

Appendix E

Geotechnical Study (December 10, 2024)
and Draft Geotechnical Study
(November 5, 2019)

Geotechnical Study
(December 10, 2024)



December 10, 2024
Kleinfelder Project No. 20193141.002A

Costco Wholesale
9 Corporate Park, Suite 230
Irvine, California 92606

Attention: Mr. Michael Okuma
Director of Real Estate Development

**SUBJECT: Geotechnical Study
Proposed Costco Fuel Facility
Silva Valley Parkway
El Dorado Hills, California
CW# 18-0487**

Dear Mr. Okuma:

Kleinfelder is pleased to present this report summarizing our geotechnical study for the proposed fuel facility located at Silva Valley Parkway (APN 122-720-019) in El Dorado Hills, California. The purpose of our geotechnical study was to evaluate subsurface soil and groundwater conditions at the project site to provide geotechnical recommendations for design and construction. The conclusions and recommendations presented in this report are subject to the limitations presented in Section 7.

We appreciate the opportunity to provide geotechnical engineering services to you on this project. If you have any questions regarding this report or if we can be of further service, please do not hesitate to contact Andrea Traum at 408.595.3275, or Andy Franks, Kleinfelder's Client Account Manager for Costco, at 480.650.4905.

Sincerely,

KLEINFELDER, INC.

Dan Dockendorf, EIT
Project Engineer

Andrea Traum, PE, LEED AP
Senior Program Manager



**GEOTECHNICAL STUDY
PROPOSED COSTCO FUEL FACILITY
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA
CW# 18-0487
KLEINFELDER PROJECT NO. 20193141.002A**

DECEMBER 10, 2024

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A Report Prepared for:

Costco Wholesale

9 Corporate Park, Suite 230
Irvine, California 92606

**Geotechnical Study
Proposed Costco Fuel Facility
Silva Valley Parkway
El Dorado Hills, California
CW# 18-0487**



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December 10, 2024
Kleinfelder Project No. 20193141.002A

Geotechnical Investigation Summary Checklist for Costco Wholesale Projects

General Information

Costco Real Estate Main Contact: Michael Okuma
 Geotechnical Main Contact: Andrea Traum (408-595-3275)
 Geotechnical Engineer of Record: Kleinfelder
 Project Location: Silva Valley Parkway (APN 122-720-019)
 CW#: 18-0487
 Warehouse #: New Fuel Facility
 Report Date: December 10, 2024
 Consultant Project/Document Number: 20193141.002A/SJO24R175733
 Addendums (List):

Report Purpose: Preliminary Draft Final Addendum/Revision

	Yes	No or NA	Describe/ Comments	Report Section
<i>Pre-existing Conditions/Information</i>				
Developer provided geotechnical report (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Pre-existing development (describe)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	The site is undeveloped with rolling hills running from east to west with elevations between 739 to 760 feet. At the time of our field exploration, much of the site was covered by low-lying vegetation (weeds and shrubs) and animal burrows.	2.1
Foundation type (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Performance Issues (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Environmental Issues (describe)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	NOA not detected upon sampling.	3.4.9
Site Grading Records (stripping, compaction test results, field reports, etc.)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Typical Building Structural Design Criteria</i>				
Other (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	New fuel facility servicing new warehouse to be built on opposite side of Siva Valley Parkway.	1.1
Building size (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Four Gas Refueling Islands, USTs, Controller Enclosure, and Canopy Structure	1.1
<i>Typical wall loading</i>				
3 kips / foot* (Metal Buildings)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
4.5 kips / foot* (CMU or pre-cast)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Typical column loading</i>				
120 kips in non-snow regions	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
150 kips in snow regions	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Typical canopy loading:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	~30 kips vertical	1.1
<i>Typical floor slab loading</i>				
500 pounds per square foot, (psf, total)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
250 psf (dead) at rack areas	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
150 psf (dead) at non-rack areas	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
350 psf (live)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Paving Design (20 year life)</i>				
Heavy Duty paving shall accommodate 30 trucks per day (Traffic Index of 7.0)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	5.0" AC/10.0" AB	4.6.2
Light Duty paving shall accommodate 6,600 cars per day (Traffic Index of 5.0)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.0" AC/6.0" AB	4.6.2
Performance Grade (PG) binder oil identified for local climate conditions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	PG 64-10	4.6.3

Site Grading Conditions/Assumptions				
Deviations to Typical Criteria (list/describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Design Finished Floor Elevation (FFE) (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Basis for FFE (assumed, per Civil) (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Effects of change to assumed FFE (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Maximum anticipated cuts (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Approximately 5 to 6 feet max on southern entrance roadway.	1.1
Maximum anticipated fills (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Approximately 13 to 18 feet max throughout fueling canopy, queuing areas, and tanks. Approximately 4 to 5 feet of fills on northern entrance roadway.	1.1
Cross sections prepared for sites that are not essentially flat	<input checked="" type="checkbox"/>	<input type="checkbox"/>		Figure 3
Amount of import/export anticipated (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Preliminary grading plans have not determined whether site will be balanced with onsite soils or imported.	
Frost Depth (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Retaining walls	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Number of walls (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Height/Length of walls (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Wall construction/type (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Cut/fill transition in pad (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Offsite Improvements (describe)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Fieldwork/Results				
<i>Costco Due Diligence Design Criteria</i>				
Version (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Version 2022, dated October 28, 2022	
Followed Criteria?	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Deviations to standard investigation (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Test Pits utilized due to shallow rock depth and fill conditions.	
Groundwater				
Depth (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>	None observed during investigation up to 9 feet bgs explored.	3.3
Perched	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Perched water will be anticipated at bedrock contact point after periods of rainfall. Seasonal creeks run through the property as seen during our 2019 investigation of the adjacent property.	3.3
Expected seasonal fluctuation (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Perched water will be present seasonally during winter and spring months.	3.3
Piezometers installed?	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Unusual/Challenging Soils conditions encountered				
Moisture-sensitive soils	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Wet/soft soils to be removed in seasonal creeks during construction	5.2
Undocumented fill	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Unsuitable soils (require removal)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		5.2
Wet soils	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Will be present during seasonal rainfall	5.2
Debris	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Bedrock/potential non-rippable conditions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Seismic Refraction Survey found that non-rippable conditions ($V_p > 6,000$ ft/s) exist around 10 to 15 feet below grade on average.	Appendix C
Refusal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Test Pit Excavations hit refusal on bedrock between 1.3 and 9 feet below grade across site with backhoe.	3.2
Collapsible soils	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Expansive soils	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Low to Moderate in upper colluvium layer	3.4.4
Compressible soils	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Liquefaction	<input type="checkbox"/>	<input checked="" type="checkbox"/>		4.2.2
Sinkholes	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Other (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		

Potential Contamination Identified				
Soil	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Groundwater	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Restoration of Disturbed Areas				
Backfilled with soil	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Test Pits backfilled with excavated soil	
Backfilled with grout	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Other (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Topsoil samples collected/analyzed	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Analyzed in 2019 during previous investigation	Appendix B
Corrosivity testing performed/addressed	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Extremely Corrosive to buried ferrous metals as analyzed in 2019	4.7
Report				
Executive summary	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Wet weather construction recommendations	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Pad winterization/pad recommendations	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Frost protection recommendations	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Design Parameters				
<i>Fill material parameters provided</i>				
Structural fill (below foundations, slabs)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		5.2
Site grading fill (below pavements, flatwork)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		5.2
Select backfill (behind truck dock walls, foundations, grade beams, etc.)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Trench backfill	<input checked="" type="checkbox"/>	<input type="checkbox"/>		5.2
Drainage fill	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Frost resistant fill	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Slab base aggregate	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
<i>Limits of debris/unsuitable removal provided</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Over-excavation/recompaction required</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		5.2
Depth (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>		5.2
Extent (include cross-section diagram)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Pad subgrade stabilization required (describe):</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Surcharge</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Height (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Lateral extent (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Estimated duration (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Shallow Foundations</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		4.3.2
psf allowable soil bearing pressure (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3,000 psf on structural fill	4.3.2
<i>Deep Foundations (Parking Lot Light Poles)</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Type (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Light pole foundations	4.3.3
Options and Value Engineering Matrix provided	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Floor Slabs</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Unreinforced (>2500 psf)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Reinforced (describe why)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Subgrade modulus (ksi/in) (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Base Material thickness (min 6") (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Seismic Conditions				
Governing Building Code (IBC, UBC, other)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2022 California Building Code	4.2
Geologic Hazard Identified	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Proximity to earthquake fault zone(s)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Proximity to seismic hazard zone(s)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Potential for liquefaction	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No Hazard	4.2.2
Potential for lateral spreading	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Potential for seismic settlement	<input type="checkbox"/>	<input checked="" type="checkbox"/>		4.2.2
Potential for slope stability/landslides	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Potential for groundshaking or geologic hazards	<input checked="" type="checkbox"/>	<input type="checkbox"/>	High	
<i>Retaining Walls</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		

Recommended Wall Types	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Recommend Kleinfelder Design	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Lateral earth pressure design values	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Active:	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
At-rest:	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Passive:	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Seismic:	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Backfill material, placement requirements	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Drainage requirements and cross-section drawing	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Finger Drains</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Required for frost	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Recommended for long term maintenance and constructability	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Pavement</i>				
Pavement subgrade stabilization required (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Proof-roll, scarify, and recompact	5.2.2
Costco asphalt mix design specified	<input checked="" type="checkbox"/>	<input type="checkbox"/>	PG 64-10	4.6.3
Heavy and light duty pavement sections specified	<input checked="" type="checkbox"/>	<input type="checkbox"/>		4.6.2
Alternative pavement sections identified	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Portland Cement Concrete	4.6.4
Specification for offsite pavement sections included	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Data Gaps/Unknowns (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		

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FIGURES

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APPENDICES

Appendix A	Field Explorations
Appendix B	Laboratory Testing
Appendix C	Seismic Refraction Survey

EXECUTIVE SUMMARY

This report presents the results of our geotechnical study for the proposed Costco fuel facility at Silva Valley Parkway (APN 122-720-019) in El Dorado Hills, California. The purpose of our study was to evaluate subsurface soil/bedrock and groundwater conditions to provide geotechnical recommendations for design and construction. We understand Costco had originally planned to have the fuel facility on the same property as the proposed warehouse on parcel (APN 122-720-018) on the west side of Silva Valley Parkway. However, the fuel facility has been relocated east of Silva Valley Parkway onto parcel (APN 122-720-019). Kleinfelder had performed field investigations on this eastern parcel in 2019 for the new warehouse (Kleinfelder, 2019), but the project was moved to the western parcel prior to the completion of fieldwork.

The new fueling facility will consist of four gasoline refueling islands with four pumps at each island, three underground storage tanks (UST), a fuel additive UST, a controller enclosure, and a canopy structure. In addition, asphalt concrete and Portland cement concrete pavements will also be constructed. Our geotechnical study was based generally on the Costco Wholesale Development Requirements (CWDRs), Version 2022, dated October 28, 2022.

The proposed fuel facility site is located northeast side of the Silva Valley Parkway, in El Dorado Hills as shown on Figure 2. The land is zoned as commercial and is located around ¼ mile south of Oak Meadow Elementary school and the Serrano residential development. This site located directly east across Silva Valley Parkway from the proposed warehouse site location. Costco is proposing this site as an alternative to allow additional parking on the warehouse property side.

At the time of our field exploration, the site was an undeveloped field with rolling hills generally sloping from east to west with ground surface elevations ranging from approximately 739 to 770 feet. The majority of the project site is characterized by slope gradients of 5:1 (horizontal to vertical) and shallower (less steep). At the time of our field exploration, much of the site was covered by low-lying vegetation (weeds and shrubs) and animal burrows as well as some native trees. Rock outcrops were also visible throughout the site. Additionally, a seasonal creek runs through the property from east to west. This creek was dry during our July 2024 investigation but was observed to be flowing during our initial field exploration of the property in Spring 2019. Finally, a ditch runs the property boundary along Silva Valley Parkway. The ditch is approximately 5 feet deep and is filled with large angular boulders.

Subsurface conditions at the site were recently explored by excavating 9 test pits across the proposed site. Test pits were excavated by Gulf Shore Excavation of Rancho Cordova, California

with a John Deere 310 G track excavator to depths ranging from approximately 1½ and 9 feet bgs within the fuel facility area. Kleinfelder also subcontracted a Geophysics company (Gasch Geophysical Services) to perform a seismic refraction survey across the proposed site. The survey was used to evaluate the excavatability (rippability) of the bedrock within the proposed area.

Subsurface materials encountered during the explorations consisted of colluvium/residual soil overlying bedrock. The colluvium/residual soil consisted primarily of sandy silts and lean clays with variable amount of sand and gravel and varied in depth from approximately 1½ to 5 feet bgs. Below the colluvium/residual soil lies bedrock comprised of highly weathered and fractured metavolcanic rock ($V_p = 3,000$ to $6,000$ ft/s) underlain by slightly weathered, intact rock ($V_p > 6,000$ ft/s). The highly weathered rock was observed to be approximately 10 feet thick. The rock increased in strength and decreased in weathering and fracture amount with depth, as shown in the seismic refraction survey report (Appendix C). Test pits were dug until practical rock refusal was encountered.

Groundwater was not encountered in our explorations to the maximum depth explored of approximately 9 feet. During Kleinfelder's investigation of the adjacent property in 2019, the seasonal creek across the property had been flowing rapidly and all excavated test pits encountered perched water near bedrock contact. Rainfall will infiltrate near surface soils and collect on less permeable soil and rock at shallow depth. Therefore, perched groundwater will likely be present at or near subgrade level across the entire site during and after rainfall events.

Based on the results of our prior field exploration, laboratory testing, and geotechnical analyses, it is our professional opinion that the proposed project is geotechnically feasible, provided the recommendations presented in this geotechnical report are incorporated into the project design and construction. The following key items were developed from our study.

- Based on the results of the seismic refraction lines, the near surface soils are comprised of a thin colluvium/residual soil layer varying in thickness from approximately 1½ to 5 feet thick. Below the colluvium/residual soil lies bedrock comprised of highly weathered and fractured metavolcanic rock ($V_p = 3,000$ to $6,000$ ft/s). The strength of this highly weathered rock layer increases in depth and is approximately 10 feet thick. The highly weather rock layer is underlain by slightly weathered, intact rock ($V_p > 6,000$ ft/s). The depth to the bottom of this layer varies from approximately 10 to 20 feet bgs.

- Soils and rock with velocities of less than 3,000 fps can usually be excavated with conventional earth moving equipment. The intermediate material (velocities between 3,000 fps and 6,000 fps) would likely require heavy equipment and possibly localized use of jackhammers, ram-hoes, or selective blasting to provide cost-effective excavation. Where materials with velocities in excess of 6,000 fps are found, blasting would normally be required for efficient fragmentation. However, if the rock is thinly bedded, jointed, or fractured, it may be possible to break the rock with heavy ripping using a single shank ripper or large ram-hoe. The resulting fragments will be of a size consistent with the fracture spacing and the progress of excavation would be very slow.
- Based on the preliminary grading plans provided by Kier and Wright (project civil engineer), the fuel facility area including the canopy, tanks, and queuing aisles will receive fills of approximately 13 to 18 feet across the site to achieve desired grades. The entrance roadway on the north side will have fills of approximately 4 to 5 feet and on the southern roadway cuts of approximately 5 to 6 feet are planned. In discussions with Costco and the project civil engineer, it has not been decided if fills will be achieved using import soils or balancing the site with rock fill. Fuel facility canopy foundations are anticipated to be founded in structural fill and underground storage tanks will likely tip into the highly weathered rock layer ($V_p = 3,000$ to $6,000$ ft/s).
- Due to the composition of the bedrock, it will not reduce to a soil-like material when excavated and will not be suitable for re-use as structural fill. It is anticipated that crushing and processing the harder rock layers will prove challenging and may require soil to be imported onsite. Import materials, if required, should have a Plasticity Index of less than 10 with no less than 70 percent passing the No. 4 sieve, no more than 30 percent of the particles passing the No. 200 sieve, and no particles greater than 3 inches in maximum dimension. The maximum Plasticity Index for imported soils may be modified upon approval by Costco depending on its proposed use. The contractor should provide documentation to Costco that imported fill is free of hazardous materials, including petroleum or petroleum byproducts, chemicals and harmful minerals prior to its transportation and use on site.
- Prior to grading and subgrade preparation, all vegetation should be cut and removed from the site. Roots and vegetative matter in excess of one inch should be removed by screening or raking soils to a minimum depth of 12 inches. Other than plant roots, organic matter in the topsoil is minimal based on our laboratory testing (between one and three percent). The topsoil can be re-used on site in fills.

- A seasonal creek runs through the property from east to west toward Silva Valley Parkway. Soft and wet soils found at the base of seasonal creeks should be removed and replaced to the satisfaction of Kleinfelder’s geotechnical representative during construction. Prior to filling in the seasonal creek, subdrains should be installed within the creek bottom. This creek was observed to be flowing rapidly in April 2019.
- Rainfall will infiltrate near surface soils and collect on less permeable soil and rock at shallow depth. Therefore, perched groundwater will likely be present at or near bedrock contact elevation across the site. Temporary dewatering provisions will likely be required during construction, as discussed in Section 5.2.4.
- The proposed fuel facility canopy may be supported on a conventional shallow foundation system founded on structural fill. Light poles may be supported on short drilled piles.
- For areas with new pavements, we recommend that the exposed subgrade be proof-rolled with heavy construction equipment (e.g., loader or smooth-drum roller) to disclose areas of soft and yielding material after the area has been stripped of soft earth materials and debris. Where soft or yielding material are observed, the material should be overexcavated and replaced with structural fill. The proof-rolling should extend beyond the proposed improvements a horizontal distance of at least 2 feet, if practicable.
- After proof-rolling and/or prior to placement of fill, the subgrade should be scarified to a depth of 6 to 8 inches, moisture conditioned, and compacted in accordance with the compaction criteria presented in section 5.2.6. The proof-rolling should extend beyond the proposed improvements a horizontal distance of at least 2 feet, if practicable.
- Due to poor draining subgrade conditions, we recommend drainage inlets and catch basins include pavement underdrains as shown in Detail 1 6_16 of the CWDRs.
- Resistivity values below 1,000 ohm-cm are considered extremely corrosive to buried ferrous metals (NACE, 2006). The concentrations of soluble sulfates indicate that the subsurface soils represent a Class S0 exposure to sulfate attack on concrete in contact with the soil based on ACI 318-19 Table 19.3.1.1 (ACI, 2019). Therefore, in accordance with ACI Building Code 318-19, no special provisions for selection of cement type are required.

The findings, conclusions, and recommendations presented in this executive summary should not be relied upon without consulting our geotechnical report for more detailed description of the

geotechnical evaluation performed by Kleinfelder. The conclusions and recommendations presented in this report are subject to the limitations presented in Section 7.

1 INTRODUCTION

This report presents the results of our geotechnical study for the proposed Costco fuel facility at Silva Valley Parkway (APN 122-720-019) in El Dorado Hills, California. The location of the project site is presented on Figure 1, Site Vicinity Map. The purpose of our study is to evaluate subsurface soil/bedrock and groundwater conditions at the project site to provide geotechnical recommendations for design and construction. The scope of our services was presented in our proposal titled, “Contract Amendment Request No. 2, Geotechnical Study – Relocated Fuel Facility, Proposal Costco Wholesale Warehouse and Fuel Facility, Silva Valley Parkway, El Dorado Hills, California, CW# 18-0487”, dated June 6, 2024.

This report includes a description of the work performed, a discussion of the geotechnical conditions observed at the site, and recommendations developed from our engineering analyses of field and laboratory data.

1.1 PROJECT DESCRIPTION

Kleinfelder understands Costco plans to construct a new fueling facility consisting of four gasoline refueling islands with four pumps at each island, three 40,000-gallon underground storage tanks (UST), a fuel additive UST, a controller enclosure, and a canopy structure. In addition, asphalt concrete and Portland cement concrete pavements will also be constructed. Kleinfelder understands Costco had originally planned to have the fuel facility on the same property as the proposed warehouse on parcel (APN 122-720-018) on the west side of Silva Valley Parkway. However, the fuel facility has been relocated east of Silva Valley Parkway onto parcel (APN 122-720-019). Kleinfelder had performed field investigations on this parcel in 2019 for the new warehouse (Kleinfelder, 2019), but the project was moved to the western parcel prior to the completion of fieldwork. The location of the project site is presented on Figure 1, Site Vicinity Map.

Based on our experience with fuel facilities, the canopy for the service islands is typically founded on spread footings and the design is typically governed by overturning moments from wind and seismic loading. Typical column dead loads are anticipated to be approximately 4 kips and typical live loads are up to approximately 30 kips, which result in bearing pressures of less than 1,000 pounds per square foot (psf).

The tank excavation is anticipated to be approximately 16 to 18 feet deep. The tanks are planned to be placed on gravel bedding and anchored with “deadmen” to resist potential buoyant forces. Based on the preliminary grading plans provided by Kier and Wright (project civil engineer), the fuel facility area including the canopy, tanks, and queuing aisles will receive fills of approximately

13 to 18 feet across the site to achieve desired grades. The entrance roadway on the north side will have fills of approximately 4 to 5 feet and on the southern roadway cuts of approximately 5 to 6 feet are planned. In discussions with Costco and the project civil engineer, it has not been decided if fills will be achieved via import soils or balancing the site with rock fill. Based on fill volumes, the fuel facility canopy foundations will be founded in structural fill and underground storage tanks will likely tip into bedrock.

1.2 SCOPE OF SERVICES

The scope of our geotechnical study consisted of a literature review, subsurface excavations, seismic refraction lines, geotechnical laboratory testing, engineering evaluation and analysis, and preparation of this report. Studies to assess environmental hazards that may affect the soil and groundwater at the site were beyond our geotechnical scope of work. A description of our scope of services performed for the geotechnical portion of the project follows.

1.2.1 Task 1 – Background Data Review

We reviewed readily available published and unpublished geologic literature in our files and the files of public agencies, including selected publications prepared by the California Geological Survey (formerly known as the California Division of Mines and Geology) and the U.S. Geological Survey (USGS). We also reviewed readily available seismic and faulting information, including data for designated earthquake fault zones as well as our in-house database of faulting in the general site vicinity.

In addition, we reviewed our 2019 geotechnical report for a prior iteration of the Costco development (Kleinfelder, 2019). Data from the previous and current study were used in our geotechnical analysis. Pertinent logs from the previous explorations are noted on Figure 2 and presented in Appendix A.

1.2.2 Task 2 – Field Exploration

Subsurface conditions at the site were recently explored by excavating 9 test pits across the proposed site. Test pits were excavated by Gulf Shore Excavation of Rancho Cordova, California with a John Deere 310 G track excavator to depths ranging from approximately 1½ and 9 feet bgs within the fuel facility area. Kleinfelder also subcontracted a Geophysics company (Gasch Geophysical Services) to perform a seismic refraction survey across the proposed site. The survey was used to evaluate the excavatability (rippability) of the subsurface conditions within the proposed area.

Prior to commencement of the fieldwork, Underground Service Alert (USA) was notified, and various geophysical techniques were used at the boring and test pit locations to identify potential conflicts with subsurface structures. A Kleinfelder staff engineer supervised the field operations and logged the explorations. Selected samples were retrieved, placed in plastic bags or sealed, and transported to our Sacramento laboratory for evaluation. Descriptions used on the logs result from field observations and data, as well as from laboratory test data. Stratification lines on the logs represent the approximate boundary between soil types, and the actual transition may vary and can be gradual. Appendix A presents a description of the field exploration program, test pit logs and a legend of terms and symbols used on the logs. Appendix C presents the seismic refraction survey.

1.2.3 Task 4 – Laboratory Testing

Laboratory testing was performed on selected samples to evaluate the physical and engineering characteristics of the subsurface soils. Laboratory testing consisted of in-situ moisture content and dry density, wash sieve, Atterberg limits, Modified proctor, and R-Value. In addition, testing for Naturally Occurring Asbestos (NOA) was conducted by ATEM Laboratories. A summary of the laboratory testing and results are presented in Appendix B. Results for the NOA testing will be published separately in Kleinfelder's Phase 2 environmental report (Kleinfelder, 2024). In summary, no NOA was detected during the investigation.

Previous lab results for soil corrosion testing and plant suitability from our previous investigation of this property (Kleinfelder, 2019) are also included in Appendix B.

1.2.4 Task 5 – Geotechnical Analyses and Report Preparation

We analyzed field and laboratory data in conjunction with the finished grades, facility layout, and assumed structural loads to provide geotechnical recommendations for the design and construction. We evaluated feasible foundation systems, including constructability and compatibility constraints, floor slab support, and earthwork. Seismic design parameters based on the 2022 California Building Code (CBC) are also presented.

This report summarizes the work performed, data acquired, and our findings, conclusions, and geotechnical recommendations for the design and construction. Our report includes the following items:

- Site Vicinity Map (Figure 1) and Field Exploration Map (Figure 2) showing the approximate field exploration locations;

- Cross Section Figures (Figure 3);
- Logs of test pits (Appendix A);
- Results of laboratory tests (Appendix B);
- Results of the seismic refraction survey (Appendix C);
- Discussion of general site conditions;
- Discussion of general subsurface conditions as encountered in our field exploration, including the depth to groundwater (if encountered);
- Discussion of regional and local geology;
- Recommendations for seismic design parameters in accordance 2022 CBC;
- Recommendations for site preparation, earthwork, temporary slope inclinations, fill placement, and compaction specifications;
- Recommendations for foundation design (shallow foundation) under various loading conditions, including allowable bearing pressures, embedment depths, and settlement estimates;
- Recommendations for flexible and ridged pavement structural sections for light and heavy-duty pavement based on the Equivalent Single Axle Loading (ESALs), as stated in the Costco Wholesale Development Requirements (CWDR); and
- Preliminary evaluation of the corrosion potential of the on-site soils.

2 SITE CONDITIONS

2.1 SITE DESCRIPTION

The proposed fuel facility site is located northeast side of the Silva Valley Parkway in El Dorado Hills, as shown on Figure 2. The land is zoned as commercial and is located around ¼ mile south of Oak Meadow Elementary school and the Serrano residential development. The proposed site is located directly east across Silva Valley Parkway from the proposed warehouse site location. Costco is proposing this site as an alternative to allow additional parking on the warehouse property side.

At the time of our field exploration, the site was an undeveloped field with rolling hills generally sloping from east to west with ground surface elevations ranging from approximately 739 to 760 feet. The majority of the project site is characterized by slope gradients of 5:1 (horizontal to vertical) and shallower (less steep). At the time of our field exploration, much of the site was covered by low-lying vegetation (weeds and shrubs) and animal burrows as well as some native trees. Rock outcrops were also visible throughout the site. Additionally, a seasonal creek runs through the property from east to west. This creek was dry during our July 2024 investigation but was observed to be flowing during our initial field exploration of the adjacent property in Spring 2019. A ditch also runs the property boundary along Silva Valley Parkway. The ditch is approximately 5 feet deep and is filled with large angular boulders. An unfinished portion (~100 feet long) of Tong Road resides on the southwest corner of the property.

