trend northwestward. More specifically, the site is situated within the Perris Block, an eroded mass of Cretaceous and older crystalline rock.

The Perris Block, approximately 20 miles by 50 miles in extent, is bounded by the San Jacinto Fault Zone to the northeast, the Elsinore Fault Zone to the southwest, the Cucamonga Fault Zone to the northwest, and the Temecula Basin to the southeast. The southeast boundary of the Perris block is poorly defined. The Perris Block has had a complex tectonic history, apparently undergoing relative vertical land movements of several thousand feet in response to movement on the Elsinore and San Jacinto Fault Zones. Thin sedimentary and volcanic materials locally mantle the crystalline bedrock. Alluvial and colluvial deposits fill the lower valley areas.

Geologic units on the subject property include Older Alluvial Fan Deposits (Qvof) and granitic bedrock locally known as the Val Verde Tonalite (Kvt), see the Regional Geologic Map, (Figure 2 and Plate 1). Undocumented artificial fill soils associated with adjacent development and roadway embankments, stockpile soils, and other construction debris/refuse exist on site.

3.2 Site Specific Geology

The site geologic units are discussed in the following sections in order of increasing age and further described on the logs of geotechnical borings in Appendix A.

3.2.1 Undocumented fill

Although not encountered in any of our borings, artificial undocumented fill was observed throughout the eastern portions of the subject site as piles of oversize granitic rock to possibly storm water control embankments. Based on our field observations, the undocumented fill embankments appear to range between 3 and 10 feet in thickness. It should be anticipated that boulders (greater than 12 inches) in stockpiles will require special placement as described later in this report.

3.2.2 Very Old Fan Deposits (Qvof)

Older alluvial soils were observed within the upper 4 to 21 feet at various locations across the site. As encountered, these soils appear to have individual layers that vary in color, moisture content, density and composition. Unit layers are typically composed of reddish brown, moist, medium dense to dense, silty sand (SM) and lessor silty/clayey sand (SM/SC) with abundant iron oxide staining, caliche, scattered pebbles, mottling, and minor porosity. Isolated pockets of thicker older alluvial soils should be anticipated. This older alluvium appears to be generally dense and is expected to generally possess a very low expansion potential (EI<21). The upper 5 feet is locally subject to hydro-consolidation as evidenced in LB-8 (Appendix B).

3.2.3 Val Verde Tonalite (Map Symbol Kvt)

The Val Verde Tonalite (Cretaceous granite) was encountered near surface across the majority of the site and ranged from 4 to 21 feet below ground surface. As observed during the field exploration, the condition of the near-surface bedrock varies from that of completely disintegrated rock that has become a dense soil-like deposit to that of highly to moderately weathered rock. Where encountered in our borings, the bedrock is generally massive and can be expected to range from readily rippable to non-rippable depending on the degree of weathering. The less weathered granitic rock is anticipated to generate sand, gravel, cobble, and oversize boulders. The weathered bedrock produced fine to coarse sand with silt and gravel size rock fragments. The weathered bedrock is expected to be suitable for re-use as compacted fill. It should be anticipated that deep cuts in the elevated portions of the site may generate boulders or core stones (greater than 12 inches) that will require special placement described later in this report.

3.3 Landslide/Debris Flow and Rockfall

No evidence of on-site landslides/debris flow was observed during our field investigation and review of referenced reports. The onsite bedrock is generally not prone to landsliding. Thin deposits of surficial soils are present only in the relatively low-lying portions of the site and, therefore, are not considered prone to landsliding.

Due to the presence of rounded boulder outcropping in the central portion of the site, rockfall during seismic shaking is possible. Preliminary Rock Fall Hazard Areas are depicted on the Geotechnical Map (Plate 1). However, several of these boulder outcrops were locally noted to be fractured which reduces the potential for roll-out and the possibility of rockfall. Once grading plans are developed, this hazard should be further evaluated. Mitigation of this hazard can be boulder removal, strategic movement by heavy equipment to remove perched boulders, local rock reduction, setbacks or other rock constraining methods.

3.4 Rippability

Based on the previous seismic refraction survey (GGI, 2004), the bedrock materials appear to be readily to marginally rippable to depths of 5-15 feet below the existing grades with the material becoming difficult to very difficult with increasing depth, where evaluated (see Appendix C). As such, the rippability of site bedrock can vary significantly with depth and location. The grading contractor should consider the possibility of utilizing dozer excavation pits with the type and size of equipment likely to be used during grading if additional information is needed with regard to rippability. It should be noted that the estimated depth of rippable materials is based on our interpretation of the previous limited seismic survey data, our borings and the generally accepted ripper performance tables published in the Caterpillar Performance Handbook. It has been our experience, that significant quantities of oversized materials could still be generated when working in bedrock materials like those encountered onsite. Rocks greater than 12 inches in greatest dimension should not be utilized in fill within the upper 10 feet of finished grade. We recommend that the project budget consider the costs associated with the generation of oversized rock that will require special handling, deep onsite placement/ disposal, additional size reduction, and/or off-site disposal. Areas that may be considered for onsite disposal with additional deep overexcavation are depicted on the Geotechnical Map (Plate 1). A thorough field review of the onsite materials and seismic data presented herein should be performed by any grading contractor prior to, or as part of, the bidding process.

For planning purposes, the proposed building pads and utility trenches in marginally rippable to non-rippable rock areas, it may be desirable to over-excavate at least 2 feet below the bottom of proposed utility trenches or 4 to 5 feet below pad grade to facilitate future trenching operations, where applicable.

3.5 Groundwater and Surface Water

Groundwater was not encountered during this and previous explorations to total depth explored of 46 feet and no standing or surface water was observed on the site at the time of our field exploration. However, some natural drainages enter the eastern portion of the property and the control of surface water flowing into the site should be considered by the design civil engineer. Historic groundwater data, as reported by Eastern Municipal Water District’s (EMWD) in well located 1.7 miles east of the site, reflect a groundwater elevation of 1369 feet (about 50 feet deep) in October 2017. The site is approximately at elevation 1490 feet (or 121 feet above GWT).

3.6 Faulting

No active or potentially active faults were observed on-site or trending to the project site. The closest active fault is the Temecula Segment of the Elsinore Fault Zone. The subject site is not included within an Earthquake Fault Zone as created by the Alquist-Priolo Earthquake Fault Zoning Act (CGS, 2018, Bryant, 2007). The nearest zoned active faults are the Elsinore-Temecula Fault, located approximately 8.6 miles southwest of the site, Elsinore-Glen Ivy Fault, located approximately 9.1 miles west of the site; and the San Jacinto-San Jacinto Valley Fault, located approximately 14.0 miles east of the site (Blake, 2000). This site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone or County of Riverside Fault Zone.

3.7 Seismicity

Strong ground shaking can be expected at the site during moderate to severe earthquakes in this general region. This is common to virtually all of Southern California. Intensity of ground shaking at a given location depends primarily upon earthquake magnitude, site distance from the source, and site response (soil type) characteristics. The site-specific seismic coefficients based on the 2016 California Building Code (CBC) are presented below in Table 1.

Table 1. CBC Site-Specific Seismic Coefficients

CBC Categorization/Coefficient		Value (g)
Site Longitude (decimal degrees)	-117.2382	
Site Latitude (decimal degrees)	33.7881	
Site Class Definition	**C**	
Mapped Spectral Response Acceleration at 0.2s Period, S_s		**1.50**
Mapped Spectral Response Acceleration at 1s Period, S_1		**0.60**
Short Period Site Coefficient at 0.2s Period, F_a		**1.0**
Long Period Site Coefficient at 1s Period, F_v		**1.3**
Adjusted Spectral Response Acceleration at 0.2s Period, S_{MS}		**1.50**
Adjusted Spectral Response Acceleration at 1s Period, S_{M1}		**0.78**
Design Spectral Response Acceleration at 0.2s Period, S_{DS}		***1.00***
Design Spectral Response Acceleration at 1s Period, S_{D1}		***0.52***

* g- Gravity acceleration

3.8 Dynamic Settlement (Liquefaction and Dry Settlement)

Assuming that the loose, near-surface soils will be removed and recompacted in accordance with the recommendations of Section 5.0 of this report in the areas of development, the potential for liquefaction or dynamic settlement due to the design earthquake event to affect structures at this site is considered very low, based on the lack of shallow groundwater and relatively dense nature of underlying materials.

3.9 Flooding

The site is not located within a “100-year” flood zone on the official FEMA Flood Hazard Areas Map (FEMA Map Sheet 06065C1440H) dated August 18, 2014.

3.10 Seiche and Tsunami

The site is not located within a coastal area and therefore, tsunamis are not considered a hazard. Seiches are large waves generated in enclosed bodies of water in response to ground shaking.

3.11 Expansive Soils

Limited laboratory testing indicated that near surface soils generally possess a very low expansion potential (EI<21). Soils generated from excavation of bedrock are also expected to possess a very low expansion potential.

3.12 Collapsible Soils

Laboratory testing indicates that the onsite soils (older alluvium) are expected to possess a slight to moderate collapse potential in the upper 5 feet. Based on the remedial grading recommendations to remove and compact the near surface collapse prone soils (Section 5.2.1), this geologic hazard on this site is considered mitigated.

3.13 Slope Stability

It is anticipated that cut and fill slopes constructed within the site are to be less than 30 feet in height. If constructed at 2:1 gradient using onsite soils, fill slopes should be grossly stable under short- and long-term conditions (including seismic loading). Cut slopes up to 30 feet located in granitic bedrock may be considered at 1.5:1 slope ratio. Steeper slopes may be locally acceptable with additional stability analysis and/or review of site conditions. Localized small wedge shaped pop outs may be anticipated due to the fractured nature of the bedrock. All cut-slopes should be mapped by the geotechnical consultant during grading to confirm stable slope conditions.

4.0 SUMMARY OF FINDINGS AND CONCLUSIONS

Based on the results of this geotechnical review/evaluation, the following is a summary of our main geotechnical findings and conclusions:

- The existing onsite soils are suitable for reuse as fill during proposed grading provided they are relatively free of organic material, debris and oversize rocks.
- Removal and recompaction of all undocumented fill, topsoil and surficial alluvial soils will be required as part of overall site development. Based on our site evaluation, remedial removals to 5 feet in the older alluvial soils are anticipated. Locally deeper removals might be required in areas of undocumented fill soils and depending on the subsurface conditions exposed during grading.
- On-site bedrock materials encountered are rippable to marginally rippable to depths of 5-15 feet below existing grades utilizing a Caterpillar D9R Tracked Dozer or larger in good working condition. Below these depths the material is likely to be difficult to very difficult ripping with blasting or other rock reducing techniques possible.
- Excavations in granitic bedrock will produce oversize rock (greater than 12 inches), which will require special handling and placement at depths of at least 10 feet below finish grade.
- Proposed cut and fill slopes designed at 2:1 or flatter are considered grossly stable.
- Strong ground shaking may occur at this site due to local earthquake activities.
- Evidence of active faulting was not observed within or immediately adjacent to the subject site.
- Groundwater is not anticipated to be a constraint during future site grading and underground utility construction.
- Based on preliminary laboratory results and field observations, onsite earth materials are expected to possess a very low expansion potential. Additional testing should be performed during site grading to verify these observations and limited laboratory data.
- Limited laboratory testing (Appendix B) indicates that the on-site soils present a negligible sulfate exposure to concrete. Additional testing should be performed during site grading to verify these observations and limited laboratory data.

5.0 RECOMMENDATIONS

5.1 General

The proposed development of the site appears feasible from a geotechnical viewpoint provided that the following recommendations are incorporated into the design and construction phases of development.

5.2 Earthwork

Earthwork should be performed in accordance with our recommendations below and the *Earthwork and Grading Specifications* included in Appendix D. The recommendations contained in Appendix D, are general grading specifications provided for typical grading projects and some of the recommendations may not be strictly applicable to this project. The specific recommendations contained in the text of this report should supersede those in Appendix D. The contract between the developer and earthwork contractor should be worded such that it is the responsibility of the contractor to place the fill properly in accordance with the recommendations of this report, the specifications in Appendix D, applicable City Grading Ordinances, notwithstanding the testing and observation of the geotechnical consultant.

5.2.1 Site Preparation and Remedial Grading

Prior to grading, the proposed structural improvement areas (i.e. all structural fill areas, pavement areas, etc.) of the site should be cleared of surface and subsurface obstructions, heavy vegetation and boulders. Roots and debris should be disposed of offsite. Septic tanks or seepage pits, if encountered, should be abandoned in accordance with the County of Riverside Department of Health Services guidelines.

The undocumented fill, surficial topsoil, and some of the alluvial deposits are potentially compressible in their present state and may settle under the surcharge of fills or foundation loading. If not removed by proposed grading, the upper 5 feet of these soils should be removed and recompacted in areas supporting additional fill soils or structural improvements. The bottom of removal should expose competent materials consisting of dense alluvium or bedrock. Dense competent alluvium should possess a minimum of 85 percent relative compaction (based on ASTM D1557). Acceptability of all removal bottoms should be reviewed by an engineering geologist with field or laboratory testing under the supervision of a geotechnical engineer. The removal bottom elevations should be documented in the as-graded geotechnical report.

The removal limit should be established by a 1:1 projection from the edge of fill soils supporting settlement-sensitive structures downward and outward to competent material identified by the geotechnical consultant. Removals will also include benching into competent material as the fills rise. Areas adjacent to existing structures, including roadways, may require special monitoring. Temporary slopes in these areas should be no steeper than 1:1. Friable materials, if encountered, may require additional layback.

In shallow rock areas, remedial grading/overexcavation should extend to a minimum depth of 3 feet below pad grade or one-half of the maximum fill thickness beneath the proposed structure, whichever is deeper. Overexcavation can encompass the entire lot or extend laterally beyond the building limits a minimum horizontal distance of 5 feet. Overexcavation bottoms should be sloped as needed to prevent the accumulation of subsurface water.

5.2.2 Cut/Fill Transition Lots and Streets

In order to mitigate the impact of underlying cut/fill transition conditions, we recommend overexcavation of the cut portion underlying building pads during grading to a minimum depth of 3 feet below finish pad elevation. This overexcavation does not include scarification or preprocessing prior to placement of fill. Overexcavation should encompass the entire building limits a horizontal distance equal to the depth of overexcavation or to a minimum distance of 5 feet, whichever is greater. Overexcavation bottoms should be sloped a minimum of 1 percent to reduce the accumulation of subsurface water.

We further recommend that streets located in the dense bedrock be overexcavated to a depth of 2 feet below the deepest utility and then brought back up to design grades with compacted fill.

5.2.3 Suitability of Site Soils for Fills

The onsite soils are generally suitable for re-use as compacted fill, provided they are free of debris and organic matter. Fills placed within 10 feet of finish pad grades or slope faces should contain no rocks over 12 inches in maximum dimension. In addition, clayey soils (EI>21), if any, should be placed at depth greater than 3 feet below finished grades where feasible. All structural fill should be compacted throughout to 90 percent of the ASTM D 1557 laboratory maximum density, at or slightly above optimum moisture.

Areas to receive structural fill and/or other surface improvements should be approved by the geotechnical consultant then scarified to a minimum depth of 8 inches, conditioned to at least optimum moisture content, and recompacted. Fill soils should be placed at a minimum of 90 percent relative compaction (based on ASTM D1557) and near or above optimum moisture content. Placement and compaction of fill should be performed in accordance with local grading ordinances under the observation and testing of the geotechnical consultant. The optimum lift thickness to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. In general, fill should be placed in uniform lifts not exceeding 8 inches in thickness.

Fill slope keyways will be necessary at the toe of all fill slopes and at fill-over-cut contacts. Keyway schematics, including dimensions and subdrain recommendations, are provided in Appendix D. All keyways should be excavated into dense bedrock or dense older alluvium as determined by the geotechnical consultant. The cut portions of all slope and keyway excavations should be geologically mapped and approved by a geologist prior to fill placement.

Fills placed on slopes steeper than 5:1 (horizontal:vertical) should be benched into dense soils (see Appendix D for benching detail). Benching should be of sufficient depth to remove all loose material. A minimum bench height of 2 feet into approved material should be maintained at all times. A grading contractor with experience in the handling and placement of oversize rock should be selected for this project.

5.2.4 Oversize Rock

Based on our observations, we anticipate that grading of the site will produce a significant amount of oversized rock (greater than 12 inches in maximum dimension). No rock in excess of 12 inches in maximum dimension may be placed in any fill within 10 feet of finish grade. Oversized rock may be placed in fills more than 10 feet below finish grade, if placed in accordance with the following guidelines and the specifications contained in Appendix D. Deeper overexcavation may be required to provide sufficient area and depth of cover of the oversized rock. Potential areas for deeper excavation are depicted on the Geotechnical Map (Plate 1).

Within the upper 5 feet of finish grade, fill soils should not contain rock greater than 6 inches in maximum dimension in order to facilitate foundation and utility trench excavation. For fill soils between 5 and 10 feet below finish grade, the fill may contain rock up to 12 inches in maximum dimension and should be mixed with sufficient soil to eliminate voids. Below a depth of 10 feet, rocks up to a maximum dimension of 36 inches may be incorporated into the fill provided adequate fines to fill all voids are present. Rocks greater than 36 inches in diameter may be placed on a case-by-case basis.

We anticipate that a minimum of approximately 35 to 40 percent coarse grained sandy material will be necessary to adequately fill all voids in rock fills. Soil used to fill voids in rock fills should be flooded during placement with a sufficient amount of water to wash soil into all voids. Material filling voids should be compacted to a minimum of 90 percent of the soil's maximum dry density. The outer 20 feet (10 feet vertically) of all fill slopes should not contain rocks greater than 12 inches. Subdrains should be considered at the base of rock fills to minimize the potential for a build-up of hydrostatic pressure.

In the case where the fill volume is not sufficient to allow for burial of all oversized rocks generated, those remainder rocks may also be placed on the surface in ungraded areas. Rocks placed on the surface should be embedded or nested, as needed, to prevent a rockfall hazard.

5.2.5 Shrinkage and Bulking

The volume-change of excavated onsite materials upon recompaction is expected to vary with materials, density, insitu moisture content, location, and compaction effort. The in-place and compacted densities of soil materials vary and accurate overall determination of shrinkage and bulking cannot be made. Therefore, we recommend site grading include, if possible, a balance area or ability to adjust import quantities to accommodate some variation. Based on our experience with similar materials, the following values are provided as guidelines:

Table 2. Earthwork Shrinkage and Bulking Estimates

Geologic Unit	Estimated Shrinkage/Bulking
Undocumented Fill/Surficial Soils	5 to 15 percent shrinkage
Older Alluvium	0 to 10 percent shrinkage
Granitic Bedrock	0 to 10 percent bulking

5.2.6 Import Soils

Import soils and/or borrow sites, if needed, should be evaluated by us prior to import. Import soils should be uncontaminated, granular in nature, free of organic material (loss on ignition less-than 2 percent), have low expansion potential (with an Expansion Index less than 21) and have a low corrosion impact to the proposed improvements.

5.2.7 Utility Trenches

Utility trenches should be backfilled with compacted fill in accordance with the *Standard Specifications for Public Works Construction,* (“Greenbook”), 2018 Edition. Fill material above the pipe zone should be placed in lifts not exceeding 8 inches in uncompacted thickness and should be compacted to at least 90 percent relative compaction (ASTM D 1557) by mechanical means only. Site soils may generally be suitable as trench backfill provided these soils are screened of rocks over 1½ inches in diameter and organic matter. The upper 6 inches of backfill in all pavement areas should be compacted to at least 95 percent relative compaction.

Excavation of utility trenches should be performed in accordance with the project plans, specifications and the *"Greenbook"*. The contractor should be responsible for providing a "competent person" as defined in Article 6 of the *California Construction Safety Orders*. Contractors should be advised that sandy soils (such as fills generated from the onsite alluvium) could make excavations particularly unsafe if all safety precautions are not properly implemented. In addition, excavations at or near the toe of slopes and/or parallel to slopes may be highly unstable due to the increased driving force and load on the trench wall. Spoil piles from the excavation(s) and construction equipment should be kept away from the sides of the trenches. Leighton does not consult in the area of safety engineering.

5.2.8 Drainage

All drainage should be directed away from structures a minimum of 1% by means of approved permanent/temporary drainage devices. Adequate storm drainage of any proposed pad should be provided to avoid wetting of foundation soils. Irrigation adjacent to buildings should be avoided when possible. As an option, sealed-bottom planter boxes and/or drought resistant vegetation should be used within 5-feet of buildings.

5.2.8.1 Subdrainage

Subdrains will be necessary in fill over cut keyways and deepened overexcavations made to bury oversize rock, if needed. Canyon subdrains are not anticipated for this grading due to lack of significant canyon fills. Contacts on fill over cut slopes which daylight cut material can present seepage problems once irrigation of the slopes and upper pads begins. The subdrains within the fill over cut keyways should mitigate this seepage problem. Subdrain details are provided in Appendix D. All outlets should be protected with a concrete apron and cover. Subdrain pipe may be schedule 40 PVC (or equal) placed in accordance with Appendix D.

5.2.9 Slope Construction

Compacted fill or cut slopes up to 30 feet in height at 2:1 (horizontal:vertical) are considered grossly stable for static and pseudostatic conditions. Higher or steeper slopes should be subject to further review and evaluation. Any new 2:1 slopes using the onsite soils compacted to minimum 90 percent should also be stable under short and long term conditions. The outer portion of new fill slopes should be either overbuilt by 2 feet (minimum) and trimmed back to the finished slope configuration or compacted in vertical increments of 5 feet (maximum) by a weighted sheepsfoot roller as the fill is placed. The slope face should then be track-walked by dozers of appropriate weight to achieve the final slope configuration and compaction to the slope face.

New fill slopes should be provided a toe of slope keyways as depicted in Appendix D. Any new fill slopes placed along existing fill slope, the minimum new fill width should be 8 feet. No stab fills are allowed. If fill is placed against existing cut slope (exposing older alluvium), the minimum fill width should be 15 feet per Appendix D.

All cut slopes should be observed and mapped by a Leighton geologist to confirm the exposed conditions are stable and no minor fill width is left in place. In this case when cutting an existing fill slope back into the fill core, a minimum remaining fill width of 15 feet is recommended.

Slope faces are inherently subject to erosion, particularly if exposed to rainfall and irrigation. Landscaping and slope maintenance should be conducted as soon as possible in order to increase long-term surficial stability. Berms should be provided at the top of fill slopes. Drainage should be directed such that surface runoff on the slope face is minimized

5.3 Preliminary Foundation Design

5.3.1 Bearing and Lateral Pressures

Based on our analysis, the proposed single-family residential structures may be founded on conventional slab-on-grade system based on prevailing finish pad soils conditions after grading. As indicated previously in this report, the compacted fill possesses very low expansion potential. As such, we recommend that the structural consultant and/or foundation engineer presents foundation design categories (i.e. conventional or stiffened slab-on-grade design) based on actual expansion potential of subgrade soils of each pad at completion of grading. Foundation footings may be designed with the following geotechnical design parameters:

▪ Allowable Bearing Capacity:	2,000 psf at a minimum depth of embedment of 12 inches (minimum width of 12 inches). This bearing capacity may be increased by ⅓ for short-term loading conditions (e.g., wind, seismic).
▪ Sliding Coefficient:	0.35
▪ Total Settlement:	1 inch
▪ Differential Settlement:	0.5 inch in 40 feet

The conventional slabs should be designed in accordance with the 2016 CBC.

5.3.2 Vapor Retarder

It has been a standard of care to install a moisture retarder underneath all slabs where moisture condensation is undesirable. Moisture vapor retarders may retard but not totally eliminate moisture vapor movement from the underlying soils up through the slabs. However, we recommend that the slab subgrade soils be properly moisture conditioned prior to placement of the vapor barrier system and foundation concrete. The extent of moisture conditioning or depth of presoaking, if required, should be determined during grading based on expansion potential testing of near finish grade soils.

5.4 Retaining Walls

Retaining wall earth pressures are a function of the amount of wall yielding horizontally under load. If the wall can yield enough to mobilize full shear strength of backfill soils, then the wall can be designed for "active" pressure. If the wall cannot yield under the applied load, the shear strength of the soil cannot be mobilized and the earth pressure will be higher. Such walls should be designed for "at rest" conditions. If a structure moves toward the soils, the resulting resistance developed by the soil is the "passive" resistance. Retaining walls backfilled with non-expansive soils should be designed using the following equivalent fluid pressures:

Table 3. Retaining Wall Design Earth Pressures (Static, Drained)

Loading Conditions	Equivalent Fluid Density (pcf)	
	Level Backfill	2:1 Backfill
Active	36	50
At-Rest	55	85
Passive*	300	150 (2:1, sloping down)

* This assumes level condition in front of the wall will remain for the duration of the project, not to exceed 3,500 psf at depth. If sloping down (2:1) grades exist in front of walls, then they should be designed using passive values reduced to ½ of level backfill passive resistance values.

Unrestrained (yielding) cantilever walls should be designed for the active equivalent-fluid weight value provided above for very low to low expansive soils that are free draining. In the design of walls restrained from movement at the top (non-yielding) such as basement or elevator pit/utility vaults, the at-rest equivalent fluid weight value should be used. Total depth of retained earth for design of cantilever walls should be measured as the vertical distance below the ground surface measured at the wall face for stem design, or measured at the heel of the footing for overturning and sliding calculations. Should a sloping backfill other than a 2:1 (horizontal: vertical) be constructed above the wall (or a backfill is loaded by an adjacent surcharge load), the equivalent fluid weight values provided above should be re-evaluated on an individual case basis by us. Non-standard wall designs should also be reviewed by us prior to construction to check that the proper soil parameters have been incorporated into the wall design.

All retaining walls should be provided with appropriate drainage. The outlet pipe should be sloped to drain to a suitable outlet. Typical wall drainage design is illustrated in Appendix D, *Retaining Wall Backfill and Subdrain Detail*. Wall backfill should be non-expansive (EI ≤ 21) sands compacted by mechanical methods to a minimum of 90 percent relative compaction (ASTM D 1557). Clayey site soils should not be used as wall backfill. Walls should not be backfilled until wall concrete attains the 28-day compressive strength and/or as determined by the Structural Engineer that the wall is structurally capable of supporting backfill. Lightweight compaction equipment should be used, unless otherwise approved by the Structural Engineer.

5.5 Foundation Setback from Slopes

We recommend a minimum horizontal setback distance from the face of slopes for all structural footings (retaining and decorative walls, flatwork, building footings, pools, etc.). This distance is measured from the outside bottom edge of the footing horizontally to the slope face (or the face of a retaining wall) and should be a minimum of H/2, where H is the slope height (in feet).

Table 4. Footing Setbacks

Slope Height	Recommended Footing Setback
<5 feet	5 feet minimum
5 to 15 feet	7 feet minimum
>15 feet	H/2, where H is the slope height, not to exceed 10 feet to 2:1 slope face

The soils within the structural setback area generally possess poor lateral stability and improvements (such as retaining walls, pools, sidewalks, fences, pavements, decorative flatwork, etc.) constructed within this setback area will be subject to lateral movement and/or differential settlement. Potential distress to such improvements may be mitigated by providing a deepened footing or a pier and grade-beam foundation system to support the improvement. The deepened footing should meet the setback described above. Modifications of slope inclinations near foundations may increase the setback and should be reviewed by the design team prior to completion of design or implementation.

5.6 Sulfate Attack

The results of limited laboratory testing indicated negligible exposure to concrete per ACI 318. Type II soils or equivalent may be used. Further testing should be performed during site grading to confirm soluble-sulfate content of near finish subgrade soils. Additional testing for general corrosion potential to ferrous materials should also be performed during grading.

5.7 Concrete Flatwork

Sidewalk/Flatwork should conform to applicable City and County standards. A representative of Leighton should verify subgrade soil expansion, moisture conditions and compaction prior to formwork and reinforcement placement. If subgrade soils possess expansion index greater than 21, we recommend a minimum 8-inch deepened edge be constructed for all flatwork to reduce moisture variation in subgrade soils along concrete edges adjacent to open (unfinished) or irrigated landscape areas.

Concrete flatwork should be constructed of uniformly cured, low-slump concrete and should contain sufficient control/contraction joints. Additional provisions such as ascending/descending slope conditions, perched (irrigation) water, special surcharge loading conditions, potential expansive soil pressure and differential settlement/heave should be incorporated into the design of exterior improvements. Additional exterior slab details are suggested in the American Concrete Institute (ACI) guidelines. Homeowners (HOA) should be advised of their maintenance responsibilities as well as geotechnical issues that could affect performance of site improvements.

5.8 Preliminary Pavement Design

The preliminary pavement design provided below is based on the locally accepted Caltrans Highway Design Manual and a preliminary R-value of 14. For planning and estimating purposes, the pavement sections are calculated based on assumed Traffic Indexes (TI) as shown in Table below.

Table 5. Asphalt Pavement Sections

General Traffic Condition*	Traffic Index (TI)**	Asphalt Concrete (inches)	Aggregate Base* (inches)
Private Street	5.0	4.0	6.0
General Local Street	5.5	4.0	8.0
Collector/Enhanced Local	7.0	4.5	12.0

*Per City minimum or as calculated

Actual R-value of the subgrade soils will need to be verified after completion of site grading to finalize the pavement design. Pavement design and minimum sections should conform to applicable City standards, where applicable.

The upper 6 inches of the subgrade soils should be moisture-conditioned to near optimum moisture content, compacted to at least 95 percent relative compaction (ASTM D1557) and kept in this condition until the pavement section is constructed. Minimum relative compaction requirements for aggregate base should be 95 percent of the maximum laboratory density as determined by ASTM D1557. If applicable, aggregate base should conform to the "Standard Specifications for Public Works Construction" (Greenbook) current edition or Caltrans Class 2 aggregate base and applicable City standards

If pavement areas are adjacent to watered landscape areas, some deterioration of the subgrade load bearing capacity may result. Moisture control measures such as deepened curbs or other moisture barrier materials may be used to prevent the subgrade soils from becoming saturated. The use of concrete cutoff or edge barriers should be considered when pavement is planned adjacent to either open (unfinished) or irrigated landscaped areas.

6.0 GEOTECHNICAL CONSTRUCTION SERVICES

Geotechnical review is of paramount importance in engineering practice. Poor performances of many foundation and earthwork projects have been attributed to inadequate construction review. We recommend that Leighton be provided the opportunity to review the grading plan and foundation plan(s) prior to bid.

Reasonably-continuous construction observation and review during site grading and foundation installation allows for evaluation of the actual soil conditions and the ability to provide appropriate revisions where required during construction. Geotechnical conclusions and preliminary recommendations should be reviewed and verified by Leighton during construction, and revised accordingly if geotechnical conditions encountered vary from our findings and interpretations. Geotechnical observation and testing should be provided:

- After completion of site clearing,
- During preparation and overexcavation of surface soils as described herein,
- During compaction of all fill materials,
- All cut slopes to be mapped by project geologist,
- Testing of slab subgrade moisture content, prior to placement of vapor retarder,
- After excavation of all footings, and prior to placement of concrete,
- During utility trench backfilling and compaction, and
- When any unusual conditions are encountered.

Additional geotechnical exploration and analysis may be required based on final development plans, for reasons such as significant changes in proposed structure locations/footprints. We should review grading (civil) and foundation (structural) plans, and comment further on geotechnical aspects of this project.

7.0 LIMITATIONS

This report was necessarily based in part upon data obtained from a limited number of observances, site visits, soil samples, tests, analyses, histories of occurrences, spaced subsurface explorations and limited information on historical events and observations. Such information is necessarily incomplete. The nature of many sites is such that differing characteristics can be experienced within small distances and under various climatic conditions. Changes in subsurface conditions can and do occur over time. This investigation was performed with the understanding that the subject site is proposed for residential and commercial development. The client is referred to Appendix E regarding important information provided by the GBA (Geoprofessional Business Association) on geotechnical engineering studies and reports and their applicability.

This report was prepared for J & C INTERNATIONAL GROUP based on J & C INTERNATIONAL GROUP needs, directions, and requirements at the time of our investigation. This report is not authorized for use by, and is not to be relied upon by any party except J & C INTERNATIONAL GROUP, and its successors and assigns as owner of the property, with whom Leighton and Associates, Inc. has contracted for the work. Use of or reliance on this report by any other party is at that party's risk. Unauthorized use of or reliance on this report constitutes an agreement to defend and indemnify Leighton and Associates, Inc. from and against any liability which may arise as a result of such use or reliance, regardless of any fault, negligence, or strict liability of Leighton and Associates, Inc.

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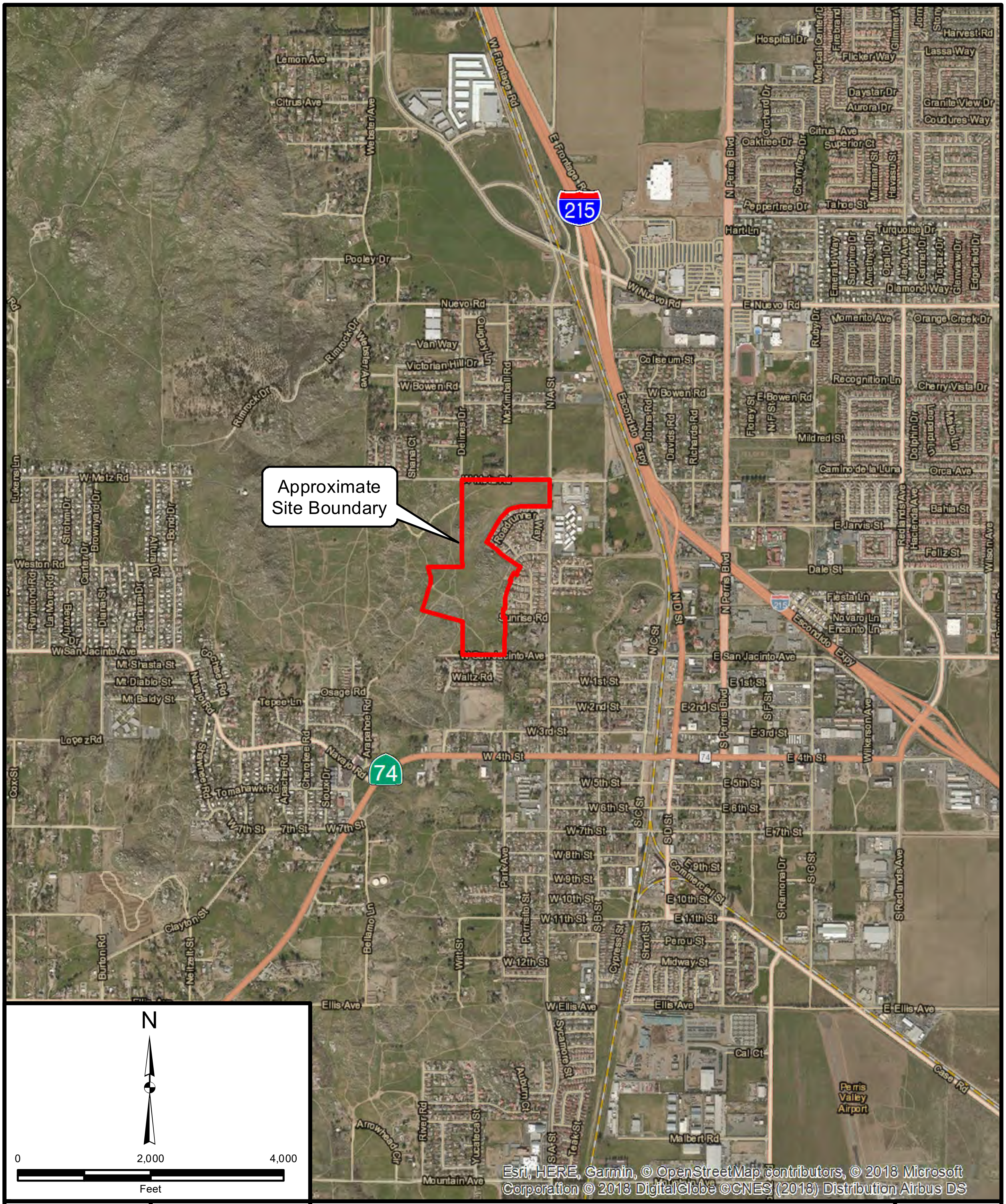

Esri, HERE, Garmin, © OpenStreetMap contributors, © 2018 Microsoft Corporation © 2018 DigitalGlobe ©CNES (2018) Distribution Airbus DS

Project: 12223.001	Eng/Geol: SIS/RFR
Scale: 1 " = 2,000 '	Date: December 2018

Base Map: Bing Maps 2018
Thematic Information: Leighton
Author: Leighton Geomatics (mmurphy)

SITE LOCATION MAP

Tentative Tract Map 33200
Perris, California

Figure 1

Leighton

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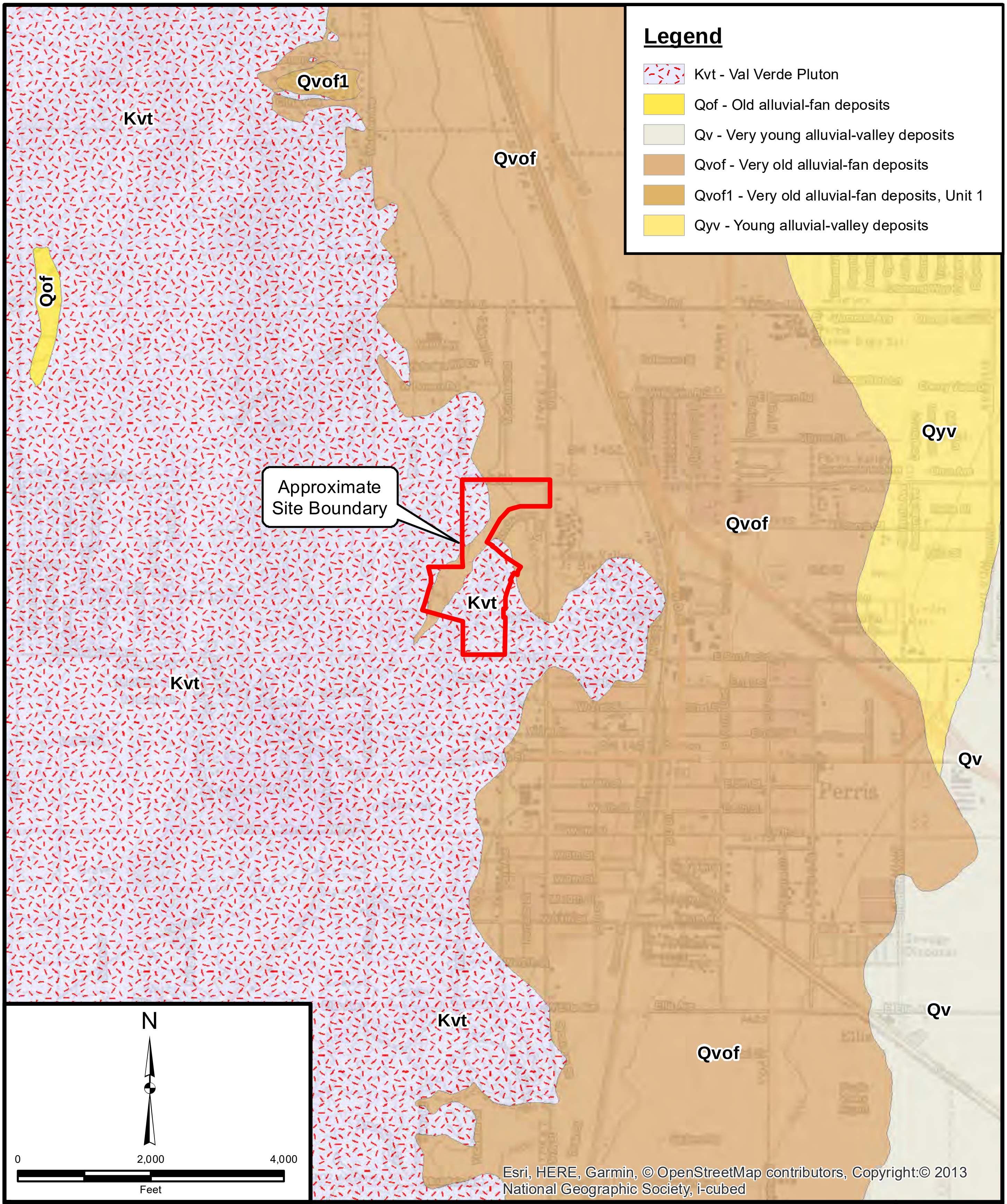

Legend

- ▨ Kvt - Val Verde Pluton
- 🟨 Qof - Old alluvial-fan deposits
- ⬜ Qv - Very young alluvial-valley deposits
- 🟫 Qvof - Very old alluvial-fan deposits
- 🟫 Qvof1 - Very old alluvial-fan deposits, Unit 1
- 🟨 Qyv - Young alluvial-valley deposits

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Project: 12223.001

Eng/Geol: SIS/RFR

Scale: 1 " = 2,000 '

Date: December 2018

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

Author: Leighton Geomatics (mmurphy)

REGIONAL GEOLOGY MAP

Tentative Tract Map 33200
Perris, California

Figure 1

Leighton

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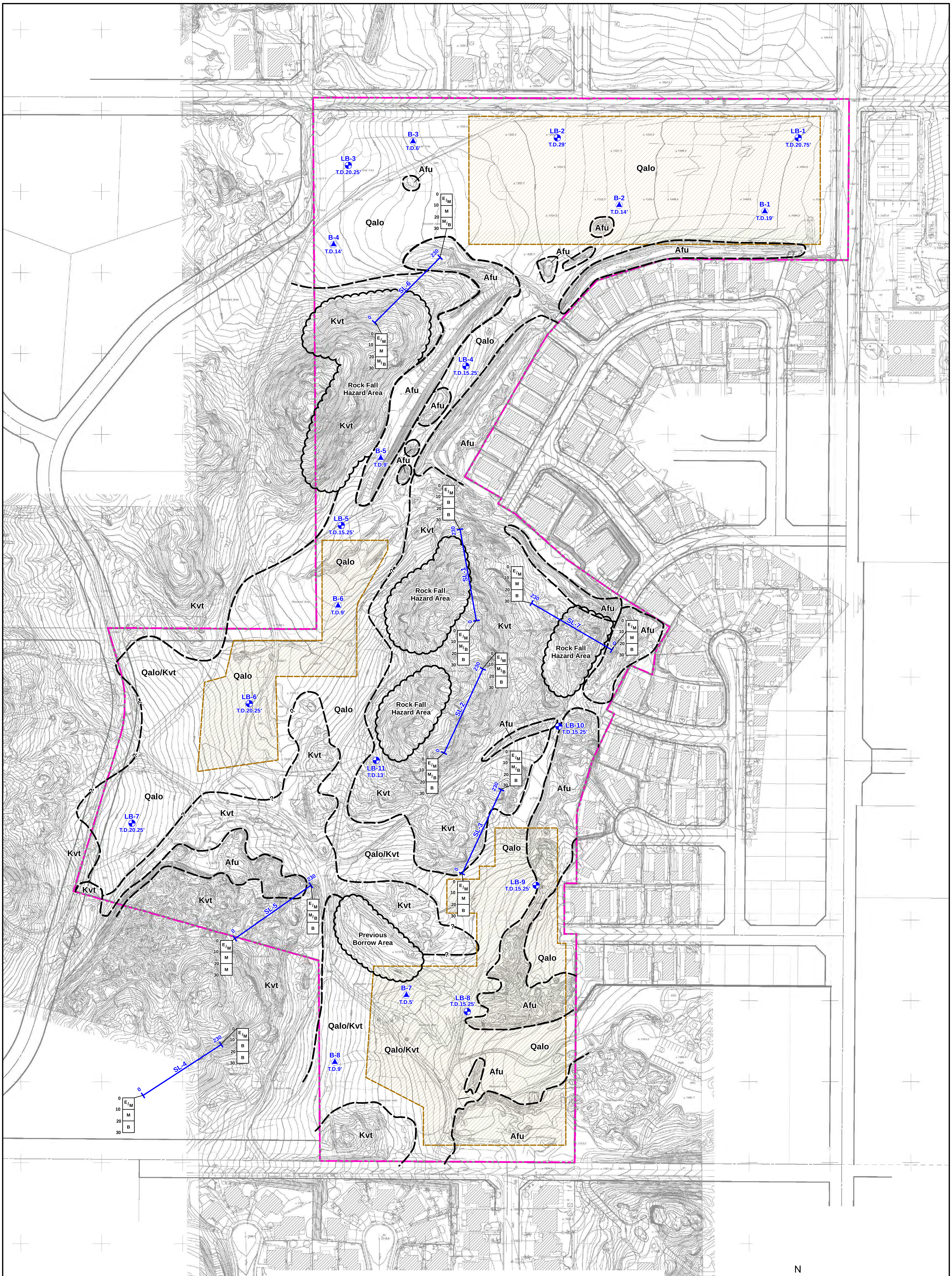

Legend

LB-11 T.D.13'	Approximate Location of Boring showing Total Depth (This Study)
B-8 T.D.9'	Approximate Location of Boring showing Total Depth (Global Geo-Engineering, Inc., September 2004)
SL-7	Approximate Location of Seismic Refraction Survey Line (Global Geo-Engineering, Inc., September 2004)
FEET 0 E 10	Easy to Moderate Ripping within Specified Depth Zone
10 M 20	Moderate to Difficult Ripping with Specified Depth Zone
20 B 30	Blasting Probable within Specified Depth Zone
FEET 0 B/M 10	Indicates Variable Ripping Conditions within Specified Depth Zone
—?—	Approximate Geologic Contact Queried Where Uncertain
▨	Potential Areas for Deeper Excavation for Rock Burial
▭	Approximate Site Boundary

Geologic Units

Afu	Undocumented Fill and Boulder Stockpile
Qalo	Older Alluvium
Qalo/Kvt	Older Alluvium with Outcrops of Granitic Bedrock
Kvt	Granitic Bedrock (Tonalite)

GEOTECHNICAL MAP
Tentative Tract Map 33200
Perris, California

Plate 1

Project: 12223.001
Eng/Geol: SIS/RFR
Scale: 1 " = 100 feet
Date: December 2018
Reference: Hunsaker, 2018.
Author: (mmurphy)
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APPENDIX A

FIELD EXPLORATION/BORING LOGS

(This and Previous Exploration)

GEOTECHNICAL BORING LOG LB-1

Project No. 12223.001
Project TTM 33200
Drilling Co. 2R Drilling
Drilling Method Hollow Stem Auger - 140lb - Autohammer - 30" Drop
Location See Boring Location Map

Date Drilled 12-3-18
Logged By BSS
Hole Diameter 8"
Ground Elevation 1505'
Sampled By BSS

Elevation Feet	Depth Feet	Graphic Log N S	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	**SOIL DESCRIPTION** *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
1505	0							SC-SM	**Quaternary Older Alluvium (Qvof):** SILTY, CLAYEY SAND, medium dense, light reddish brown, slightly moist, fine sand	
				R-1	8 15 50-5"	126	5		very dense, light brown, slightly moist, fine to medium sand, few fine gravel	
1500	5			R-2	30 45 50-5"	134	9		very dense, brown, moist, fine to coarse sand, some mica (CO = -0.57%)	CO
1495	10			R-3	35 50-5"	131	9		very dense, light reddish brown, moist, fine sand, few fine gravel	
1490	15			R-4	50-5"			SC	CLAYEY SAND, very dense, light brown, slightly moist, fine sand, trace caliche	
1485	20			R-5	35 50-3"				**Tonalite (Kvt):** very dense, brown, moist, fine sand, some weathered bedrock toward the bottom, micaceous Drilled to 20' Sampled to 20.75' Groundwater not encountered Backfilled with soil cuttings (12/3/18)	
1480	25									
1475	30									

SAMPLE TYPES:

- **B BULK SAMPLE**
- **C CORE SAMPLE**
- **G GRAB SAMPLE**
- **R RING SAMPLE**
- **S SPLIT SPOON SAMPLE**
- **T TUBE SAMPLE**

TYPE OF TESTS:

-200	% FINES PASSING
AL	ATTERBERG LIMITS
CN	CONSOLIDATION
CO	COLLAPSE
CR	CORROSION
CU	UNDRAINED TRIAXIAL
DS	DIRECT SHEAR
EI	EXPANSION INDEX
H	HYDROMETER
MD	MAXIMUM DENSITY
PP	POCKET PENETROMETER
RV	R VALUE
SA	SIEVE ANALYSIS
SE	SAND EQUIVALENT
SG	SPECIFIC GRAVITY
UC	UNCONFINED COMPRESSIVE STRENGTH

*** * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * ***

GEOTECHNICAL BORING LOG LB-2

Project No. 12223.001
Project TTM 33200
Drilling Co. 2R Drilling
Drilling Method Hollow Stem Auger - 140lb - Autohammer - 30" Drop
Location See Boring Location Map

Date Drilled 12-3-18
Logged By BSS
Hole Diameter 8"
Ground Elevation 1504'
Sampled By BSS

Elevation Feet	Depth Feet	Graphic Log N S	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0								**Quaternary Older Alluvium (Qvof):**	
				B-1				SC-SM	SILTY, CLAYEY SAND, dense, light brown, dry, fine to medium sand, few gravel (EI = 7, MD: 130.9 @ 8.2%, R-Value = 14)	EI, MD, RV
1500										
	5			R-1	34 50-3"	130	5		very dense, light brown, dry, fine to medium sand, some fine gravel	
1495										
	10			R-2	17 35 50-4"	126	8	SW-SM	Well-graded SAND with SILT, very dense, grayish brown, moist, fine to coarse sand, some caliche	
1490										
	15			R-3	12 22 29	119	11		SILTY, CLAYEY SAND, dense, dark brown, moist, fine sand, trace caliche, some weathered bedrock toward the bottom	
									Tonalite (Kvt):	
1485										
	20			R-4	50-2"				Highly weathered bedrock recovered as Well-Graded GRAVEL with SILT and SAND, very dense, light gray, dry, fine to coarse sand	
1480										
	25			R-5	50-2"				hard, dark gray, slightly moist, fine to coarse sand	
				S-6	50-1"				hard, no recovery	
1475									Refusal at 29'	
	30									

SAMPLE TYPES:
- **B** BULK SAMPLE
- **C** CORE SAMPLE
- **G** GRAB SAMPLE
- **R** RING SAMPLE
- **S** SPLIT SPOON SAMPLE
- **T** TUBE SAMPLE

TYPE OF TESTS:
- **-200** % FINES PASSING
- **AL** ATTERBERG LIMITS
- **CN** CONSOLIDATION
- **CO** COLLAPSE
- **CR** CORROSION
- **CU** UNDRAINED TRIAXIAL
- **DS** DIRECT SHEAR
- **EI** EXPANSION INDEX
- **H** HYDROMETER
- **MD** MAXIMUM DENSITY
- **PP** POCKET PENETROMETER
- **RV** R VALUE
- **SA** SIEVE ANALYSIS
- **SE** SAND EQUIVALENT
- **SG** SPECIFIC GRAVITY
- **UC** UNCONFINED COMPRESSIVE STRENGTH

*** * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * ***

GEOTECHNICAL BORING LOG LB-2

Project No.	12223.001	**Date Drilled**	12-3-18
Project	TTM 33200	**Logged By**	BSS
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1504'
Location	See Boring Location Map	**Sampled By**	BSS

Elevation Feet	**Depth Feet**	**Graphic Log** N S	**Attitudes**	**Sample No.**	**Blows Per 6 Inches**	**Dry Density pcf**	**Moisture Content, %**	**Soil Class. (U.S.C.S.)**	**SOIL DESCRIPTION** *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	**Type of Tests**
	30								Sampled to 29' Groundwater not encountered Backfilled with soil cuttings (12/3/18)	
1470										
	35									
1465										
	40									
1460										
	45									
1455										
	50									
1450										
	55									
1445										
	60									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

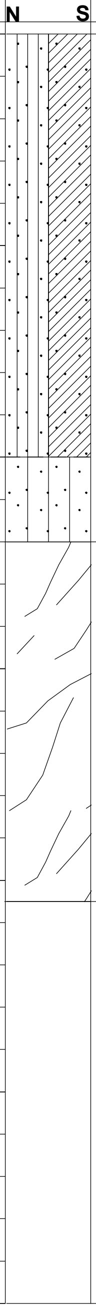
-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG LB-3

Project No.	12223.001	**Date Drilled**	12-3-18
Project	TTM 33200	**Logged By**	BSS
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1516'
Location	See Boring Location Map	**Sampled By**	BSS

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.