3 GEOLOGY

3.1 GEOLOGIC SETTING

3.1.1 Regional Geology

The subject site is situated in the gently rolling topography that forms the western foothills of the Sierra Nevada Mountains. The western foothills are broadly tilted, dipping westward, and uplifted increasingly to the east, due to maximum uplift of the Sierra Nevada at its eastern edge. The Sierra Nevada is comprised mostly of large, north-south elongated blocks of Mesozoic granitic terrain forming the backbone of California. The foothills in the project vicinity consist of a northwest-trending belt of metamorphosed volcanic and sedimentary rock that separate the Sierran crystalline basement rock (granites) from the Central Valley sediments. These rocks are distributed within three major north-south trending, fault-bounded lithologic terrains that extend along the length of the metamorphic belt. Rocks within these terrains have been isoclinally folded and metamorphosed on a regional scale and represent a “collage” of tectonically accreted blocks emplaced during convergent plate tectonism that occurred during the Early Paleozoic and Late Jurassic. Bedding, foliation, and major faults throughout the metamorphic belt normally trend northwest and dip steeply to the east.

3.1.2 Site Geology

The project area is mapped by Loyd (1983 and 1984) as being underlain by Jurassic and Triassic age metavolcanic rocks (map symbol Kgv). This formation is almost entirely of marine origin and consist mostly of basaltic to andesitic breccias, flows, and tuffs that have been metamorphosed, but with primary volcanic features generally recognizable. The formation also contains minor associated sandstone and conglomerate, although none were encountered during our field investigation. Foliation that developed from regional metamorphism is often evident in the rock structure and typically has a north-trending direction. Locally, schistose fabric may be evident. The rock strength of the in less weathered portions of the formation is typically very high and can result in difficult excavation conditions.

3.2 SUBSURFACE CONDITIONS

Subsurface materials encountered during the explorations consisted of colluvium/residual soil overlying bedrock. The colluvium/residual soil consisted primarily of sandy silts and lean clays with variable amount of sand and gravel and varied in depth from approximately 1½ to 5 feet bgs. Below the colluvium/residual soil, bedrock comprised of highly weathered and fractured metavolcanic rock ($V_p = 3,000$ to $6,000$ ft/s) underlain by slightly weathered, intact rock ($V_p >$

6,000 ft/s). The highly weathered rock was observed to be approximately 10 feet thick. The rock increased in strength and decreased in weathering and fracture amount with depth, as shown in the seismic refraction survey report (Appendix C). Test pits were dug until practical rock refusal was encountered. Table 1 below shows rock depths observed and practical refusal depths in the field in relation to approximate elevation.

**TABLE 1
OBSERVED FIELD ROCK CONDITIONS**

TEST PIT LOCATION	APPROXIMATE SURFACE ELEVATION	APPROXIMATE DEPTH TO ROCK (FT BGS)	PRACTICAL REFUSAL DEPTH (FT BGS)
TP-1	754	1.5	1.91
TP-2	760	1.0	1.3
TP-3	747	1.5	3.25
TP-4	739	2.75	5.0
TP-5	743	2.5	6.0
TP-6	740	2.0	4.0
TP-7	743	1.5	2.25
TP-8	746	2.5	4.25
TP-9	741	5.0	9.0

3.3 GROUNDWATER

Groundwater was not encountered in our explorations to the maximum depth explored of approximately 9 feet. During Kleinfelder’s investigation of the property in 2019, the seasonal creek across the property had been flowing rapidly and all excavated test pits encountered perched water near bedrock contact. Rainfall will infiltrate near surface soils and collect on less permeable soil and rock at shallow depth. Therefore, perched groundwater will likely be present at or near bedrock contact elevation across the site.

Localized zones of perched water, increased soil moisture content and fluctuations of the groundwater level, should be anticipated during and following the rainy season. Irrigation of landscaped areas on or adjacent to the site can also cause a fluctuation of local groundwater levels.

3.4 ASSESSMENT OF POTENTIAL GEOLOGIC HAZARDS

3.4.1 Localized Faulting

According to the California Geological Survey (CGS, 2024), the site is not located within an Alquist-Priolo Earthquake Fault Zone and no mapped active or potentially active fault traces are known to traverse the site. The project area is situated within a region traditionally characterized by few active faults, numerous inactive faults, and low to moderate seismic activity.

An active fault is a fault that has experienced seismic activity during historic time (since roughly 1800) or exhibits evidence of surface displacement during Holocene time (Hart and Bryant, 1997). The definition of "potentially active" varies. A generally accepted definition of "potentially active" is a fault showing evidence of displacement that is older than 11,000 years (Holocene age) and younger than 1.7 million years (Pleistocene age). However, "potentially active" is no longer used as criteria for zoning by the California Geologic Survey (CGS), formerly known as the Division of Mines and Geology. The terms "sufficiently active" and "well-defined" are now used by the CGS as criteria for zoning faults under the Alquist-Priolo Earthquake Fault Act. A "sufficiently active fault" is a fault that shows evidence of Holocene surface displacement along one or more of its segments and branches, while a "well-defined fault" is a fault whose trace is clearly detectable by a trained geologist as a physical feature at or just below the ground surface. The definition "inactive" generally implies that a fault has not been active since the beginning of the Pleistocene Epoch (older than 1.7 million years old).

The nearest well-defined faults to the project are the Genoa and Cordelia faults. Both faults are located over 50 miles from the project site. A major seismic event on either of these faults is anticipated to cause weak ground shaking at the project site.

The nearest fault to the project site is the west trace of the Bear Mountain Fault Zone that strikes northwest-southeast for approximately 84 miles along the Sierra Foothill region. A fault trace within this zone is located approximately 650 feet west of the project and forms a major contact between the metavolcanics rock that underly the project and the younger Copper Hills Volcanics Formation to the west of the fault. Seismically, the mapped fault near the project is mapped as Pre-Quaternary (CGS, 2010). However, current seismic data (ANSS, 2011) shows micro-earthquakes (magnitude less than 2 or 3) are generated along the northern portion of the fault zone and UCEF3 includes the Swain Ravine – Spenceville segment of the Bear Mountains Fault Zone in their probability model (USGS, 2013). This low seismic activity is not expected to impact the project.

3.4.2 Landsliding

Landslides and other forms of mass wasting, including mud flows, debris flows, soil slips, and rock falls occur as soil or rock moves down slope under the influence of gravity. Landslides are frequently triggered by intense rainfall or seismic shaking. Debris flows are known to travel great distances from their source based on the gradients, channel geometry and amount of fluid within the slide mass.

The majority of the project site is characterized by slope gradients of 5:1 (horizontal to vertical) and shallower (less steep). Given the elevation differential and shallow gradients the potential for slope instability is considered low.

3.4.3 Liquefaction and Seismic Compression

The term liquefaction describes a phenomenon in which saturated, cohesionless soils temporarily lose shear strength (liquefy) due to increased pore water pressures induced by strong, cyclic ground motions during an earthquake. Structures founded on or above potentially liquefiable soils may experience bearing capacity failures due to the temporary loss of foundation support, vertical settlements (both total and differential), and/or undergo lateral spreading. The factors known to influence liquefaction potential include soil type, relative density, grain size, confining pressure, depth to groundwater, and the intensity and duration of the seismic ground shaking. Liquefaction is most prevalent in loose to medium dense, silty, sandy, and gravelly soils below the groundwater table. No groundwater was observed during our field investigation. Based on our review of available groundwater well data, it is our opinion that the regional groundwater is deep. Therefore, based on the results of the subsurface explorations and review data, the potential for liquefaction and its adverse effects (i.e., seismic settlement and lateral spreading) is not considered a hazard at the site.

Seismic compression results from the accumulation of contractive volumetric strains in unsaturated soil during earthquake shaking. Loose to medium dense granular material with no fines or with low plasticity fines are most susceptible to seismic compression. Based on the density and soil composition of the underlying soils, the potential for seismic compression is considered low. We estimate dry seismic settlement potential at this site will be low.

3.4.4 Expansive Soils

Expansive soils are characterized by their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought,

or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade. The surficial soils are generally sandy lean clays and sandy silts with gravel overlying rock, the observed expansion potential of these soils are low to moderate.

3.4.5 Collapsible Soils

Collapsible soils are characterized by their ability to undergo significant shrinkage (collapse) during inundation. Inundation in soils can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade. Based on the results of laboratory testing, the soil encountered are not expected to collapse during inundation, so the impact of collapsible soils for this site is considered low.

3.4.6 Subsidence

The site is not located in an area of known significant ground subsidence due to the withdrawal of subsurface fluids. Subsidence may be present but adverse impacts have not been recorded. Therefore, the potential for subsidence occurring at the site due to the withdrawal of oil, gas, or water is considered low.

3.4.7 Flooding

The Flood Insurance Rate Map prepared by the Federal Emergency Management Agency (FEMA) was reviewed to identify the potential flood hazard for the project. This map indicates the site is within Zone X which is defined as being an area with a 0.2-percent-annual-chance-flood and an area of 1-percent-annual-chance flood with average depths of less than 1 foot. Based on this information the potential for the project site to be impacted by regional flooding is considered low. However, the accuracy of this information should be confirmed by a qualified civil engineer/hydrologist. The need and/or method for mitigation of potential flooding should also be addressed.

3.4.8 Oil and Gas Fields

Upon review of the California Division of Oil, Gas & Geothermal Resources (2016) interactive well-finder map accessed at <https://maps.conservation.ca.gov/doggr/wellfinder>, the El Dorado Hills region does not contain any known abandoned oil wells. Additionally, no active wells are known to exist within the project boundary.

3.4.9 Naturally Occurring Asbestos

Naturally occurring asbestos (NOA) has been identified as a source of potentially hazardous airborne asbestos fibers when disturbed by mining or earthwork activities, if present (Clinkenbeard et al., 2002). NOA generally occurs within mafic or ultramafic metamorphic rock units in which one of the asbestiform minerals defined by the California Air Resources Board (CARB, 2002) are present. These NOA minerals have unique flexibility and strength characteristics and include asbestiform varieties of the six minerals chrysotile, amosite, crocidolite, tremolite actinolite, and anthophyllite. Kleinfelder gathered asbestos samples within the project alignment and the results were negative for the presence of NOA minerals upon testing. Full results and discussion is published in Kleinfelder's Phase 2 environmental report for this project.

In addition, based on numerous NOA studies Kleinfelder has performed in the project area, typical NOA concentration level ranges (measured as a percent volume using the polarized light microscopy identification method [PLM]) can be identified for the rock types/geologic units present along the project alignment. These typical values can be compared to the threshold limits established by CARB's Airborne Toxic Control Measures (ATCM) for Construction Grading, Quarrying, and Surface Mining Operation (CARB, 2002) to identify whether mitigative measurements need to be implemented during excavation of the foundation towers and how the excavation spoils are to be handled relative to disposal and off-haul. Generally, the metavolcanic rock has concentration levels at or below the threshold level of 0.25 percent. Where NOA levels are at or above 0.25 percent, contractors are required to implement mitigation practices to protect workers and the public from airborne NOA particles generated during earthwork operations. NOA levels at or above 1 percent is considered a hazardous material and will require special handling during transportation and will need to be disposed of at an approved site. The Asbestos Review Areas map (Churchill, 2000) indicates the project site is in an area that has been removed as mappable NOA bearing unit based on geologic evaluation. Based on this data the potential for NOA to be encountered at levels at or exceeding regulatory threshold levels is considered low. However, testing by Costco could be performed to further define NOA concentrations across the project area in order to assist Costco with identifying their risk associated with this hazard. Should levels be equal to or exceed regulatory threshold levels mitigation procedures will need to be implemented. Mitigation alternatives will need to be consistent with guidelines outlined in the CARB's current ATCM and Occupational Safety and Health Administration (OSHA) standards for the handling of NOA.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 GENERAL

Based on the results of our field exploration, laboratory testing and engineering analyses conducted during this study, it is our professional opinion that the proposed project is geotechnically feasible, provided the design and construction recommendations presented in this report are incorporated into the project. We identify the following key geotechnical considerations during our study.

- Based on the results of the seismic refraction lines, the near surface soils are comprised of a thin colluvium/residual soil layer varying in thickness from approximately 1½ to 5 feet thick. Below the colluvium/residual soil lies bedrock comprised of highly weathered and fractured metavolcanic rock ($V_p = 3,000$ to $6,000$ ft/s). The strength of this highly weathered rock layer increases in depth and is approximately 10 feet thick. The highly weathered rock layer is underlain by slightly weathered, intact rock ($V_p > 6,000$ ft/s). The depth to the bottom of this layer varies from approximately 10 to 20 feet bgs.
- Soils and rock with velocities of less than 3,000 fps can usually be excavated with conventional earth moving equipment. The intermediate material (velocities between 3,000 fps and 6,000 fps) would likely require heavy equipment and possibly localized use of jackhammers, ram-hoes, or selective blasting to provide cost-effective excavation. Where materials with velocities in excess of 6,000 fps are found, blasting would normally be required for efficient fragmentation. However, if the rock is thinly bedded, jointed, or fractured, it may be possible to break the rock with heavy ripping using a single shank ripper or large ram-hoe. The resulting fragments will be of a size consistent with the fracture spacing and the progress of excavation would be very slow.
- Based on the preliminary grading plans provided by Kier and Wright (project civil engineer), the fuel facility area including the canopy, tanks, and queuing aisles will receive fills of approximately 13 to 18 feet across the site to achieve desired grades. The entrance roadway on the north side will have fills of approximately 4 to 5 feet and on the southern roadway cuts of approximately 5 to 6 feet are planned. In discussions with Costco and the project civil engineer, it has not been decided if fills will be achieved via import soils or balancing the site with rock fill. Fuel facility canopy foundations are anticipated to be founded in structural fill and underground storage tanks will likely tip into the highly weathered rock layer ($V_p = 3,000$ to $6,000$ ft/s).
- Due to the composition of the bedrock, it will not reduce to a soil-like material when excavated and will not be suitable for re-use as structural fill. It is anticipated that crushing

and processing the harder rock layers will prove challenging and may require soil to be imported onsite. Import materials, if required, should have a Plasticity Index of less than 10 with no less than 70 percent passing the No. 4 sieve, no more than 30 percent of the particles passing the No. 200 sieve, and no particles greater than 3 inches in maximum dimension. The maximum Plasticity Index for imported soils may be modified upon approval by Costco depending on its proposed use. The contractor should provide documentation to Costco that imported fill is free of hazardous materials, including petroleum or petroleum byproducts, chemicals and harmful minerals prior to its transportation and use on site.

- Prior to grading and subgrade preparation, all vegetation should be cut and removed from the site. Roots and vegetative matter in excess of one inch should be removed by screening or raking soils to a minimum depth of 12 inches. Other than plant roots, organic matter in the topsoil is minimal based on our laboratory testing (between one and three percent). The topsoil can be re-used on site in fills.
- A seasonal creek runs through the property from east to west toward Silva Valley Parkway. Soft and wet soils found at the base of seasonal creeks should be removed and replaced to the satisfaction of Kleinfelder's geotechnical representative during construction. Prior to filling in the seasonal creek, subdrains should be installed within the creek bottom. This creek was observed to be flowing rapidly in April 2019.
- Rainfall will infiltrate near surface soils and collect on less permeable soil and rock at shallow depth. Therefore, perched groundwater will likely be present at or near bedrock contact elevation across the site. Temporary dewatering provisions will likely be required during construction, as discussed in Section 5.2.4.
- The proposed fuel facility canopy may be supported on a conventional shallow foundation system founded on structural fill. Light poles may be supported on short drilled piles.
- For areas with new pavements, we recommend that the exposed subgrade be proof-rolled with heavy construction equipment (e.g., loader or smooth-drum roller) to disclose areas of soft and yielding material after the area has been stripped of soft earth materials and debris. Where soft or yielding material are observed, the material should be overexcavated and replaced with structural fill. The proof-rolling should extend beyond the proposed improvements a horizontal distance of at least 2 feet, if practicable.
- After proof-rolling and/or prior to placement of fill, the subgrade should be scarified to a depth of 6 to 8 inches, moisture conditioned, and compacted in accordance with the

compaction criteria presented in section 5.2.6. The proof-rolling should extend beyond the proposed improvements a horizontal distance of at least 2 feet, if practicable.

- Due to poor draining subgrade conditions, we recommend drainage inlets and catch basins include pavement underdrains as shown in Detail 1 6_16 of the CWDRs.
- Resistivity values below 1,000 ohm-cm are considered extremely corrosive to buried ferrous metals (NACE, 2006). The concentrations of soluble sulfates indicate that the subsurface soils represent a Class S0 exposure to sulfate attack on concrete in contact with the soil based on ACI 318-19 Table 19.3.1.1 (ACI, 2019). Therefore, in accordance with ACI Building Code 318-19, no special provisions for selection of cement type are required.

The following opinions, conclusions, and recommendations are based on the properties of the materials encountered in the borings, the results of the laboratory-testing program, and our engineering analyses performed. Our recommendations regarding the geotechnical aspects of the design and construction of the project are presented in the following sections.

4.2 2022 CBC SEISMIC DESIGN PARAMETERS

According to the 2022 California Building Codes (CBC), every structure, and portion thereof, including non-structural components that are permanently attached to structures and their supports and attachments, shall be designed and constructed to resist the effects of earthquake motions in accordance with ASCE 7-16. The Seismic Design Category for a structure may be determined in accordance with Section 1613 of the 2022 CBC.

Based on information obtained from the investigation, published geologic literature and maps, and on our interpretation of the ASCE 7-16 criteria, it is our opinion that the project site may be classified as Site Class C, Soft Rock. Approximate coordinates for the site are noted below.

Latitude: 38.66208°N

Longitude: 121.05749°W

The Risk-Targeted Maximum Considered Earthquake (MCE_R) mapped spectral accelerations for 0.2 seconds and 1 second periods (S_s and S_1) were estimated using Section 1613 of the 2022 CBC and the Structural Engineering Association (SEA) web based application (available at <http://https://www.seismicmaps.org/>). The mapped acceleration values and associated soil amplification factors (F_a and F_v) based on the 2022 CBC and corresponding site modified spectral accelerations (S_{MS} and S_{M1}) and design spectral accelerations (S_{DS} and S_{D1}) are presented in Table 2.

**TABLE 2
2022 CBC SESIMIC DESIGN PARAMETERS**

DESIGN PARAMETER	RECOMMENDED VALUE
Site Class	C
S_s (g)	0.404
S_1 (g)	0.207
F_a	1.300
F_v	1.500
S_{MS} (g)	0.526
S_{M1} (g)	0.311
S_{DS} (g)	0.351
S_{D1} (g)	0.207
PGA_M (g)	0.172

4.3 FOUNDATIONS

4.3.1 General

Based on the results of our field exploration, laboratory testing, and geotechnical analyses, the proposed fueling facility canopy may be supported on a conventional shallow foundation system founded on structural fill. New light poles may be supported on short, drilled piles. Recommendations for the design and construction of spread footings and drilled piles are presented below.

4.3.2 Conventional Shallow Foundations

Allowable Soil Bearing Pressure

We understand that new spread footing foundations for the canopies will be embedded approximately 6 to 7 feet below the finished grade. Spread footings founded on structural fill may be designed for a net allowable soil bearing pressure of 3,000 psf for dead plus sustained live loads. A one-third increase in the above bearing pressures can be used for short term load conditions for wind or seismic loads. The footing dimension and reinforcement should be designed by the structural engineer; however, continuous footings should have minimum widths of 18 inches.

Estimated Settlement

We estimate total static settlement for foundations designed and constructed in accordance with the recommendations presented above to be ½ inch or less. Differential static settlement between similarly loaded footings is estimated to be less than ½ inch over 50 feet. Differential seismic settlement is also estimated to be less than ½ inch over 50 feet.

Lateral Resistance

Lateral load resistance may be derived from passive resistance along the vertical sides of the footings, friction acting at the base of the footing, or a combination of the two. An allowable passive resistance of 250 psf per foot of depth may be used for design. Allowable passive resistance values should not exceed 2,500 psf. An allowable coefficient of friction value of 0.3 between the base of the footings and the engineered fill soils can be used for sliding resistance using the dead load forces. Friction and passive resistance may be combined without reduction. We recommend that the first foot of soil cover be neglected in the passive resistance calculations if the ground surface is not protected from erosion or disturbance by a slab, pavement or in a similar manner.

4.3.3 Drilled Pile Foundations

Axial Capacity

The compressive axial capacity of drilled piles may be estimated based on an allowable skin friction capacity of 200 pounds per square foot. The upper one foot of the skin friction capacity should be ignored. The uplift capacity may be estimated as 70 percent of the allowable compressive axial capacity. A one-third increase in the allowable capacities may be used for transient loading conditions such as wind or seismic loads.

Settlement

Settlement of the proposed canopy supported on drilled piles, as recommended, is estimated to be less than ½ inch.

Lateral Resistance

The drilled pile foundations lateral resistance can be designed in general accordance with Section 1807.3 of the CBC. We recommend a lateral soil bearing pressure of 250 psf per foot of depth below grade. The total lateral soil bearing pressure should not exceed 2,500 psf per pile. Since drilled piles will act as isolated pole foundations, the allowable lateral soil bearing pressure may be increased by

a factor of 2 for short-term lateral loads provided the structure will not be adversely affected by ½ inch of lateral movement at the ground surface.

4.4 EXTERIOR FLATWORK

Prior to casting exterior flatwork, the subgrade soils should be scarified, moisture conditioned, and recompacted or overexcavated, as recommended in Section 5.2.2. Exterior concrete slabs for pedestrian traffic or landscape should be at least four inches thick. Weakened plane joints should be located at intervals of about 6 feet. Careful control of the water/cement ratio should be performed to avoid shrinkage cracking due to excess water or poor concrete finishing or curing. Unreinforced slabs should not be built in areas where further saturation may occur following construction.

4.5 SITE DRAINAGE

Foundation and slab performance depend greatly on proper irrigation and how well runoff water drains from the site. As such, we recommend that good drainage be provided away from structures and other improvements as discussed below. Drainage should be maintained both during construction and over the entire life of the project. The ground surface around structures should be graded such that water drains rapidly away from structures without ponding. The surface gradient needed to do this depends on the surface type and should follow CWDRs (Costco, 2022).

A seasonal creek is present on the site running east to west, this creek was observed to be flowing rapidly during a previous investigation in 2019. After stripping the site and prior to filling in the creek, subdrains should be installed within the creek bottom.

Due to the presence of shallow rock and because the upper soils are predominately clayey, poor draining subgrade conditions may be present. Accordingly, we recommend drainage inlets and catch basins include pavement underdrains as shown in Detail 16_16 of the CWDRs. Drains should be designed and constructed per Costco's standard details and laterals should extend at least 10 feet from the catch basins. Foundation drains are not necessary.

We recommend that landscape planters either not be located adjacent to buildings and pavement areas or be isolated and properly drained to area drains such that cycles of wetting and drying do not impact pavements, flatwork, and other structures. Drought resistant plants and minimum watering are recommended for planters, if used. No planters should be installed immediately adjacent to structures unless they are water-proofed and have a drainpipe connected to an area drain outlet. Planters should be built such that water exiting from them will not seep into the foundation areas or beneath slabs and pavement. Roof water should be directed to fall on hardscape

areas sloping to an area drain, or roof gutters and downspouts should be installed and routed to area drains. Roof downspouts and their associated drains should be isolated from other subdrain systems, where used, to avoid flooding. In any event, maintenance personnel should be instructed to keep areas uniformly moist throughout the life of the project (e.g., limit or eliminate cycles of wetting and drying) as cycles of wetting and drying will cause distress in surrounding improvements. Should excessive irrigation, waterline breaks, or unusually high rainfall occur, saturated zones and “perched” groundwater may develop. Consequently, the site should be graded so that water drains away readily without saturating the foundation or landscaped areas. Potential sources of water such as water pipes, drains, and the like should be frequently examined for signs of leakage or damage. Any such leakage or damage should be promptly repaired. Wet utilities should also be designed to be watertight and should be inspected and repaired as needed.

4.6 PAVEMENTS

The required pavement structural sections will depend on the expected wheel loads, volume of traffic, and subgrade soils. We have provided asphalt concrete pavement sections for traffic indices provided in the CWDRs (Costco, 2022). Positive drainage of the paved areas should be provided since moisture infiltration into the subgrade may decrease the life of pavements. Curbing located adjacent to paved areas should be founded in the subgrade, not the aggregate base, in order to provide a cutoff, which reduces water infiltration into the base course.

The following pavement sections are based on the soil conditions encountered during our field investigation, our assumptions regarding final site grades, and limited laboratory testing.

4.6.1 Costco Design Parameters

We developed pavement design recommendations using traffic loading parameters provided in the Costco Wholesale Development Requirements and the following test data:

- A 20-year pavement design life;
- Light-duty pavements subject to 6,600 passenger vehicle trips per year (Traffic Index of 5.0);
- Heavy-duty pavements subject to 30 tractor-trailer truck trips per day (Traffic Index of 7.0);
- For asphalt concrete pavements: an R-value of 15 based on previous laboratory testing results; and
- For Portland cement concrete (PCC) Pavements: a 28-day flexural strength (modulus of rupture determined by the third-point method) of at least 550 pounds per square inch (psi)

(approximate compressive strength of 4,000 psi); a modulus of subgrade reaction (k value) of 125 pounds per square inch per inch (pci); and interlock at the control joints.

4.6.2 Asphalt Concrete Pavement

We have developed new asphalt concrete pavement, also referred to as Hot Mix Asphalt (HMA) pavements sections in accordance the Caltrans Highway Design Manual in lieu of the Asphalt Institute Manual Series (MS-1) so that the pavement structural sections are somewhat comparable to the existing sections. HMA should conform to requirements of the Costco Wholesale Specification Section 321216, Asphalt Paving. Table 3 presents recommended HMA pavement sections. The designer should select the appropriate pavement sections based on project requirements. Prior to placement of aggregate base, pavement subgrade should be prepared in accordance with Section 5.2.2.

**TABLE 3
ASPHALT CONCRETE PAVEMENT SECTIONS**

TRAFFIC USE	TRAFFIC INDEX, TI	ASPHALT CONCRETE (INCHES)*	AGGREGATE BASE (INCHES)*
Light-Duty Pavement	5.0	4.0	6.0
Heavy-Duty Pavement	7.0	5.0	10.0

*Rounded to the nearest ½ inch

4.6.3 Asphalt Performance Grade Binder

An asphalt performance grade (PG) binder of 64-10 should be used for the project and is locally available. This recommendation was developed in accordance with Costco Wholesale Asphalt Paving Specification Section 321216. Air temperature data near the project site was used with the MERRA Climate Data option and the PG binder was selected using the FHWA program LTTTPBind Online web-based tool based on the AASHTO M323-13 standard. The high-end and low-end temperature rating was selected to provide a reliability of at least 98 and 90 percent, respectively.

4.6.4 Portland Cement Concrete Pavement

We designed PCC pavement in accordance with the Portland Cement Association (PCA) Thickness Design for Concrete Pavements (PCA, 1984) using the design parameters stated above. For heavy-duty pavements, we recommend that PCC pavement should be comprised of

7.5 inches of PCC with 6.0 inches of aggregate base. Prior to placement of aggregate base, pavement subgrade should be prepared in accordance with Section 5.2.2.

Longitudinal and transverse joint spacing should not exceed 12 feet and 15 feet, respectively. Joint details should conform to PCA guidelines. Expansion joints in concrete slabs should be sealed with petroleum resistant sealant to prevent minor releases from impacting subsurface soil.

4.6.5 Aggregate Base

Aggregate base materials should meet current Caltrans specifications for Class 2 aggregate base and be compacted to at least 95 percent relative compaction (ASTM D1557).

4.7 SOIL CORROSION

A preliminary evaluation of the corrosion potential of the on-site soils to steel and buried concrete was completed during our initial site investigation of the property in 2019. Laboratory testing was performed on two soil samples to evaluate pH, minimum resistivity, chloride, and soluble sulfate content. Results from our samples gathered in 2019 are provided in Table 3 below.

**TABLE 4
CORROSION TEST RESULTS**

Location	Depth (ft)	Minimum Resistivity (ohm-cm)	pH	Soluble Sulfate Content (ppm)	Soluble Chloride Content (ppm)
TP-1 (2019)	0.5	3,255	6.4	33	34
TP-2 (2019)	0	769	6.6	185	204

These tests are only an indicator of soil corrosivity for the samples tested. Other soils found on site may be more, less, or of a similar corrosive nature. Imported fill materials should be tested to confirm that their corrosion potential is not more severe than those noted.

Resistivity values less than 1,000 ohm-cm are considered extremely corrosive to buried ferrous metals (NACE, 2006). The concentrations of soluble sulfates indicate that the subsurface soils represent a Class S0 exposure to sulfate attack on concrete in contact with the soil based on ACI 318-19 Table 19.3.1.1 (ACI, 2019). Therefore, in accordance with ACI Building Code 318-19, no special provisions for selection of cement type are required.

Kleinfelder's scope of services does not include corrosion engineering and, therefore, a detailed analysis of the corrosion test results is not included. We understand gasoline station equipment is constructed of corrosion resistant synthetic materials. We recommend the gasoline station designer review these results and consult a corrosion expert for further evaluation, if necessary.

4.8 STORM WATER MANAGEMENT

We have assessed the potential for storm water infiltration into the subgrade soils at the subject project site based on soil type and laboratory testing. Pursuant to the current standard of practice, an infiltration evaluation is a two-step process. The first step is to characterize the site to assess whether infiltration is feasible. If infiltration is feasible, then infiltration testing is needed to provide a design infiltration rate (step two).

Based on visual soil classification and laboratory testing of the soil samples collected during our field exploration, the onsite soils in the upper 5 feet below the existing ground surface at the site are comprised primarily colluvium/residual soil consisted primarily of sandy silts and lean clays underlain by bedrock. Seasonal perched groundwater was also observed within these soils above the bedrock. Given the low infiltration capacity of the on-site soils and observed perched groundwater, we recommend alternatives to infiltration Best Management Practices (BMPs), such as bio filtration/bio-retention systems (bio-swales and planter boxes), be implemented at the project site.

If bio-filtration/bio-retention systems are employed, we recommend that the BMPs be built such that water exiting from them will not seep into the foundation areas or beneath slabs and pavement. If planters are located within 10 feet of the structures, or adjacent to slabs and pavements, then some means of diverting water away from the building, building foundation soils, or soils that support slabs and pavements would be required, such as lining the planters.

5 CONSTRUCTION RECOMMENDATIONS

5.1 GENERAL

The following recommendations should be used by the contractor for construction of the project.

5.2 EARTHWORK

5.2.1 General

Site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations and other local, state, or federal specifications, and the recommendations included in this report. References to maximum dry unit weights are established in accordance with the latest version of ASTM Standard Test Method D1557 (modified Proctor). The earthwork operations should be observed and tested by a representative of Kleinfelder.

5.2.2 Site Preparation

Abandoned utilities, existing pavements, foundations, and other existing improvements within the proposed fuel facility area should be removed and the excavation(s) backfilled with engineered fill. Debris produced by demolition operations, including wood, steel, piping, plastics, etc., should be separated and disposed of off-site. Existing utility pipelines or conduits that extend beyond the limits of the proposed construction and are to be abandoned in place, should be plugged with non-shrinking cement grout to prevent migration of soil and/or water. Demolition, disposal, and grading operations should be observed and tested by a representative of Kleinfelder. Areas to receive fill should be stripped of all dry or soft earth materials and unsuitable fill materials to the satisfaction of a representative of Kleinfelder. In addition, a seasonal creek runs through the property from east to west, soft and wet soils at the base of creeks must be removed and replaced with structural fill to the satisfaction of Kleinfelder's Geotechnical representative during construction. Prior to filling in the seasonal creek, subdrains should be installed within the creek bottom.

After the area has been stripped/grubbed of organic material and soft earth materials and debris have been removed and prior to fill placement, we recommend that the exposed subgrade be proof-rolled with heavy construction equipment (e.g., loader or smooth-drum roller) to disclose areas of soft and yielding material. Where soft and yielding material is observed, it should be over excavated and replaced as structural fill. After proof-rolling and/or prior to placement of fill, the subgrade should be scarified to a depth of 8 to 12 inches, moisture conditioned, and compacted

in accordance with the compaction criteria presented in section 5.2.4. The proof-rolling should extend beyond the proposed improvements a horizontal distance of at least 2 feet, if practicable.

Per our previous investigation in Spring of 2019, perched groundwater may be present at bedrock contact (as shallow as 1-2 feet bgs). The contractor should anticipate that pumping subgrade conditions may be encountered during site grading activities due to shallow perched groundwater, and the subgrade may need to be stabilized with geotextiles and crushed rock. Recommendations to stabilize pumping subgrade are provided in Section 5.3.

5.2.3 Permanent Slopes

Permanent slopes should be constructed at 2:1 (horizontal to vertical) or flatter. Slopes will be subject to erosion and should be planted as soon as practicable. Where new fill slopes are to be constructed on hillsides or existing slopes, the topsoil, colluvial soils, and other materials considered unsuitable should be removed. Where the exposed slope is steeper than 5:1, or where recommended by personnel by our firm, the original ground on which fill is to be placed should be keyed and benched. The benches should extend in the underlying bedrock. Key should be at least 8 feet wide and sloped a minimum of 2 percent towards the slope. Benches should be at least 4 feet wide and not exceed 4 feet in height. Fill slopes should be overbuilt by 2 feet then cut back to facilitate compaction at the face. Fill and cut slopes should be observed by our firm during grading to evaluate the anticipated geologic conditions and make any necessary modifications.

5.2.4 Groundwater Impacts

Rainfall will infiltrate near surface soils and collect on less permeable soil and rock at shallow depth. Perched groundwater above the bedrock was encountered in test pits excavated in Spring 2019 that were advanced following a period of heavy rainfall and may be encountered during construction. This is most likely to occur following periods of rainfall and in the winter and spring months. If encountered, excavations which encounter perched groundwater will need to be temporarily dewatered. In our opinion, dewatering of narrow trench excavations, which penetrate less than a few feet below the groundwater level and do not encounter loose and/or cohesionless soils, may be possible by directing inflow to a sump where water can be removed by a pump. Temporary dewatering of wider, deeper, and/or more extensive excavations may require well points, deep wells, and/or deep sumps. To help maintain bottom stability of wider, deeper, and/or more extensive excavations, groundwater levels should be drawn-down a minimum of 2 feet below the lowest portion of the excavation. Since temporary dewatering will impact and be dependent on construction methods and scheduling, we recommend the contractor be solely

responsible for the design, installation, maintenance, and performance of all temporary dewatering systems.

Depending on the depth of excavation below perched groundwater, soil conditions encountered along the excavation face, and slope inclination, caving or sloughing of excavation slopes is likely within the vicinity of a sump dewatering system. Sloughing or caving of excavation slopes could endanger personnel working within or adjacent to the excavation as well as nearby equipment, structures, or other existing improvements. The contractor should be aware of the potential for caving and take appropriate precautions to ensure the safety of site personnel as well as the integrity of the excavation slopes and any existing, nearby structures or other improvements.

5.2.5 Foundation Excavations

Shallow Foundations

Following excavation to the foundation subgrade elevations, the exposed subgrade should be observed by a representative of the geotechnical engineer to evaluate the presence of satisfactory materials at design elevations. If unsatisfactory material, such as soft or disturbed soil, debris or otherwise unsuitable soil is present at the base of footing excavations, then unsuitable materials should be overexcavated and replaced (e.g., with structural concrete, 2-sack sand-cement slurry, structural fill) to the depth and extent determined by the geotechnical engineer. As a minimum, the contractor should be prepared to scarify, moisture condition, and re-compact the upper 12 inches of footing subgrade.

Drilled Pile Foundations

The performance and capacities of piles can be influenced significantly by the selected construction methods and procedures used. Construction methods that create large zones of disturbance around the drilled shafts can lead to lower-than-expected skin friction due to excessive stress relief around the shaft length. Drilling of the pile shafts should be accomplished using conventional heavy-duty excavation equipment maintained in good condition. It should be noted that shallow bedrock may be encountered in cut areas and difficult excavation conditions may be encountered. The foundation drilling contractor should select equipment and tooling that is capable of reaching the planned foundation depths in such material.

Concrete should be placed immediately after drilling of the hole is complete. The concrete should be pumped to the bottom of the drilled shaft using a down-hole tremie. If steel casing is used, the

casing should be removed as the concrete is placed, but the bottom of the casing should be kept at least 5 feet below the top of the concrete.

5.2.6 Fill Material and Compaction Criteria

Materials placed below pavement or structures should be structural fill. The on-site soils, minus any debris, organic matter, or other deleterious materials may be used as structural fill. Rock or other soil fragments greater than 6 inches in size should not be used in the fills and disposed off-site.

We recommend granular (sandy) fill soils and imported material should be compacted to at least 95 percent of the maximum dry unit weight (ASTM D1557) in accordance with the CWDRs. Due to compaction difficulties, we do not recommend compacting the onsite clayey soils to 95 percent relative compaction in accordance with the CWDRs. Clayey fill soils should be compacted to between 92 percent of the soil's maximum dry unit weight (ASTM D1557). Compacting the onsite clayey soils to at least 92 percent relative compaction will achieve the necessary strength assumed in our design recommendations.

Fill should be placed in loose horizontal lifts not more than 8 inches thick (loose measurement). The moisture content of the fill should be maintained at -2 to +2 percent of optimum for sandy soils and +2 percent above of optimum for clayey soils during compaction. The moisture content of the clayey fill is considered very important, and therefore, both relative compaction and moisture content should be used to evaluate compaction acceptance. If both criteria are not within the specified tolerances, the fill should not be accepted, and the contractor should rework the material until the fill is placed within the specified tolerances.

Moisture reduction processing of on-site soil maybe required prior to placement as structural fill. Processing may require ripping the material, disking to break up clumps, and blending to attain uniform moisture contents necessary for compaction. Compaction of mass graded areas should be accomplished with a sheep's foot type roller compactor to aid in moisture conditioning. Utility trench backfill should be mechanically compacted. Flooding should not be permitted.

Import soils, if required, should have no particles greater than 3 inches in maximum dimension, no less than 70 percent of the particles passing the No. 4 sieve, no more than 30 percent of particles passing the No. 200 sieve, and a Plasticity Index (PI) less than 10. The contractor should provide documentation that all imported soil is free of hazardous materials, including petroleum or petroleum byproducts, chemicals and harmful minerals. Test results with the geotechnical and

analytical properties of the proposed import material should be provided to Costco for approval prior to transportation and use on site.

5.2.7 Excavation Characteristics

Due to the relatively deep site fills anticipated (about 13 to 18 feet), the excavations for the USTs and foundations should be excavatable with conventional heavy-duty construction equipment maintained in good condition. However, if onsite excavations and grading operations extend into the highly weathered bedrock layer, the contractor should expect the following excavation conditions.

Based on the results of the seismic refraction lines, the near surface soils are comprised of a colluvium/residual soil layer varying in thickness from approximately 1½ to 5 feet thick. Below the colluvium/residual soil, bedrock comprised of highly weathered and fractured metavolcanic rock ($V_p = 3,000$ to $6,000$ ft/s). The strength of this highly weathered rock increases in depth and is approximately 10 feet thick. The highly weathered rock layer is underlain by slightly weathered, intact rock ($V_p > 6,000$ ft/s). The depth to the bottom of this layer varies as well but is approximately 10 to 20 feet bgs based on seismic refraction lines SL-1 through SL-3 across the entire site. The results of the seismic refraction survey are presented in Appendix C.

Soils and rock with velocities of less than 3,000 fps can usually be excavated with conventional earth moving equipment. Where materials with velocities in excess of 6,000 fps are found, blasting would normally be required for efficient fragmentation. However, if the rock is thinly bedded, jointed, or fractured, it may be possible to break the rock with heavy ripping using a single shank ripper or large ram-hoe. The resulting fragments will be of a size consistent with the fracture spacing and the progress of excavation would be very slow. The intermediate material (velocities between 3,000 fps and 6,000 fps) would likely require heavy equipment and possibly localized use of jackhammers, ram-hoes, or selective blasting to provide cost-effective excavation. If encountered, locally massive (unfractured) or resistant zones of rock may decrease production and require the use of a rock drill, hydraulic hammer, or other specialized rock excavating attachments. The presence of oversized materials, such as cobbles and boulders, should also be anticipated.

A representative of Kleinfelder should be present during excavation in this area to observe the soil conditions. If soft, loose, or deleterious materials are encountered in the base of the excavation then the materials should be removed and replaced as compacted fill or otherwise remediated to provide competent bearing material under site improvements.

5.2.8 Temporary Excavations

All excavations must comply with applicable local, state, and federal safety regulations, including OSHA requirements. The responsibility for excavation safety and stability of temporary construction slopes lies solely with the contractor. We are providing this information below solely as a service to our client. Under no circumstances should this information provided be interpreted to mean that Kleinfelder is assuming responsibility for final engineering of excavations or shoring, construction site safety, or the contractors' activities; such responsibility is not being implied and should not be inferred.

Minor sloughing and/or raveling of slopes should be anticipated as they dry out. Where space for sloped embankments is not available, shoring will be necessary. In addition, excavations within a 1:1 plane extending downward from a horizontal distance of 2 feet beyond the bottom outer edge of existing improvements should not be attempted without bracing and/or underpinning the footings, as discussed above. The geotechnical engineer or their field representative should observe the excavations so that modifications can be made to the excavations, as necessary, based on variations in the encountered soil conditions. All applicable excavation safety requirements and regulations, including OSHA requirements, should be met.

All trench excavations should be braced and shored in accordance with good construction practice and all applicable safety ordinances and codes. Stockpiled (excavated) materials should be placed no closer to the edge of an excavation than a distance equal to the depth of the excavation, but no closer than 4 feet.

5.2.9 Trench Backfill

Pipe zone backfill (i.e., material beneath and in the immediate vicinity of the pipe) should consist of imported soil less than $\frac{3}{4}$ -inch in maximum dimension. Trench zone backfill (i.e., material placed between the pipe zone backfill and finished subgrade) may consist of onsite soil or imported fill that meets the requirements for engineered fill provided above.

If imported material is used for trench zone backfill, we recommend it consist of silty sand. In general, gravel and cobble should not be used for trench zone backfill due to the potential for soil migration into the relatively large void spaces present in this type of material and water seepage along trenches backfilled with coarse-grained sand and/or gravel.

Recommendations provided above for pipe zone backfill are minimum requirements only. More stringent material specifications may be required to fulfill local building requirements and/or

bedding requirements for specific types of pipes. We recommend the project civil engineer develop these material specifications based on planned pipe types, bedding conditions, and other factors beyond the scope of this study.

Trench backfill should be placed and compacted in accordance with recommendations provided for structural fill in Section 5.2.6. Mechanical compaction is recommended; ponding or jetting should be avoided, especially in areas supporting structural loads or beneath concrete slabs supported on grade, pavements, or other improvements.

5.3 UNSTABLE SUBGRADE CONDITIONS

It is common to encounter wet, unstable soils upon removal of site pavements or flatwork as a result of subsurface moisture becoming trapped beneath relatively impervious asphalt concrete or Portland cement concrete surfaces. Pumping subgrade conditions may be encountered during site grading activities, and the subgrade may need to be stabilized with geotextiles and crushed rock or chemical treatment. Additionally, should grading be performed during or following periods of rainfall, the moisture content of the near-surface soils will also be significantly above the optimum moisture content. These conditions could seriously impede grading by causing an unstable subgrade condition. Typical remedial measures include the following:

- Drying: Drying unstable subgrade involves disking or ripping wet subgrade to a depth of approximately 18 to 24 inches and allowing the exposed soil to dry. Multiple passes of the equipment (likely on a daily basis) will be needed because as the surface of the soil dries, a crust forms that reduces further evaporation. Frequent disking will help prevent the formation of a crust and will promote drying. This process could take several days to several weeks depending on the depth of ripping, the number of passes, and the weather.
- Removal and Replacement with Crushed Rock and Geotextile Fabric: Unstable subgrade could be over-excavated 12 to 24 inches below existing grade and replaced with ¾- or 1-inch crushed rock underlain by geotextile fabric. The geotextile fabric should consist of a woven geotextile, such as Mirafi 600HP series or equivalent. The final depth of removal will depend upon the conditions observed in the field once over-excavation begins. The geotextile fabric should be placed in accordance with the manufacturer's recommendations.
- Chemical Treatment: Unstable subgrade could be stabilized by mixing the upper 12 to 18 inches of the subgrade with Portland cement, Class C flyash or lime. For estimating purposes, an application rate of 10 to 12 percent Class C flyash, 3 to 5 percent high

calcium quick lime, or 4 to 5 percent Portland cement may be used. Final application rates should be determined in the field at the time of construction in consultation with the geotechnical engineer. Chemical treatment should be performed by a specialty contractor experienced in this work. Since soil treatment uses the on-site soil, the expense of importing material can be avoided.

5.4 EXTERIOR FLATWORK

Prior to casting exterior flatwork, the subgrade soils should be moisture conditioned and recompacted or overexcavated, as recommended in Section 5.2.2. The moisture content of the subgrade soils should be maintained at least optimum prior to the placement of any flatwork. In the event that these subgrade soils are allowed to dry out, the exposed subgrade should be re-moisture conditioned.

Exterior concrete slabs for pedestrian traffic or landscape should be at least four inches thick. Weakened plane joints should be located at intervals of about 6 feet. Careful control of the water/cement ratio should be performed to avoid shrinkage cracking due to excess water or poor concrete finishing or curing. Unreinforced slabs should not be built in areas where further saturation may occur following construction.

5.5 PAVEMENTS

5.5.1 HMA Design

Hot Mix Asphalt (HMA) should conform to requirements of the Costco Wholesale Specification Section 321216, Asphalt Paving. Section 1.3.C of the HMA specification requires that the HMA section be placed in at least two lifts. The HMA specification allows the use of 1/2- or 3/4-inch Nominal Maximum Aggregate Size (NMAS) mixes for the base course and 3/8- or 1/2-inch NMAS mixes for surface course. Maximum and minimum HMA compacted lift thicknesses are provided in Table 3.1 in Section 3.3.B of the HMA specification.

5.5.2 Construction Considerations

The pavement sections provided in Section 4.6 are contingent on the following recommendations being implemented during construction.

- Pavement subgrade should be prepared as recommended in Section 5.2.2.
- Subgrade soils should be in a stable, non-pumping condition at the time the aggregate base materials are placed and compacted.

- Aggregate base materials should be moisture conditioned to at least the optimum moisture content and compacted to at least 95 percent relative compaction (ASTM D1557).
- Asphalt paving materials and placement methods should meet current Costco Wholesale Specifications Section 321216.
- Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils and aggregate base materials are not allowed to become wet.

Note that pavement materials and construction must be completed in strict accordance with the Costco's specifications that contain very specific pavement material (asphalt, aggregate and concrete) criteria and construction practices to be used (compaction and material sampling). The general contractor and pavement construction subcontractor should be aware that asphalt and concrete mix designs must be submitted to the design architect and Kleinfelder at least 45 days prior to the scheduled production and laydown for review and approval.

6 ADDITIONAL SERVICES

6.1 PLANS AND SPECIFICATIONS REVIEW

We recommend that Kleinfelder perform a general review of the project plans and specifications before they are finalized to verify that our geotechnical recommendations have been properly interpreted and implemented during design. If we are not accorded the privilege of performing this review, we can assume no responsibility for misinterpretation of our recommendations.

6.2 CONSTRUCTION OBSERVATION AND TESTING

The construction process is an integral design component with respect to the geotechnical aspects of a project. Because geotechnical engineering is an inexact science due to the variability of natural processes, and because we sample only a limited portion of the soils affecting the performance of the proposed structure, unanticipated or changed conditions can be encountered during grading. Proper geotechnical observation and testing during construction are imperative to allow the geotechnical engineer the opportunity to verify assumptions made during the design process. Therefore, we recommend that Kleinfelder be retained during the construction of the proposed improvements to observe compliance with the design concepts and geotechnical recommendations, and to allow design changes in the event that subsurface conditions or methods of construction differ from those assumed while completing this study.

Our services are typically needed at the following stages of grading.

- During grading;
- During the installation of temporary construction shoring;
- After the overexcavation, but prior to scarification;
- During utility trench backfill;
- During base placement and site paving; and
- After excavation for foundations.

7 LIMITATIONS

This geotechnical study has been prepared for the exclusive use of Costco Wholesale and their agents for specific application to the proposed fuel facility located at Silva Valley Parkway (APN 122-720-019) in El Dorado Hills, California. The findings, conclusions and recommendations presented in this report were prepared in accordance with generally accepted geotechnical engineering practice. No other warranty, express or implied, is made.

The scope of services was limited to a background data review and the field exploration described in Section 1.2. It should be recognized that definition and evaluation of subsurface conditions are difficult. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions present due to the limitations of data from field studies. The conclusions of this assessment are based on our field exploration and laboratory testing programs, and engineering analyses.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service, which provide information for their purposes at acceptable levels of risk. The client and key members of the design team should discuss the issues covered in this report with Kleinfelder, so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk and expectations for future performance and maintenance.

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. It is possible that soil or groundwater conditions could vary between or beyond the points explored. If soil or groundwater conditions are encountered during construction that differ from those described herein, the client is responsible for ensuring that Kleinfelder is notified immediately so that we may reevaluate the recommendations of this report. If the scope of the proposed construction, including the estimated Traffic Index or locations of the improvements, changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid until the changes are reviewed, and the conclusions of this report are modified or approved in writing, by Kleinfelder.

The scope of services for this subsurface exploration and geotechnical report did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil, surface water, or groundwater at this site.

Kleinfelder cannot be responsible for interpretation by others of this report or the conditions encountered in the field. Kleinfelder must be retained so that all geotechnical aspects of construction will be monitored on a full-time basis by a representative from Kleinfelder, including site preparation, preparation of foundations, and placement of engineered fill and trench backfill. These services provide Kleinfelder the opportunity to observe the actual soil and groundwater conditions encountered during construction and to evaluate the applicability of the recommendations presented in this report to the site conditions. If Kleinfelder is not retained to provide these services, we will cease to be the engineer of record for this project and will assume no responsibility for any potential claim during or after construction on this project. If changed site conditions affect the recommendations presented herein, Kleinfelder must also be retained to perform a supplemental evaluation and to issue a revision to our original report.

This report, and any future addenda or reports regarding this site, may be made available to bidders to supply them with only the data contained in the report regarding subsurface conditions and laboratory test results at the point and time noted. Bidders may not rely on interpretations, opinion, recommendations, or conclusions contained in the report. Because of the limited nature of any subsurface study, the contractor may encounter conditions during construction which differ from those presented in this report. In such event, the contractor should promptly notify the owner so that Kleinfelder's geotechnical engineer can be contacted to confirm those conditions. We recommend the contractor describe the nature and extent of the differing conditions in writing and that the construction contract include provisions for dealing with differing conditions. Contingency funds should be reserved for potential problems during earthwork and foundation construction.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance, but in no event later than one year from the date of the report. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party, other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of this report and the nature of the new project, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party and the client agrees to defend, indemnify, and hold harmless Kleinfelder from any claims or liability associated with such unauthorized use or non-compliance.

8 REFERENCES

- Advanced National Seismic System (ANSS), 2011, <http://www.quake.geo.berkeley.edu/cass>
- American Concrete Institute (ACI), 2019, Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19).
- American Society of Civil Engineers (ASCE), 2019. Minimum Design Load for Buildings and Other Structures (ASCE/SEI 7-16) and supplements.
- Asphalt Institute, 2001. Thickness Design: Asphalt Pavements for Highways and Streets, Manual Series 1 (MS1), 9th Edition.
- California Department of Conservation, Division of Oil, Gas and Geothermal Resources (DOGGR), 2016. interactive oil well location map, available at website: <http://maps.conservation.ca.gov/doggr/index.html>.
- California Department of Water Resources (DWR), 2016, interactive water well location map, available at website: <http://well.water.ca.gov/>.
- California Geological Survey (CGS), 2010, Fault Activity Map of California (2010) available at website: <http://maps.conservation.ca.gov/cgs/fam/>
- California Geological Survey (CGS), 2024, Earthquake Fault Zones – A Guide for Government Agencies, Property Owners/Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California: California Geological Survey Special Publication 42, 83p.
- California State Water Resources Control Board, Geo Tracker data management system, accessed via web March 2023 <https://geotracker.waterboards.ca.gov/>
- CARB (California Air Resources Board), (2002), Asbestos Airborne Toxic Control Measures (ATCM) for Construction, Grading, Quarrying, and Surface Mining Operations.
- Caterpillar, (2000) Caterpillar Performance Handbook, 12th Edition available at website: <https://www.wagnerequipment.com/caterpillar-performance-handbook-no-45/>
- Churchill, R. K., Higgins, C. T., and Hill, B. (2000), Areas More Likely to Contain Natural Occurrences of Asbestos in Western El Dorado County, California, California Geological Survey, Open-File Report 2000-002.

Clinkenbeard, J.P., Churchill, R.K., and Lee, K. (2002), Special Publication 124 – Guidelines for Geologic Investigations of Naturally Occurring Asbestos in California.

Costco, 2022. Costco Wholesale Development Requirements, Version 2022, dated October 28, 2022.