Elevation Feet	Depth Feet	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0							**Quaternary Older Alluvium (Qvof):**	
1515			B-1				SC-SM	SILTY, CLAYEY SAND, medium dense, light brown, dry, fine to medium sand, (EI = 4, MD: 130.3 @ 9.0%)	EI, MD
			R-1	50-5"	113	3		very dense, light reddish brown, slightly moist, fine sand	
	5		R-2	40 50-2"	123	6		very dense, light brown, moist, fine to medium sand, some fine gravel	
1510									
	10		R-3	16 28 32			SM	SILTY SAND, dense, brown, moist, fine to medium sand, trace caliche, some weathered bedrock toward the bottom	
1505									
								Tonalite (Kvt):	
	15		R-4	50-3"				Highly weathered bedrock recovered as: Well-graded SAND with GRAVEL, very dense, dark gray, slightly moist, fine to coarse sand	
1500									
	20		R-5	50-2"				hard, gray, slightly moist, fine to coarse sand with fine gravel, (sample disturbed)	
1495								Drilled to 20' Sampled to 20.25' Groundwater not encountered Backfilled with soil cuttings (12/3/18)	
	25								
1490									
	30								

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

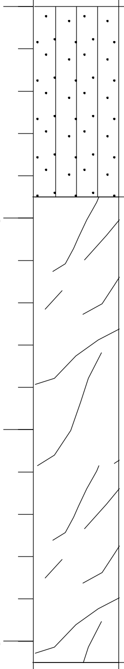
TYPE OF TESTS:

-200	% FINES PASSING
AL	ATTERBERG LIMITS
CN	CONSOLIDATION
CO	COLLAPSE
CR	CORROSION
CU	UNDRAINED TRIAXIAL
DS	DIRECT SHEAR
EI	EXPANSION INDEX
H	HYDROMETER
MD	MAXIMUM DENSITY
PP	POCKET PENETROMETER
RV	R VALUE
SA	SIEVE ANALYSIS
SE	SAND EQUIVALENT
SG	SPECIFIC GRAVITY
UC	UNCONFINED COMPRESSIVE STRENGTH

*** * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * ***

GEOTECHNICAL BORING LOG LB-4

Project No.	12223.001	**Date Drilled**	12-3-18
Project	TTM 33200	**Logged By**	BSS
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1509'
Location	See Boring Location Map	**Sampled By**	BSS

Elevation Feet	Depth Feet	Graphic Log N S	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	**SOIL DESCRIPTION** *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0								**Quaternary Older Alluvium (Qvof):**	
				R-1	16 26 40	123	3	SM	SILTY SAND, dense, light reddish brown, moist, fine to medium sand	
1505										
	5			R-2	50-5"				**Tonalite (Kvt):** Well-graded SAND with SILT and GRAVEL, very dense, grayish brown, slightly moist, fine to coarse sand	
1500										
	10			R-3	50-3"				very dense, grayish brown, moist, fine to coarse sand, some mica	
1495										
	15			R-4	50-3"				same as above	
									Drilled to 15' Sampled to 15.25' Groundwater not encountered Backfilled with soil cuttings (12/3/18)	
1490										
	20									
1485										
	25									
1480										
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING
AL	ATTERBERG LIMITS
CN	CONSOLIDATION
CO	COLLAPSE
CR	CORROSION
CU	UNDRAINED TRIAXIAL
DS	DIRECT SHEAR
EI	EXPANSION INDEX
H	HYDROMETER
MD	MAXIMUM DENSITY
PP	POCKET PENETROMETER
RV	R VALUE
SA	SIEVE ANALYSIS
SE	SAND EQUIVALENT
SG	SPECIFIC GRAVITY
UC	UNCONFINED COMPRESSIVE STRENGTH

*** * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * ***

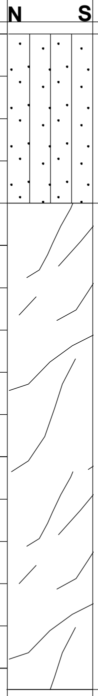
GEOTECHNICAL BORING LOG LB-5

Project No. 12223.001
Project TTM 33200
Drilling Co. 2R Drilling
Drilling Method Hollow Stem Auger - 140lb - Autohammer - 30" Drop
Location See Boring Location Map

Date Drilled 12-3-18
Logged By BSS
Hole Diameter 8"
Ground Elevation 1522'
Sampled By BSS

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.



Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0			B-1			3	SM	**Quaternary Older Alluvium (Qvof):** SILTY SAND, dense, light brown, dry, fine to medium sand, few gravel	
1520										
	5			R-1	50-4"	111	4		**Tonalite (Kvt):** Highly weathered bedrock recovered as: Well-graded SAND with SILT, very dense, grayish brown, moist to wet, fine to coarse sand with fine gravel	
1515										
	10			R-2	50-4"				very dense, grayish brown, slightly moist, fine to coarse sand with fine gravel	
1510										
	15			R-4	50-3"				Moderately weathered bedrock recovered as: Well-graded GRAVEL with SAND, hard, dark grayish brown, slightly moist, fine to coarse sand, micaceous	
1505									Drilled to 15' Sampled to 15.25' Groundwater not encountered Backfilled with soil cuttings (12/3/18)	
	20									
1500										
	25									
1495										
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING
AL	ATTERBERG LIMITS
CN	CONSOLIDATION
CO	COLLAPSE
CR	CORROSION
CU	UNDRAINED TRIAXIAL
DS	DIRECT SHEAR
EI	EXPANSION INDEX
H	HYDROMETER
MD	MAXIMUM DENSITY
PP	POCKET PENETROMETER
RV	R VALUE
SA	SIEVE ANALYSIS
SE	SAND EQUIVALENT
SG	SPECIFIC GRAVITY
UC	UNCONFINED COMPRESSIVE STRENGTH

*** * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * ***

GEOTECHNICAL BORING LOG LB-6

Project No.	12223.001	**Date Drilled**	12-3-18
Project	TTM 33200	**Logged By**	BSS
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1530'
Location	See Boring Location Map	**Sampled By**	BSS

Elevation Feet	Depth Feet	Graphic Log N S	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
1530	0								**Quaternary Older Alluvium (Qvof):** SILTY SAND, medium dense, light brown, slightly moist, fine to medium sand	
				R-1	9 12 18	118	3	SM	medium dense, light brown, slightly moist, fine to medium sand	
1525	5			R-2	13 17 50-5"	127	3	SW-SM	Well-graded SAND with SILT, dense, dark grayish brown, moist, fine to coarse sand with fine gravel, micaceous	
									Tonalite (Kvt):	
1520	10			R-3	50-4"				Highly weathered bedrock recovered as: Well-graded SAND with GRAVEL, hard, grayish brown, slightly moist, fine to coarse sand, micaceous, some silt	
1515	15			R-4	50-2"				hard, grayish brown, slightly moist, fine to coarse sand, micaceous	
									Moderately weathered bedrock recovered as:	
1510	20			R-5	50-3"				Well-graded GRAVEL with SAND, hard, light reddish brown, slightly moist, fine to coarse sand, micaceous	
									Drilled to 20' Sampled to 20.25' Groundwater not encountered Backfilled with soil cuttings (12/3/18)	
1505	25									
1500	30									

SAMPLE TYPES:

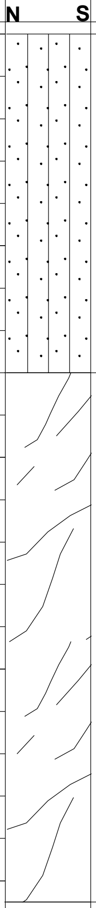
B	**BULK SAMPLE**
C	**CORE SAMPLE**
G	**GRAB SAMPLE**
R	**RING SAMPLE**
S	**SPLIT SPOON SAMPLE**
T	**TUBE SAMPLE**

TYPE OF TESTS:

-200	**% FINES PASSING**	**DS**	**DIRECT SHEAR**	**SA**	**SIEVE ANALYSIS**
AL	**ATTERBERG LIMITS**	**EI**	**EXPANSION INDEX**	**SE**	**SAND EQUIVALENT**
CN	**CONSOLIDATION**	**H**	**HYDROMETER**	**SG**	**SPECIFIC GRAVITY**
CO	**COLLAPSE**	**MD**	**MAXIMUM DENSITY**	**UC**	**UNCONFINED COMPRESSIVE STRENGTH**
CR	**CORROSION**	**PP**	**POCKET PENETROMETER**		
CU	**UNDRAINED TRIAXIAL**	**RV**	**R VALUE**		

GEOTECHNICAL BORING LOG LB-7

Project No.	12223.001	**Date Drilled**	12-3-18
Project	TTM 33200	**Logged By**	BSS
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1552'
Location	See Boring Location Map	**Sampled By**	BSS



Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	**SOIL DESCRIPTION** *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0								**Quaternary Older Alluvium (Qvof):**	
				B-1			3	SM	SILTY SAND, medium dense, light reddish brown, slightly moist, fine to medium sand	
1550										
	5			R-1	11 12 16	120	2		medium dense, light reddish brown, slightly moist, fine to medium sand, some mica (CO = -0.57%)	CO
1545										
									Tonalite (Kvt):	
									Highly weathered bedrock recovered as:	
	10			R-2	50-4"				Well-graded SAND with GRAVEL, hard, dark grayish brown, slightly moist, fine to coarse sand, micaceous	
1540										
	15			R-3	50-3"				no recovery	
1535										
									Moderately weathered bedrock recovered as:	
	20			R-4	50-1"				Well-graded SAND with SILT and GRAVEL, hard, light gray, slightly moist, fine to coarse sand, micaceous	
									Drilled to 20' Sampled to 20.25' Groundwater not encountered Backfilled with soil cuttings (12/3/18)	
1530										
	25									
1525										
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING
AL	ATTERBERG LIMITS
CN	CONSOLIDATION
CO	COLLAPSE
CR	CORROSION
CU	UNDRAINED TRIAXIAL
DS	DIRECT SHEAR
EI	EXPANSION INDEX
H	HYDROMETER
MD	MAXIMUM DENSITY
PP	POCKET PENETROMETER
RV	R VALUE
SA	SIEVE ANALYSIS
SE	SAND EQUIVALENT
SG	SPECIFIC GRAVITY
UC	UNCONFINED COMPRESSIVE STRENGTH

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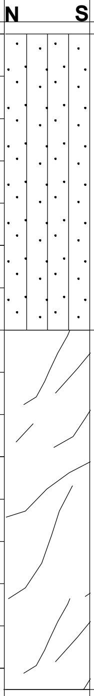
GEOTECHNICAL BORING LOG LB-8

Project No. 12223.001
Project TTM 33200
Drilling Co. 2R Drilling
Drilling Method Hollow Stem Auger - 140lb - Autohammer - 30" Drop
Location See Boring Location Map

Date Drilled 12-3-18
Logged By BSS
Hole Diameter 8"
Ground Elevation 1506'
Sampled By BSS

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								**Quaternary Older Alluvium (Qvof):**	
1505								SM	SILTY SAND, medium dense, light brown, slightly moist, fine to coarse sand	
				R-1	16 24 43	124	2		dense, light reddish brown, dry, fine to medium sand, (CO = -3.99%)	CO
	5			R-2	14 28 50-5"	124	5		dense, light brown, slightly moist, fine to medium sand, some caliche	
1500										
									Tonalite (Kvt):	
									Moderately weathered bedrock recovered as:	
	10			R-3	40 50-3"				Well-graded SAND with SILT and GRAVEL, very dense, reddish brown, slightly moist, fine to coarse sand, micaceous	
1495										
	15			R-4	50-5"				Well-graded SAND with GRAVEL, hard, dark gray, slightly moist, fine to coarse sand, micaceous	
1490									Drilled to 15' Sampled to 15.25' Groundwater not encountered Backfilled with soil cuttings (12/3/18)	
	20									
1485										
	25									
1480										
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG LB-9

Project No. 12223.001
Project TTM 33200
Drilling Co. 2R Drilling
Drilling Method Hollow Stem Auger - 140lb - Autohammer - 30" Drop
Location See Boring Location Map
Date Drilled 12-3-18
Logged By BSS
Hole Diameter 8"
Ground Elevation 1505'
Sampled By BSS

Elevation Feet	Depth Feet	Graphic Log N S	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
1505	0								**Quaternary Older Alluvium (Qvof):**	
				B-1				SM	SILTY SAND, medium dense, light reddish brown, dry, fine to medium sand, (MD: 132.2 @ 8.0%)	MD
				R-1	8 10 11	116	2		medium dense, light brown, slightly moist, fine sand, (CO = -0.25%)	CO
1500	5			R-2	8 26 46	127	3		dense, light brown, dry, fine to medium sand, some weathered bedrock at the bottom	
									Tonalite (Kvt):	
									Highly weathered bedrock recovered as:	
1495	10			R-3	45 50-3"				Well-graded SAND with SILT and GRAVEL, hard, light brown, slightly moist, fine to coarse sand with fine gravel, micaceous	
1490	15			R-4	50-1"				no recovery	
									Drilled to 15' Sampled to 15.25' Groundwater not encountered Backfilled with soil cuttings (12/3/18)	
1485	20									
1480	25									
1475	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING
AL	ATTERBERG LIMITS
CN	CONSOLIDATION
CO	COLLAPSE
CR	CORROSION
CU	UNDRAINED TRIAXIAL
DS	DIRECT SHEAR
EI	EXPANSION INDEX
H	HYDROMETER
MD	MAXIMUM DENSITY
PP	POCKET PENETROMETER
RV	R VALUE
SA	SIEVE ANALYSIS
SE	SAND EQUIVALENT
SG	SPECIFIC GRAVITY
UC	UNCONFINED COMPRESSIVE STRENGTH

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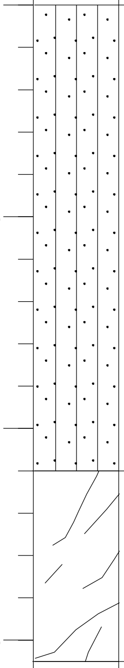
GEOTECHNICAL BORING LOG LB-10

Project No. 12223.001
Project TTM 33200
Drilling Co. 2R Drilling
Drilling Method Hollow Stem Auger - 140lb - Autohammer - 30" Drop
Location See Boring Location Map
Date Drilled 12-3-18
Logged By BSS
Hole Diameter 8"
Ground Elevation 1518'
Sampled By BSS

Elevation Feet	Depth Feet	Graphic Log N S	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0							SM	**Quaternary Older Alluvium (Qvof):** SILTY SAND, medium dense, dark brown, moist, fine to medium sand	
1515										
	5			R-1	17 28 28	122	4		dense, dark brown, moist, fine sand, (CO = -1.12%)	CO
1510										
	10			R-2	50-3"				very dense, brown, moist, fine sand, becomes highly weathered bedrock	
									Tonalite (Kvt): Highly weathered bedrock recovered as: Well-graded SAND with SILT and GRAVEL, hard, light brown, slightly moist, fine to coarse sand with fine gravel, micaceous	
1505										
	15			R-3	50-2"				no recovery	
									Drilled to 15' Sampled to 15.25' Groundwater not encountered Backfilled with soil cuttings (12/3/18)	
1500										
	20									
1495										
	25									
1490										
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING
AL	ATTERBERG LIMITS
CN	CONSOLIDATION
CO	COLLAPSE
CR	CORROSION
CU	UNDRAINED TRIAXIAL
DS	DIRECT SHEAR
EI	EXPANSION INDEX
H	HYDROMETER
MD	MAXIMUM DENSITY
PP	POCKET PENETROMETER
RV	R VALUE
SA	SIEVE ANALYSIS
SE	SAND EQUIVALENT
SG	SPECIFIC GRAVITY
UC	UNCONFINED COMPRESSIVE STRENGTH

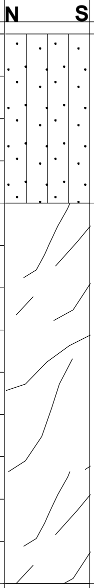
GEOTECHNICAL BORING LOG LB-11

Project No. 12223.001
Project TTM 33200
Drilling Co. 2R Drilling
Drilling Method Hollow Stem Auger - 140lb - Autohammer - 30" Drop
Location See Boring Location Map

Date Drilled 12-3-18
Logged By BSS
Hole Diameter 8"
Ground Elevation 1547'
Sampled By BSS

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.



Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0			B-1				SM	**Quaternary Older Alluvium (Qvof):** SILTY SAND, medium dense, dark brown, moist, fine to medium sand	
1545										
	5			R-1	50-3"				**Tonalite (Kvt):** Highly weathered bedrock recovered as: Well-graded SAND with SILT and GRAVEL, very dense, light gray, dry, fine to coarse sand, micaceous	
1540										
	10			R-2	50-2"				Moderately weathered bedrock recovered as: Well-graded SAND with GRAVEL, hard, light brownish gray, slightly moist, fine to coarse sand with fine gravel, micaceous	
1535										
									Refusal at 13' Sampled to 10' Groundwater not encountered Backfiled with soil cuttings (12/3/18)	
	15									
1530										
	20									
1525										
	25									
1520										
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING
AL	ATTERBERG LIMITS
CN	CONSOLIDATION
CO	COLLAPSE
CR	CORROSION
CU	UNDRAINED TRIAXIAL
DS	DIRECT SHEAR
EI	EXPANSION INDEX
H	HYDROMETER
MD	MAXIMUM DENSITY
PP	POCKET PENETROMETER
RV	R VALUE
SA	SIEVE ANALYSIS
SE	SAND EQUIVALENT
SG	SPECIFIC GRAVITY
UC	UNCONFINED COMPRESSIVE STRENGTH

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Global Geo-Engineering, Inc
GEOLOGIC & SOILS ENGINEERING
TUSTIN, CALIFORNIA

Tentative Tracts 25160, 25334, and 25356
Perris, California

Project 1779-04

LOG OF BORING B-1

Date : July 26, 2004
Logged By : KBY
Diameter of Boring : 8"
Drilling Company : Glodich Drilling
Drilling Rig : B-53 Mobile

Drilling Method : Hollow stem
Drilling Method : California Modified
Hammer Weight (lbs) : 140
Hammer Height (in) : 30

Sample Type
☒ Ring
▨ Bulk
■ Standard Penetration Test

Water Levels
▼ Groundwater Encountered
▽ Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Water Level	USCS	GRAPHIC	DESCRIPTION
0								Silty SAND: fine to medium grained, orange brown, dry to slightly moist, medium dense
	☒	5.3	121.3	51				
	▨							
	☒	6.1	131.6	70				
5								@5' medium dense to dense, slightly moist
	☒	7.1	121.0	74		SM		
10								
	☒	7.5	122.4	100				@13' dense
15								
								ALLUVIUM
	☒	10.0	126.4	>100		GR		Quartz Diorite: coarse textured, hard, gray to orange brown BASEMENT ROCK
20								Bottom of Boring at 19 feet
25								

Bottom of Boring at 19 feet

NOTES:
1. Caving to 12 feet
2. No groundwater or seepage encountered
3. Boring backfilled

09-21-2004 C:\Boring Logs 2002 Editon\1779-04 Albert Shen, B-1.bor

Global Geo-Engineering, Inc.
GEOLOGIC & SOILS ENGINEERING
TUSTIN, CALIFORNIA

Tentative Tracts 25160, 25334, and 25356
Perris, California

Project 1779-04

LOG OF BORING B-2

Date : July 26, 2004
Logged By : KBY
Diameter of Boring : 8"
Drilling Company : Glodich Drilling
Drilling Rig : B-53 Mobile

Drilling Method : Hollow stem
Drilling Method : California Modified
Hammer Weight (lbs) : 140
Hammer Height (in) : 30

Sample Type
☒ Ring
▨ Bulk
■ Standard Penetration Test

Water Levels
▼ Groundwater Encountered
▽ Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Water Level	USCS	GRAPHIC	DESCRIPTION
0								SAND: fine to medium grained, yellow to orange brown, dry, loose
	☒	10.0	126.4	17				
						SP		@4' fine to coarse grained
	☒	1.5	105.4	20				
5								
								Silty SAND: fine grained, olive brown, slightly moist, loose to medium dense
	☒	3.4	110.0	23				
10						SM		
								ALLUVIUM
	☒	5.6	111.7	100		GR		Granite: coarse textured, hard BASEMENT ROCK
								Bottom of Boring at 14 feet
15								
20								
25								

NOTES:
1. Caving to 10 feet
2. No groundwater or seepage encountered
3. Boring backfilled

Figure B-3

Global Geo-Engineering, Inc
GEOLOGIC & SOILS ENGINEERING
TUSTIN, CALIFORNIA

Tentative Tracts 25160, 25334, and 25356
Perris, California

Project 1779-04

LOG OF BORING B-3

Date : July 26, 2004
Logged By : KBY
Diameter of Boring : 8"
Drilling Company : Glodich Drilling
Drilling Rig : B-53 Mobile

Drilling Method : Hollow stem
Drilling Method : California Modified
Hammer Weight (lbs) : 140
Hammer Height (in) : 30