FEMA Flood Map Service Center accessed in August 2024 at <https://msc.fema.gov/portal/home>

Hart, E.W. and Bryant, W.A., 1997 (revised), Fault-rupture hazard zones in California: California Department of Conservation, Division of Mines and Geology Special Publication 42, 38 p. (Revised periodically; information on state law and zoning program for regulating development near hazardous faults.)

International Code Council, Inc., 2022, California Building Code.

Jennings, C.W. and Bryant, W.A. (2010). Fault Activity Map of California: California Geological Survey.

Kleinfelder, 2019 “Preliminary Site Preparation Recommendations, Proposed Costco Wholesale Warehouse and Fuel Facility, Silva Valley Parkway, El Dorado Hills, California, CW# 18-0487” dated October 31, 2019.

Kleinfelder, 2024 “Asbestos and Lead Sampling, Proposed Costco Warehouse and Gasoline Station, Silva Valley Parkway, Assessor Parcel Numbers 122-720-002, 122-720-018, 122-720-019, 122-720-020, and 122-720-021, El Dorado Hills, El Dorado County, California, CW# 18-0487” dated October 1, 2024.

Loyd, R., Anderson, T, and Bushnell, et all (1983), Mineral Land Classification of the Placerville 15-minute Quadrangle, El Dorado and Amador Counties, California, California Geological Survey (formerly California Division of Mines and Geology) Open File Report 83-29 SAC.

Loyd, R. (1984) Mineral Land Classification of the Folsom 15-minute Quadrangle, Sacramento, El Dorado Placer, and Amador Counties, California, California Geological Survey (formerly California Division of Mines and Geology) Open File Report 84-50 SAC.

National Association of Corrosion Engineers (NACE), 2006. “Corrosion Basics, An Introduction, 2nd Edition” National Association of Corrosion Engineers.

OSHPD, 2024, Seismic Design Maps website, accessed via web August 2024 <https://seismicmaps.org/>.

Portland Cement Association (PCA), 1984, Thickness Design for Concrete Highway and Street Pavements, Skokie, Illinois: Portland Cement Association.

Portland Cement Association, 1988. Design and Control of Concrete Mixtures, Portland Cement Association, Skokie, Illinois.

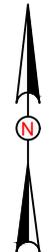
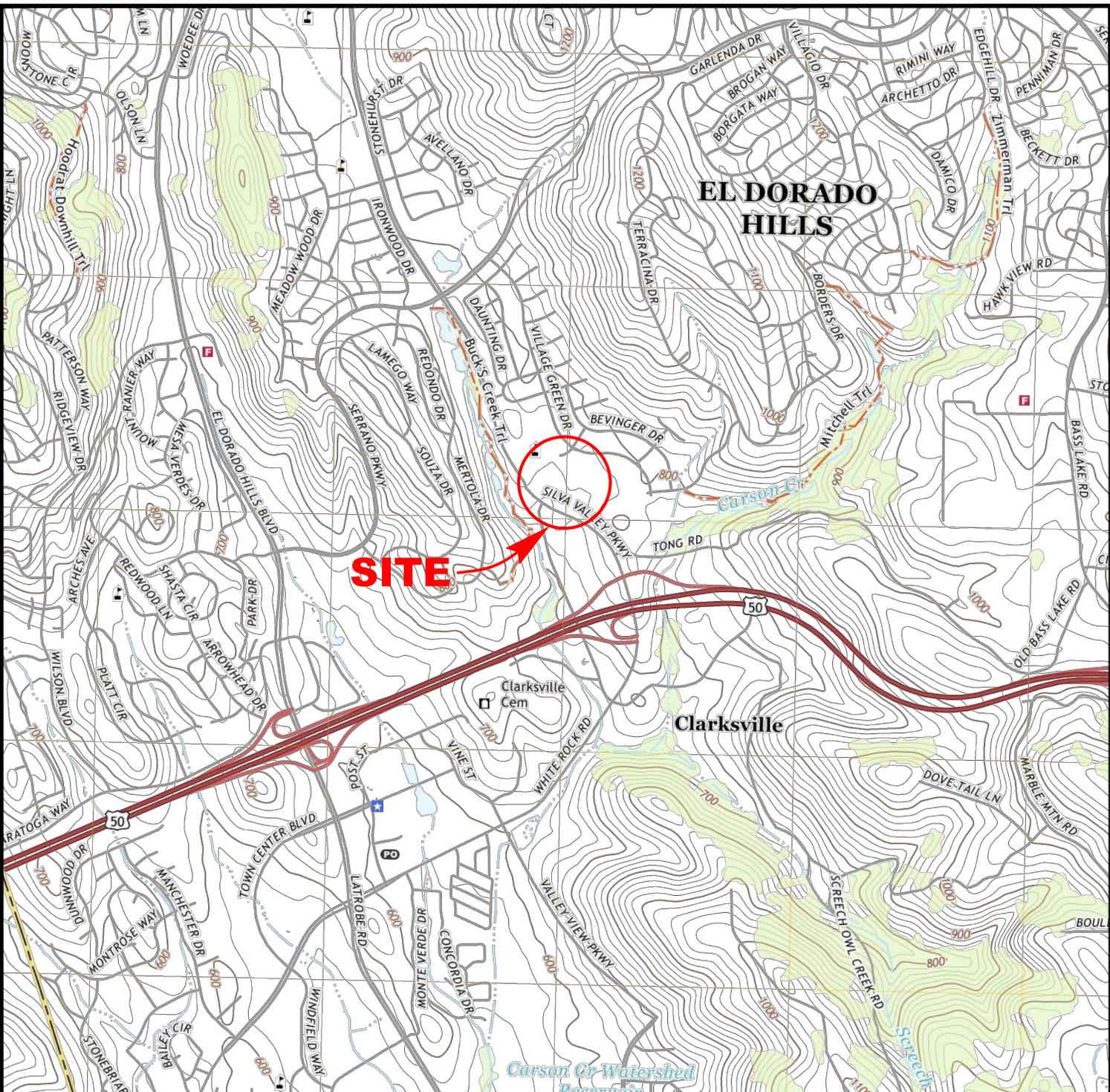
United States Geological Survey (USGS), 2003. National Seismic Hazard Mapping Project [https://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatory maps](https://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatory%20maps).



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CAD FILE: W:\2019\20193141.002A - CSM COSTCO EL DORADO HILLS\PLANS\ LAYOUT: FIGURE 1 PLOTTED: 18 Jul 2024, 3:15pm, GGomez



REFERENCE:
Clarksville, ca. Quadrangle California 7.5-Minute Series

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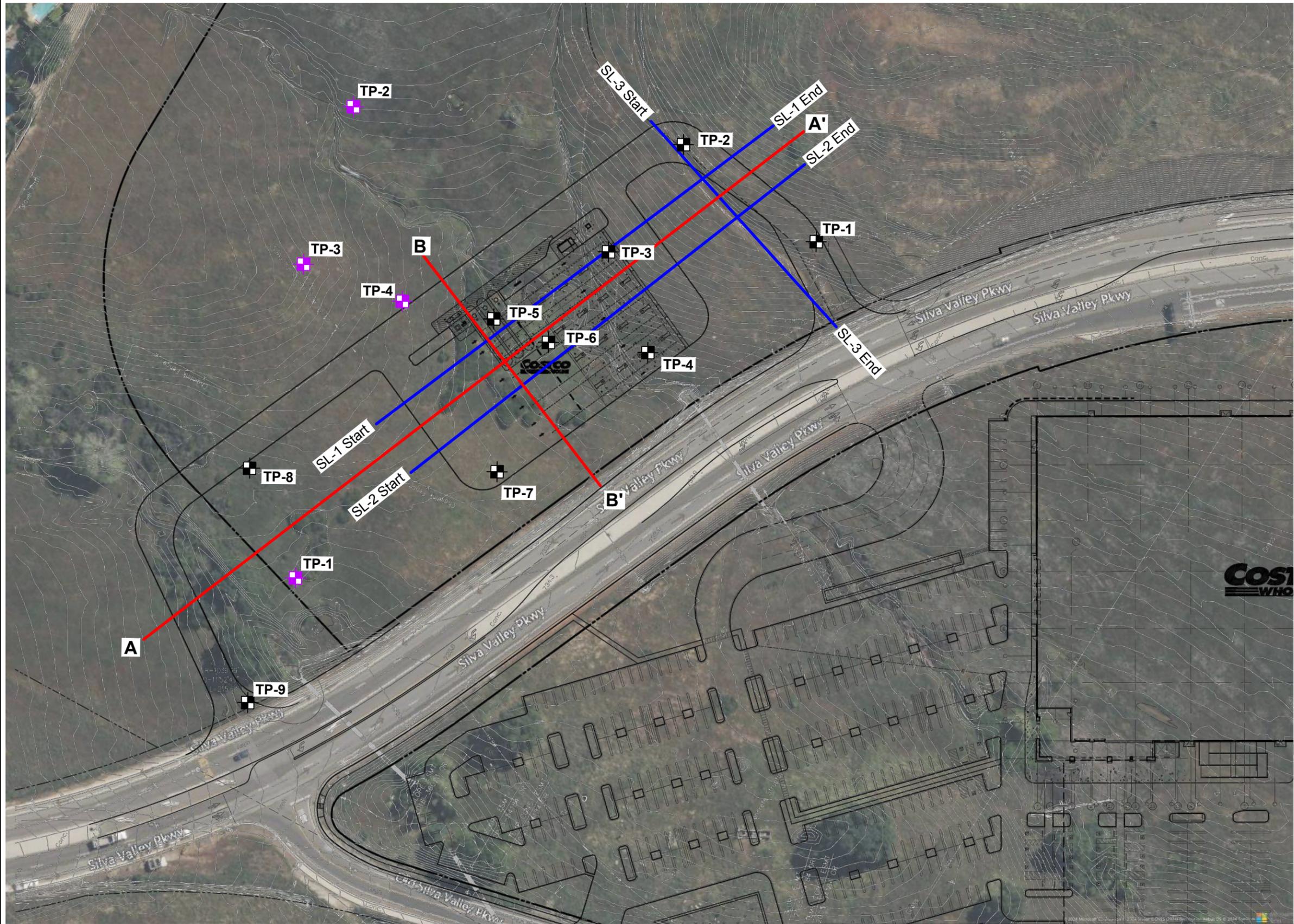
ATTACHED IMAGES:
ATTACHED XREFS:
OFFICE_NAME

PROJECT NO. 20193141.002A
DRAWN: 7/18/2024
DRAWN BY: GG
CHECKED BY: DA
FILE NAME: STO24D053.CAD

SITE VICINITY MAP

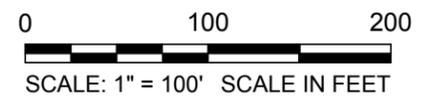
PROPOSED COSTCO FUEL FACILITY
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

FIGURE
1



LEGEND

- CROSS SECTIONS
- SEISMIC LINES
- TEST PIT LOCATIONS (2024)
- TEST PIT LOCATIONS (2019)



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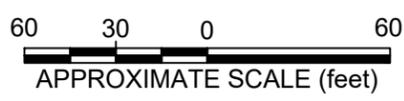
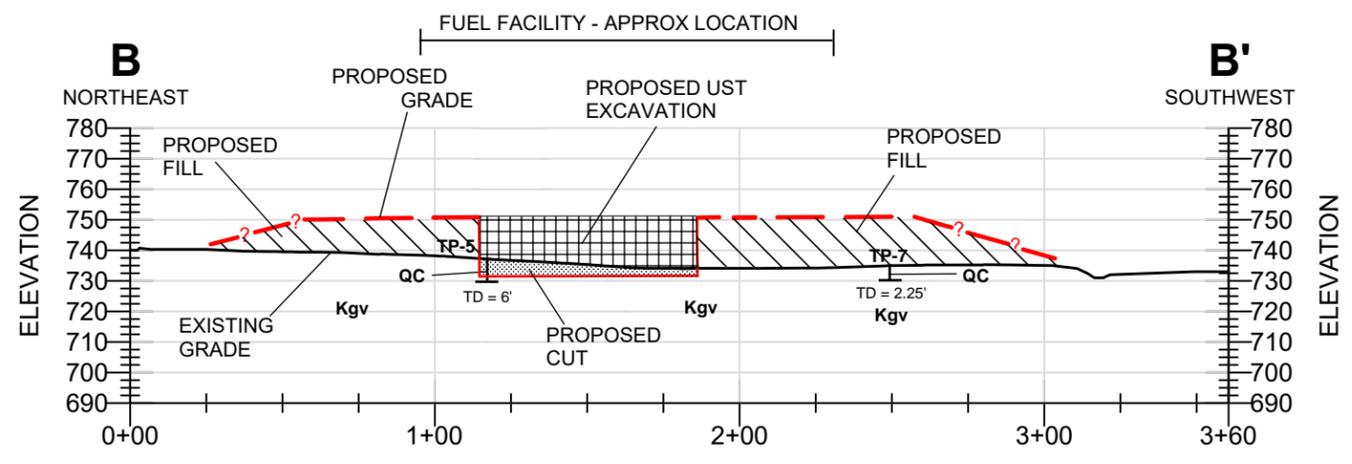
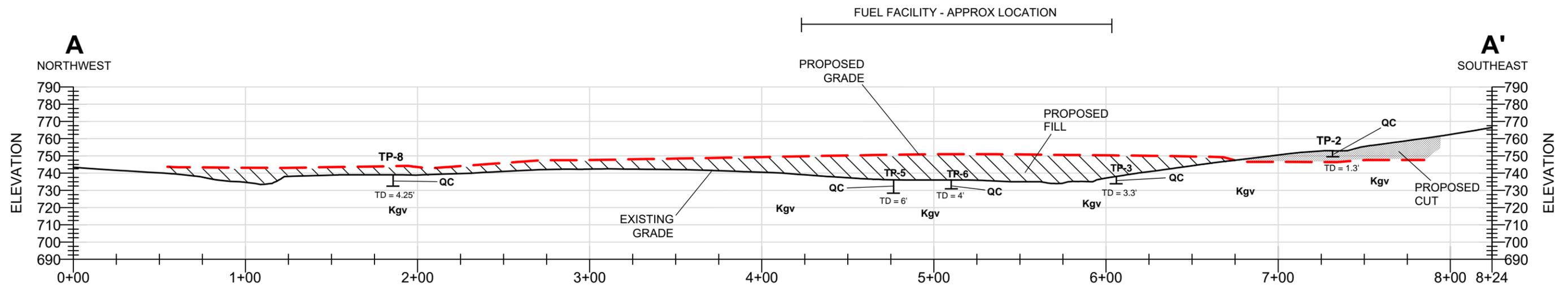
PROJECT NO. 20193141
DRAWN BY JDS
CHECKED BY DD
DATE: 12/10/2024
REVISED:

EXPLORATION LOCATION MAP

PROPOSED COSTCO FUEL FACILITY
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

FIGURE

2



EXPLANATION

- QC** Colluvial/Residual Soils comprised of sandy silts and lean clays with variable amount of sand and gravel. Observed to be approximately 1 to 5 feet thick.
- Kgv** Metavolcanic Rock - Highly Weathered within upper 10 feet (Vp = 3,000 to 6,000 ft/s), Slightly Weather intact rock below 10 to 15 feet bgs (Vp > 6,000 ft/s)

**UST excavation location and depth estimated as it was not depicted on grading plans provided by Kier and Wright.

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	PROJECT: 20193141	CROSS-SECTIONS A-A' AND B-B'	FIGURE 3
	DRAWN BY: DMF		
CHECKED BY: DD	DATE: 08/2024	PROPOSED COSTCO FUEL FACILITY SILVA VALLEY PARKWAY EL DORADO HILLS, CALIFORNIA	
REVISD:			



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APPENDIX A FIELD EXPLORATIONS

GENERAL

Our field exploration program consisted of excavating nine test pits. The test pits were excavated on July 9, 2024. Prior to commencement of the fieldwork, the test pit locations were cleared for buried utilities through Underground Service Alert (USA).

Nine test pits were excavated by Gulf Shore Exploration of Rancho Cordova, California using a John Deere 50G track-mounted excavator to excavate to depths ranging from 1½ to 9 feet bgs. The logs of the test pits are attached to this appendix. The approximate locations of the test pits are presented on Figure 2.

An explanation to the log is presented as Figure A-1 and A-2. The logs of the test pits are presented on Figures A-3 through A-11. The test pits describe the earth materials encountered, samples obtained and show field and laboratory tests performed. The log also shows the location, test pit number, excavation date and the name of the excavation subcontractor. The test pits were logged by a Kleinfelder engineer using the Unified Soil Classification System (ASTM 2487/2488). The boundaries between soil types shown on the log are approximate where indicated with a dashed line because the transition between different soil layers may be gradual or location of the transition may be unknown. In a few cases the transition was captured within samples obtained from the subsurface exploration or other information enable us to define an approximately exact location as depicted by a solid line on the logs.

Bulk and grab samples of the near-surface soils were directly retrieved from the auger cuttings from the borings and the excavated material in the test pits.

Current Test Pit Logs (Kleinfelder, 2024)

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 PROJECT NUMBER: 20230767.001A
 OFFICE FILTER: SAN JOSE
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DRILLING METHOD/SAMPLER TYPE GRAPHICS



GROUND WATER GRAPHICS

- WATER LEVEL (level where first observed)
- WATER LEVEL (level after stabilizing period)
- WATER LEVEL (additional levels after exploration)
- OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Solid lines separating strata on the logs represent approximate boundaries only, dashed lines are inferred or extrapolated boundaries. Actual transitions may be gradual or differ from those represented.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System (ASTM D2488/D2487) designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, i.e., CL-ML, GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

ABBREVIATIONS

WOH - Weight of Hammer
 WOR - Weight of Rod

REFERENCES

1. American Society for Materials and Testing (ASTM), 2011, ASTM D2487: Classification of Soils for Engineering Purposes (Unified Soil Classification System).

UNIFIED SOIL CLASSIFICATION SYSTEM¹

GRAVELS (More than 50% of coarse fraction retained on No. 200 Sieve)	CLEAN GRAVEL WITH <5% FINES		GW	WELL-GRADED GRAVEL, WELL-GRADED GRAVEL WITH SAND		
			GP	POORLY GRADED GRAVEL, POORLY GRADED GRAVEL WITH SAND		
		GRAVELS WITH 5% TO 12% FINES		GW-GM	WELL-GRADED GRAVEL WITH SILT, WELL-GRADED GRAVEL WITH SILT AND SAND	
				GW-GC	WELL-GRADED GRAVEL WITH CLAY (OR SILTY CLAY), WELL-GRADED GRAVEL WITH CLAY AND SAND (OR SILT CLAY AND SAND)	
				GP-GM	POORLY GRADED GRAVEL WITH SILT, POORLY GRADED GRAVEL WITH SILT AND SAND	
				GP-GC	POORLY GRADED GRAVEL WITH CLAY (OR SILTY CLAY), POORLY GRADED GRAVEL WITH CLAY AND (OR SILTY CLAY AND SAND)	
	GRAVELS WITH > 12% FINES		GM	SILTY GRAVEL, SILTY GRAVEL WITH SAND		
			GC	CLAYEY GRAVEL, CLAYEY GRAVEL WITH SAND		
			GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL WITH SAND		
		COARSE GRAINED SOILS (More than 50% retained on No. 200 Sieve)	CLEAN SANDS WITH <5% FINES		SW	WELL-GRADED SAND, WELL-GRADED SAND WITH GRAVEL
					SP	POORLY GRADED SAND, POORLY GRADED SAND WITH GRAVEL
			SANDS WITH 5% TO 12% FINES		SW-SM	WELL-GRADED SAND WITH SILT, WELL-GRADED SAND WITH SILT AND GRAVEL
	SW-SC			WELL-GRADED SAND WITH CLAY (OR SILTY CLAY), WELL-GRADED SAND WITH CLAY AND GRAVEL (OR SILTY CLAY AND GRAVEL)		
	SP-SM			POORLY GRADED SAND WITH SILT, POORLY GRADED SAND WITH SILT AND GRAVEL		
SANDS WITH > 12% FINES			SP-SC	POORLY GRADED SAND WITH CLAY, POORLY GRADED SAND WITH CLAY AND GRAVEL (OR SILTY CLAY AND GRAVEL)		
		SM	SILTY SAND, SILTY SAND WITH GRAVEL			
		SC	CLAYEY SAND, CLAYEY SAND WITH GRAVEL			
FINE GRAINED SOILS (50% or more passes the No. #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)		ML	SILT, SILT WITH SAND, SILT WITH GRAVEL		
			CL	LEAN CLAY, LEAN CLAY WITH SAND, LEAN CLAY WITH GRAVEL		
			CL-ML	SILTY CLAY, SILTY CLAY WITH SAND, SILTY CLAY WITH GRAVEL		
	SILTS AND CLAYS (Liquid Limit 50 or greater)		OL	ORGANIC CLAY, ORGANIC CLAY WITH SAND, ORGANIC CLAY WITH GRAVEL, ORGANIC SILT, ORGANIC SILT WITH SAND, ORGANIC SILT WITH GRAVEL		
			MH	ELASTIC SILT, ELASTIC SILT WITH SAND, ELASTIC SILT WITH GRAVEL		
			CH	FAT CLAY, FAT CLAY WITH SAND, FAT CLAY WITH GRAVEL		
			OH	ORGANIC CLAY, ORGANIC CLAY WITH SAND, ORGANIC CLAY WITH GRAVEL, ORGANIC SILT, ORGANIC SILT WITH SAND, ORGANIC SILT WITH GRAVEL		

NOTE: USE MATERIAL DESCRIPTION ON THE LOG TO DEFINE A GRAPHIC THAT MAY NOT BE PROVIDED ON THIS LEGEND.

	PROJECT NO.: 20193141.002A	GRAPHICS KEY PROPOSED COSTCO FUEL FACILITY SILVA VALLEY PARKWAY EL DORADO HILLS, CALIFORNIA	FIGURE
	DRAWN BY: JDS CHECKED BY: DD DATE:		A-1

GRAIN SIZE¹

DESCRIPTION	SIEVE SIZE	GRAIN SIZE
Boulders	>12 in.	>12 in. (304.8 mm.)
Cobbles	3 - 12 in.	3 - 12 in. (76.2 - 304.8 mm.)
Gravel	coarse	3/4 - 3 in. (19 - 76.2 mm.)
	fine	#4 - 3/4 in. (4.8 - 19 mm.)
Sand	coarse	#10 - #4 (0.075 - 0.425 mm.)
	medium	#40 - #10 (0.075 - 0.425 mm.)
	fine	#200 - #40 (0.075 - 0.425 mm.)
Fines	Passing #200	<0.0029 in. (<0.07 mm.)

SECONDARY CONSTITUENT¹

Term of Use	AMOUNT	
	Secondary Constituent is Fine Grained	Secondary Constituent is Coarse Grained
Trace	<5%	<15%
With	≥5 to <15%	≥15 to <30%
Modifier	≥15%	≥30%

PLASTICITY¹

DESCRIPTION	CRITERIA
Non-Plastic	A 1/8 in. (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

MOISTURE CONTENT¹

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

CONSISTENCY - FINE-GRAINED SOIL^{2,3}

CONSISTENCY	SPT - N (# blows / ft)	Pocket Pen (tsf)	UNCONFINED COMPRESSIVE STRENGTH (Q _u)(psf)	VISUAL / MANUAL CRITERIA
Very Soft	<2	PP < 0.25	<500	Easily penetrated several inches by fist
Soft	2 - 4	0.25 ≤ PP < 0.5	500 - 1,000	Easily penetrated several inches by thumb
Medium Stiff	4 - 8	0.5 ≤ PP < 1	1,000 - 2,000	Can be penetrated several inches by thumb with moderate effort
Stiff	8 - 15	1 ≤ PP < 2	2,000 - 4,000	Readily indented by thumb but penetrated only with great effort
Very Stiff	15 - 30	2 ≤ PP < 4	4,000 - 8,000	Readily indented by thumbnail
Hard	>30	4 ≤ PP	>8,000	Indented by thumbnail with difficulty

APPARENT DENSITY - COARSE-GRAINED SOIL²

APPARENT DENSITY	SPT-N (# blows / ft)
Very Loose	<4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	>50

STRUCTURE¹

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. (6mm) thick, note thickness.
Laminated	Alternating layers of varying material or color with the layers less than 1/4-in. (6 mm) thick, note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.
Homogeneous	Same color and appearance throughout

ANGULARITY¹

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

REACTION WITH HYDROCHLORIC ACID¹

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

CEMENTATION¹

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or little finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

REFERENCES

- American Society for Materials and Testing (ASTM), 2017, ASTM D2488: Standard Practice for Description and Identification of Soils (Visual Manual Procedures).
- Terzaghi, K and Peck, R., 1948, Soil Mechanics in Engineering Practice, John Wiley & Sons, New York.
- United States Department of the Interior Bureau of Reclamation (USBR), 1998, Earth Manual, Part I.



PROJECT NO.:
20193141.002A

DRAWN BY: JDS
CHECKED BY: DD
DATE:

SOIL DESCRIPTION KEY
(For additional tables, see ASTM D2488)

PROPOSED COSTCO FUEL FACILITY
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

FIGURE

A-2

PLOTTED: 07/29/2024 08:54 AM BY: DArakkal

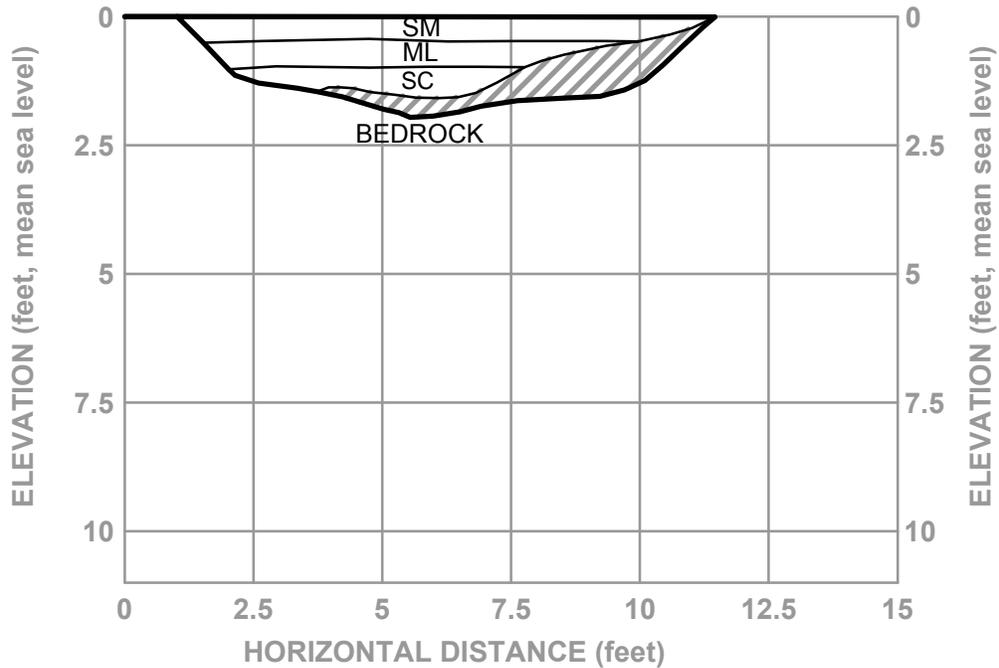
Date Begin - End: 7/09/2024 **Excavation Co.-Lic.#:** Gulf Shore - #964224
Logged By: C. Freeman **Excavation Crew:** Devin, David
Hor.-Vert. Datum: Not Available **Excavation Equip.:** 310 G-Tier Backhoe
Plunge: N/A degrees **Excav. Dimensions:** 3'x10.5'x1.9' ft
Weather: Clear

TEST PIT LOG TP-1

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS						Additional Tests/Remarks	
			Lithologic Description		Sample Number	Sample Type	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit		Plasticity Index (NP=NonPlastic)
			Latitude: 38.66147° Longitude: -121.05619° Approximate Ground Surface Elevation (ft.): 754.00 Surface Condition: Grass											
			Silty SAND (SM): fine to medium-grained sand, non-plastic, reddish brown, dry, medium dense											
			Sandy SILT (ML): fine to medium-grained sand, low plasticity, yellowish brown, dry, hard		1	X		6.5						PP= >4.5 tsf
			Clayey SAND (SC): fine-grained sand, medium plasticity, olive, dry, dense		2	X				27				PP= >4.5 tsf
			Meta-Volcanic ROCK: olive gray, very weak to strong, moderately to highly weathered, decomposition at soil/rock interface, intensely to medium fractured		3	X								Refusal at 1'11"

The test pit was terminated at approximately 2 ft. below ground surface. The test pit was backfilled with on July 09, 2024.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during excavation or after completion.
GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.



GINT FILE: KLF_gint_master_2019 PROJECT NUMBER: 20193141.002A OFFICE FILTER: SALINAS
GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2019.GLB [] KLF_BORING/TEST PIT SOIL LOG

	PROJECT NO.: 20193141	TEST PIT LOG TP-1	APPENDIX
	DRAWN BY: DA CHECKED BY: DD DATE: 7/11/2024 REVISED: 7/29/2024	PROPOSED COSTCO FUEL FACILITY SILVA VALLEY PARKWAY EL DORADO HILLS, CALIFORNIA	A-3

PLOTTED: 07/29/2024 08:54 AM BY: DArakkal

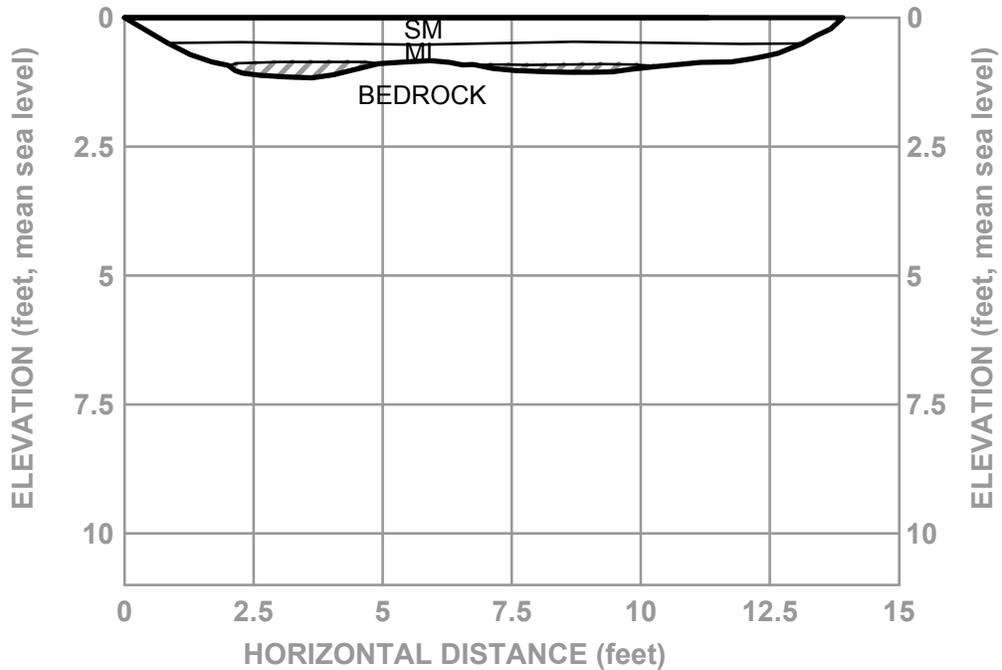
Date Begin - End: 7/09/2024 **Excavation Co.-Lic.#:** Gulf Shore - #964224
Logged By: C. Freeman **Excavation Crew:** Devin, David
Hor.-Vert. Datum: Not Available **Excavation Equip.:** 310 G-Tier Backhoe
Plunge: N/A degrees **Excav. Dimensions:** 3'x14'x1.25' ft
Weather: Clear

TEST PIT LOG TP-2

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS						Additional Tests/Remarks		
			Latitude: 38.66193° Longitude: -121.05614° Approximate Ground Surface Elevation (ft.): 760.00 Surface Condition: Grass	Sample Number	Sample Type	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)			
Lithologic Description															
			Silty SAND (SM): fine to medium-grained sand, non-plastic, yellowish brown, dry, medium dense												
			Sandy SILT (ML): fine to medium-grained sand, low plasticity, yellowish brown, dry, hard	1	SM										
				2	ML		6.7								PP= >4.5 tsf
			Saprolitic Meta-Volcanic ROCK: fine-grained, olive, dry, decomposed, extremely weak, intensely fractured below 1.25': Meta-Volcanic Rock, olive, dry, highly weathered, very weak, intensely fractured, Fe-Mn surface staining along joint surfaces	3	MR										Refusal at 1'3"

The test pit was terminated at approximately 1.5 ft. below ground surface. The test pit was backfilled with on July 09, 2024.

GROUNDWATER LEVEL INFORMATION:
 Groundwater was not observed during excavation or after completion.
GENERAL NOTES:
 The exploration location and elevation are approximate and were estimated by Kleinfelder.



GINT FILE: KLF_gint_master_2019 PROJECT NUMBER: 20193141.002A OFFICE FILTER: SALINAS
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2019.GLB [KLF_BORING/TEST PIT SOIL LOG]



PROJECT NO.: 20193141
 DRAWN BY: DA
 CHECKED BY: DD
 DATE: 7/11/2024
 REVISED: 7/29/2024

TEST PIT LOG TP-2
 PROPOSED COSTCO FUEL FACILITY
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

APPENDIX
A-4
 PAGE: 1 of 1

PLOTTED: 07/29/2024 08:55 AM BY: DArakkal

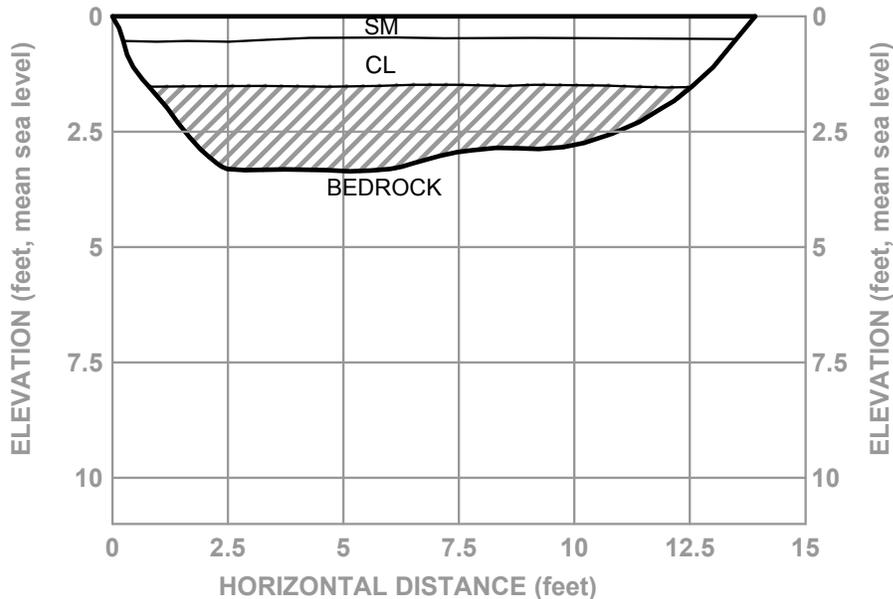
Date Begin - End: 7/09/2024 **Excavation Co.-Lic.#:** Gulf Shore - #964224
Logged By: C. Freeman **Excavation Crew:** Devin, David
Hor.-Vert. Datum: Not Available **Excavation Equip.:** 310 G-Tier Backhoe
Plunge: N/A degrees **Excav. Dimensions:** 3'x14'x3.25' ft
Weather: Clear

TEST PIT LOG TP-3

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
			Latitude: 38.66199° Longitude: -121.05654° Approximate Ground Surface Elevation (ft.): 747.00 Surface Condition: Grass		Sample Number	Sample Type	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/Remarks
			Lithologic Description											
			Silty SAND (SM): fine to medium-grained sand, non-plastic, yellowish brown, dry, medium dense, roots											
			Sandy Lean CLAY (CL): fine to medium-grained sand, low plasticity, yellowish brown, dry, hard, trace sub-angular gravel		1	X		5.1						
					2	X					28	9	PP= >4.5 tsf	
			Saprolitic Meta-Volcanic ROCK: olive gray, dry, R0, intensely fractured											
745			Meta-Volcanic ROCK: olive gray, dry, moderately to highly weathered, R1 to R3, highly fractured											
					3	X							Refusal at 3'3"	

The test pit was terminated at approximately 3.5 ft. below ground surface. The test pit was backfilled with on July 09, 2024.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during excavation or after completion.
GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.



GINT FILE: KLF_gint_master_2019 PROJECT NUMBER: 20193141.002A OFFICE FILTER: SALINAS
GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2019.GLB []_KLF_BORING/TEST PIT SOIL LOG

 Bright People. Right Solutions.	PROJECT NO.: 20193141	TEST PIT LOG TP-3 PROPOSED COSTCO FUEL FACILITY SILVA VALLEY PARKWAY EL DORADO HILLS, CALIFORNIA	APPENDIX
	DRAWN BY: DA		A-5
CHECKED BY: DD	DATE: 7/11/2024		
REvised: 7/29/2024			PAGE: 1 of 1

PLOTTED: 07/29/2024 08:55 AM BY: DArakkal

Date Begin - End: 7/09/2024 **Excavation Co.-Lic.#:** Gulf Shore - #964224
Logged By: C. Freeman **Excavation Crew:** Devin, David
Hor.-Vert. Datum: Not Available **Excavation Equip.:** 310 G-Tier Backhoe
Plunge: N/A degrees **Excav. Dimensions:** 3'x12'x5' ft
Weather: Clear

TEST PIT LOG TP-4

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION			LABORATORY RESULTS								
			Lithologic Description	Sample Number	Sample Type	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/Remarks	
			Latitude: 38.66179° Longitude: -121.05681° Approximate Ground Surface Elevation (ft.): 739.00 Surface Condition: Grass											
			Silty SAND (SM): fine to medium-grained sand, non-plastic, yellowish brown, dry, medium dense, roots											
			Sandy SILT (ML): fine to medium-grained sand, low plasticity, yellowish brown to reddish brown, dry, very stiff	1	X		7.5							PP= 3.5 tsf
				2	X		10.7	130.8						
			Sandy Lean CLAY (CL): fine to medium-grained sand, medium plasticity, olive, dry, very stiff											
				3	X									PP= 3.5 tsf
			Saprolitic Meta-Volcanic ROCK: fine-grained, olive, moist, decomposed to slightly weathered, R0 to R4, highly fractured, similar to gravelly sandy clay with cobble, fine to coarse angular gravel, cobbles up to 12" and small boulders up to 16"											
735														
5				4	X									Refusal at 5'

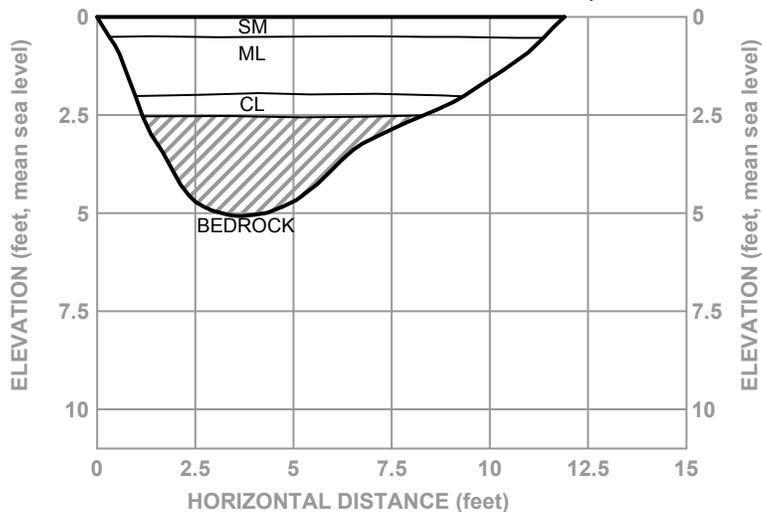
The test pit was terminated at approximately 5 ft. below ground surface. The test pit was backfilled with on July 09, 2024.

GROUNDWATER LEVEL INFORMATION:

Groundwater was not observed during excavation or after completion.

GENERAL NOTES:

The exploration location and elevation are approximate and were estimated by Kleinfelder.



PROJECT NUMBER: 20193141.002A OFFICE FILTER: SALINAS
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2019.GLB [KLF_BORING/TEST PIT SOIL LOG]



PROJECT NO.: 20193141
 DRAWN BY: DA
 CHECKED BY: DD
 DATE: 7/11/2024
 REVISED: 7/29/2024

TEST PIT LOG TP-4
 PROPOSED COSTCO FUEL FACILITY
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

APPENDIX
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 PAGE: 1 of 1

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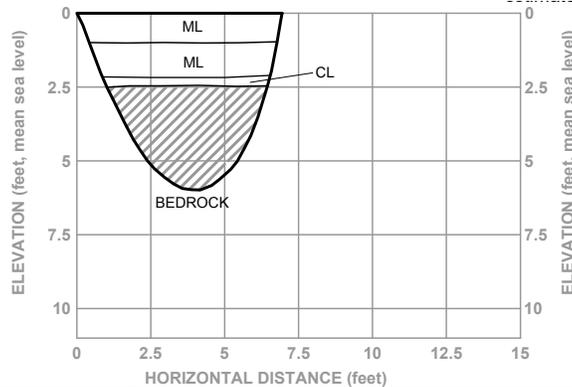
Date Begin - End: 7/09/2024 **Excavation Co.-Lic.#:** Gulf Shore - #964224
Logged By: C. Freeman **Excavation Crew:** Devin, David
Hor.-Vert. Datum: Not Available **Excavation Equip.:** 310 G-Tier Backhoe
Plunge: N/A degrees **Excav. Dimensions:** 3'x14'x6' ft
Weather: Clear

TEST PIT LOG TP-5

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
			Latitude: 38.66218° Longitude: -121.05693° Approximate Ground Surface Elevation (ft.): 743.00 Surface Condition: Grass		Sample Number	Sample Type	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/Remarks
			Lithologic Description											
			Sandy SILT (ML): fine to medium-grained sand, low plasticity, olive brown, dry, stiff, roots		1			13.5						PP= 1 tsf
			Sandy Elastic SILT (MH): fine to medium-grained sand, medium plasticity, olive, moist, medium stiff		2						61	21		PP= 0.5 tsf
			Sandy Lean CLAY with Gravel (CL): olive yellow, moist, stiff, decomposed and extremely weak saprolitic meta-volcanic rock fragments		3									PP= 1.5 tsf
			Saprolitic Meta-Volcanic ROCK: olive, moist, decomposed and extremely weak											
740			Meta-Volcanic ROCK: olive gray, dry, moderately to highly weathered, R1 to R3, highly fractured		4									
	5													
														Refusal at 6'

The test pit was terminated at approximately 6 ft. below ground surface. The test pit was backfilled with on July 09, 2024.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during excavation or after completion.
GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.



PROJECT NUMBER: 20193141.002A OFFICE FILTER: SALINAS
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2019.GLB [KLF_BORING/TEST PIT SOIL LOG]

	PROJECT NO.: 20193141	TEST PIT LOG TP-5	APPENDIX
	DRAWN BY: DA		
CHECKED BY: DD		A-7	
DATE: 7/11/2024			
REVISED: 7/29/2024			PAGE: 1 of 1

PLOTTED: 07/29/2024 08:55 AM BY: DArakkal

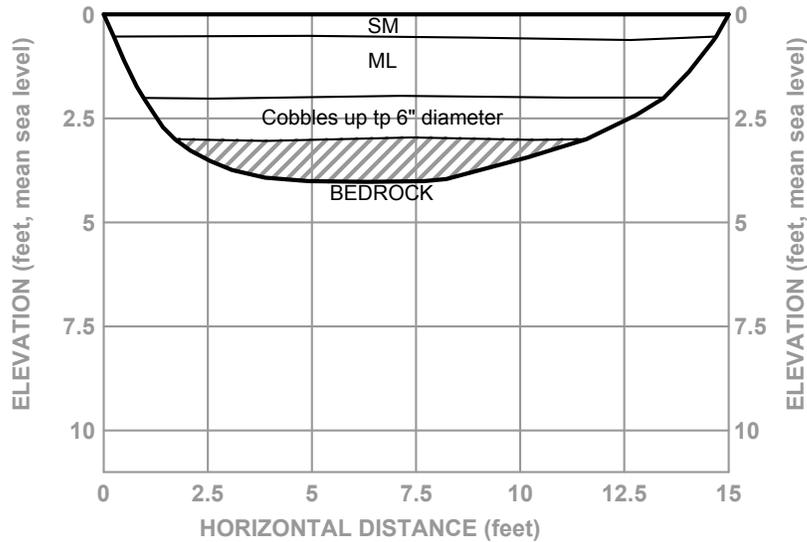
TEST PIT LOG TP-6

Date Begin - End: 7/09/2024 **Excavation Co.-Lic.#:** Gulf Shore - #964224
Logged By: C. Freeman **Excavation Crew:** Devin, David
Hor.-Vert. Datum: Not Available **Excavation Equip.:** 310 G-Tier Backhoe
Plunge: N/A degrees **Excav. Dimensions:** 3'x14'x4' ft
Weather: Clear

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS						
			Lithologic Description		Sample Number	Sample Type	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
			Latitude: 38.66200° Longitude: -121.05691° Approximate Ground Surface Elevation (ft.): 740.00 Surface Condition: Grass										
			Silty SAND (SM): fine to medium-grained sand, non-plastic, olive brown, dry, medium dense, roots										
			Sandy SILT (ML): fine to medium-grained sand, low plasticity, olive brown, dry, hard		1			14.2					PP= >4.5 tsf
					2					69			
			Saprolitic Meta-Volcanic ROCK: rounded to sub-rounded, olive gray, moist, cobbles, rounded to subrounded, cobbles up to 6" in diameter										
			Meta-Volcanic ROCK: olive gray, dry, moderately to highly weathered, R1 to R3, highly fractured		3								Refusal at 4'

The test pit was terminated at approximately 4 ft. below ground surface. The test pit was backfilled with on July 09, 2024.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during excavation or after completion.
GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.



PROJECT NUMBER: 20193141.002A OFFICE FILTER: SALINAS
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2019.GLB [KLF_BORING/TEST PIT SOIL LOG]



PROJECT NO.: 20193141
 DRAWN BY: DA
 CHECKED BY: DD
 DATE: 7/11/2024
 REVISED: 7/29/2024

TEST PIT LOG TP-6
 PROPOSED COSTCO FUEL FACILITY
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

APPENDIX
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 PAGE: 1 of 1

PLOTTED: 07/29/2024 08:55 AM BY: DArakkal

Date Begin - End: 7/09/2024 **Excavation Co.-Lic.#:** Gulf Shore - #964224
Logged By: C. Freeman **Excavation Crew:** Devin, David
Hor.-Vert. Datum: Not Available **Excavation Equip.:** 310 G-Tier Backhoe
Plunge: N/A degrees **Excav. Dimensions:** 3'x13.5'x2.3' ft
Weather: Clear

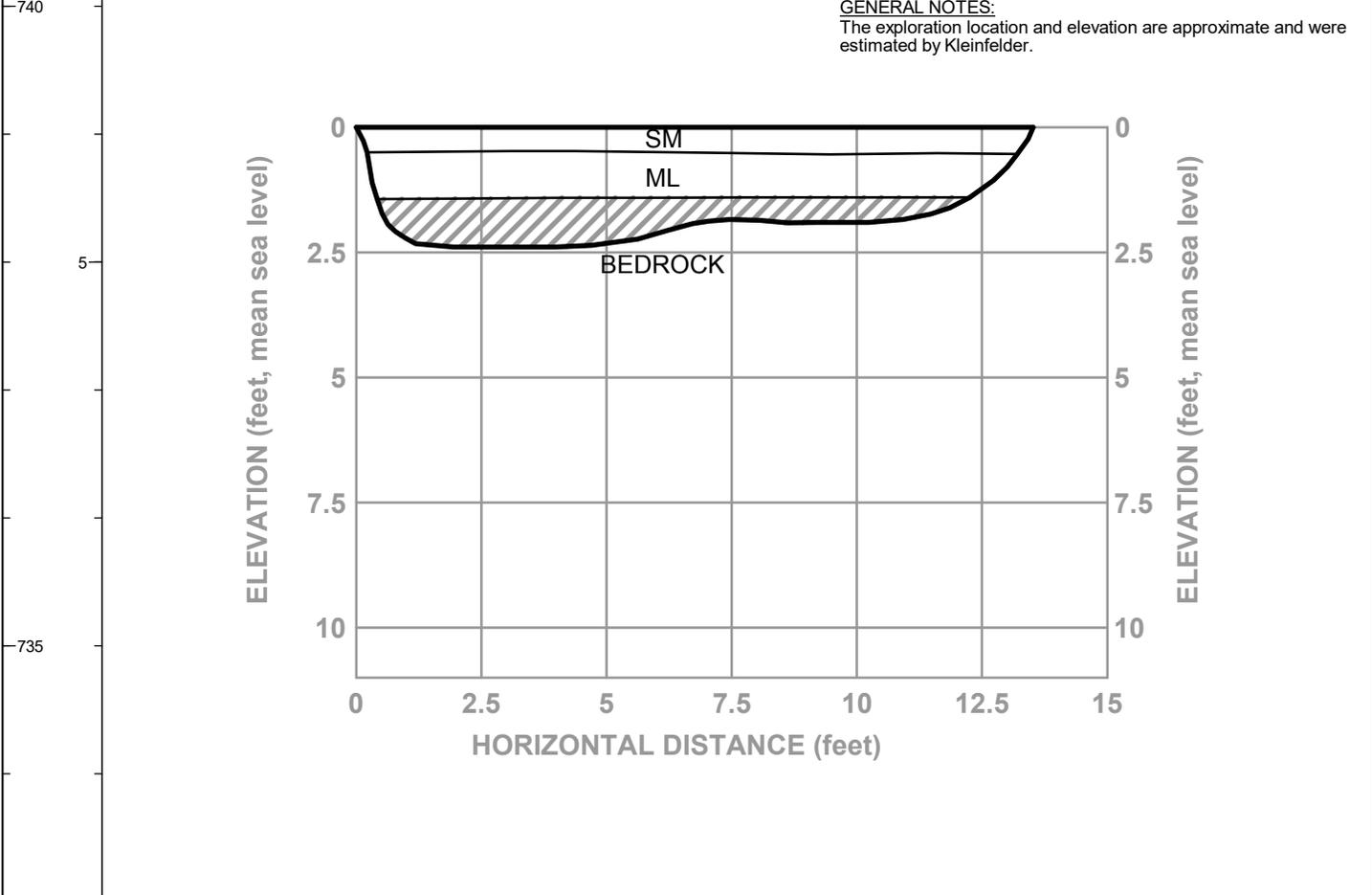
TEST PIT LOG TP-7

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS								
			Latitude: 38.66195° Longitude: -121.05738° Approximate Ground Surface Elevation (ft.): 743.00 Surface Condition: Grass		Sample Number	Sample Type	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/Remarks	
			Lithologic Description												
			Silty SAND (SM): fine to medium-grained sand, non-plastic, reddish brown, dry, medium dense, roots												
			SILT (ML): fine to medium-grained sand, low plasticity, reddish brown, dry, very stiff		1										PP= 3.5 tsf
					2			5.9							
			Meta-Volcanic ROCK: fine-grained, medium gray with reddish brown, surface staining, moderately weathered, highly fractured, strong, R1 to R3, grades similar to silty sand												

Refusal at 2.3'

The test pit was terminated at approximately 2.5 ft. below ground surface. The test pit was backfilled with on July 09, 2024.

GROUNDWATER LEVEL INFORMATION:
 Groundwater was not observed during excavation or after completion.
GENERAL NOTES:
 The exploration location and elevation are approximate and were estimated by Kleinfelder.