Sample Type
- ☒ Ring
- ▨ Bulk
- ■ Standard Penetration Test

Water Levels
- ▼ Groundwater Encountered
- ▽ Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Water Level	USCS	GRAPHIC	DESCRIPTION
0								Silty SAND: fine grained, olive brown, dry to slightly moist, loose
	☒	7.9	126.7	14		SM		
								ALLUVIUM
								Quartz Diortie: coarse textured, hard
5	☒	2.0	103.0	>100		GR		BASEMENT ROCK
								Bottom of Boring at 6 feet NOTES: 1. No caving 2. No groundwater or seepage encountered 3. Boring backfilled
10								
15								
20								
25								

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GEOLOGIC & SOILS ENGINEERING
TUSTIN, CALIFORNIA

Tentative Tracts 25160, 25334, and 25356
Perris, California

Project 1779-04

LOG OF BORING B-4

Date : July 26, 2004
Logged By : KBY
Diameter of Boring : 8"
Drilling Company : Glodich Drilling
Drilling Rig : B-53 Mobile

Drilling Method : Hollow stem
Drilling Method : California Modified
Hammer Weight (lbs) : 140
Hammer Height (in) : 30

Sample Type
☒ Ring
▨ Bulk
■ Standard Penetration Test

Water Levels
▼ Groundwater Encountered
▽ Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Water Level	USCS	GRAPHIC	DESCRIPTION
0							▒	Silty SAND: fine grained, orange brown, dry, loose
	☒	8.2	124.1	13			▒	
	☒	2.1	103.5	12			▒	
5						SM	▒	
	☒	2.9	100.0	13			▒	@8' less Silty, olive brown, slightly moist
10							▒	ALLUVIUM
						GR	※	Quartz Diortie: coarse textured, hard
	☒	5.9	104.9	>100			※	BASEMENT ROCK
								Bottom of Boring at 14 feet
15								
20								
25								

NOTES:
1. No caving
2. No groundwater or seepage encountered
3. Boring backfilled

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LOG OF BORING B-5

Tentative Tracts 25160, 25334, and 25356
Perris, California

Project 1779-04

Date : July 27, 2004
Logged By : KBY
Diameter of Boring : 8"
Drilling Company : Glodich Drilling
Drilling Rig : B-53 Mobile

Drilling Method : Hollow stem
Drilling Method : California Modified
Hammer Weight (lbs) : 140
Hammer Height (in) : 30

Sample Type
☒ Ring
▨ Bulk
■ Standard Penetration Test

Water Levels
▼ Groundwater Encountered
▽ Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Water Level	USCS	GRAPHIC	DESCRIPTION
0							▒	Silty SAND: fine to medium grained, brown to orange brown, dry, loose
	☒	2.2	121.1	15			▒	
						SM	▒	
5	☒	1.9	101.4	21			▒	
							▒	ALLUVIUM
						GR	▞	Quartz Diortie: coarse textured, hard
	☒	2.0	106.0	>100			▞	BASEMENT ROCK
								Bottom of Boring at 9 feet
10								NOTES: 1. Caving to 5 feet 2. No groundwater or seepage encountered 3. Boring backfilled
15								
20								
25								

09-21-2004 C:\Boring Logs 2002 Edition\1779-04 Albert Shen, B-5.bor

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Tentative Tracts 25160, 25334, and 25356
Perris, California

Project 1779-04

LOG OF BORING B-6

Date : July 27, 2004
Logged By : KBY
Diameter of Boring : 8"
Drilling Company : Glodich Drilling
Drilling Rig : B-53 Mobile

Drilling Method : Hollow stem
Drilling Method : California Modified
Hammer Weight (lbs) : 140
Hammer Height (in) : 30

Sample Type
☒ Ring
▨ Bulk
■ Standard Penetration Test

Water Levels
▼ Groundwater Encountered
▽ Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Water Level	USCS	GRAPHIC	DESCRIPTION
0								Silty SAND: fine to medium grained, orange brown, dry, loose
	☒	2.1	122.5	18				
						SM		
5	☒	2.1	103.4	17				
								ALLUVIUM
						GR		Quartz Diortie: coarse textured, hard
	☒	2.0	105.7	>100				BASEMENT ROCK
10								Bottom of Boring at 9 feet
15								
20								
25								

NOTES:
1. Caving to 5 feet
2. No groundwater or seepage encountered
3. Boring backfilled

Figure B-7

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Tentative Tracts 25160, 25334, and 25356
Perris, California

Project 1779-04

LOG OF BORING B-7

Date : July 27, 2004
Logged By : KBY
Diameter of Boring : 8"
Drilling Company : Glodich Drilling
Drilling Rig : B-53 Mobile

Drilling Method : Hollow stem
Drilling Method : California Modified
Hammer Weight (lbs) : 140
Hammer Height (in) : 30

Sample Type
☒ Ring
▨ Bulk
■ Standard Penetration Test

Water Levels
▼ Groundwater Encountered
▽ Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Water Level	USCS	GRAPHIC	DESCRIPTION
0								
	☒	2.3	110.7	26		SM		Silty SAND: fine to medium grained, orange brown, dry, loose ALLUVIUM
	☒	3.2	106.6	>100		GR		Quartz Diortie: coarse textured, hard BASEMENT ROCK
5								Bottom of Boring at 5 feet
10								
15								
20								
25								

NOTES:
1. No caving
2. No groundwater or seepage encountered
3. Boring backfilled

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Figure B-8

Global Geo-Engineering, Inc
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Tentative Tracts 25160, 25334, and 25356
Perris, California

Project 1779-04

LOG OF BORING B-8

Date : July 27, 2004
Logged By : KBY
Diameter of Boring : 8"
Drilling Company : Glodich Drilling
Drilling Rig : B-53 Mobile

Drilling Method : Hollow stem
Drilling Method : California Modified
Hammer Weight (lbs) : 140
Hammer Height (in) : 30

Sample Type
☒ Ring
▨ Bulk
■ Standard Penetration Test

Water Levels
▼ Groundwater Encountered
▽ Seepage Encountered

Depth in Feet	Sample	Field Moisture % Dry Weight	Dry Density lb./cubic ft.	Blow Count	Water Level	USCS	GRAPHIC	DESCRIPTION
0								Silty SAND: fine to medium grained, orange brown, dry, loose
	☒	4.1	104.8	6				
	▨					SM		
	☒	1.8	97.4	12				@4' slightly moist
5								ALLUVIUM
						GR		Granite: coarse textured, hard
	☒	2.2	103.9	>100				BASEMENT ROCK
10								Bottom of Boring at 9 feet
15								
20								
25								

NOTES:
1. No caving
2. No groundwater or seepage encountered
3. Boring backfilled

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APPENDIX B

GEOTECHNICAL LABORATORY TESTING RESULTS

(This and Previous Exploration)

Leighton

EXPANSION INDEX of SOILS

ASTM D 4829

Project Name: Perris TR 33200 Geo
Tested By: F. Mina
Date: 12/11/18
Project No. : 12223.001
Checked By: M. Vinet
Date: 12/12/18
Boring No.: LB-2
Depth: 0 - 5.0
Sample No. : B-1
Location: N/A
Sample Description: Silty, Clayey Sand (SC-SM), Brown.

Dry Wt. of Soil + Cont. (gm.)	2220.0
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	2220.0
Weight Soil Retained on #4 Sieve	0.0
Percent Passing # 4	100.0

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0074
Wt. Comp. Soil + Mold (gm.)	600.2	624.6
Wt. of Mold (gm.)	180.6	180.6
Specific Gravity (Assumed)	2.70	2.70
Container No.	8	8
Wet Wt. of Soil + Cont. (gm.)	339.3	624.6
Dry Wt. of Soil + Cont. (gm.)	315.8	386.7
Wt. of Container (gm.)	39.3	180.6
Moisture Content (%)	8.5	14.8
Wet Density (pcf)	126.6	132.9
Dry Density (pcf)	116.7	115.8
Void Ratio	0.445	0.456
Total Porosity	0.308	0.313
Pore Volume (cc)	63.8	65.3
Degree of Saturation (%) [S meas]	**51.6**	**87.7**

SPECIMEN INUNDATION in distilled water for the period of 24 h or expansion rate < 0.0002 in./h.

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
12/11/18	10:00	1.0	0	0.5000
12/11/18	10:10	1.0	10	0.5000
	Add Distilled Water to the Specimen			
12/12/18	8:00	1.0	1310	0.5074
12/12/18	9:00	1.0	1370	0.5074

Expansion Index (EI meas) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	7.4
Expansion Index (Report) = Nearest Whole Number or Zero (0) if Initial Height is > than Final Heigh	**7**

Rev. 03-08

Leighton

EXPANSION INDEX of SOILS

ASTM D 4829

Project Name: Perris TR 33200 Geo
Tested By: F. Mina
Date: 12/11/18
Project No. : 12223.001
Checked By: M. Vinet
Date: 12/12/18
Boring No.: LB-3
Depth: 0 - 5.0
Sample No. : B-1
Location: N/A
Sample Description: Silty Sand (SM), Brown.

Dry Wt. of Soil + Cont. (gm.)	1958.7
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	1958.7
Weight Soil Retained on #4 Sieve	23.5
Percent Passing # 4	98.8

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0044
Wt. Comp. Soil + Mold (gm.)	613.5	637.9
Wt. of Mold (gm.)	199.2	199.2
Specific Gravity (Assumed)	2.70	2.70
Container No.	7	7
Wet Wt. of Soil + Cont. (gm.)	350.0	637.9
Dry Wt. of Soil + Cont. (gm.)	326.5	381.8
Wt. of Container (gm.)	50.0	199.2
Moisture Content (%)	8.5	14.9
Wet Density (pcf)	125.0	131.8
Dry Density (pcf)	115.2	114.7
Void Ratio	0.464	0.470
Total Porosity	0.317	0.320
Pore Volume (cc)	65.6	66.5
Degree of Saturation (%) [S meas]	**49.5**	**85.5**

SPECIMEN INUNDATION in distilled water for the period of 24 h or expansion rate < 0.0002 in./h.

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
12/11/18	9:21	1.0	0	0.5000
12/11/18	9:31	1.0	10	0.5000
	Add Distilled Water to the Specimen			
12/12/18	8:00	1.0	1349	0.5044
12/12/18	9:00	1.0	1409	0.5044

Expansion Index (EI meas) =	((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	4.4
Expansion Index (Report) =	Nearest Whole Number or Zero (0) if Initial Height is > than Final Heigh	**4**

Rev. 03-08

Leighton

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name: Perris TR 33200 Geo
Tested By: M. Vinet
Date: 12/5/18
Project No.: 12223.001
Input By: M. Vinet
Date: 12/10/18
Boring No.: LB-2
Depth (ft.): 0 - 5.0
Sample No.: B-1
Soil Identification: Silty, Clayey Sand (SC-SM), Brown.

Preparation Method: ☒ Moist ☐ Dry

☒ Mechanical Ram ☐ Manual Ram

Mold Volume (ft³) 0.03340

Ram Weight = 10 lb.; Drop = 18 in.

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	5610	5679	5664			
Weight of Mold (g)	3528	3528	3528			
Net Weight of Soil (g)	2082	2151	2136			
Wet Weight of Soil + Cont. (g)	2492.9	2554.9	2553.7			
Dry Weight of Soil + Cont. (g)	2367.4	2384.4	2348.1			
Weight of Container (g)	419.9	421.2	421.1			
Moisture Content (%)	6.4	8.7	10.7			
Wet Density (pcf)	137.4	142.0	141.0			
Dry Density (pcf)	129.1	130.6	127.4			

Maximum Dry Density (pcf) 130.9 **Optimum Moisture Content (%)** 8.2

PROCEDURE USED

☒ **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

☐ **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

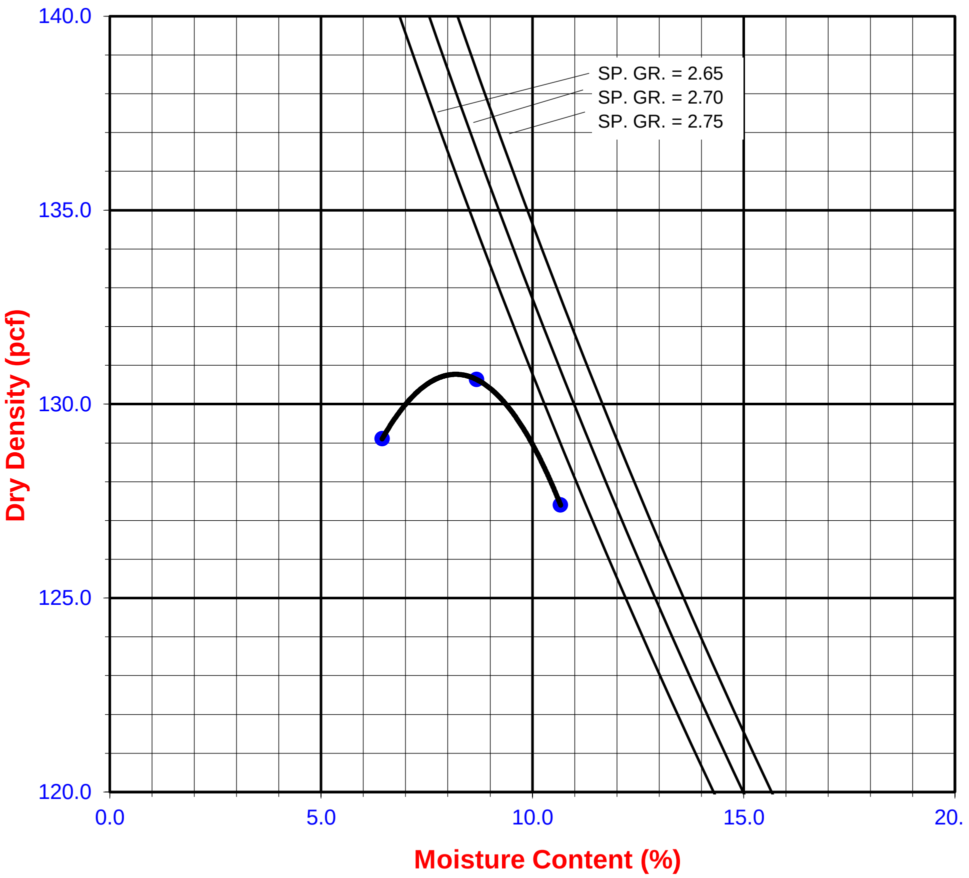
☐ **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



Compaction; LB-2, B-1 (12-3-18)

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name: Perris TR 33200 Geo
Tested By: M. Vinet
Date: 12/10/18
Project No.: 12223.001
Input By: M. Vinet
Date: 12/11/18
Boring No.: LB-3
Depth (ft.): 0 - 5.0
Sample No.: B-1
Soil Identification: Silty, Clayey Sand (SC-SM), Brown.

Preparation Method:
☒ Moist
☐ Dry

☒ Mechanical Ram
☐ Manual Ram

Mold Volume (ft³) 0.03340

Ram Weight = 10 lb.; Drop = 18 in.

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	5606	5686	5615			
Weight of Mold (g)	3528	3528	3528			
Net Weight of Soil (g)	2078	2158	2087			
Wet Weight of Soil + Cont. (g)	2496.2	2570.6	2506.0			
Dry Weight of Soil + Cont. (g)	2351.6	2383.6	2287.7			
Weight of Container (g)	420.9	419.9	421.4			
Moisture Content (%)	7.5	9.5	11.7			
Wet Density (pcf)	137.2	142.4	137.8			
Dry Density (pcf)	127.6	130.1	123.3			

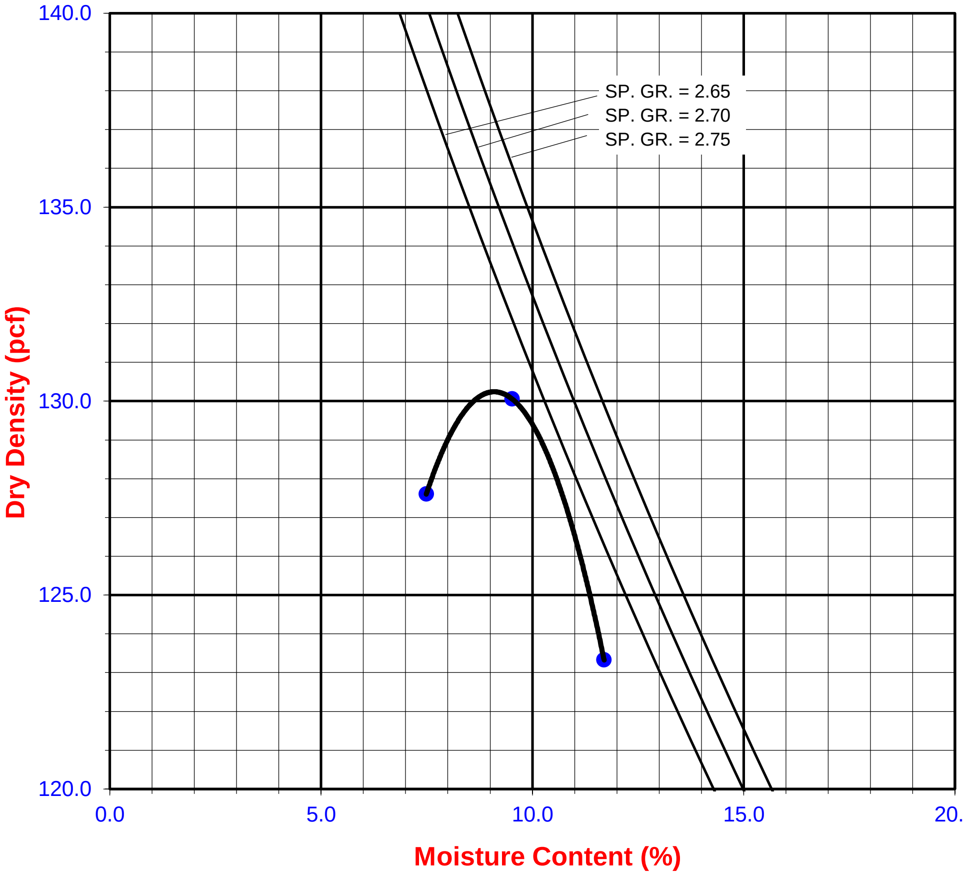
Maximum Dry Density (pcf) 130.3
Optimum Moisture Content (%) 9.0

PROCEDURE USED

☒ **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

☐ **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

☐ **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%



Particle-Size Distribution:
GR:SA:FI

Atterberg Limits:
LL,PL,PI

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MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name: Perris TR 33200 Geo
Tested By: M. Vinet
Date: 12/11/18
Project No.: 12223.001
Input By: M. Vinet
Date: 12/12/18
Boring No.: LB-9
Depth (ft.): 0 - 5.0
Sample No.: B-1
Soil Identification: Silty Sand (SM), Brown.

Preparation Method: ☒ Moist ☐ Dry

☒ Mechanical Ram ☐ Manual Ram

Mold Volume (ft³) 0.03340

Ram Weight = 10 lb.; Drop = 18 in.

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	5629	5695	5657			
Weight of Mold (g)	3528	3528	3528			
Net Weight of Soil (g)	2101	2167	2129			
Wet Weight of Soil + Cont. (g)	2513.2	2575.0	2545.9			
Dry Weight of Soil + Cont. (g)	2388.2	2410.1	2341.4			
Weight of Container (g)	421.2	419.2	421.1			
Moisture Content (%)	6.4	8.3	10.6			
Wet Density (pcf)	138.7	143.0	140.5			
Dry Density (pcf)	130.4	132.1	127.0			

Maximum Dry Density (pcf) 132.2 **Optimum Moisture Content (%)** 8.0

PROCEDURE USED

☒ **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

☐ **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

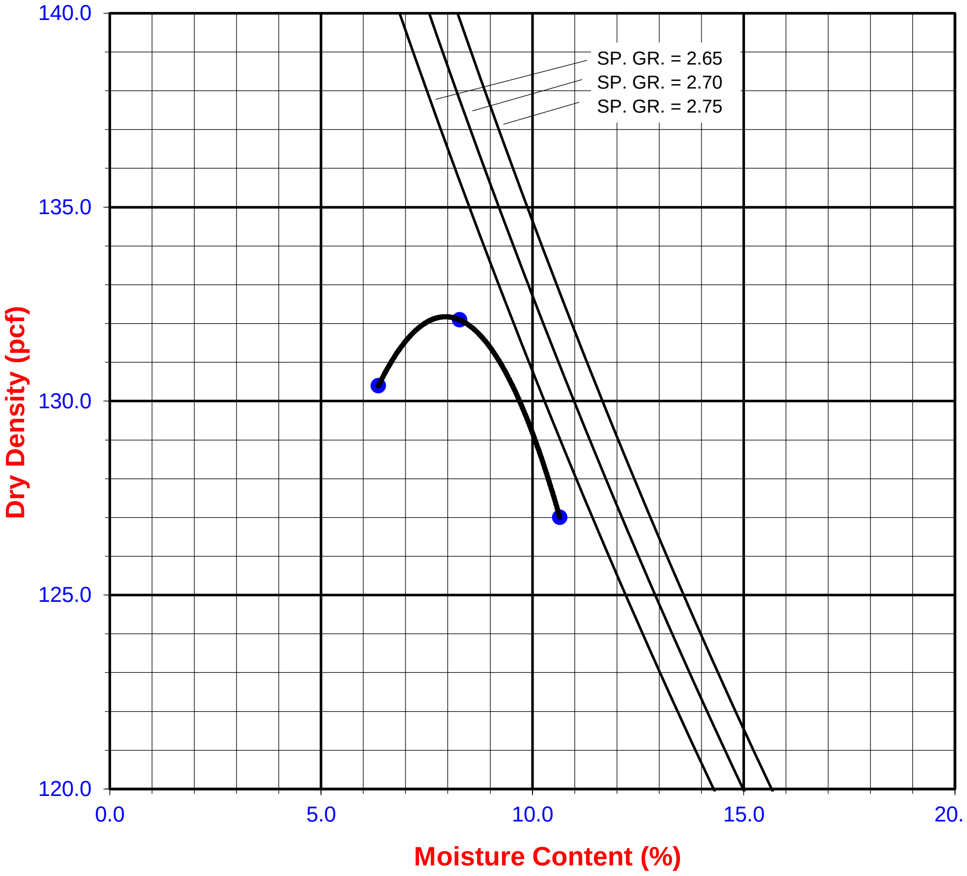
☐ **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



Compaction; LB-9, B-1 (12-3-18)

Leighton

One-Dimensional Swell or Settlement Potential of Cohesive Soils

(ASTM D 4546) -- Method 'B'

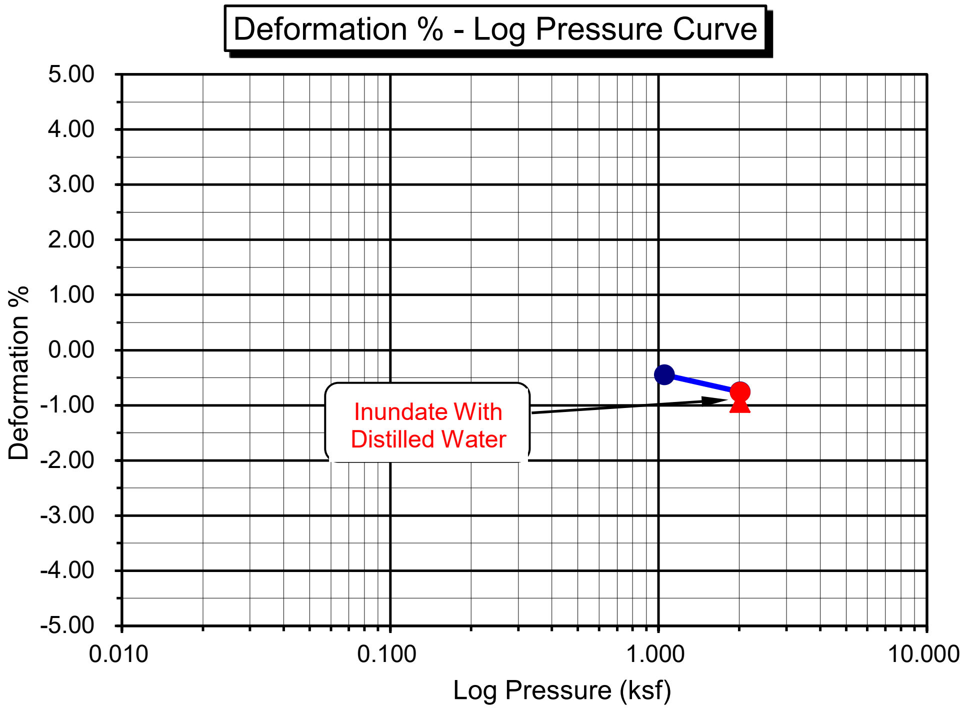
Project Name: Perris TR 33200 Geo
Tested By: M. Vinet Date: 12/10/18
Project No.: 12223.001
Checked By: M. Vinet Date: 12/11/18
Boring No.: **LB-1**
Sample Type: IN SITU
Sample No.: **R-2**
Depth (ft.) 5.0
Sample Description: Silty Sand (SM), Brown.
Source and Type of Water Used for Inundation: Arrowhead (Distilled)
** Note: Loading After Wetting (Inundation) not Performed Using this Test Method.