 Bright People. Right Solutions.	PROJECT NO.: 20193141	TEST PIT LOG TP-7	APPENDIX
	DRAWN BY: DA	PROPOSED COSTCO FUEL FACILITY SILVA VALLEY PARKWAY EL DORADO HILLS, CALIFORNIA	A-9
CHECKED BY: DD	DATE: 7/11/2024		
	REVISED: 7/29/2024		PAGE: 1 of 1

GINT FILE: KLF_gint_master_2019 PROJECT NUMBER: 20193141.002A OFFICE FILTER: SALINAS
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2019.GLB [] KLF_BORING/TEST PIT SOIL LOG

PLOTTED: 07/29/2024 08:55 AM BY: DArakkal

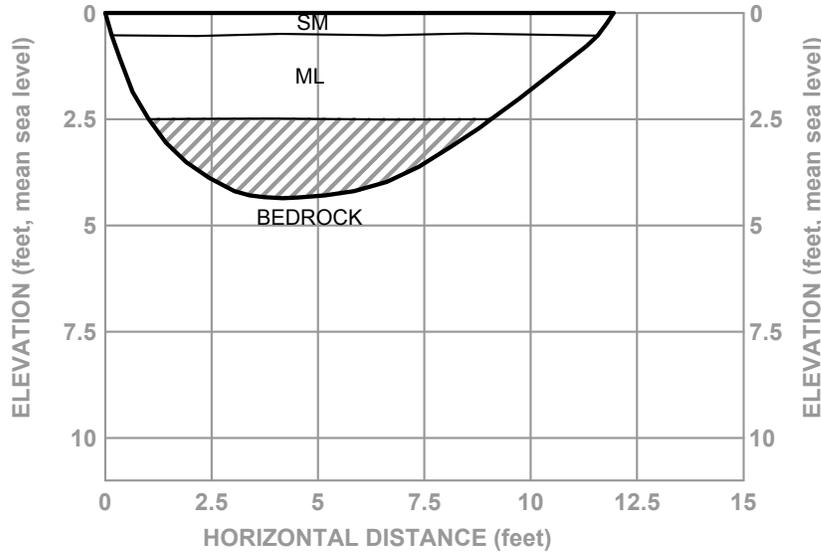
Date Begin - End: 7/09/2024 **Excavation Co.-Lic.#:** Gulf Shore - #964224
Logged By: C. Freeman **Excavation Crew:** Devin, David
Hor.-Vert. Datum: Not Available **Excavation Equip.:** 310 G-Tier Backhoe
Plunge: N/A degrees **Excav. Dimensions:** 3'x12'x4.3' ft
Weather: Clear

TEST PIT LOG TP-8

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION				LABORATORY RESULTS							
			Latitude: 38.66258° Longitude: -121.05788° Approximate Ground Surface Elevation (ft.): 746.00 Surface Condition: Grass		Sample Number	Sample Type	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/Remarks
			Lithologic Description											
			Silty SAND (SM): fine to medium-grained sand, non-plastic, reddish brown, dry, medium dense, roots											
745			Sandy SILT (ML): fine to medium-grained sand, low plasticity, reddish brown, dry, very stiff		1			6.9						PP= 3.5 tsf
					2			16.1	119.0					R-Value= 19
			Saprolitic Meta-Volcanic ROCK: fine-grained, olive gray, moist, decomposed, extremely to very weak, intensely fractured											PP= >4.5 tsf
			Meta-Volcanic ROCK: olive gray, dry, moderately weathered, R0 to R4		3									
					4									Refusal at 4.3'

The test pit was terminated at approximately 4.5 ft. below ground surface. The test pit was backfilled with on July 09, 2024.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during excavation or after completion.
GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.



GINT FILE: KLF_gint_master_2019
GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2019.GLB [_KLF_BORING/TEST PIT SOIL LOG]
PROJECT NUMBER: 20193141.002A
OFFICE FILTER: SALINAS



PROJECT NO.: 20193141
 DRAWN BY: DA
 CHECKED BY: DD
 DATE: 7/11/2024
 REVISED: 7/29/2024

TEST PIT LOG TP-8

PROPOSED COSTCO FUEL FACILITY
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

APPENDIX

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PAGE: 1 of 1

PLOTTED: 07/29/2024 08:55 AM BY: DArakkal

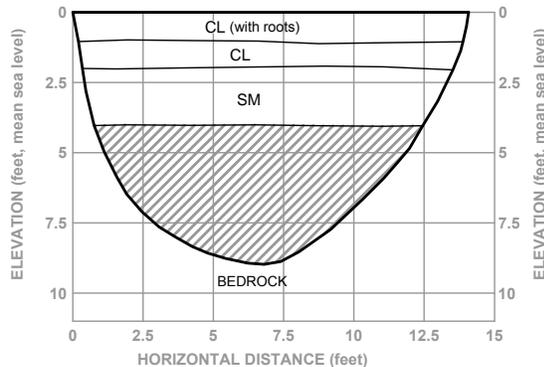
Date Begin - End: 7/09/2024 **Excavation Co.-Lic.#:** Gulf Shore - #964224
Logged By: C. Freeman **Excavation Crew:** Devin, David
Hor.-Vert. Datum: Not Available **Excavation Equip.:** 310 G-Tier Backhoe
Plunge: N/A degrees **Excav. Dimensions:** 3'x14'x9' ft
Weather: Clear

TEST PIT LOG TP-9

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION		LABORATORY RESULTS								
			Lithologic Description	Sample Number	Sample Type	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/Remarks
			Latitude: 38.66220° Longitude: -121.05861° Approximate Ground Surface Elevation (ft.): 741.00 Surface Condition: Grass										
740			Sandy Lean CLAY (CL): fine to medium-grained sand, medium plasticity, olive brown, dry, very stiff, roots yellowish brown	1	X								PP= 3.5 tsf
				2	X		10.7				32	20	PP= 3.5 tsf
			Lean CLAY with Sand (CL): fine to medium-grained sand, medium plasticity, yellowish brown, moist, very stiff	3	X		30.1						PP= 3.5 tsf
			Silty SAND (SM): fine-grained, yellowish brown, decomposed, extremely weak, intensely fractured saprolitic meta-volcanic rock fragments										
5													
			Saprolitic Meta-Volcanic ROCK: fine-grained, olive gray with yellowish brown, moist, decomposed, extremely weak, intensely fractured, grades similar to silty sand	4	X								
735													
			Meta-Volcanic ROCK: olive with yellowish brown, highly weathered, weak, highly fractured, R1 to R3	5	X								
				6	X								Refusal at 9'

The test pit was terminated at approximately 9 ft. below ground surface. The test pit was backfilled with on July 09, 2024.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during excavation or after completion.
GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.



PROJECT NUMBER: 20193141.002A
 OFFICE FILTER: SALINAS
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2019.GLB [KLF_BORING/TEST PIT SOIL LOG]

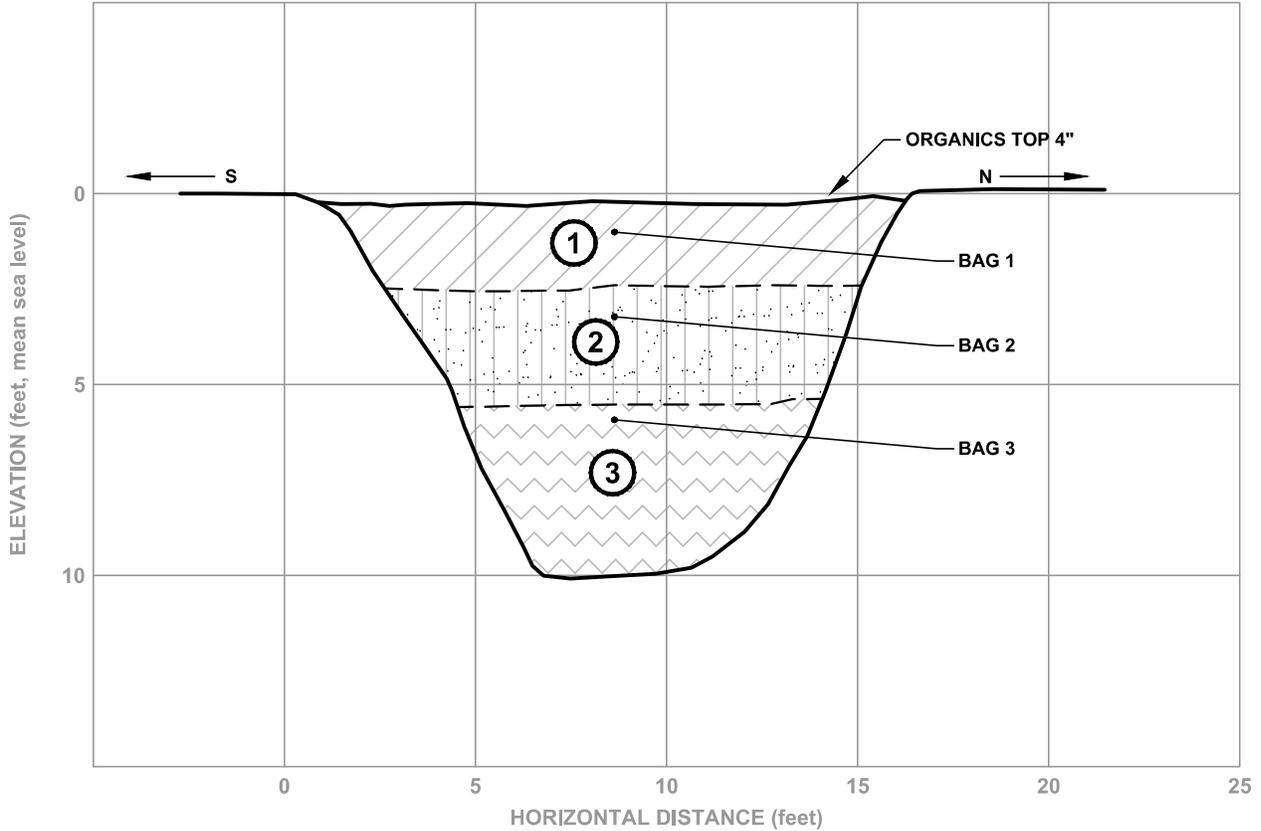


PROJECT NO.: 20193141
 DRAWN BY: DA
 CHECKED BY: DD
 DATE: 7/11/2024
 REVISED: 7/29/2024

TEST PIT LOG TP-9
 PROPOSED COSTCO FUEL FACILITY
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

APPENDIX
A-11
 PAGE: 1 of 1

Previous Test Pit Logs (Kleinfelder, 2019)



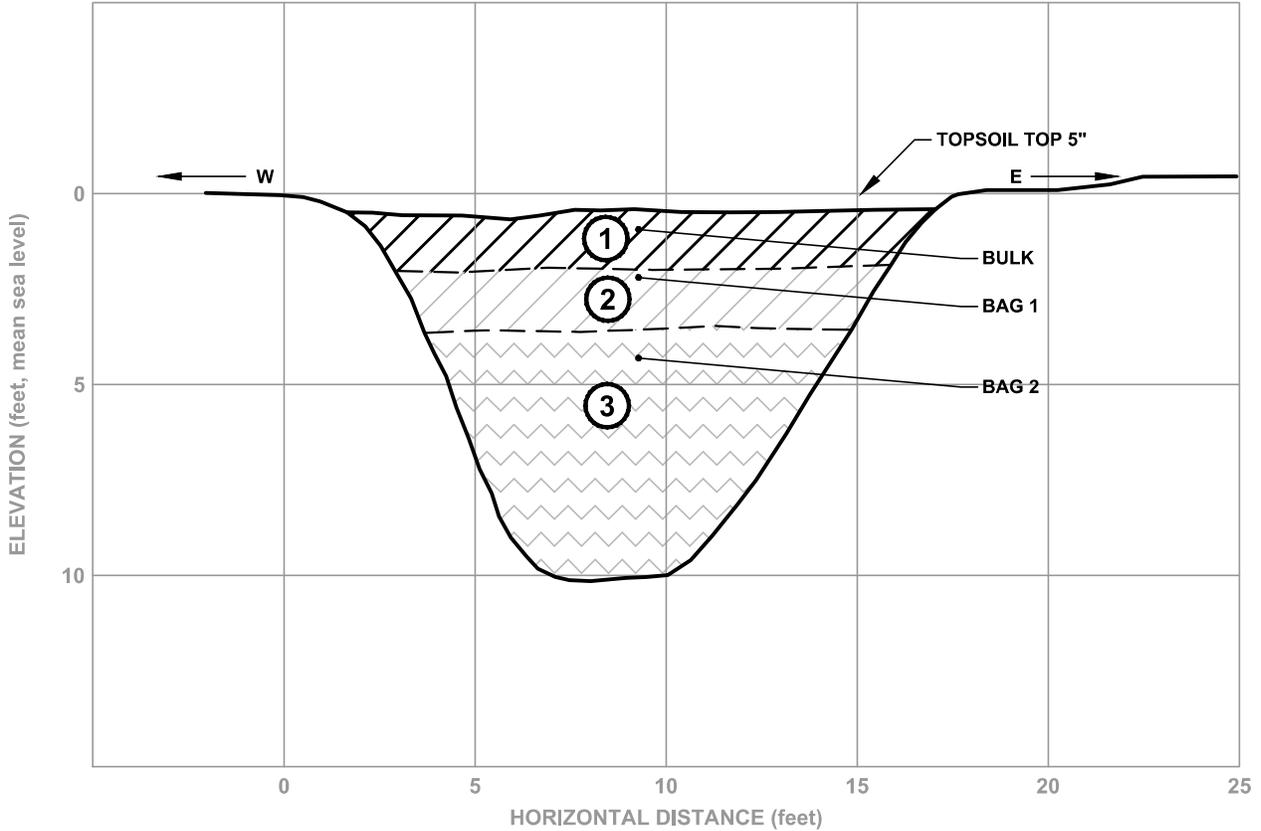
UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY (CL) - reddish brown, moist, soft, fine grained sand, medium plasticity, at 2' perched groundwater
②	SILTY SAND WITH GRAVEL (SM) - moist, coarse grained sand, 1/4"-1" angular gravels
③	METAVOLCANIC ROCK - well defined foliation, decomposed to highly weathered, extremely weak to weak, intensely fractured, behaves like silty gravel, at 9' highly fractured, weak

Latitude: 38.662952
Longitude: -121.05795

LOGGED BY: Dan Dockendorf DATE: 2/5/19

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	PROJECT NO. 20193141 DRAWN BY: JDS CHECKED BY: DD DATE: 02/21/2019 REVISED:	TEST PIT LOG TP-1 CSM COSTCO EL DORADO HILLS SILVA VALLEY PARKWAY EL DORADO HILLS, CALIFORNIA	FIGURE A-1
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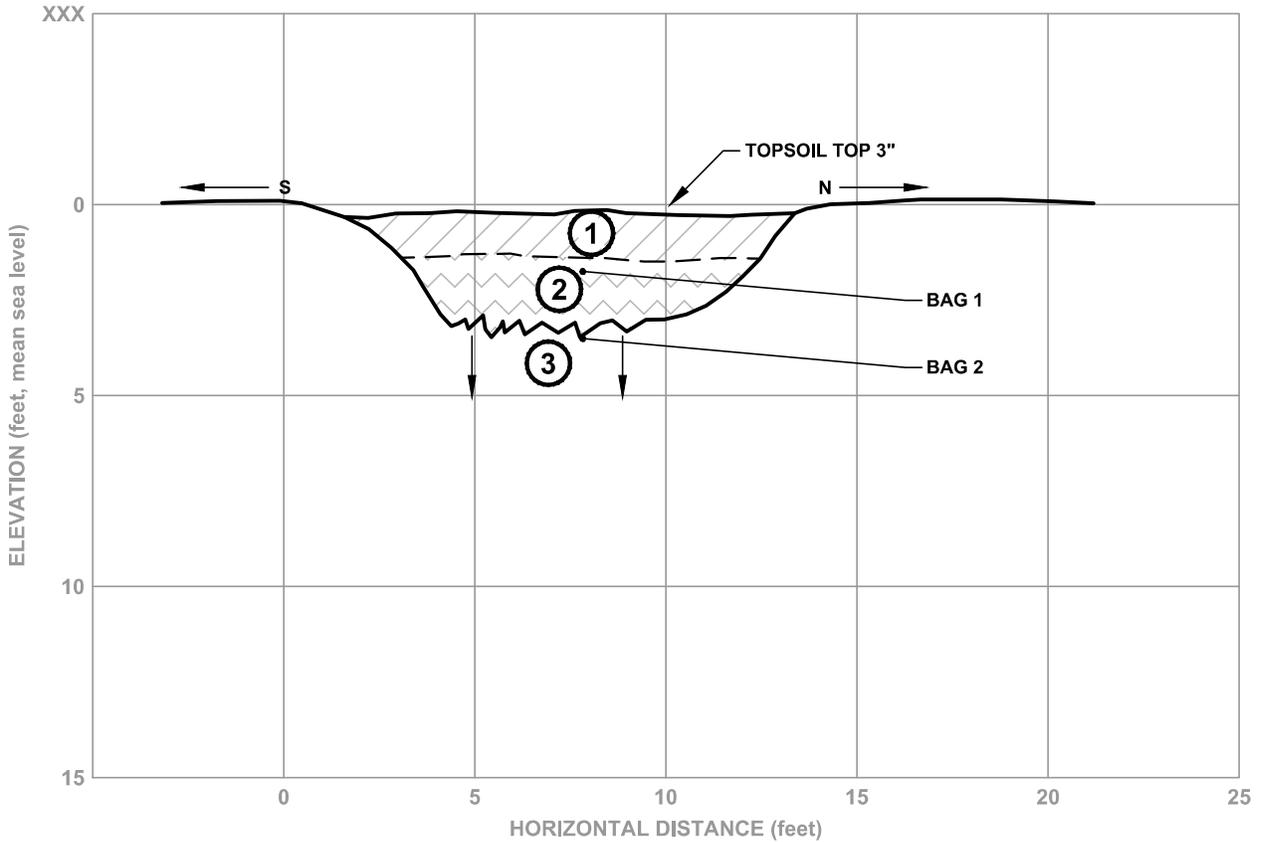
UNIT NO.	MATERIALS DESCRIPTION
①	FAT CLAY WITH SAND (CH) - wet, very soft, fine grained sand, high plasticity, at 2' perched groundwater
②	SANDY LEAN CLAY WITH GRAVEL (CL) - pale olive, moist, medium stiff, fine grained sand, medium plasticity, 1/4" angular gravel
③	METAVOLCANIC ROCK - highly weathered, highly fractured, slight foliation, at 8' pockets of moderately fractured rock but only about 10-20% of total

Latitude: 38.66314
Longitude: -121.05639

LOGGED BY: Dan Dockendorf DATE: 2/5/19

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	PROJECT NO. 20193141 DRAWN BY: JDS CHECKED BY: DD DATE: 02/21/2019 REVISED:	TEST PIT LOG TP-2 CSM COSTCO EL DORADO HILLS SILVA VALLEY PARKWAY EL DORADO HILLS, CALIFORNIA	FIGURE A-2
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UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY (CL) - reddish brown, moist, soft, medium plasticity, PP = 0.5
②	METAVOLCANIC ROCK - highly weathered, strong, highly fractured, well defined foliation's, some pockets of moderately fractured
③	METAVOLCANIC ROCK - moderately weathered, strong, moderately fractured, well defined foliation, 8" pieces observed, refusal at 3'-3" deep
Latitude: 38.66296 Longitude: -121.05699	

LOGGED BY: Dan Dockendorf DATE: 2/5/19

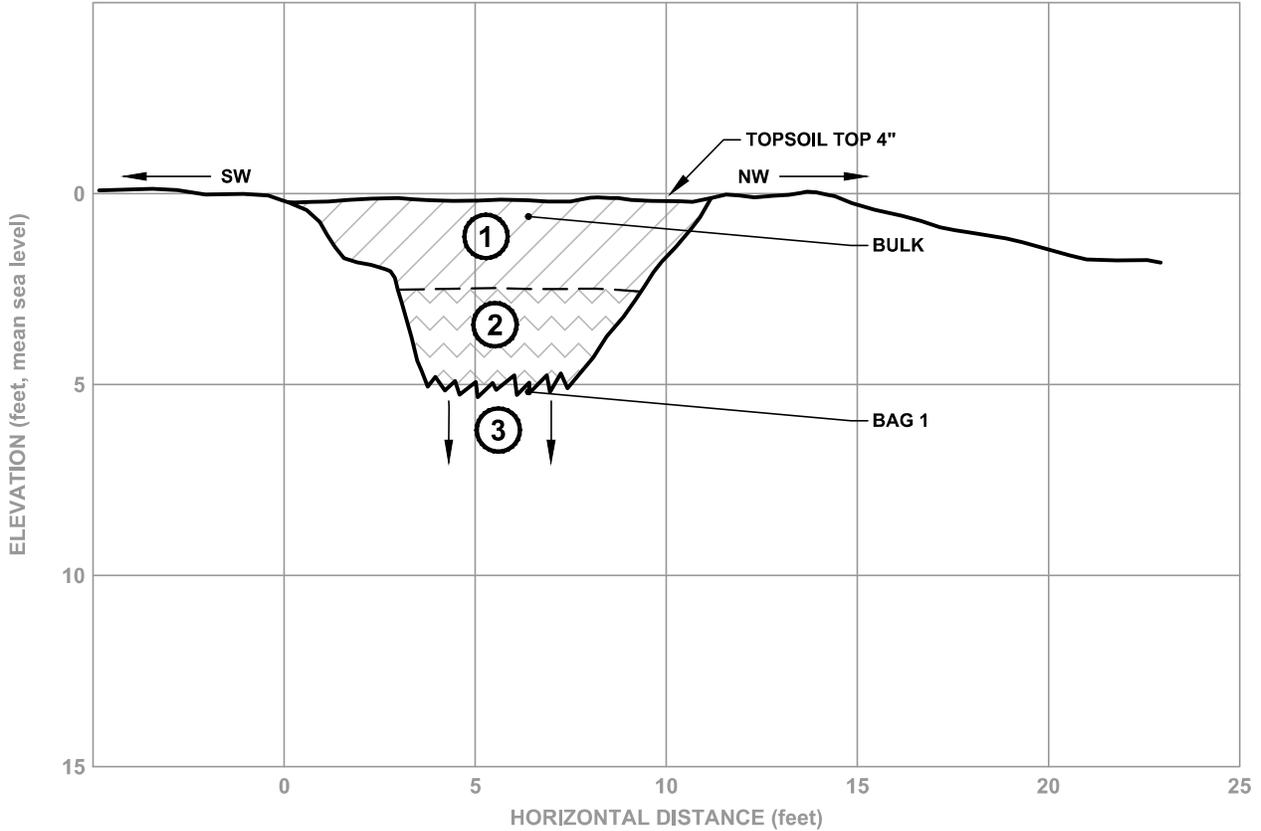
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PROJECT NO. 20193141
 DRAWN BY: JDS
 CHECKED BY: DD
 DATE: 02/21/2019
 REVISED:

TEST PIT LOG
 TP-3
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE
 A-3



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY (CL) - wet, free flowing water, soft, fine grained sand, medium plasticity, 1/4" gravel
②	METAVOLCANIC ROCK - highly weathered, medium strong, highly fractured, moderately foliated, behaves like poorly graded sand with gravel
③	METAVOLCANIC ROCK - moderately weathered, strong, moderately fractured, refusal at 5' deep Latitude: 38.66263 Longitude: -121.05695

LOGGED BY: Dan Dockendorf

DATE: 2/5/19

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PROJECT NO. 20193141
 DRAWN BY: JDS
 CHECKED BY: DD
 DATE: 02/21/2019
 REVISED:

TEST PIT LOG
 TP-4
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE
 A-4



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APPENDIX B LABORATORY TESTING

GENERAL

Laboratory tests were performed on selected samples as an aid in classifying the soils and to evaluate physical properties of the soils that may affect foundation design and construction procedures. The tests were performed in general conformance with the current ASTM standards. Laboratory testing was performed by Kleinfelder's laboratory in Sacramento, California. Corrosion testing was performed by Cerco Analytical located in Concord, California. A description of the laboratory-testing program is presented below.

MOISTURE AND UNIT WEIGHT

Moisture content and dry unit weight testing was performed on select samples recovered from our borings. Moisture contents were determined in general accordance with ASTM Test Method D2216; dry unit weight was calculated using the entire weight of the samples collected in general accordance with ASTM Test Method D7263. The test results are presented on the boring log in Appendix A and as an attachment in this appendix.

SIEVE ANALYSES

Sieve analyses were performed on selected samples of the materials encountered at the site to evaluate the grain size distribution characteristics of the soils and to aid in their classification. Sieve analysis was performed in accordance with ASTM Standard Test Method D6913. The results of these tests are presented on the boring logs in Appendix A and as an attachment to this appendix.

WASH SIEVE

Selected soil samples were tested for the percent passing the No. 200 sieve, which was performed by wash sieving in accordance with ASTM Standard Test Method D1140. The test results are presented on the boring logs.

ATTERBERG LIMITS

Atterberg limits testing was performed on a selected soil samples to assist in classification. Testing was performed in general accordance with ASTM D4318. Results of these tests are presented on the boring logs and attached to this appendix.

MAXIMUM DENSITY AND OPTIMUM MOISTURE

Maximum density and optimum moisture content testing was performed on one bulk sample of the near surface soils to evaluate the compaction characteristics of the onsite soils. Maximum density and optimum moisture content testing was performed in general accordance with ASTM Standard Test Method D1557, Method B. The test result is attached.

R-VALUE TESTS

One resistance value (R-value) test was performed on a bulk soil sample obtained within the proposed fuel facility area to evaluate pavement support characteristics of the near-surface onsite soils. R-value tests were performed in accordance with ASTM Standard Test Method D2844. Results of the testing are attached to this appendix.

SOIL CORROSIVITY TESTS

A series of chemical tests were performed on selected samples of the near-surface soils to estimate pH, resistivity and sulfate and chloride contents. The samples were taken during our 2019 investigation of the property and are provided in this report. The samples were tested for pH and minimum resistivity, soluble chlorides, and soluble sulfates, respectively. Test results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to construction materials. The results of the tests are presented in the body of the report and attached to this appendix.

TOPSOIL ANALYTICAL TESTS

Topsoil analytical testing was performed on one composite sample of the near-surface soils by Waypoint Analytical of Anaheim, California. The composite sample was taken during our 2019 investigation of the property. The composite topsoil sample was tested for percentages of organic matter, percentages of deleterious material, pH, mineral content, micro and macro nutrient content, and herbicide presence in the soil. The test results are presented in the Waypoint Analytical report attached to this appendix.

Exploration ID	Depth (ft.)	Sample No.	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
						Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
TP-1	0.5	1		6.5								
TP-1	1.0	2	CLAYEY SAND (SC)					27				
TP-2	0.7			6.7								
TP-3	0.5	1		5.1								
TP-3	1.0	2	SANDY LEAN CLAY (CL)						28	19	9	
TP-4	0.5	1		7.5								
TP-4	1.0	2		10.7	130.8							
TP-5	0.5	1		13.5								
TP-5	1.0	2	SANDY ELASTIC SILT (MH)						61	40	21	
TP-6	0.5	1		14.2								
TP-6	1.0	2	SANDY SILT (ML)					69				
TP-7	1.0	2		5.9								
TP-8	0.5	1		6.9								
TP-8	1.0	2		16.1	119.0							R-Value= 19
TP-9	1.0	2	SANDY LEAN CLAY (CL)	10.7					32	12	20	
TP-9	2.5	3		30.1								

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
 NP = NonPlastic
 NA = Not Available



PROJECT NO.: 20193141
 DRAWN BY: DA
 CHECKED BY: DD
 DATE: 8/6/2024
 REVISED: -

LABORATORY TEST RESULT SUMMARY
 PROPOSED COSTCO FUEL FACILITY
 SILVA VALEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

APPENDIX
B-1

Laboratory Test Report

Project Name: CSM Costco El Dorado, CA Gas Relo GEO
Project No.: 20193141.002A
Lab No.: 24-SAC-00855
Sample Date: July 9, 2024
Date Received: July 17, 2024
Report Date: July 26, 2024

Visual Classification of Soils (ASTM D2488)

Sample Boring/Number/Depth:	Description:
TP-5 Sample 3 @ 2' 6"	Olive Yellow Sandy Lean CLAY with Gravel (sCLg) *
TP-7 Sample 1 @ 6"	Reddish Brown SILT (ML)
TP-7 Sample 3 @ 2' 4"	Yellowish Brown Silty SAND (SM)
TP-9 Sample 4 @ 5'	Yellowish Brown Silty SAND (SM)

Remarks:

* One large gravel (passing 3" retained on 2" sieve) in a half filled gallon size sample t

Reviewed By: _____ M. Lee _____

Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided.

Laboratory Test Report

Client: **Costco Wholesale**

Report No.: **24-SAC-00855 Rev. 0**

Issued: **7/26/2024**

Project: **20193141.002A**

CSM Costco El Dorado, CA Gas Relo GEO

Sampled by: **Not Provided**

Date: **7/9/2024**

01-000L - Laboratory Testing

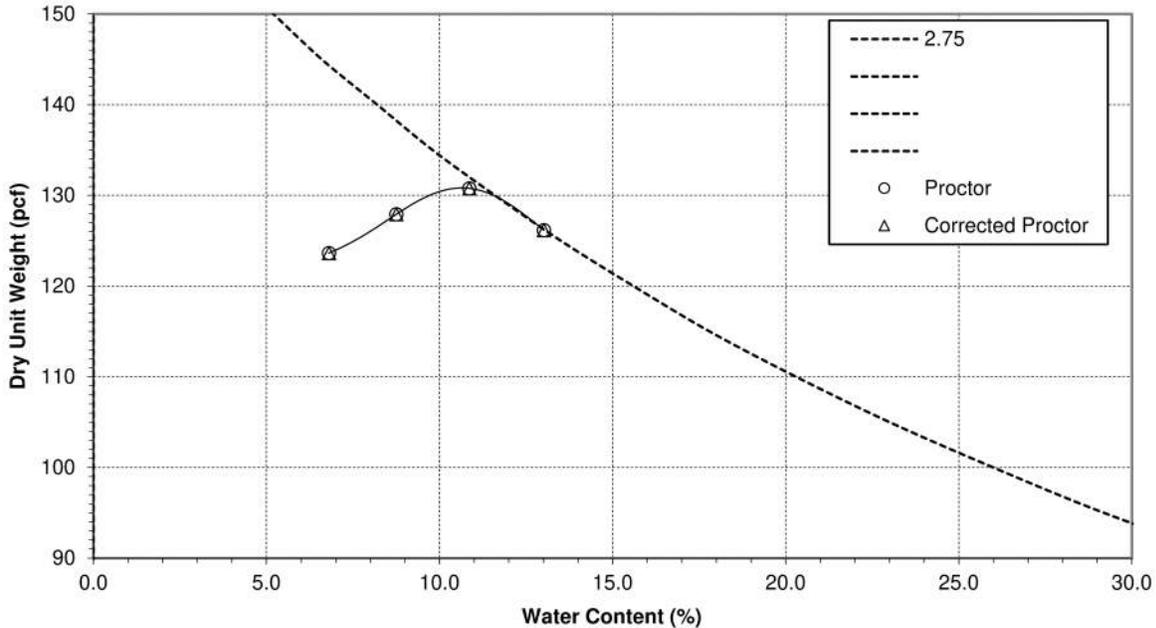
Submitted by: **Dan Dockendorf**

Date: **7/17/2024**

Tested on **7/17/2024** by **I. Khan**

Material Description: **Dark Reddish Brown Sandy Lean CLAY with Gravel**

Location: **TP-4 Sample 2 @ 1-2'**



Test Method: ASTM D1557 B	Uncorrected	Corrected
Maximum Dry Unit Weight (pcf)	130.8	na
Optimum Water Content (%)	10.7	na
Oversize Fraction, retained on 3/4 (%)		<5
Bulk Specific Gravity of Oversize Fraction		na

Rammer Type: Manual

Specimen Preparation: Moist

Reviewed on 7/26/2024 by Marley Lee,
Senior Technician



Laboratory Test Report

Client: **Costco Wholesale**

Report No.: **24-SAC-00855 Rev. 0**

Issued: **7/26/2024**

Project: **20193141.002A**

CSM Costco El Dorado, CA Gas Relo GEO

Sampled by: **Not Provided**

Date: **7/9/2024**

01-000L - Laboratory Testing

Submitted by: **Dan Dockendorf**

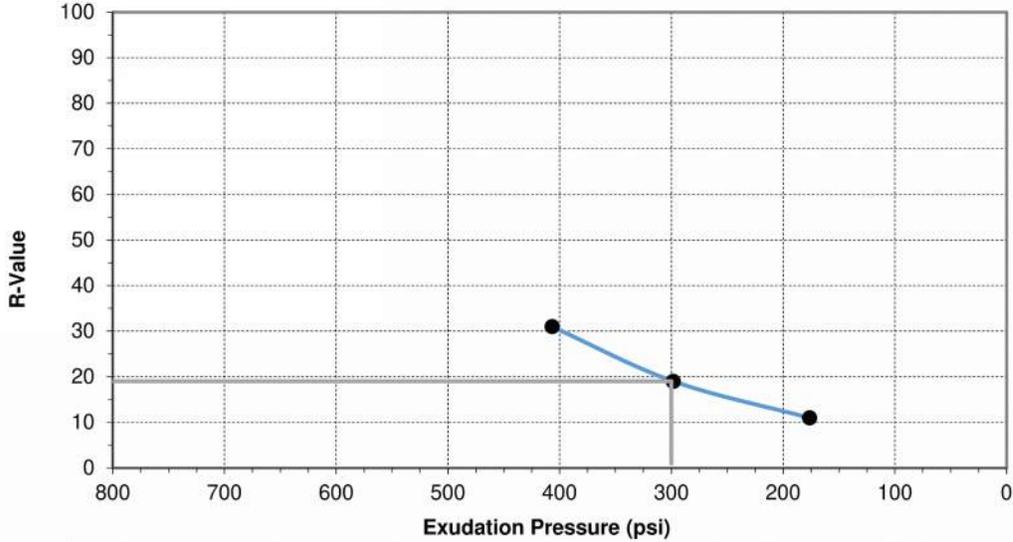
Date: **7/17/2024**

Tested on **7/25/2024** by **K. DeSouza**

Test Method: **ASTM D2844**

Material Description: **Dark Reddish Brown Lean CLAY with gravel**

Specific Location: **TP-8-1.0-2.0'**



Briquette No.	A	B	C
Dry Unit Weight at Test (pcf)	116.5	121.1	119.0
Expansion Pressure (psf)	39	104	87
Exudation Pressure (psi)	176	407	298
Moisture at Time of Test (%)	17.1	15.2	16.1
Resistance Value	11	31	19
R - VALUE AT 300 PSI EXUDATION PRESSURE:			19

Reviewed on 7/26/2024 by Marley Lee,
Senior Technician

Limitations: Pursuant to applicable building codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specifications were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. This report may not be reproduced, except in full, without written approval of Kleinfelder.



Anaheim Office
February 27, 2019
Report 19-049-0015

Kleinfelder Inc.
75 E. Santa Clara St. Floor 6
San Jose, CA 95132

Attn: Dan Dockendorf

RE: Costco El Dorado Hills New Warehouse, Job # 20192984.001A

Background

One sample was processed on February 18, 2019 identified as sample TP-1 from an area where new landscaping is scheduled for installation. Fertilizer and amendment recommendations were requested. The sample was analyzed for horticultural suitability, fertility, and physical characteristics including organic matter content. The results of the analyses are attached. Heavy metals testing is in process and this data will be sent separately.

Analytical Results and Comments

The reaction of the sample is slightly alkaline at a pH of 7.1 with qualitative lime favorably low. This is within the preferred range for most plants. Salinity (ECe), sodium, chloride and boron are safely low. The sodium adsorption ratio (SAR) indicates that sodium is adequately balanced by soluble calcium and magnesium; this balance is important for soil structure quality, which relates to the rate at which water infiltrates the soil.

According to the USDA Soil Classification system, the texture of the less than 2mm fraction of the soil is classified as sandy clay loam. Organic content is low at 0.3% dry weight. Based on this information, the estimated infiltration rate is a moderate 0.26 inch per hour. Infiltration rates may vary due to potential differences in compaction across the site.

In terms of soil fertility, nitrogen, phosphorus, potassium and sulfate are low and calcium is moderately supplied. Magnesium is abundant but not problematically so and will not require supplementing for some time. Of the micronutrients; copper, zinc, manganese and iron are low.

Recommendations

Incorporation of nitrogen, phosphorus, potassium, calcium and sulfate fertilizers is recommended at the time of planting. Incorporation of a nitrogen stabilized organic amendment or composted greenwaste product is also recommended in order to help improve the soil nutrient holding capacity and porosity. If a composted greenwaste amendment is chosen, that would provide additional phosphorus and potassium as well as supplemental micronutrients.

Boron is safely low for general ornamental plants and may be below optimum levels for plant nutritional purposes. Irrigation water often supplies sufficient boron to meet plant nutritional requirements. However, if boron is low in the irrigation water and/or plants show symptoms of boron deficiency after they are well established, you may consider an application of a product containing boron at the manufacturer's label rate. Boron deficiency symptoms often include stunted or deformed younger growth and tight internodes. Tissue testing can be performed to identify a boron deficiency if it is suspected.

Anaheim Office
Report 19-049-0015

Incorporation of a composted greenwaste amendment may be sufficient to negate this deficiency, product depending.

The primary symptom of zinc, manganese and iron deficiencies is a general yellowing of leaves with veins remaining green. In severe cases, leaves may become pale yellow or whitish, but veins remain green. Brown spots may develop between veins and leaf margins may turn brown. Zinc deficiencies typically appear first on older, interior leaves. Manganese deficiency symptoms appear first on younger leaves. Iron deficiency shows first and more severely on the newer growth at branch tips. If these symptoms are present after plant installation they may be treated with an application of a chelated micronutrient product at the manufacturer's recommended rate. Incorporation of a composted greenwaste amendment would also provide additional micronutrients and may be sufficient to negate any deficiency, product depending.

To Prepare For Mass Planting:

Drainage of the root zone should be improved by first loosening the top 10 inches of any undisturbed or compacted soil. The following materials should then be evenly spread and thoroughly blended with the top 6 inches of soil to form a homogenous layer:

<u>Amount per 1000 Square Feet</u>	
5 cubic yards	Nitrogen Stabilized Organic Amendment*
7 pounds	Ammonium Phosphate (16-20-0)*
14 pounds	Potassium Sulfate (0-0-50)*
50 pounds	Gypsum (Calcium Sulfate)

*The rate may change based on the analysis of the chosen organic amendment. This rate is based on 270 pounds of dry weight of organic matter per cubic yard of amendment. If a composted greenwaste amendment is selected that contains a significant amount of phosphorus or potassium, the ammonium phosphate should be replaced with ammonium sulfate (21-0-0) at a 7 pound rate and the potassium sulfate should be reduced or omitted accordingly.

To Prepare Backfill For Trees and Shrubs:

- Excavate planting pits at least twice as wide as the diameter of the root ball.
- Soil immediately below the root ball should be left undisturbed to provide support but the sides and the bottom around the side should be cultivated to improve porosity.
- The top of the root ball should be at or slightly above final grade.
- The top 12 inches of backfill around the sides of the root ball of trees and shrubs may consist of the above amended soil or may be prepared as follows:

3 parts	Soil Sample
1 part	Nitrogen Stabilized Organic Amendment*

Uniformly blended with:

<u>Amount per Cubic Yard of Backfill</u>	
1/3 pound	Ammonium Phosphate (16-20-0)*
3/4 pound	Potassium Sulfate (0-0-50)*
2 2/3 pounds	Gypsum (Calcium Sulfate)

- Backfill below 12 inches required for 24 inch box or larger material should not contain the organic amendment or ammonium phosphate but should still contain the potassium sulfate and gypsum

Anaheim Office
Report 19-049-0015

at the recommended rates. In order to improve phosphorus levels below 12 inches in depth, triple superphosphate (0-45-0) should be incorporated at a 1/4 pound rate.

- Ideally a weed and turf free zone should be maintained just beyond the diameter of the planting hole. A 2-4 inch deep layer of coarse mulch can be placed around the tree or shrub. Mulch should be kept a minimum 4 inches from the trunk.
- Irrigation of new plantings should take into consideration the differing texture of the rootball substrate and surrounding soil matrix to maintain adequate moisture during this critical period of establishment.

Maintenance

Maintenance fertilization should rely primarily on a nitrogen only program supplemented with a complete fertilizer in the fall and spring. Beginning 45-60 days after planting, ammonium sulfate (21-0-0) should be applied at a rate of 5 pounds per 1000 square feet with reapplication every 45-60 days. Alternatively, slow release Sulfur Coated Urea (43-0-0) may be applied at 6 pounds per 1000 square feet every 90 days. Once plants are performing satisfactorily, the frequency of fertilization may be decreased depending on color and rate of growth desired. In the winter for a quick greening effect, calcium nitrate (15.5-0-0) may be applied at a 6 pound rate if applicable. Early fall and spring, substitute a complete fertilizer such as 15-15-15 to help insure continuing adequate phosphorus and potassium.

Alternatively, Blood Meal (12-0-0) provides available nitrogen fairly rapidly while materials such as Feather Meal (12-0-0), Soybean or Cotton Seed Meal (7-1-1) are slower to provide available nitrogen, but they extend the length of time they make this contribution. In order to provide a good supply of nitrogen for a 3-4 month time frame a good combination would be 6 pounds Blood Meal and 14 pounds Feather Meal per 1000 square feet. In the fall and spring, substitute a complete organic fertilizer such as 5-5-5 applied at the manufacturer's label rate. Or, nutrient rich composted greenwaste may be spread in a 1 to 2 inch layer, which generally carries enough nutrition to boost complete nutrition though a source of nitrogen might also be added at a half rate to assure adequate nitrogen availability.

If we can be of any further assistance, please feel free to contact us.



Annmarie Lucchesi
alucchesi@waypointanalytical.com

Emailed 4 Pages: ddockendorf@kleinfelder.com

Project : Costco - El Dorado Hills - New Warehouse
El Dorado Hills, CA
Job #20193141.001A

Report No : **19-049-0015**
Purchase Order :
Date Recd : 02/18/2019
Date Printed : 02/27/2019
Page : 1 of 1

COMPREHENSIVE SOIL ANALYSIS

Sample Description - Sample ID	Half Sat %	pH	ECe dS/m	NO ₃ -N ppm	NH ₄ -N ppm	PO ₄ -P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
	TEC	Qual Lime		Sufficiency Factors											
TP-1 - 0' - 5'	16	7.1	0.3	0	14	4	25	1840	1410	0.5	0.3	2	9	0.3	01770
	210	Low		0.4	0.2	0.1	0.8	4.4	0.3	0	0.1	0.1			

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO ₄ meq/L		Coarse 5 - 12	Fine 2 - 5	Sand			Silt .002-.05	Clay 0-.002		
								Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5					
1.5	1.7	0.9	0	0.06	1.4	0.7	0.5	3.1	11.4	12.2	33.4	17.5	25.4	Sandy Clay Loam	01770

01770 Chloride (Cl) = 0.470 meq/L



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**Refraction Seismic Investigation
at the
Costco El Dorado Hills Fuel Project Site
in El Dorado Hills,
El Dorado County, California**

GGSI Project No. 2024-30.01

Prepared by:

**Gasch Geophysical Services, Inc.
Rancho Cordova, California 95742-6576**

Submitted to:

Mr. Dan Dockendorf
Kleinfelder, Inc.
25 Metro Drive, Suite 110
San Jose, California 95110

July, 2024





GASCH GEOPHYSICAL SERVICES, INC.

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CONSULTANTS IN GEOPHYSICS
FOR THE ENGINEERING,
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AND BLASTING INDUSTRIES

Since 1969

July 21, 2024

Mr. Dan Dockendorf
Kleinfelder, Inc.
25 Metro Drive, Suite 110
San Jose, California 95110

**Re: Refraction Seismic Investigation at the Costco El Dorado Hills Fuel Project Site in El Dorado Hills, El Dorado County, California
GGSI Project No. 2024-30.01
Kleinfelder Project No. 20193141.002A, Task 01-0002**

Dear Mr. Dockendorf:

At your request and authorization, Gasch Geophysical Services, Inc. (GGSI) has completed a refraction seismic investigation at Costco El Dorado Hills Fuel Project Site in El Dorado Hills, El Dorado County, California (Figure 1).

Purpose

The purpose of this investigation was to determine the depth to higher velocity material and also define the rippability (excavatability) characteristics of the sub-surface materials at the Costco El Dorado Hills Fuel Project Site.

Method, Instrumentation and Software

The refraction seismic (RS) method was used to evaluate the rock velocities on site, as seismic primary-wave travel times are used to quantify the rock velocities and, as a result, can determine the general competency/rippability in areas of various rock types. The RS method measures the velocity at which a seismic wave propagates through a soil or rock medium. In this case, the primary (i.e. p-wave or compressional) seismic waves were measured. Higher seismic p-wave velocities (measured in feet per second, ft/s) indicate material of higher density, thus quantifying the competency or strength of the soil or rock medium and providing an estimation of the rippability and/or excavatability of the sub-surface materials.

The seismic data acquisition system used for this project by GGSI was a Seistronix EX-6 Explorer, which is a distributed, 24-bit digital instrument with data output to electronic media for subsequent processing. Geophones were single, 28-Hz, digital grade units manufactured by OYO Geospace Corporation. Spread cables were manufactured by Pro-Seismic Services. The energy source for this project was a sixteen-pound sledge hammer with a hardwire connection for system triggering. All data were processed in house, on our data reduction and plotting workstation.

Refraction seismic data processing was carried out using Rayfract® version 4.06. This refraction seismic processing software utilizes Wavepath Eikonal Traveltime (WET) tomography, which models multiple signal propagation paths contributing to one first break (the Fresnel volume approach). Conventional ray tracing tomography is limited to the modeling of just one ray path per first break. The WET inversion method is founded upon a back-projection formula for inverting velocities from travel times computed by a finite-difference solution to the Eikonal equation (Qin, et al. 1992). An Eikonal solver is used for traveltimes field computation, which models diffraction in addition to refraction and transmission of acoustic waves. As a result, the velocity anomaly imaging capability is enhanced with the WET tomographic inversion method compared to conventional ray tomography. This software is developed by Intelligent Resources, Inc. of Vancouver, British Columbia, Canada.

A color-coded seismic velocity cross-section of the subsurface has been generated for each RS line, where cool colors (blues) indicate lower seismic velocities and warm colors (reds, purple) indicate higher velocities. Color scaling of these seismic velocity sections is based on the range of seismic velocity values calculated. Velocity scaling has been normalized on all RS velocity sections.

Data Acquisition Parameters

A total of three RS lines were acquired during this investigation. RS Line locations were suggested by Kleinfelder personnel and slightly adjusted in the field to allow for safe and efficient data acquisition. All RS lines were acquired with geophone stations spaced at 20-foot intervals with energy source points located between every third or every other geophone station as well as off the ends of each line. RS Lines 1 & 2 were acquired with 24 active geophone stations for a total of 500 lineal feet each. RS Line 3 was acquired using 12 active geophone stations for a total length of 260 lineal feet. A total of 1,260 lineal feet of data were collected for this investigation. Collection of the field data was carried out on July 16th, 2024. The field crew consisted of Professional Geophysicist Kent Gasch and Professional Engineer Josh Summers. The locations of the RS lines are presented on Figure 2.

Rippability

Rippability is dependent on the physical condition of the rock masses to be excavated. In addition to rock type and degree of weathering, structural features in the rock such as bedding planes, cleavage planes, joints, fractures, consolidation and shear zones also influence rippability. Rock masses tend to be more easily ripped if they have well defined, closely spaced fractures, joints, or other planes of weakness. Massive rock bodies which lack discontinuities may allow for slow and difficult ripping or refusal, even where partially weathered, and may require blasting to break the rock for efficient removal.

The association between the seismic velocity of any given earth material and its rippability varies greatly from one type of earth-moving equipment to another. For example, although a large track laying dozer with a single ripper tooth can sometimes rip material with seismic velocities in excess of 10,000 ft/s. GGSi has experienced a limiting (refusal) velocity for large excavators to range from 3,500 ft/s to 4,500 ft/s, and a standard backhoe may meet refusal at seismic velocities as low as 2,000 to 2,500 ft/s. Ultimately, the relationship between seismic velocity and rippability is dependent on both: site conditions and equipment and/or operator ability.

Seismic p-wave velocities are related to both rock hardness and fracture density. Rippability has been empirically correlated to refraction seismic velocities by Caterpillar Inc., as displayed on Figure 6 for a CAT D8R/D8T (Caterpillar Performance Handbook, Edition 49, September, 2019). According to this chart, metamorphic/sedimentary rock, in this case slates and shales, becomes marginally rippable around 6,000 to 6,300 ft/s and non-rippable around 8,200 ft/s for a D8R/D8T dozer with multiple or single shank No. 8 ripper. These estimations are based on the published values for igneous rocks on the CAT chart; however, site geology and topography may cause some variations of these values.

The Caterpillar Chart of Ripper Performance should be considered as being only one indicator of rippability. Ripper tooth penetration is the key to successful ripping, regardless of seismic velocity. This criterion is particularly true in finer-grained, homogeneous materials and in tightly cemented formations. Ripping success may ultimately be determined by the operator finding the proper combination of factors, such as: number of shanks used, length and depth of shank, tooth angle, direction of travel, and use of throttle. Although low seismic velocities in any rock type indicate probable rippability, it is possible that, if the fractures, bedding and/or joints do not allow tooth penetration, the material still may not be ripped efficiently. In some cases, drilling and blasting may be required to induce sufficient fracturing to allow for excavation.

Seismic Velocities

Generally, seismic p-wave velocities less than 3,000 ft/s indicate native soil, fill material, sand and gravel or highly weathered and/or decomposed rock, while velocities in excess of 10,000 ft/s indicate fresh (essentially non-weathered) rock. Seismic velocities between these two values typically indicate rock with varying degrees of weathering and/or fracturing. Consolidation and cementation, as well as fracture spacing and density, also affect the measured seismic velocities. Moderate velocities may indicate compacted soil, moderately weathered rock or loosely consolidated sediment such as gravel, sand and silt. Saturated sediment below the water table characteristically displays seismic velocities near or slightly above 5,000 ft/s.

Extremes in seismic velocities may range from below 1,000 ft/s to over 20,000 ft/s. Very low seismic velocities usually indicate highly weathered or poorly compacted material, either natural or man-made. Extremely high velocities are rare in the near-

surface, and only possible in certain types of rock. Rock velocities are dependent on the physical condition of the rock masses evaluated, as a result, seismic p-wave velocities are related to rock hardness, fracture density and sediment consolidation, saturation and cementation.

Findings

The results of this refraction seismic investigation are summarized by Figures 3 through 5. These seismic velocity sections, which were created through the inversion process, have very low error and provide a high degree of lateral definition of the seismic velocity horizons found beneath each line. The seismic velocity sections have been scaled from 1,500 ft/s to 20,000 ft/s for the velocity window. Horizontal and vertical axes have been scaled to 40 feet per inch in the horizontal and 20 feet per inch in the vertical.

Test pits performed by Kleinfelder prior to our arrival are shown on the RS Line Location Map (Figure 2) and on the seismic velocity sections when located near a RS Line. Locations are only approximate and based on information provided.

RS Line 1 (Figure 3)

RS Line 1 is located in the northern portion of the project area (see Figure 2). This line is oriented approximately northwest to southeast and located near test pits 2, 3 and 5 and crosses Line 3 near distance station 426 feet. Measured seismic velocities beneath this line grade at a fast rate from low velocities (1,500 ft/s) at the surface to marginally rippable velocities ($\approx 6,200$ ft/s) at depths ranging from approximately 10 to 15 feet below ground surface (bgs).

Velocities less than the $\approx 6,200$ ft/s horizon suggest materials that will be rippable with a CAT D8R/D8T or equivalent. Below this horizon, in the areas of moderate-high to high velocities (6,000 to 8,000+ ft/s), ripping will likely become slower or more difficult as higher velocity material is encountered and depending on the maximum depth of excavation in this area.

RS Line 2 (Figure 4)

RS Line 2 is located in the southern portion of the project area and is located near test pits 4, 6 and 7 (see Figure 2). This line is also oriented approximately northwest to southeast and crosses Line 3 near distance station 416 feet. Measured seismic velocities at this location grade at a fast rate from low velocities (1,500 ft/s) at the surface to marginally rippable velocities ($\approx 6,200$ ft/s) at approximate depths ranging from 8 to 15 feet bgs.

Seismic velocities less than the $\approx 6,200$ ft/s horizon suggest materials that will be rippable with a CAT D8R/D8T or equivalent. Below this horizon, in the areas of moderate-high to high velocities (6,000 to 8,000+ ft/s), ripping will likely become slower

or more difficult as higher velocity material is encountered and depending on the maximum depth of excavation in this area.

RS Line 3 (Figure 5)

RS Line 3 is located in the eastern portion of the project site (see Figure 2). This line is oriented approximately northeast to southwest (see Figure 2). Test pits 1 and 2 are near to this line. Line 3 crosses Line 1 and 2 at distance stations 36 feet and 96 feet, respectively. Measured seismic velocities at this location grade at a moderate rate from low velocities (1,500 ft/s) at the surface to marginally rippable velocities ($\approx 6,200$ ft/s) at depths ranging from approximately 11 feet to near 20 feet bgs on the southwestern end of the line.

Velocities less than the $\approx 6,200$ ft/s horizon suggest materials that will be rippable with a CAT D8R/D8T or equivalent. Below this horizon, in the areas of moderate-high to high velocities (6,000 to 8,000+ ft/s), ripping will likely become slower or more difficult as higher velocity material is encountered and depending on the maximum depth of excavation in this area.

Summary

This refraction seismic investigation provides a good sampling of the subsurface conditions at the Costco El Dorado Hills Fuel Project Site. All three RS Lines show variable gradation of seismic velocities from ground surface to the maximum depth of exploration beneath each line. Velocity correlation between lines was very good and indicates the consistency of the subsurface materials at the site.

This investigation revealed a high degree of variation in the calculated seismic velocities of the subsurface materials, with the highest seismic velocity of greater than 18,000 ft/s measured at the maximum depth of exploration on all three RS Lines. Low velocity material was measured in the near surface material, which suggests highly weathered/fractured rock and soil or fill. The moderate velocity range of 3,000 ft/s to approximately 5,000 ft/s, suggests compacted soil/fill, moderately weathered/fractured rock, or moderately consolidated sediment. The RS Lines show this low to moderate velocity section of material from the surface to varying depths and higher velocity material at the maximum depth of exploration.

In general, rippability with a CAT D8R/D8T (or equivalent) should not be problematic to the depths noted above for each RS Line; however, depending on the maximum depth of excavation, progress may be slower or difficult as zones of higher velocity material are encountered. Should this be the case, drilling and blasting may be the most effective method to fracture the rock for further excavation.