Initial Dry Density (pcf):	126.5
Initial Moisture (%):	9.9
Initial Height (in.):	1.0000
Initial Dial Reading (in):	0.0000
Inside Diameter of Ring (in):	2.416

Final Dry Density (pcf):	127.7
Final Moisture (%) :	12.0
Initial Void ratio:	0.3327
Specific Gravity (assumed):	2.70
Initial Degree of Saturation (%):	80.0

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.050	0.0045	0.9955	0.00	-0.45	0.3267	-0.45
2.013	0.0076	0.9924	0.00	-0.76	0.3226	-0.76
H2O	0.0095	0.9905	0.00	-0.95	0.3201	-0.95

Percent Swell / Settlement After Inundation = -0.19



Rev. 01-10

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One-Dimensional Swell or Settlement Potential of Cohesive Soils

(ASTM D 4546) -- Method 'B'

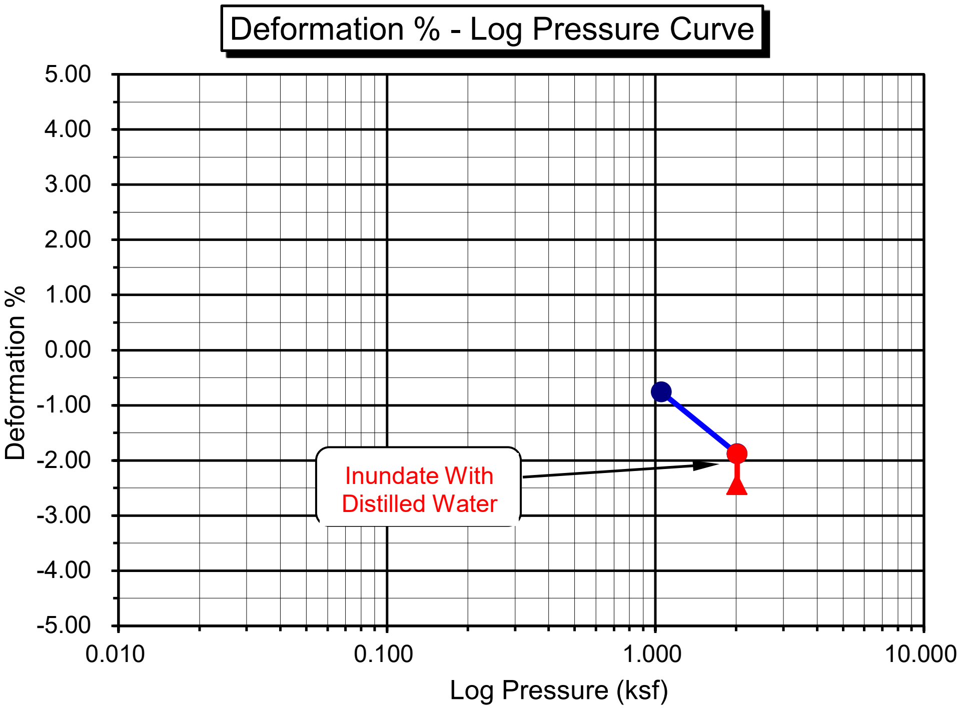
Project Name: Perris TR 33200 Geo
Tested By: M. Vinet Date: 12/10/18
Project No.: 12223.001
Checked By: M. Vinet Date: 12/11/18
Boring No.: **LB-7**
Sample Type: IN SITU
Sample No.: **R-1**
Depth (ft.) 5.0
Sample Description: Silty Sand (SM), Brown.
Source and Type of Water Used for Inundation: Arrowhead (Distilled)
** Note: Loading After Wetting (Inundation) not Performed Using this Test Method.

Initial Dry Density (pcf):	114.2
Initial Moisture (%):	2.8
Initial Height (in.):	1.0000
Initial Dial Reading (in):	0.0000
Inside Diameter of Ring (in):	2.416

Final Dry Density (pcf):	117.0
Final Moisture (%) :	14.4
Initial Void ratio:	0.4763
Specific Gravity (assumed):	2.70
Initial Degree of Saturation (%):	15.7

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.050	0.0076	0.9924	0.00	-0.76	0.4651	-0.76
2.013	0.0188	0.9812	0.00	-1.88	0.4485	-1.88
H2O	0.0244	0.9756	0.00	-2.44	0.4403	-2.44

Percent Swell / Settlement After Inundation = -0.57



Rev. 01-10

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One-Dimensional Swell or Settlement Potential of Cohesive Soils

(ASTM D 4546) -- Method 'B'

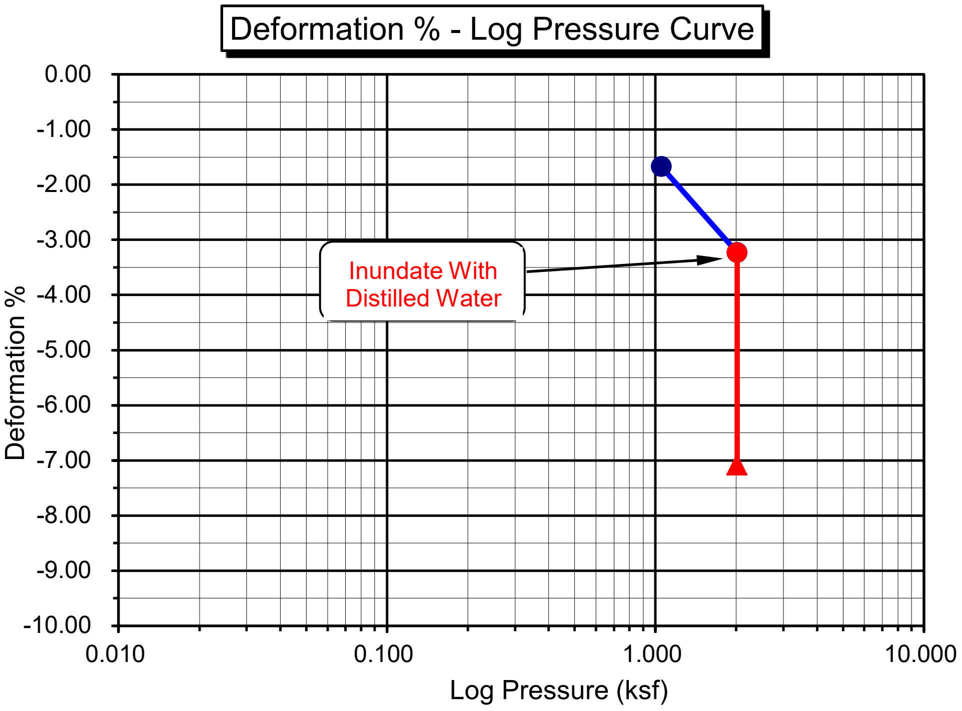
Project Name: Perris TR 33200 Geo
Tested By: M. Vinet Date: 12/10/18
Project No.: 12223.001
Checked By: M. Vinet Date: 12/11/18
Boring No.: **LB-8**
Sample Type: IN SITU
Sample No.: **R-1**
Depth (ft.) 2.0
Sample Description: Silty Sand (SM), Brown.
Source and Type of Water Used for Inundation: Arrowhead (Distilled)
** Note: Loading After Wetting (Inundation) not Performed Using this Test Method.

Initial Dry Density (pcf):	102.4
Initial Moisture (%):	3.2
Initial Height (in.):	1.0000
Initial Dial Reading (in):	0.0000
Inside Diameter of Ring (in):	2.416

Final Dry Density (pcf):	110.2
Final Moisture (%) :	15.9
Initial Void ratio:	0.6464
Specific Gravity (assumed):	2.70
Initial Degree of Saturation (%):	13.2

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.050	0.0167	0.9833	0.00	-1.67	0.6189	-1.67
2.013	0.0323	0.9677	0.00	-3.23	0.5933	-3.23
H2O	0.0709	0.9291	0.00	-7.09	0.5297	-7.09

Percent Swell / Settlement After Inundation = -3.99



Rev. 01-10

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One-Dimensional Swell or Settlement Potential of Cohesive Soils

(ASTM D 4546) -- Method 'B'

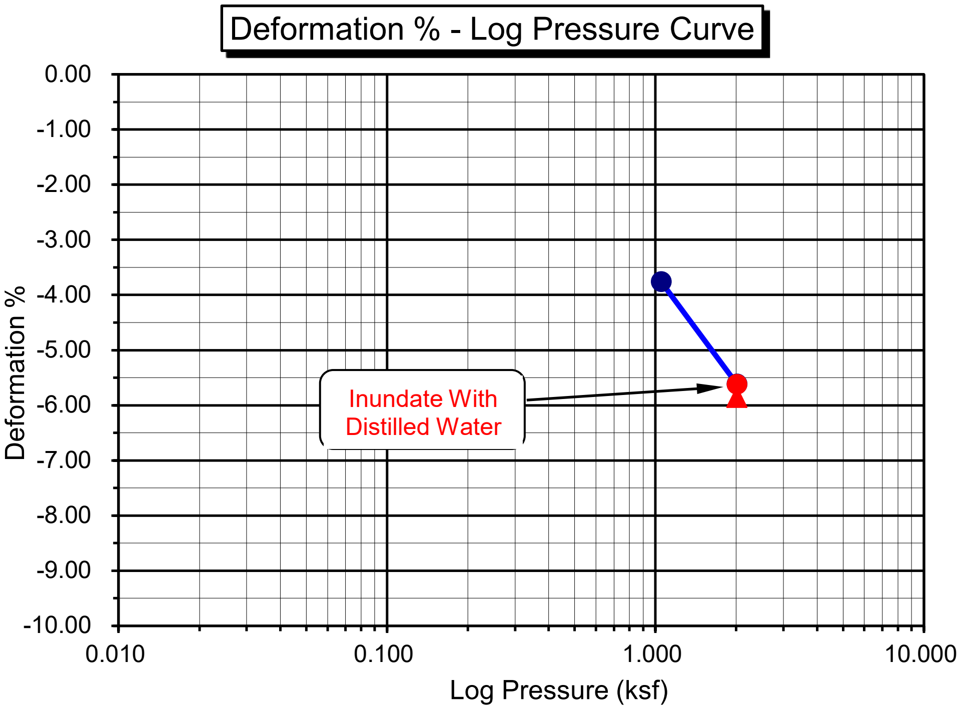
Project Name: Perris TR 33200 Geo
Tested By: M. Vinet Date: 12/10/18
Project No.: 12223.001
Checked By: M. Vinet Date: 12/11/18
Boring No.: **LB-9**
Sample Type: IN SITU
Sample No.: **R-1**
Depth (ft.) 2.0
Sample Description: Silty Sand (SM), Brown.
Source and Type of Water Used for Inundation: Arrowhead (Distilled)
** Note: Loading After Wetting (Inundation) not Performed Using this Test Method.

Initial Dry Density (pcf):	100.9
Initial Moisture (%):	2.9
Initial Height (in.):	1.0000
Initial Dial Reading (in):	0.0000
Inside Diameter of Ring (in):	2.416

Final Dry Density (pcf):	107.2
Final Moisture (%) :	17.1
Initial Void ratio:	0.6708
Specific Gravity (assumed):	2.70
Initial Degree of Saturation (%):	11.6

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.050	0.0376	0.9624	0.00	-3.76	0.6080	-3.76
2.013	0.0562	0.9438	0.00	-5.62	0.5769	-5.62
H2O	0.0586	0.9414	0.00	-5.86	0.5729	-5.86

Percent Swell / Settlement After Inundation = -0.25



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One-Dimensional Swell or Settlement Potential of Cohesive Soils

(ASTM D 4546) -- Method 'B'

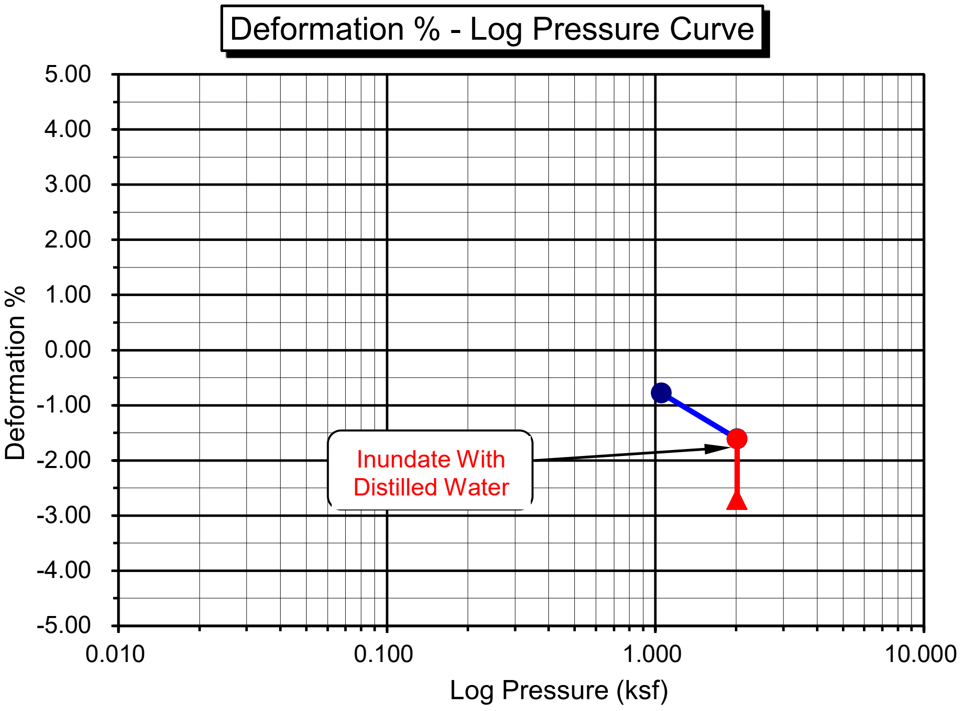
Project Name: Perris TR 33200 Geo
Tested By: M. Vinet Date: 12/10/18
Project No.: 12223.001
Checked By: M. Vinet Date: 12/11/18
Boring No.: **LB-10**
Sample Type: IN SITU
Sample No.: **R-1**
Depth (ft.) 5.0
Sample Description: Silty Sand (SM), Brown.
Source and Type of Water Used for Inundation: Arrowhead (Distilled)
** Note: Loading After Wetting (Inundation) not Performed Using this Test Method.

Initial Dry Density (pcf):	114.8
Initial Moisture (%):	3.9
Initial Height (in.):	1.0000
Initial Dial Reading (in):	0.0000
Inside Diameter of Ring (in):	2.416

Final Dry Density (pcf):	118.0
Final Moisture (%) :	13.3
Initial Void ratio:	0.4677
Specific Gravity (assumed):	2.70
Initial Degree of Saturation (%):	22.6

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.050	0.0078	0.9922	0.00	-0.78	0.4563	-0.78
2.013	0.0161	0.9839	0.00	-1.61	0.4441	-1.61
H2O	0.0271	0.9729	0.00	-2.71	0.4280	-2.71

Percent Swell / Settlement After Inundation = -1.12



Rev. 01-10

Leighton

R-VALUE TEST RESULTS

ASTM D 2844

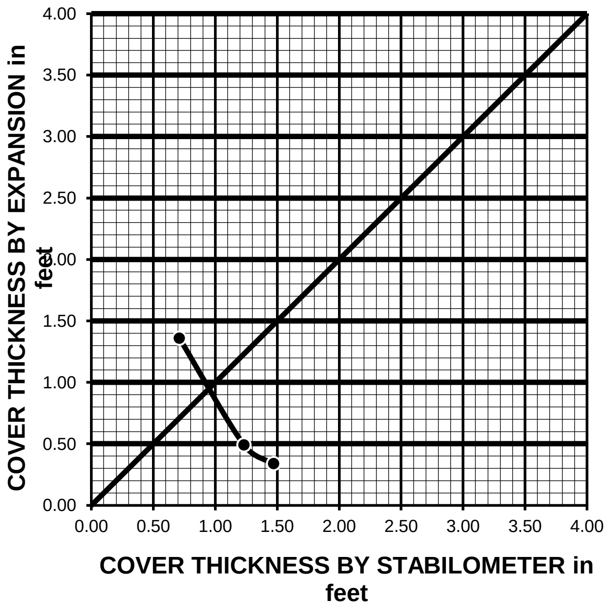
Project Name: Perris TR 33200 Geo
Project Number: 12223.001
Boring Number: LB-2
Sample Number: B-1
Sample Description: Silty, Clayey Sand (SC-SM), Brown.

Date: 12/5/18
Technician: M. Vinet
Depth (ft.): 0 - 5.0
Sample Location: N/A

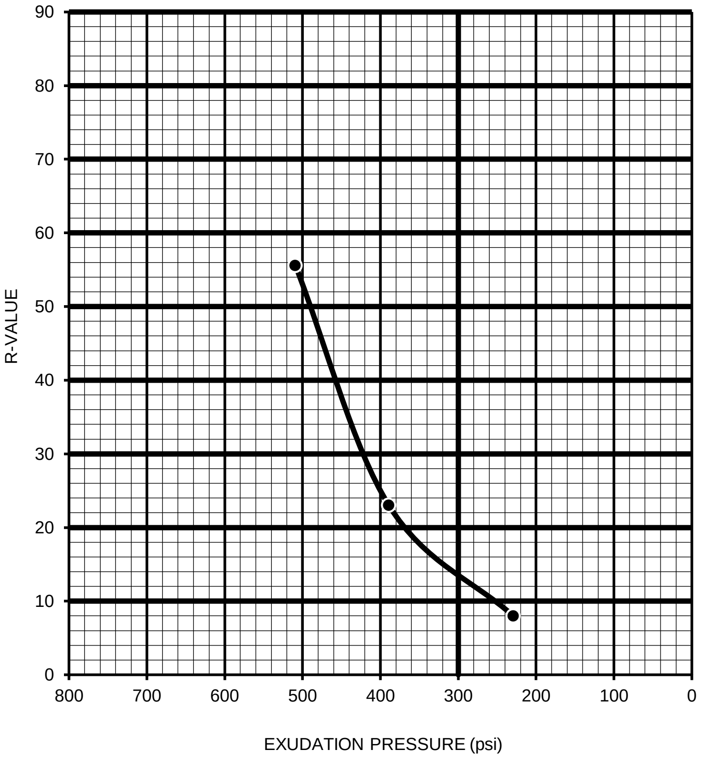
TEST SPECIMEN	A	B	C
MOISTURE AT COMPACTION %	9.9	11.3	12.9
HEIGHT OF SAMPLE, Inches	2.53	2.58	2.65
DRY DENSITY, pcf	121.6	118.9	115.2
COMPACTOR AIR PRESSURE, psi	350	250	125
EXUDATION PRESSURE, psi	509	389	229
EXPANSION, Inches x 10exp-4	36	13	9
STABILITY Ph 2,000 lbs (160 psi)	52	107	137
TURNS DISPLACEMENT	4.15	4.35	4.76
R-VALUE UNCORRECTED	56	22	8
R-VALUE CORRECTED	56	23	8

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.71	1.23	1.47
EXPANSION PRESSURE THICKNESS, ft.	1.36	0.49	0.34

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION: 41
R-VALUE BY EXUDATION: 14
EQUILIBRIUM R-VALUE: 14

Leighton

TESTS for SULFATE CONTENT

Project Name: Perris TR 33200 Geo

Project No. : 12223.001

Tested By : M. Vinet Date: 12/07/18

Data Input By: M. Vinet Date: 12/10/18

Boring No.	LB-2	LB-9		
Sample No.	B-1	B-1		
Sample Depth (ft)	0 - 5.0	0 - 5.0		
Soil Identification:	SC	SM		
Wet Weight of Soil + Container (g)	100.00	100.00		
Dry Weight of Soil + Container (g)	100.00	100.00		
Weight of Container (g)	0.00	0.00		
Moisture Content (%)	0.00	0.00		
Weight of Soaked Soil (g)	100.00	100.00		

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	1	1		
Crucible No.	1	1		
Furnace Temperature (°C)	850	850		
Time In / Time Out	Timer	Timer		
Duration of Combustion (min)	45	45		
Wt. of Crucible + Residue (g)	25.5646	25.5642		
Wt. of Crucible (g)	25.5620	25.5620		
Wt. of Residue (g) (A)	0.0026	0.0022		
PPM of Sulfate (A) x 41150	106.99	90.53		
PPM of Sulfate, Dry Weight Basis	**107**	**91**		

APPENDIX C

Laboratory Testing Program

The laboratory testing program was directed towards providing quantitative data relating to the relevant engineering properties of the soils. Samples considered representative of site conditions were tested as described below.

a) Moisture-Density

Moisture-density information usually provides a gross indication of soil consistency. Local variations at the time of the investigation can be delineated, and a correlation obtained between soils found on this site and nearby sites. The dry unit weights and field moisture contents were determined for selected samples. The results are shown on the Logs of Borings.

b) Compaction

A representative soil sample was tested in the laboratory to determine the maximum dry density and optimum moisture content, using the ASTM D1557 compaction test method. This test procedure requires 25 blows of a 10-pound hammer falling a height of 18 inches on each of five layers, in a 1/30 cubic foot cylinder. The results of the test are shown below:

Boring No.	**Sample Depth (ft)**	**Soil Description**	**Optimum Moisture Content (%)**	**Maximum Dry Density (lb/ft^3)**
B-1	1-4	Silty SAND	8.5	131.0

c) Direct Shear

Direct shear tests were conducted on remolded samples, using a direct shear machine at a constant rate of strain. Variable normal or confining loads are applied vertically and the soil shear strengths are obtained at these loads. The angle of internal friction and the cohesion are then evaluated. The samples were tested at saturated moisture contents. The test results are shown in terms of the Coulomb shear strength parameters, as shown below:

Boring No.	Sample Depth (ft)	Soil Description	Coulomb Cohesion (lb/ft^2)	Angle of Internal Friction (°)	Peak/ Residual	Undisturbed/ Remolded
B-1	1-4	Silty SAND	600 350	24 28	Peak Residual	Remolded

d) Sulfate Content

Representative soil samples were analyzed for their sulphate content in accordance with California Test Method CA417. The results are given below:

Boring No.	Sample Depth (ft.)	Soil Description	Sulphate Content (ppm)
B-7	1-4	Silty SAND	15

APPENDIX C

SEISMIC REFRACTION SURVEY

(Previous Exploration)

Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

August 10, 2004
Project No. 105331001

Mr. Kevin Young
Global Geo-Engineering, Inc.
2712 Dow Avenue, Suite B
Tustin, California 92780

Subject: Seismic Refraction Survey
Proposed Development
Southwest Corner of Metz Road and A Street
Perris, California

Dear Mr. Young:

In accordance with your verbal authorization, we have performed a seismic refraction survey for portions of the property located at the southwest corner of the intersection of Metz Road and A Street in Perris, California. Specifically, our survey consisted of seven seismic refraction traverses performed at locations selected by your office. The purpose of the refraction survey was to assess the rippability of the on-site near surface material. This report presents our survey methodology, equipment used, analysis, and findings.

We appreciate the opportunity to be of service on this project. Should you have any questions related to this report, please contact the undersigned at your convenience.

Sincerely,
NINYO & MOORE

Patrick Lehmann

Patrick F. Lehmann, R.Gp.
Project Geologist/Geophysicist

Hans van de Vrugt

Hans van de Vrugt, C.E.G., R.Gp.
Principal Geologist/Geophysicist

REGISTERED GEOPHYSICIST
Hans van de Vrugt
No 1012
Exp. 2/28/06
STATE OF CALIFORNIA

PFL/HV/msf

Distribution: (2) Addressee

5710 Ruffin Road ▪ San Diego, California 92123 ▪ Phone (858) 576-1000 ▪ Fax (858) 576-9600
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Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

SEISMIC REFRACTION SURVEY
PROPOSED DEVELOPMENT
SOUTHWEST CORNER OF
METZ ROAD AND A STREET
PERRIS, CALIFORNIA

PREPARED FOR:
Global Geo-Engineering, Inc.
2712 Dow Avenue, Suite B
Tustin, California 92780

PREPARED BY:
Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
5710 Ruffin Road
San Diego, California 92123-1013

August 10, 2004
Project No. 105331001

TABLE OF CONTENTS

1. INTRODUCTION

In accordance with your authorization, we have performed seven seismic refraction traverses at locations selected by your office. The purpose of our study was to evaluate the rippability of the on-site near surface materials in areas of proposed grading operations. This report presents our survey methodology, equipment used, analysis, and findings.

2. SCOPE OF SERVICES

Our scope of services included:

- Review of background information, including geologic maps and aerial photographs.
- Performance of seven seismic refraction lines at the project site.
- Compilation and analysis of data collected.
- Preparation of this report presenting our findings and conclusions.

3. SITE AND PROJECT DESCRIPTION

The property is located at the southwest corner of the intersection of Metz Road and A Street in Perris, California (Figure 1). The property is in the planning phase of development for future housing. The site consists of boulder covered hills, transected by washes. Vegetation on site includes annual grass. Based on discussions with you, it is our understanding that the proposed development will include cut and fill grading with cuts up to approximately 30 feet deep expected. The geology at the site was reported to be surficial soil overlying quartz diorite (Morton, 1972).

4. SURVEY METHODOLOGY

The seismic refraction method uses first-arrival times of refracted seismic waves to estimate the thicknesses and seismic velocities of subsurface layers. Seismic waves generated at the surface are refracted at boundaries separating materials of contrasting velocities. These refracted seismic waves are then detected by a series of surface geophones and recorded with a Geometrics Smart-Seis seismograph. The travel times of the seismic waves are used in conjunction with the shot-to-geophone distances to obtain thickness and velocity information on the subsurface materials.

Seven seismic lines (SL-1 through SL-7) were performed within the subject site (Figure 2). Shot points were conducted off each end of the line and between geophones 6 and 7 (midpoint). The line lengths were 230 feet.

The refraction method requires that subsurface velocities increase with depth. A layer having a velocity lower than that of the layer above will not be detectable by the seismic refraction method and, therefore, could lead to errors in the depth calculations of subsequent layers. In addition, lateral variations in velocity can also result in the misinterpretation of the subsurface conditions.

In general, seismic wave velocities can be correlated to material density and/or rock hardness. The relationship between rippability and seismic velocity is empirical and assumes a homogenous mass. Localized areas of differing composition, texture, or structure may affect both the measured data and the actual rippability of the mass. The rippability of a mass is also dependent on the excavation equipment used and the skill and experience of the equipment operator.

The following rippability chart (Table 1) is based on our experience with similar materials and assumes that a Caterpillar D-9 dozer ripping with a single shank is used. We emphasize that the cutoffs in this classification scheme are approximate and that rock characteristics, such as fracture spacing and orientation, play a significant role in determining rock rippability. These characteristics may also vary with location and depth.

Table 1 – Rippability Classification

Seismic Velocity (ft./s)	Rippability
0 to 2000	Easy
2000 to 4000	Moderate
4000 to 5500	Difficult, Possible Local Blasting
5500 to 7000	Very Difficult, Probable Local to General Blasting
Greater than 7000	Blasting Generally Required

For trenching operations, the rippability figures should be scaled downward. For example, velocities as low as 3,500 feet per second may indicate difficult ripping during trenching operations. In addition, the presence of boulders, which can be troublesome in a narrow trench, should be anticipated. The above classification scheme should be used with discretion, and contractors should not be relieved of making their own independent evaluation of the rippability of the on-site materials prior to submitting their bids.

5. RESULTS

Table 2 lists the average velocities and depths calculated from the seismic refraction traverses conducted during this evaluation. The approximate locations of the seismic refraction traverses are shown on the Seismic Line Location Map (Figure 2). Layer profiles are also included in Figures 3 through 9. Please note the vertical scale changes for the profiles.

It should also be noted that, as a general rule of thumb, the effective depth of evaluation for a seismic refraction traverse is approximately one-third to one-fifth the length of the refraction line. The lengths of the seismic refraction lines are listed with their interpretations in Table 2.

Table 2 – Seismic Traverse Results

Traverse No. And Length	Velocity Feet/Second	Approximate Depth to Bottom of Layer (feet)	Rippability*
SL-1 230 feet	V1 = 1,600 V2 = 3,350 V3 = >10,000	1 – 8 11 – 20 —	Easy Moderate Blasting Generally Required
SL-2 230 feet	V1 = 1,150 V2 = 5,700 V3 = >10,000	3 – 10 20 – 32 —	Easy Very Difficult, Probable Blasting Blasting Generally Required
SL-3 230 feet	V1 = 1,150 V2 = 3,450 V3 = >10,000	2 – 5 10 – 20 —	Easy Moderate Blasting Generally Required
SL-4 230 feet	V1 = 1,400 V2 = 4,550 V3 = 9,100	2 – 7 7 – 23 —	Easy Difficult, Possible Local Blasting Blasting Generally Required
SL-5 230 feet	V1 = 1,600 V2 = 4,450 V3 = >10,000	1 – 5 17 – 32 —	Easy Difficult, Possible Local Blasting Blasting Generally Required
SL-6 230 feet	V1 = 1,750 V2 = 2,950 V3 = >10,000	1 – 5 27 – 32 —	Easy Moderate Blasting Generally Required

Table 2 – Seismic Traverse Results

Traverse No. And Length	Velocity Feet/Second	Approximate Depth to Bottom of Layer (feet)	Rippability*
SL-7 230 feet	V1 = 1,400 V2 = 4,300 V3 = >10,000	1 – 5 18 – 22 —	Easy Difficult, Possible Local Blasting Blasting Generally Required

*Rippability criteria based on the use of a Caterpillar D-9 dozer ripping with a single shank

6. FINDINGS AND CONCLUSIONS

The results from our seismic survey indicate three distinct geologic layers present at each surveyed area. These layers have been interpreted to be colluvium and weathered bedrock overlying less weathered bedrock.

Based on our evaluation, blasting and/or special rock excavation equipment may be needed to facilitate mass grading or trenching, depending on the rate of production desired. We understand that blasting at the site may be undesirable because of the residential environment and the excessive noise and vibrations that could be generated. Please note that a contractor with experience in difficult digging conditions should be consulted for alternatives to blasting and should be consulted for expert advice on excavation methodology. It should be noted that, depending on the excavation method, the proposed excavations will likely generate oversize material (particles larger than 3 inches).

7. LIMITATIONS

The field evaluation and geophysical analyses presented in this report have been conducted in general accordance with current practice and the standard of care exercised by consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be present. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request.

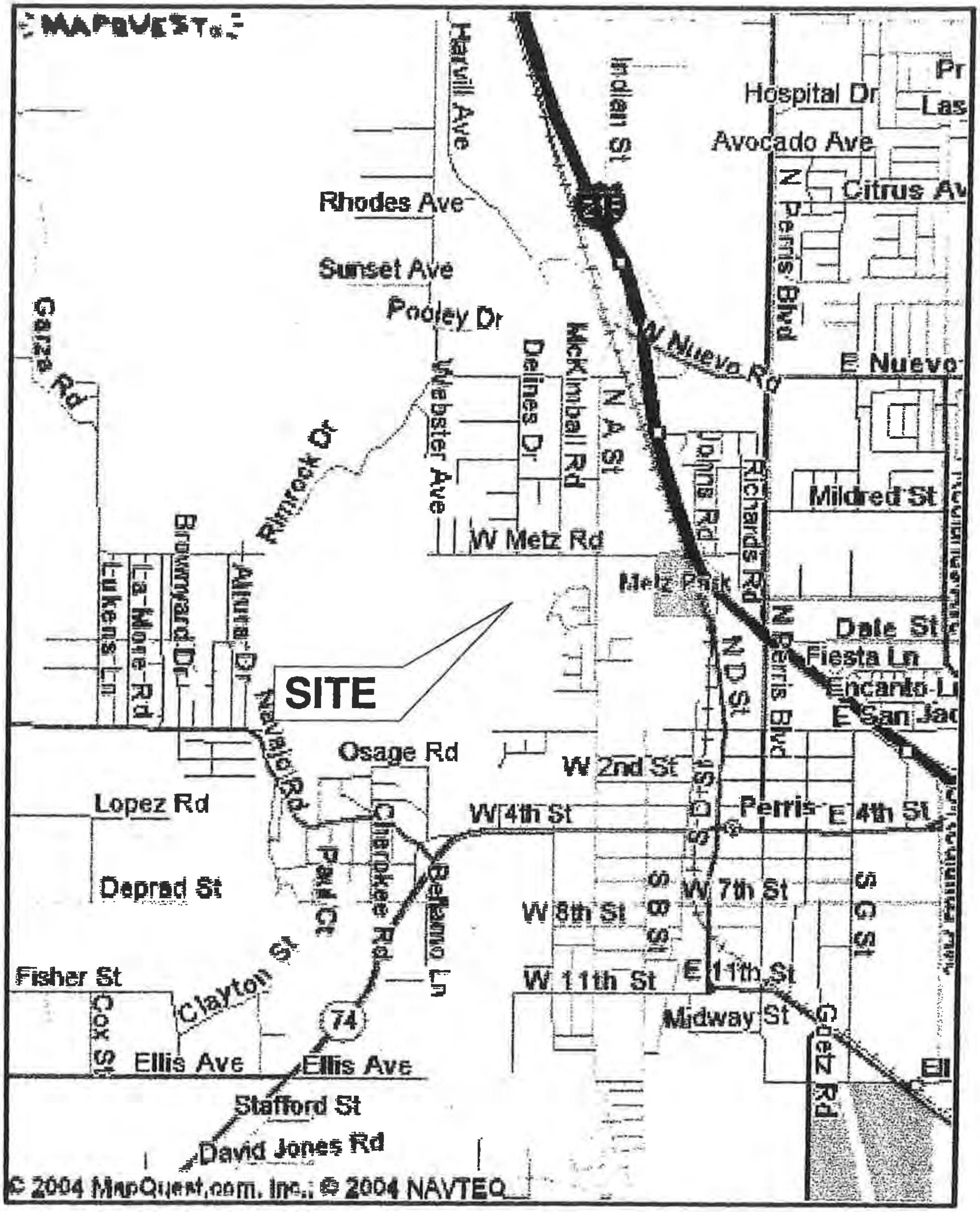
This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document. This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

8. SELECTED REFERENCES

Caterpillar, Inc., 2000, Caterpillar Performance Handbook, Caterpillar, Inc., Peoria, Illinois

Morton, D.M., Geology of the Lakeview-Perris Quadrangles, Riverside County, California: California Division of Mines and Geology: 1 Sheet, Scale 1:24,000.

Rimrock Geophysics, 1997, Seismic Refraction Interpretation Programs (SIP), V-4.1.



SITE LOCATION MAP

N

PROPOSED DEVELOPMENT
SOUTHWEST CORNER OF METZ ROAD AND A STREET
PERRIS, CALIFORNIA

PROJECT NO.: 105331001

DATE: 8/04

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FIGURE 1

NOT TO SCALE

SEISMIC LINE LOCATION MAP

N

PROPOSED DEVELOPMENT
SOUTHWEST CORNER OF METZ ROAD AND A STREET
PERRIS, CALIFORNIA

PROJECT NO.: 105331001

DATE: 8/04

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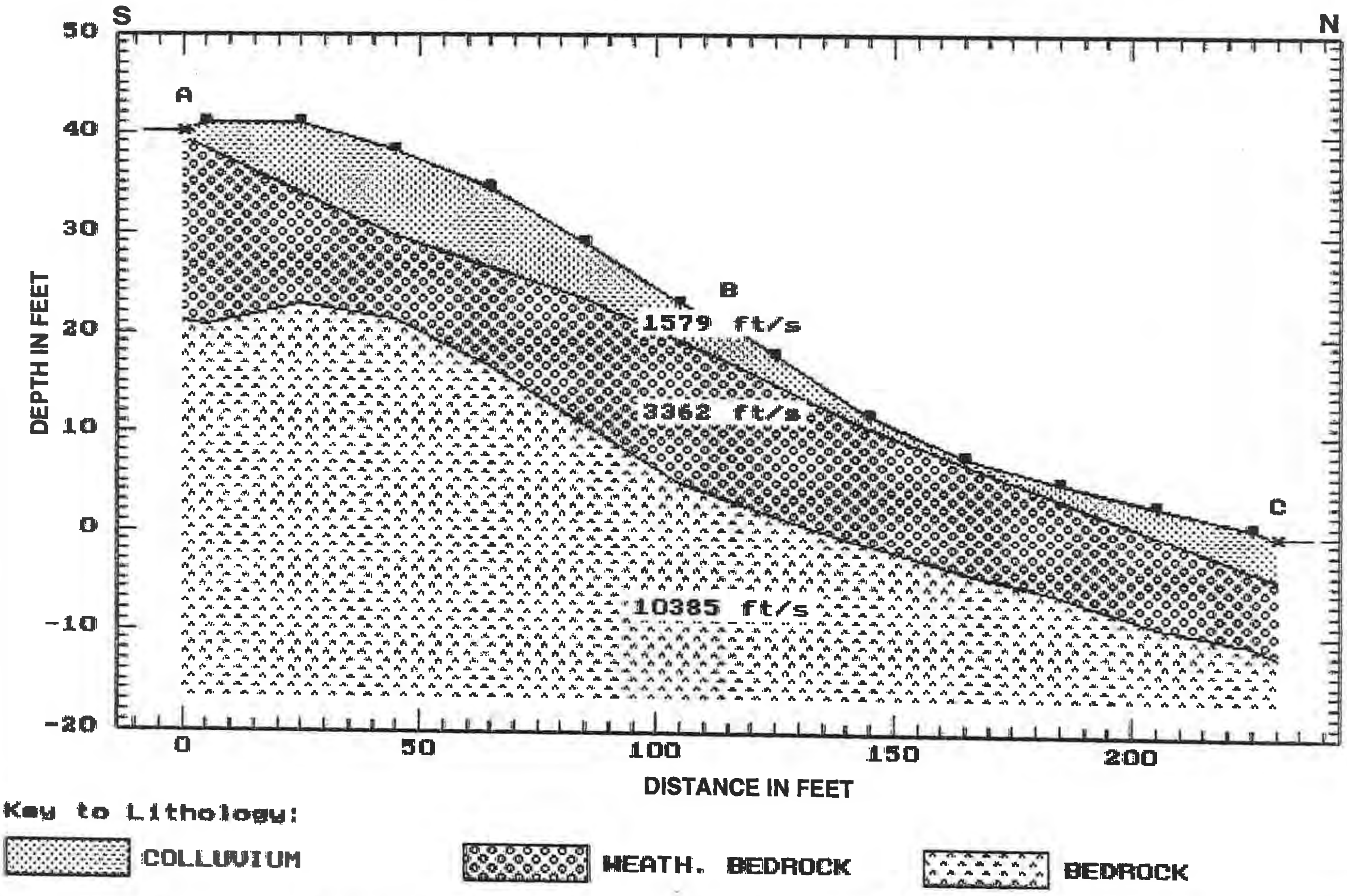
FIGURE 2



SEISMIC PROFILE
LINE 1

PROPOSED DEVELOPMENT
SOUTHWEST CORNER OF METZ ROAD AND A STREET
PERRIS, CALIFORNIA

PROJECT NO.: 105331001

DATE: 8/04

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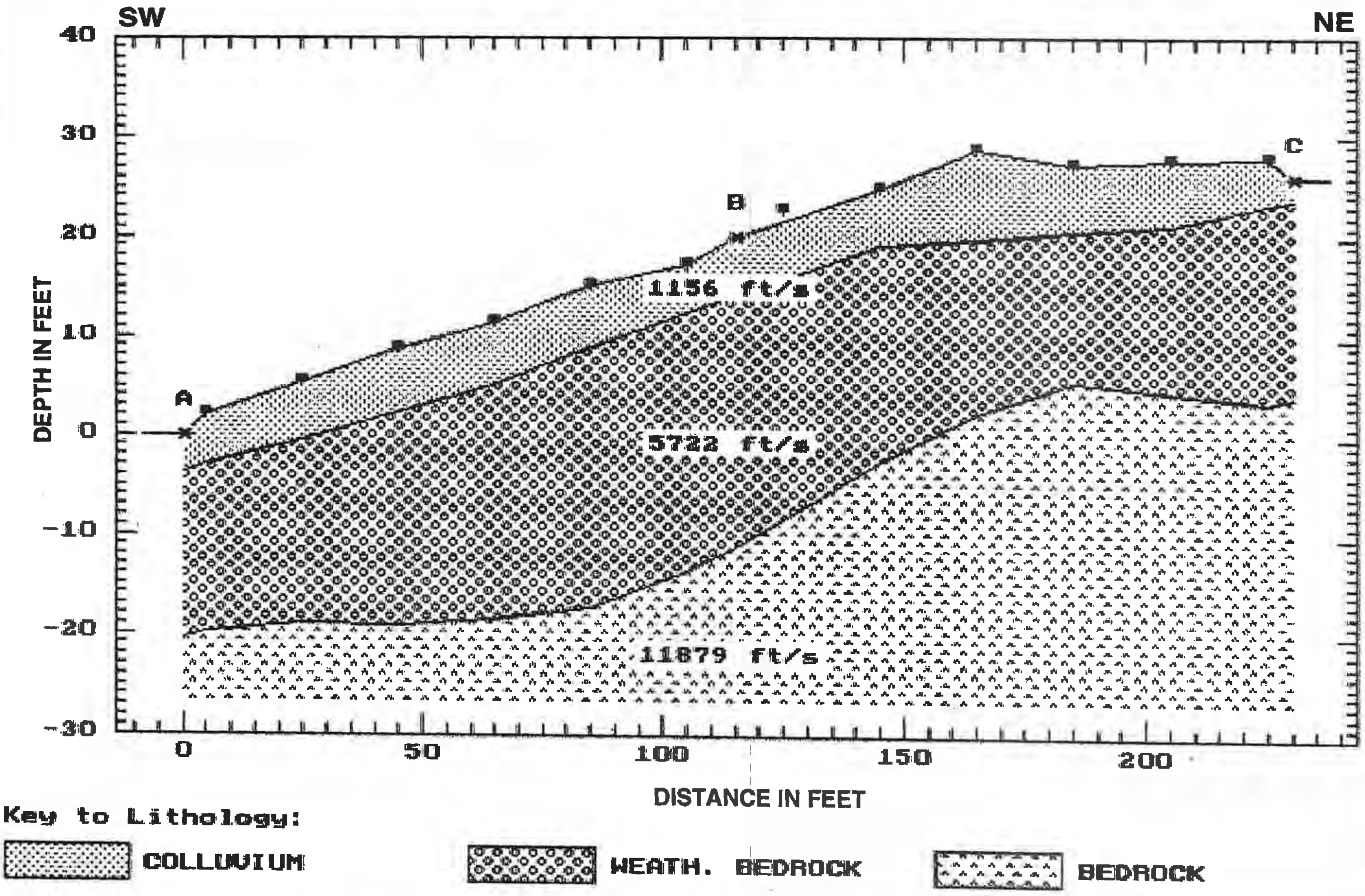
FIGURE 3



SEISMIC PROFILE
LINE 2

PROPOSED DEVELOPMENT
SOUTHWEST CORNER OF METZ ROAD AND A STREET
PERRIS, CALIFORNIA

PROJECT NO.: 105331001

DATE: 8/04

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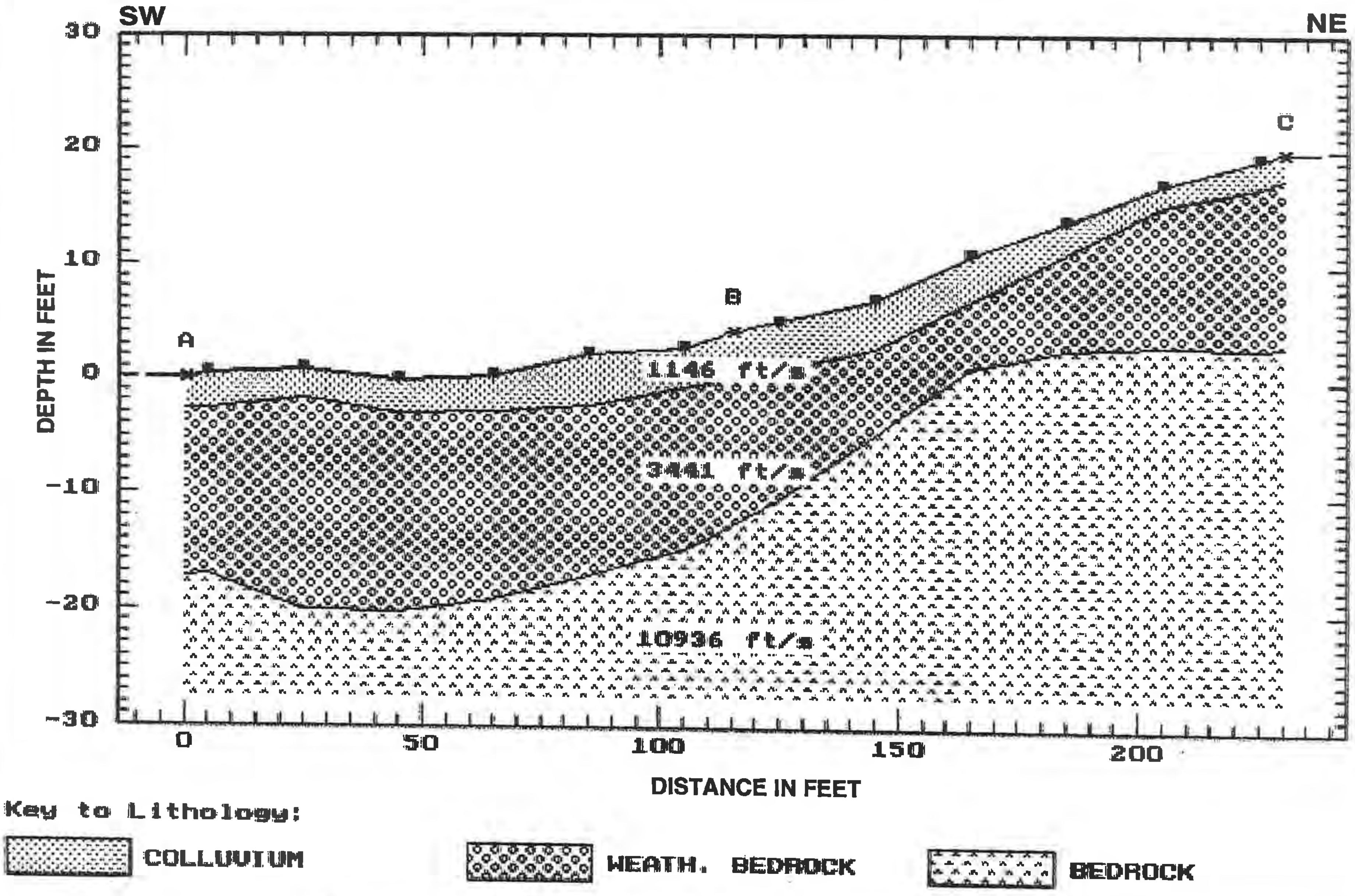
FIGURE 4



SEISMIC PROFILE
LINE 3

PROPOSED DEVELOPMENT
SOUTHWEST CORNER OF METZ ROAD AND A STREET
PERRIS, CALIFORNIA

PROJECT NO.: 105331001

DATE: 8/04

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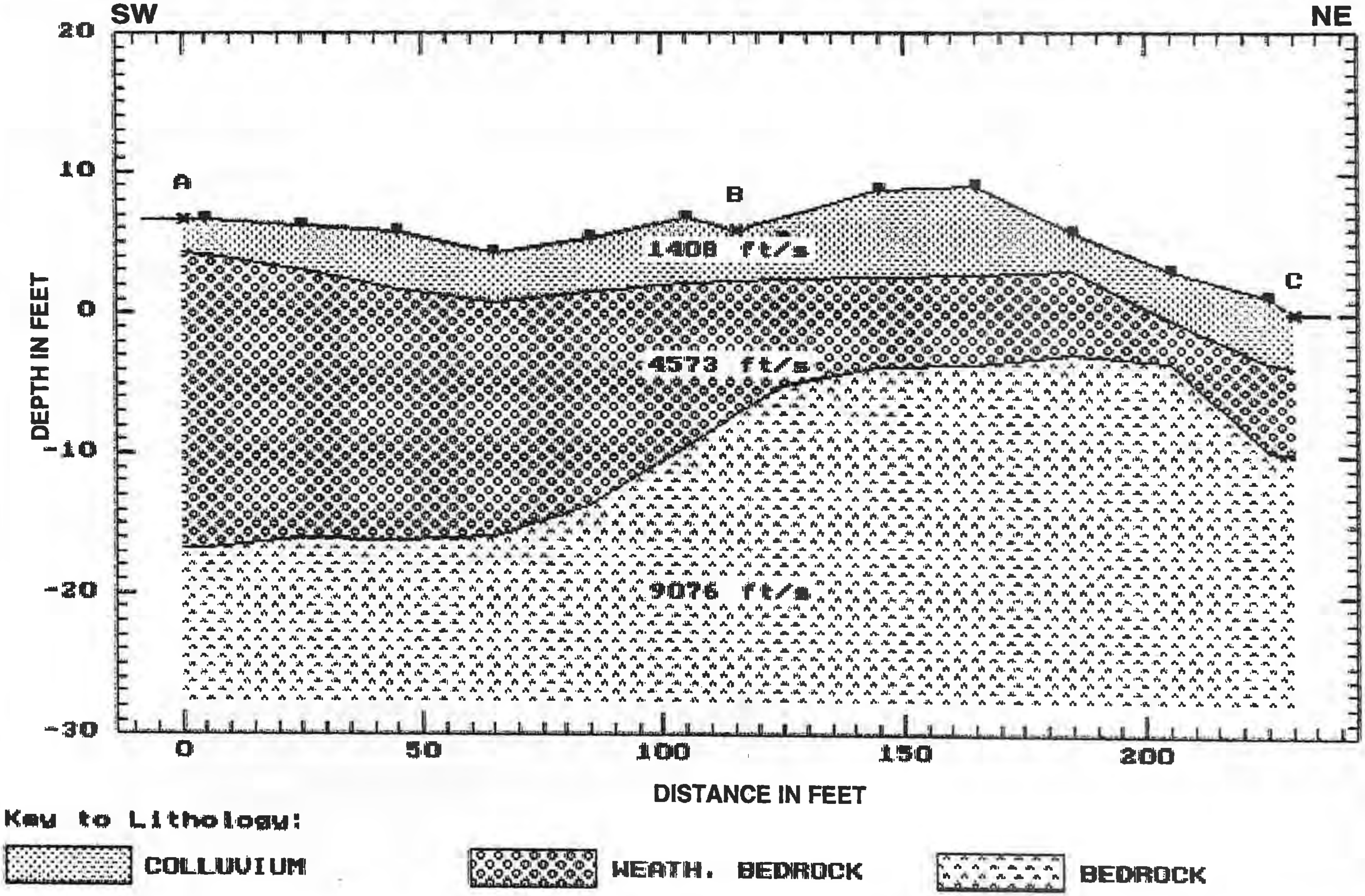
FIGURE 5



SEISMIC PROFILE
LINE 4

PROPOSED DEVELOPMENT
SOUTHWEST CORNER OF METZ ROAD AND A STREET
PERRIS, CALIFORNIA

PROJECT NO.: 105331001

DATE: 8/04

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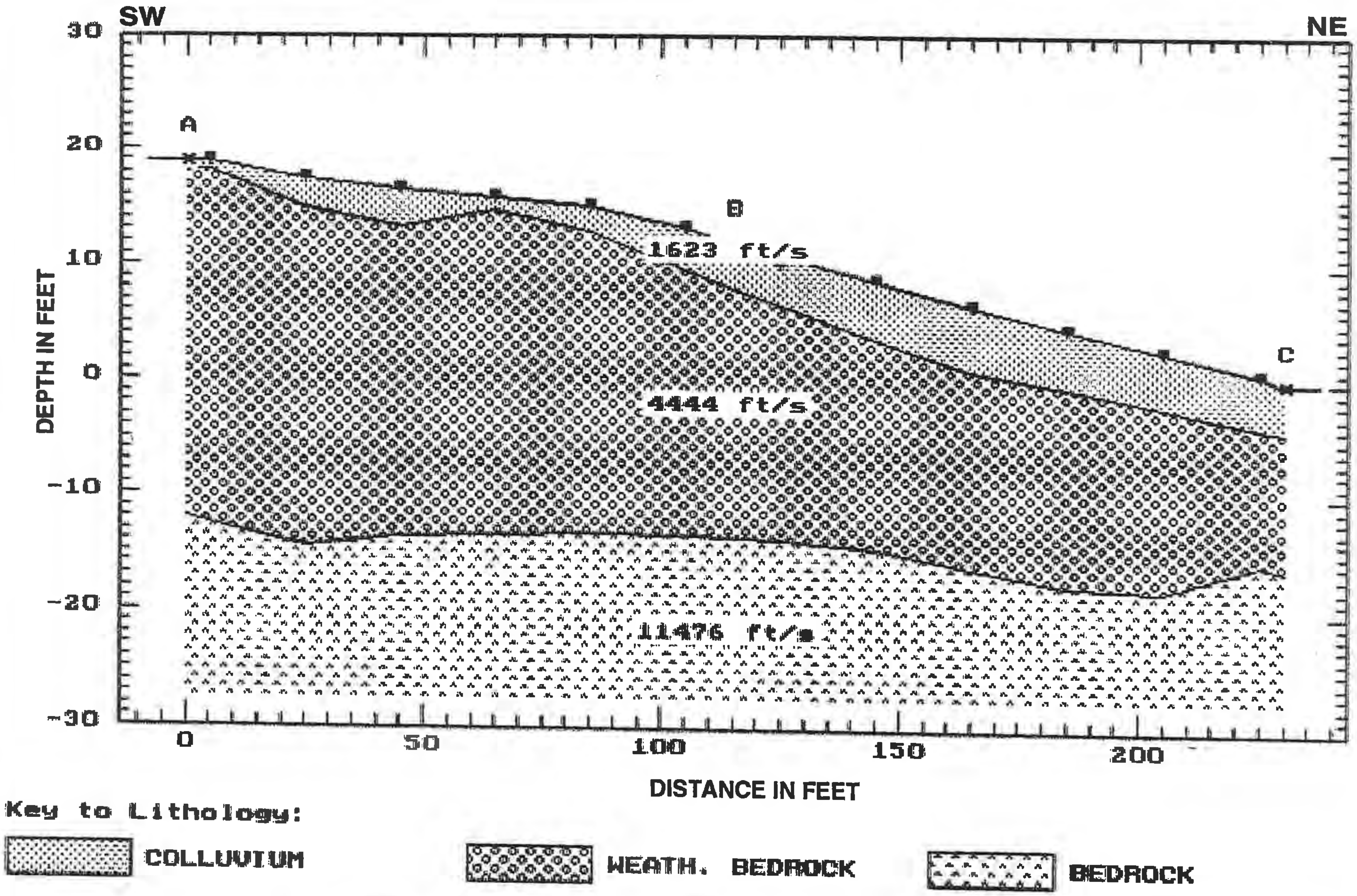
FIGURE 6



SEISMIC PROFILE
LINE 5

PROPOSED DEVELOPMENT
SOUTHWEST CORNER OF METZ ROAD AND A STREET
PERRIS, CALIFORNIA

PROJECT NO.: 105331001

DATE: 8/04

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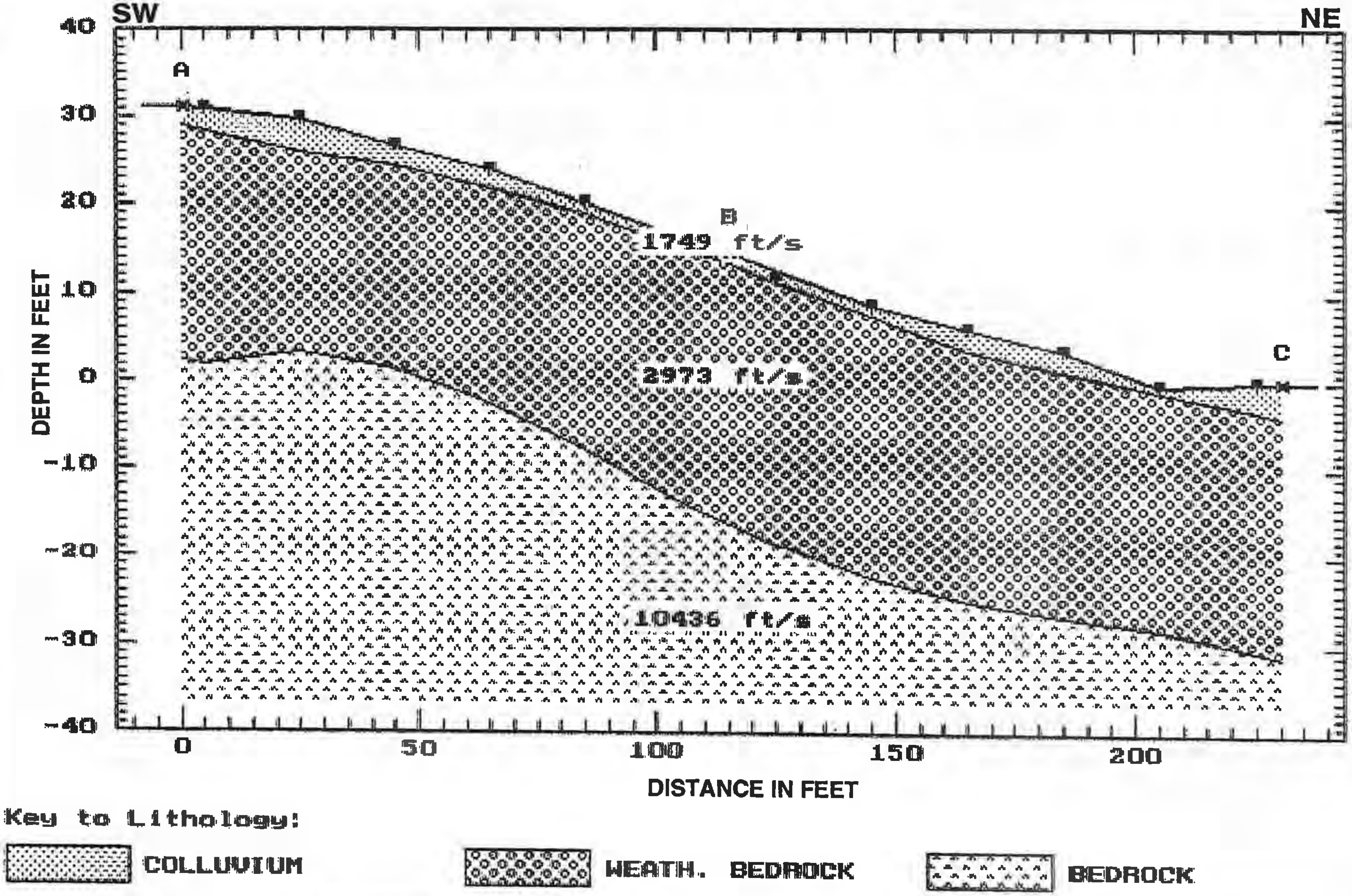
FIGURE 7



SEISMIC PROFILE
LINE 6

PROPOSED DEVELOPMENT
SOUTHWEST CORNER OF METZ ROAD AND A STREET
PERRIS, CALIFORNIA

PROJECT NO.: 105331001

DATE: 8/04

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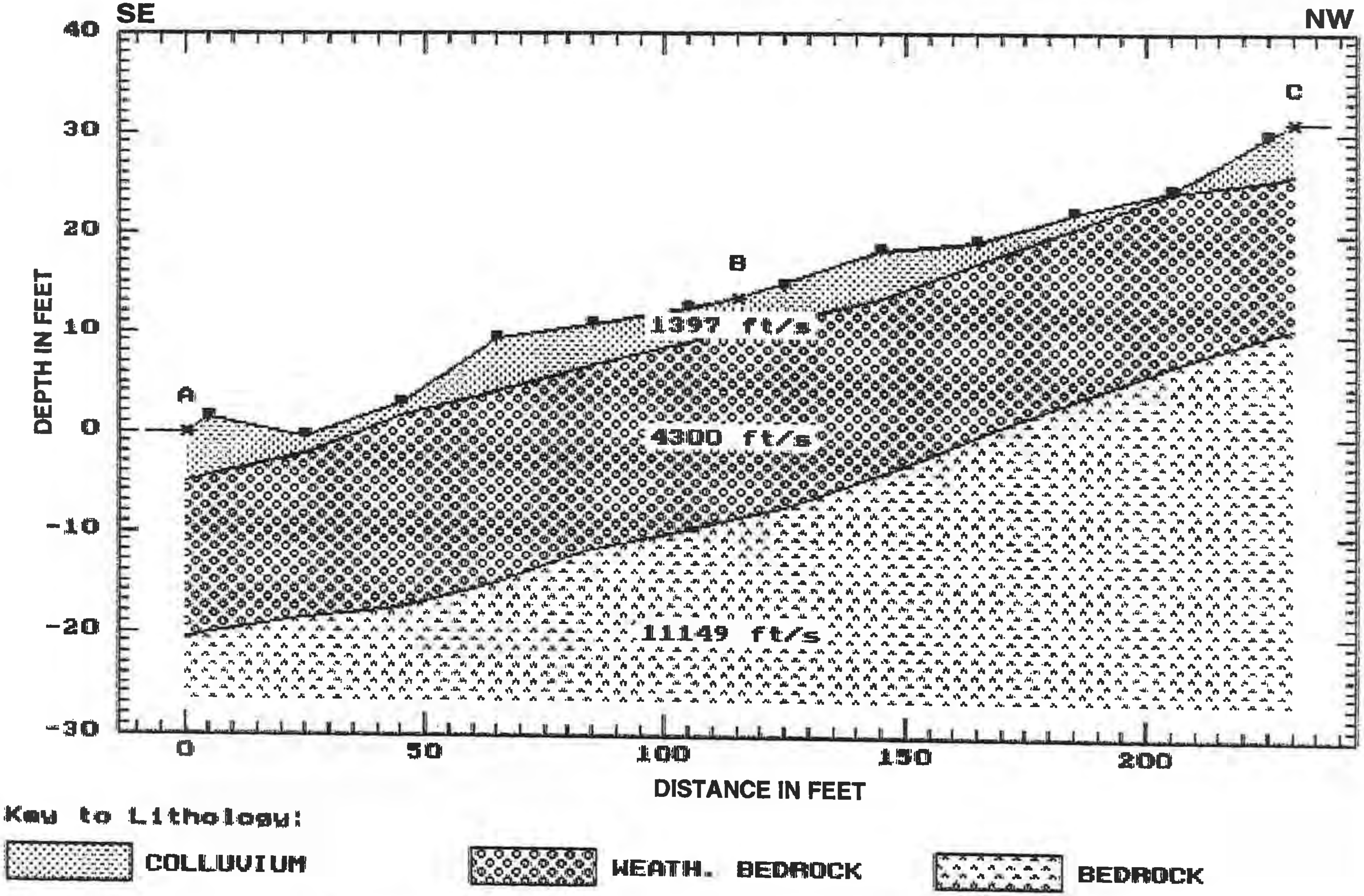
FIGURE 8



SEISMIC PROFILE
LINE 7

PROPOSED DEVELOPMENT
SOUTHWEST CORNER OF METZ ROAD AND A STREET
PERRIS, CALIFORNIA

PROJECT NO.: 105331001 DATE: 8/04

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FIGURE 9

APPENDIX D

EARTHWORK AND GRADING SPECIFICATIONS

APPENDIX D

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

TABLE OF CONTENTS

1.0 General

1.1 Intent

These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 The Geotechnical Consultant of Record

Prior to commencement of work, the owner shall employ the Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultants shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all key bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to determine the attained level of compaction. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor

The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing

Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

2.2 Processing

Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Overexcavation

In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General

Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 Oversize

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 Import

If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers

Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 Fill Moisture Conditioning

Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557).

4.3 Compaction of Fill

After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes

In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557.

4.5 Compaction Testing

Field-tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 Frequency of Compaction Testing

Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 Compaction Test Locations

The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 Safety

The Contractor shall follow all OSHA and Cal/OSHA requirements for safety of trench excavations.

7.2 Bedding and Backfill

All bedding and backfill of utility trenches shall be performed in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of relative compaction from 1 foot above the top of the conduit to the surface.

The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

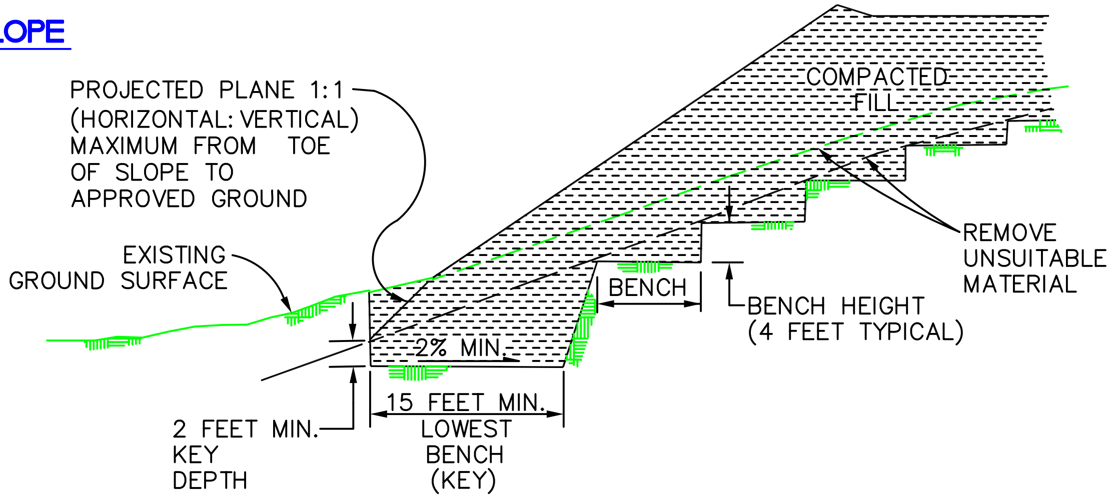
7.3 Lift Thickness

Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

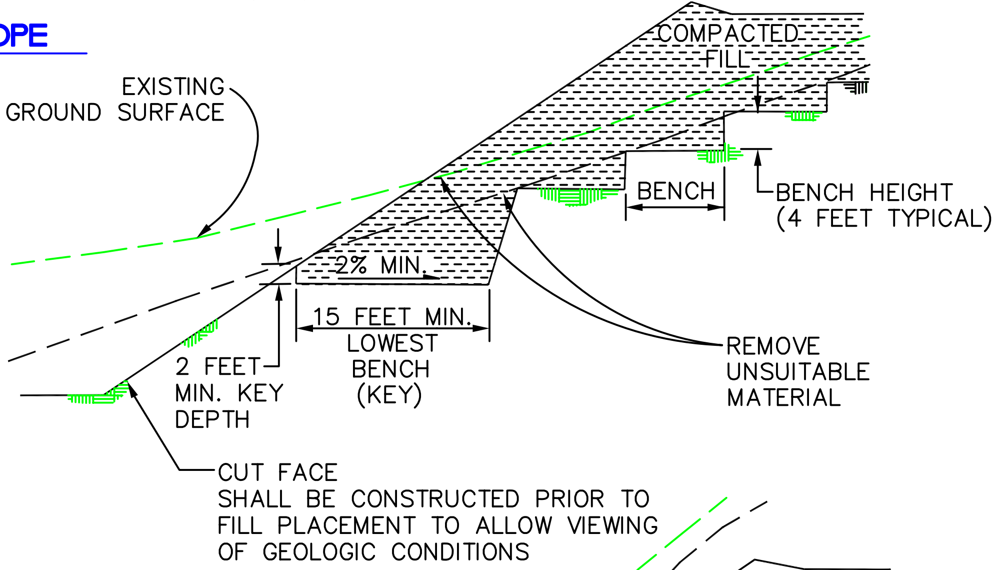
7.4 Observation and Testing

The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

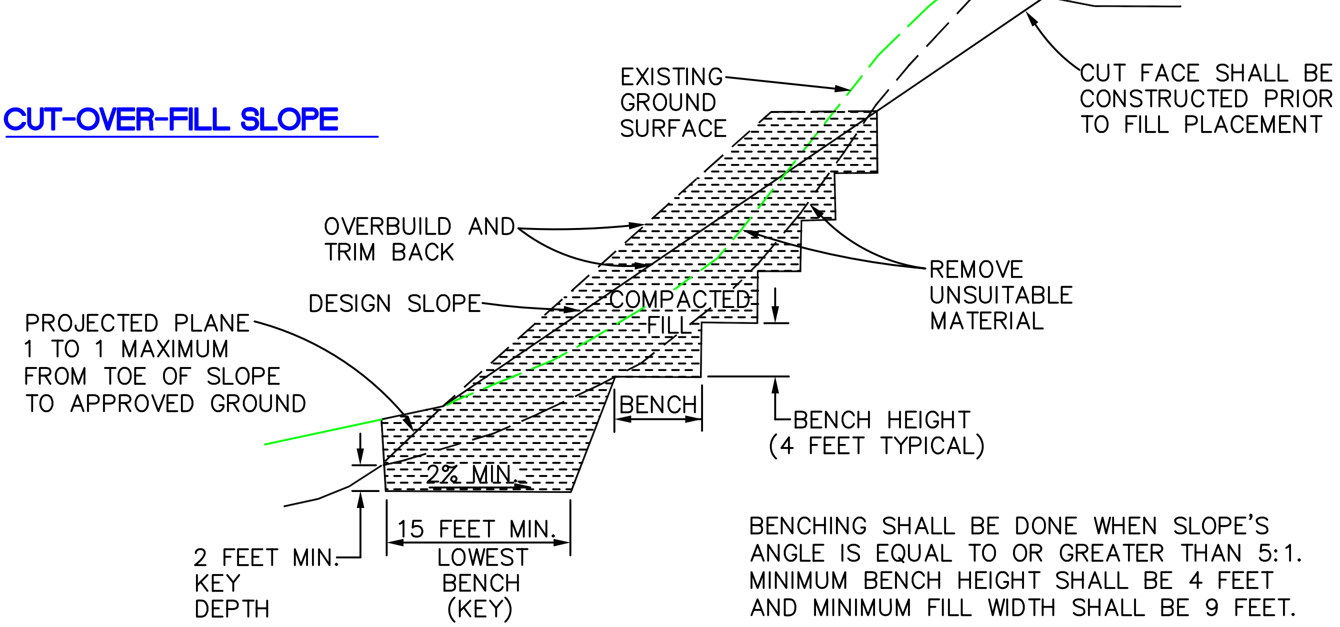
FILL SLOPE



FILL-OVER-CUT SLOPE



CUT-OVER-FILL SLOPE

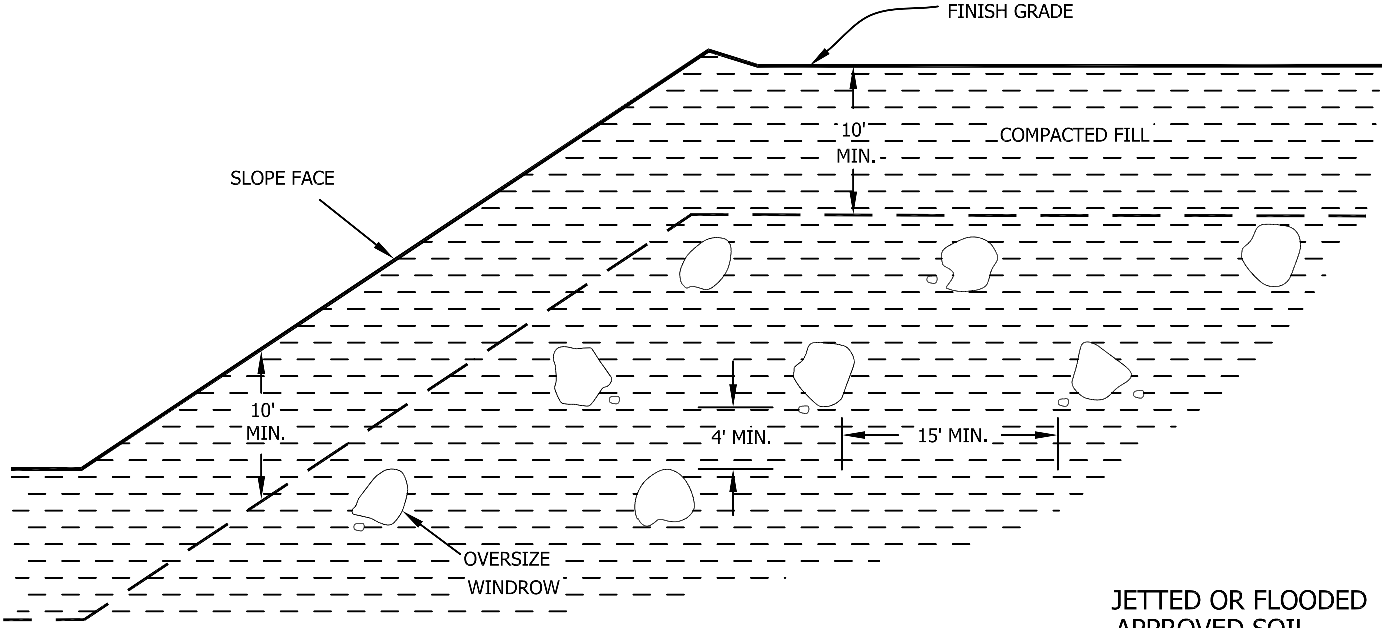


BENCHING SHALL BE DONE WHEN SLOPE'S ANGLE IS EQUAL TO OR GREATER THAN 5:1. MINIMUM BENCH HEIGHT SHALL BE 4 FEET AND MINIMUM FILL WIDTH SHALL BE 9 FEET.

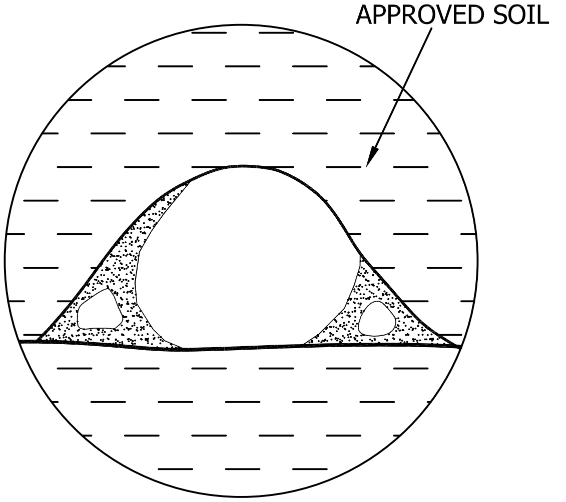
KEYING AND BENCHING

GENERAL EARTHWORK AND GRADING
SPECIFICATIONS
STANDARD DETAILS A

Leighton

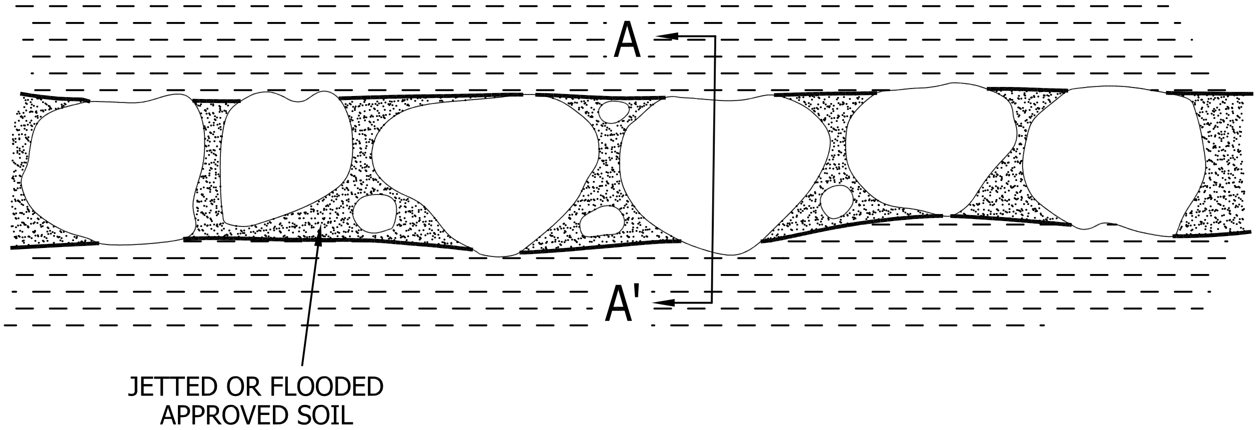


- Oversize rock is larger than 8 inches in largest dimension.
- Backfill with approved soil jetted or flooded in place to fill all the voids.
- Do not bury rock within 10 feet of finish grade.
- Windrow of buried rock shall be parallel to the finished slope face.



SECTION A-A'

PROFILE ALONG WINDROW



OVERSIZE ROCK DISPOSAL

GENERAL EARTHWORK AND GRADING
SPECIFICATIONS
STANDARD DETAILS B

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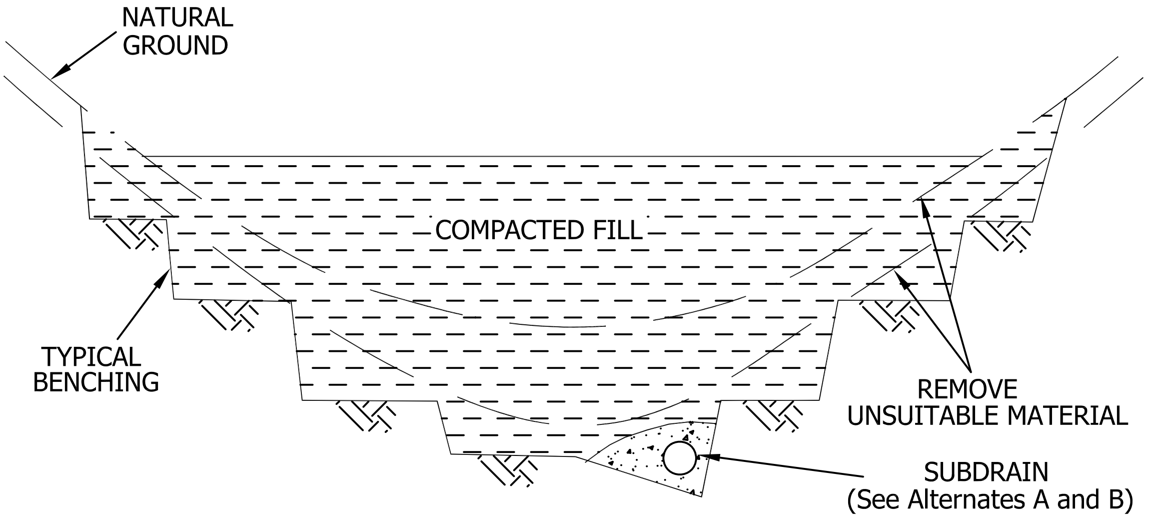
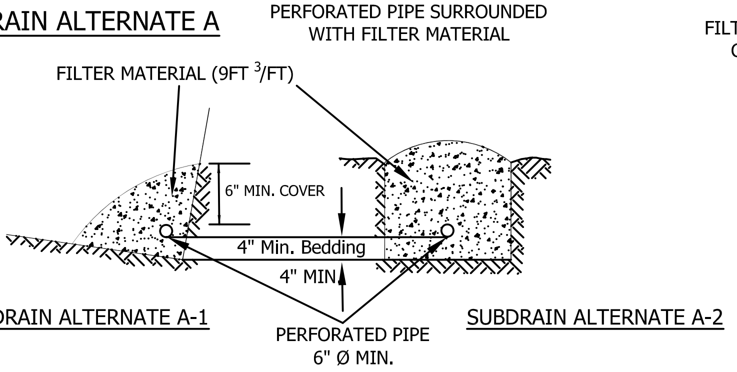


SUBDRAIN ALTERNATE A

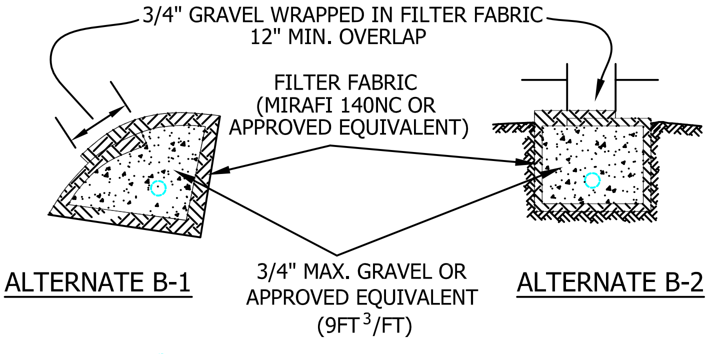


FILTER MATERIAL

FILTER MATERIAL SHALL BE CLASS 2 PERMEABLE MATERIAL PER STATE OF CALIFORNIA STANDARD SPECIFICATION, OR APPROVED ALTERNATE. CLASS 2 GRADING AS FOLLOWS:

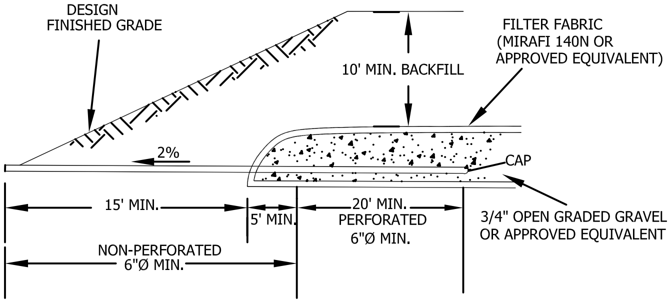
Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

SUBDRAIN ALTERNATE B



○ PERFORATED PIPE IS OPTIONAL PER GOVERNING AGENCY'S REQUIREMENTS

DETAIL OF CANYON SUBDRAIN TERMINAL



CANYON
SUBDRAIN

GENERAL EARTHWORK AND GRADING
SPECIFICATIONS
STANDARD DETAILS C

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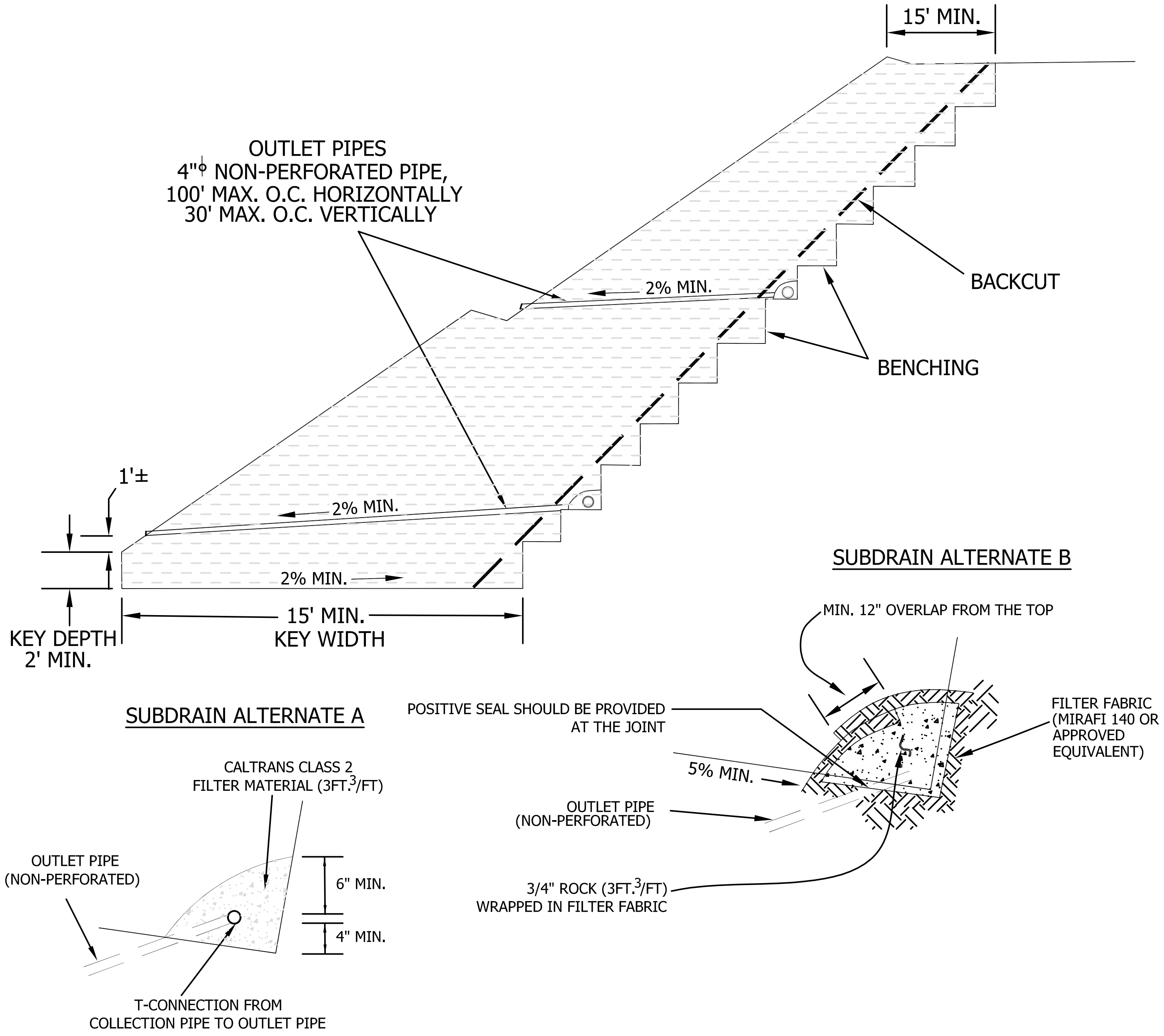

- SUBDRAIN INSTALLATION - Subdrain collector pipe shall be installed with perforations down or, unless otherwise designated by the geotechnical consultant. Outlet pipes shall be non-perforated pipe. The subdrain pipe shall have at least 8 perforations uniformly spaced per foot. Perforation shall be 1/4" to 1/2" if drilled holes are used. All subdrain pipes shall have a gradient at least 2% towards the outlet.
- SUBDRAIN PIPE - Subdrain pipe shall be ASTM D2751, ASTM D1527 (Schedule 40) or SDR 23.5 ABS pipe or ASTM D3034 (Schedule 40) or SDR 23.5 PVC pipe.
- All outlet pipe shall be placed in a trench and, after fill is placed above it, rodded to verify integrity.

BUTTRESS OR REPLACEMENT FILL SUBDRAINS

GENERAL EARTHWORK AND GRADING SPECIFICATIONS
STANDARD DETAILS D

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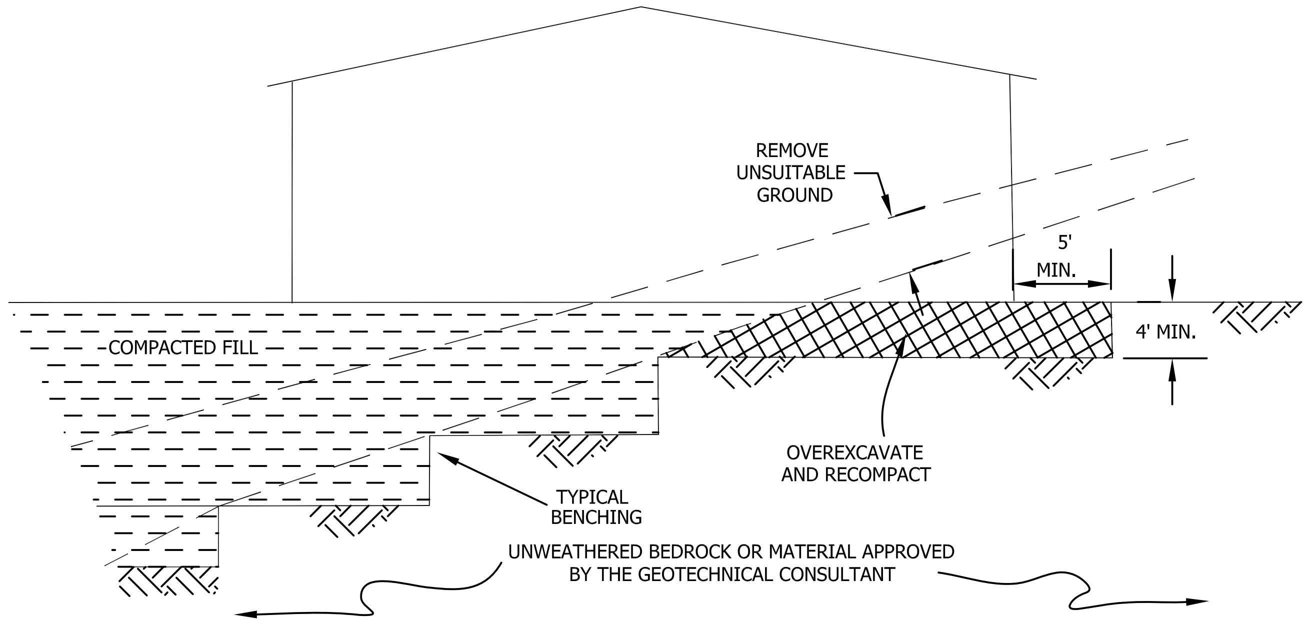
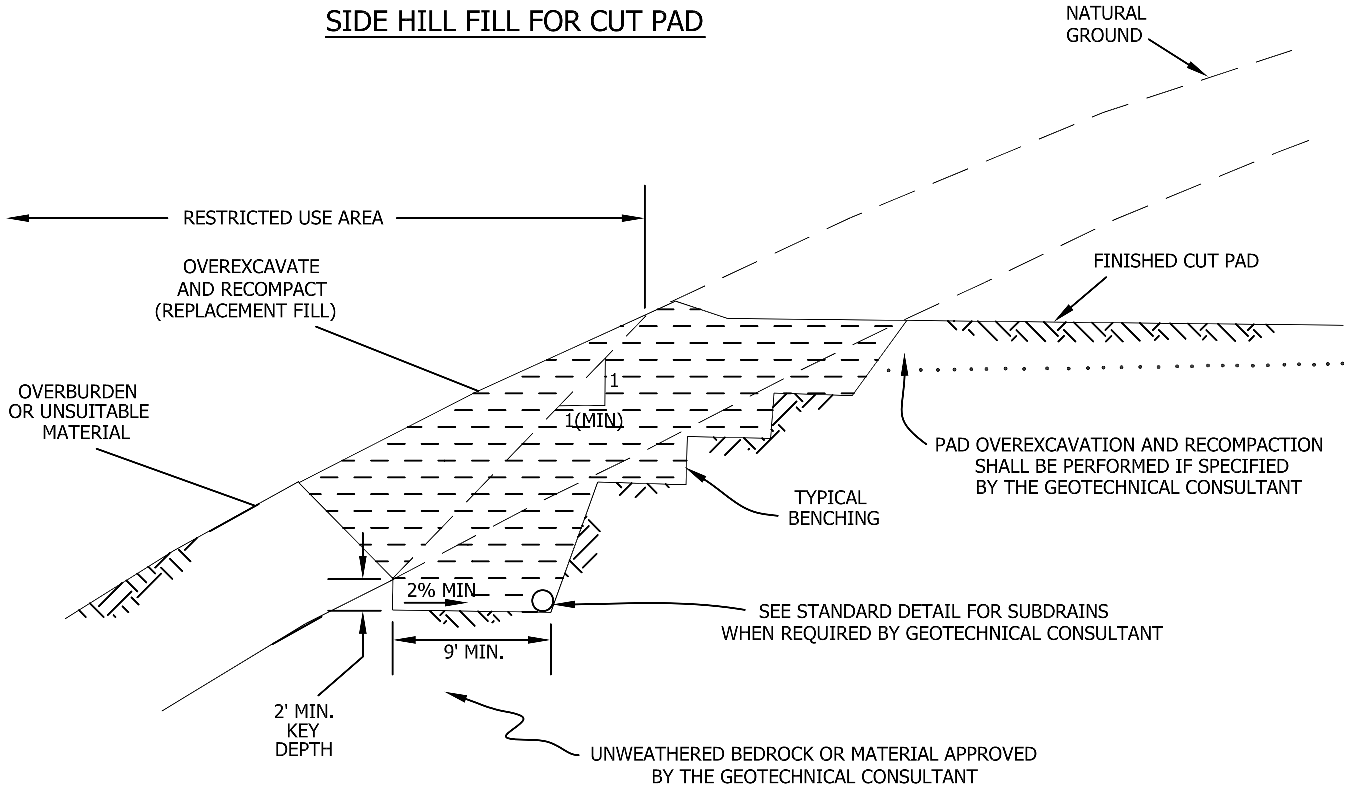
CUT-FILL TRANSITION LOT OVEREXCAVATION



SIDE HILL FILL FOR CUT PAD



TRANSITION LOT FILLS
AND SIDE HILL FILLS

GENERAL EARTHWORK AND GRADING
SPECIFICATIONS
STANDARD DETAILS E

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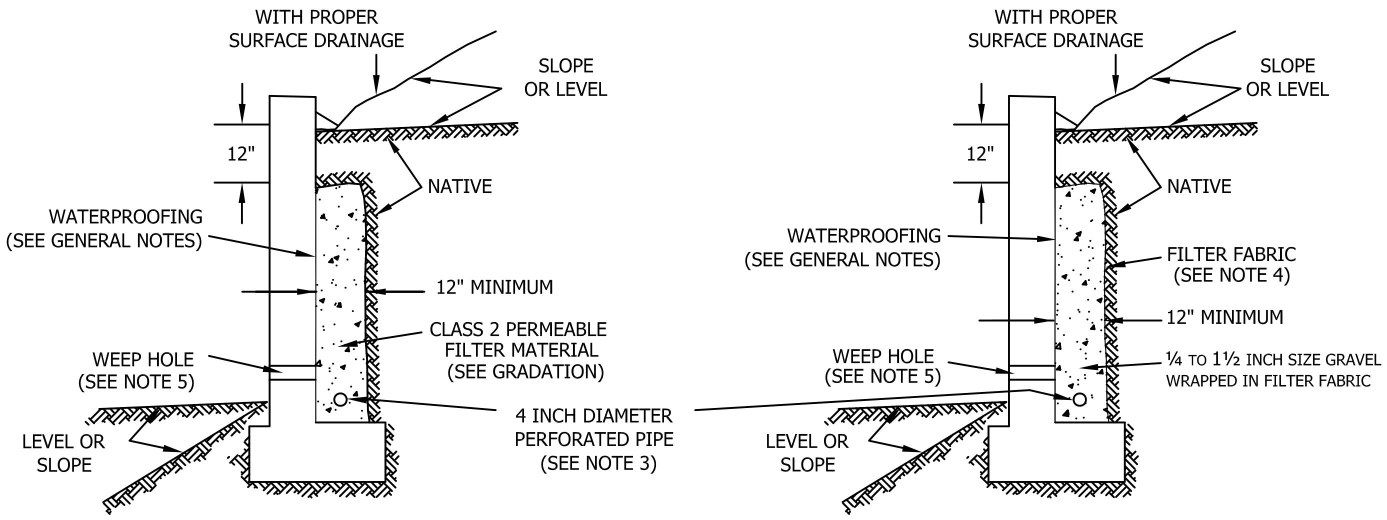
SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50



OPTION 1: PIPE SURROUNDED WITH CLASS 2 PERMEABLE MATERIAL

OPTION 2: GRAVEL WRAPPED IN FILTER FABRIC

Class 2 Filter Permeable Material Gradation
Per Caltrans Specifications

Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

GENERAL NOTES:

* Waterproofing should be provided where moisture nuisance problem through the wall is undesirable.
* Water proofing of the walls is not under purview of the geotechnical engineer
* All drains should have a gradient of 1 percent minimum
*Outlet portion of the subdrain should have a 4-inch diameter solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding)
*Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

Notes:
1) Sand should have a sand equivalent of 30 or greater and may be densified by water jetting.
2) 1 Cu. ft. per ft. of 1/4- to 1 1/2-inch size gravel wrapped in filter fabric
3) Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down. Perforations should be 3/8 inch in diameter placed at the ends of a 120-degree arc in two rows at 3-inch on center (staggered)
4) Filter fabric should be Mirafi 140NC or approved equivalent.
5) Weephole should be 3-inch minimum diameter and provided at 10-foot maximum intervals. If exposure is permitted, weepholes should be located 12 inches above finished grade. If exposure is not permitted such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to be discharged through the curb face or equivalent should be provided. For a basement-type wall, a proper subdrain outlet system should be provided.
6) Retaining wall plans should be reviewed and approved by the geotechnical engineer.
7) Walls over six feet in height are subject to a special review by the geotechnical engineer and modifications to the above requirements.

RETAINING WALL BACKFILL AND SUBDRAIN DETAIL FOR WALLS 6 FEET OR LESS IN HEIGHT

WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

Leighton

Figure

APPENDIX E

GBA IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL ENGINEERING REPORT

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL
BUSINESS
ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org   www.geoprofessional.org