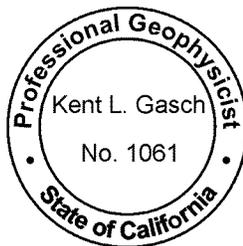
Warranty and Limitations

Gasch Geophysical Services, Inc. has performed these services in a manner which is consistent with standards of the profession. Site conditions can cause some variations of the calculated seismic velocities. Refraction seismic velocities assume that velocities increase with depth; therefore, a lower seismic velocity layer beneath a higher seismic velocity layer will not be resolved. No guarantee, with respect to the results and performance of services or products delivered for this project, is express or implied by Gasch Geophysical Services, Inc.

We trust that this is the information you require; however, should you have comments or questions, please contact our Rancho Cordova office at your convenience. Thank you for this opportunity to be of service.

Sincerely,

GASCH GEOPHYSICAL SERVICES, INC.



Expires 12/31/2025

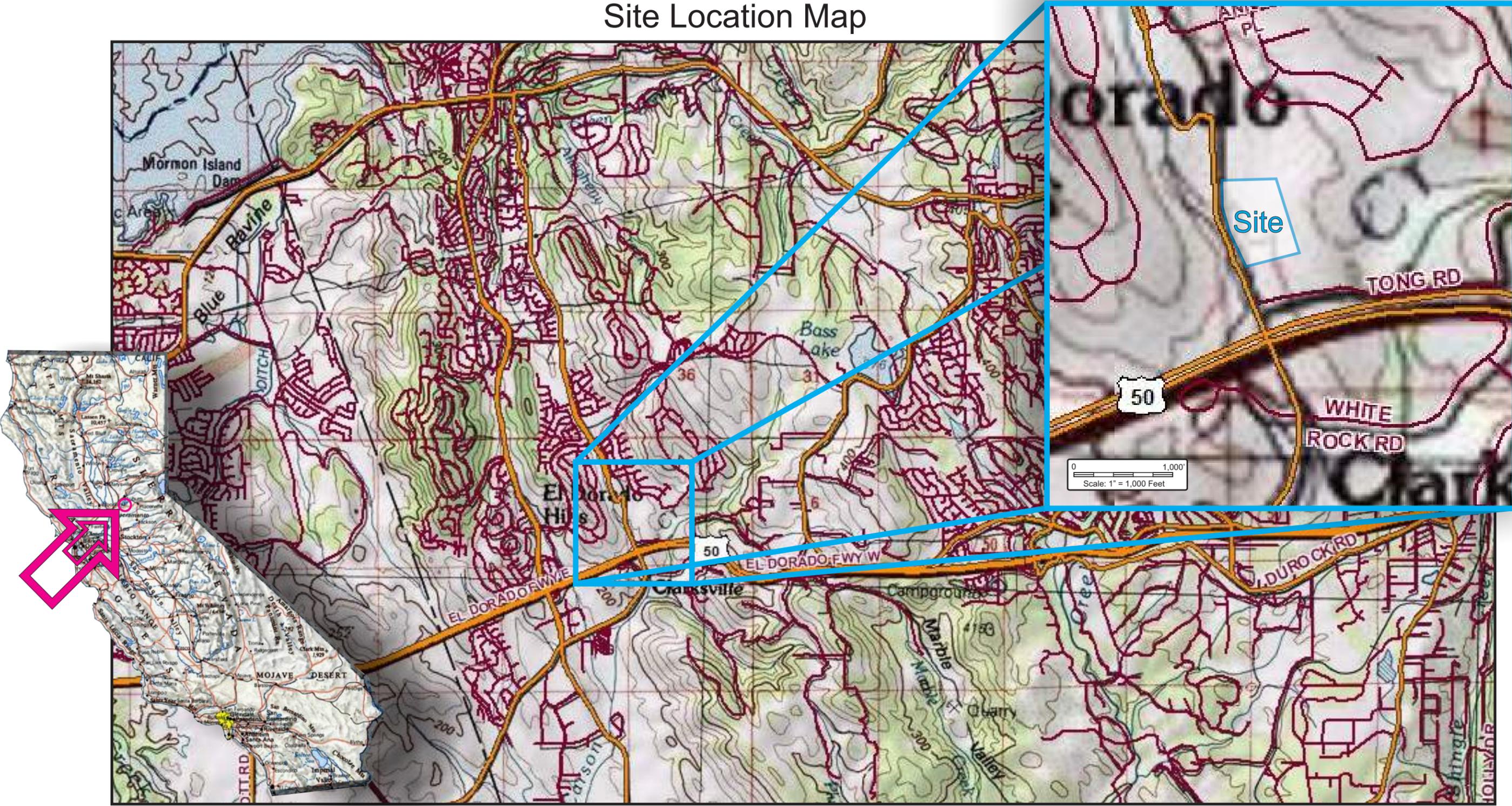
Kent L. Gasch
Professional Geophysicist #1061
Blasting Consultant



Expires 6/30/2026

Josh R. Summers
Professional Civil Engineer No. C85240

Site Location Map



Base Maps Courtesy of: USGS



Figure 1

G²S CONSULTANTS IN GEOPHYSICS
FOR THE ENGINEERING,
GROUNDWATER, OIL & GAS
AND BLASTING INDUSTRIES

GASCH GEOPHYSICAL SERVICES, INC. Since 1969
www.GEOGASCH.COM

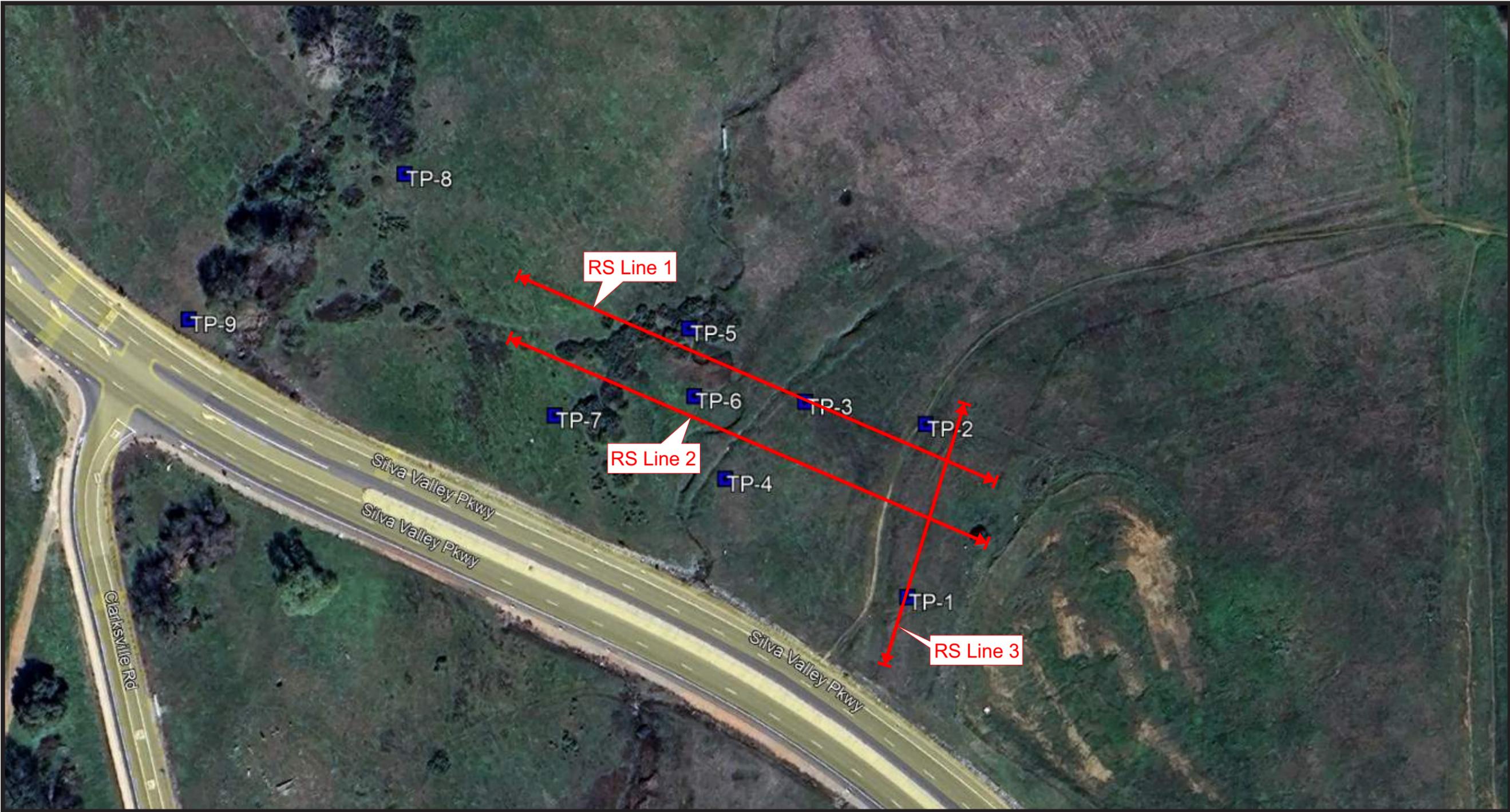
3174 Luyung Drive, Building #2
Rancho Cordova, California 95742 U.S.A.
(916) 635-8906 • FAX (916) 635-8907

Refraction Seismic Investigation:
Costco El Dorado Hills Fuel Project

Prepared for: *Kleinfelder, Inc.*

Project Number: 2024-30.01 Date: July, 2024

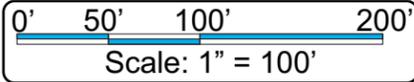
Refraction Seismic Line Location Map



Base photo map courtesy of Google Earth Pro, dated 3/14/2024

Test Pit (TP) locations provided by Kleinfelder, Inc.

Figure 2



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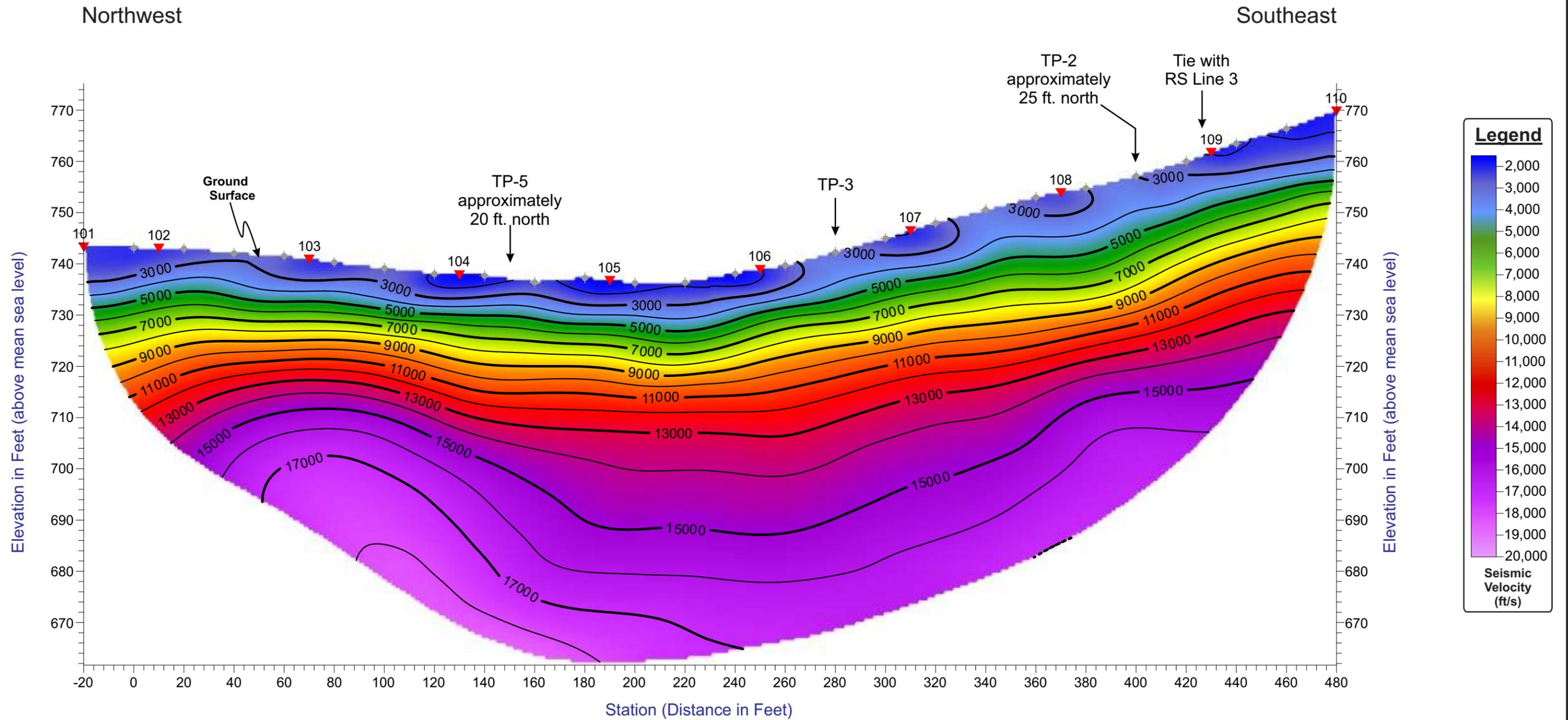
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Rancho Cordova, California 95742 U.S.A.
(916) 635-8906 • FAX (916) 635-8907

Refraction Seismic Investigation:
Costco El Dorado Hills Fuel Project

Prepared for: Kleinfelder, Inc.

Project Number: 2024-30.01 Date: July, 2024

Seismic Velocity Section • RS Line 1



Scale:
 Horizontal: 1" = 40'
 Vertical: 1" = 20'

Legend

- ◆ ◆ Geophone Station
- ▼ 101 Energy Source Locations

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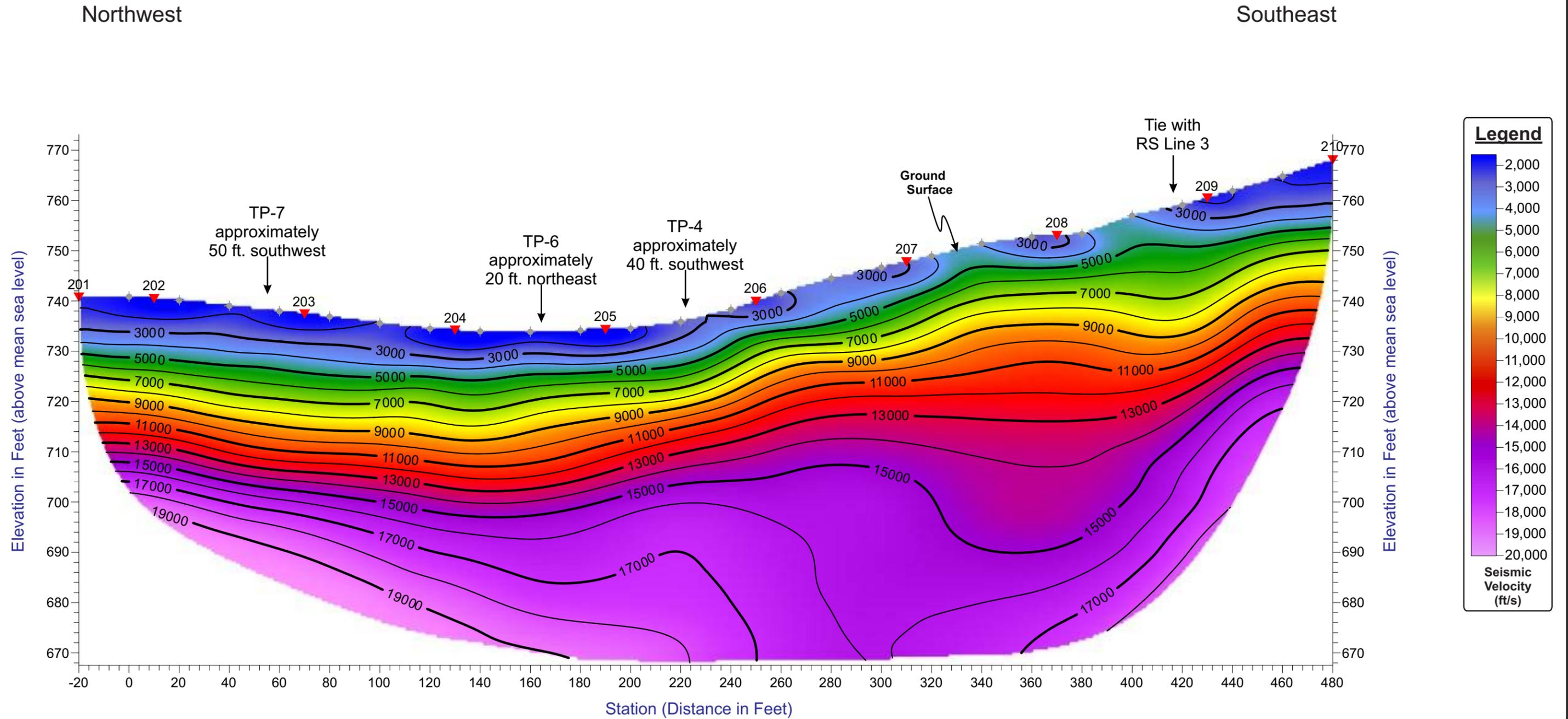
Figure 3

Refraction Seismic Investigation:
 Costco El Dorado Hills Fuel Project

Prepared for: *Kleinfelder, Inc.*

Project Number: 2024-30.01 Date: July, 2024

Seismic Velocity Section • RS Line 2



Scale:
Horizontal: 1" = 40'
Vertical: 1" = 20'

Legend

- ◆ ◆ Geophone Station
- ▼ 201 Energy Source Locations

Figure 4

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Refraction Seismic Investigation:
Costco El Dorado Hills Fuel Project

Prepared for: Kleinfelder, Inc.

Project Number: 2024-30.01 Date: July, 2024

Seismic Velocity Section • RS Line 3

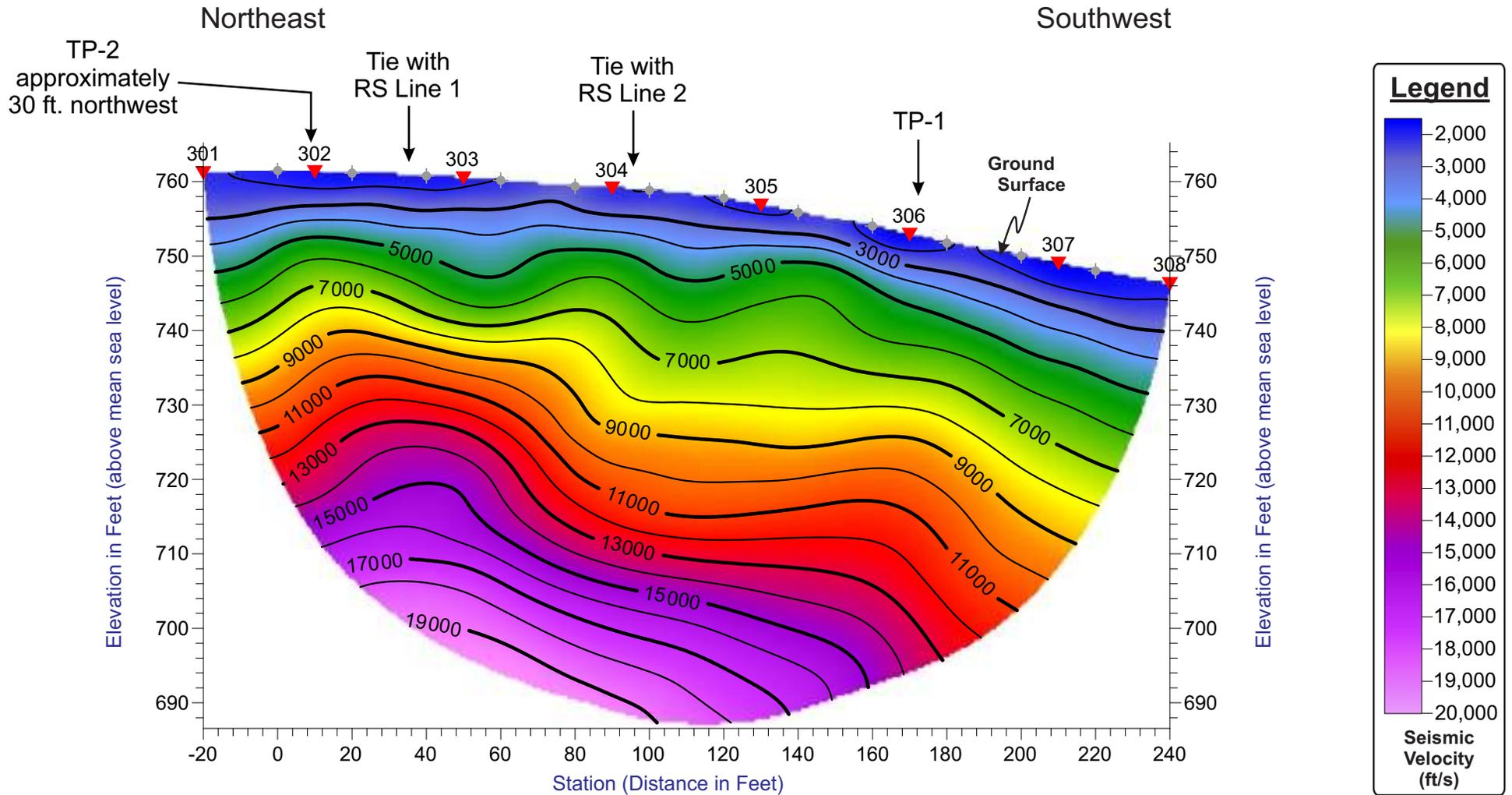


Figure 5

Scale:
Horizontal: 1" = 40'
Vertical: 1" = 20'

Legend

- ◆ Geophone Station
- ◆ Energy
- ▼ Source Locations

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**Refraction Seismic Investigation:
 Costco El Dorado Hills Fuel Project**

Prepared for: Kleinfelder, Inc.

Project Number: 2024-30.01 Date: July, 2024

Caterpillar D8R/D8T Ripper Performance Chart*

D8R/D8T

Multi or Single Shank No. 8 Ripper
 Estimated by Seismic Wave Velocities

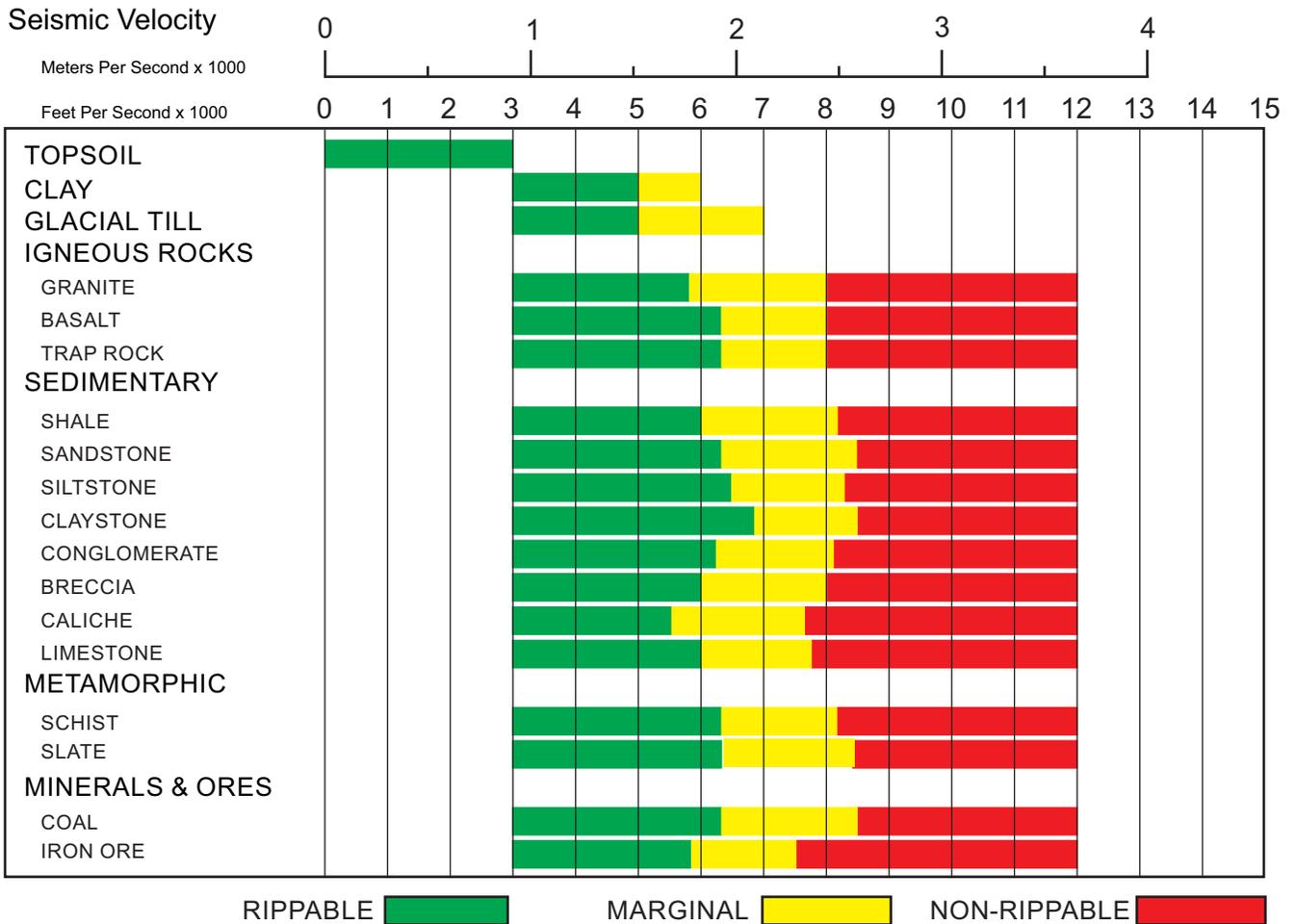


Figure 6

* Based on the Caterpillar Performance Handbook Edition 49 - September, 2019

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Refraction Seismic Investigation:
 Costco El Dorado Hills Fuel Project

Prepared for: Kleinfelder, Inc.

Project Number: 2024-30.01 Date: July, 2024

Draft Geotechnical Study
(November 5, 2019)



November 5, 2019
Kleinfelder Project No. 20193141.001A

Costco Wholesale
9 Corporate Park, Suite 230
Irvine, California 92606

Attention: Mr. Michael Okuma
Director of Real Estate Development

SUBJECT: DRAFT Geotechnical Study
Proposed Costco Wholesale Warehouse and Fuel Facility
Silva Valley Parkway
El Dorado Hills, California
CW# 18-0487

Dear Mr. Okuma

Kleinfelder is pleased to present this report summarizing our **draft** geotechnical study for the proposed Costco Wholesale warehouse and fuel facility located on Silva Valley Parkway in El Dorado Hills, California. The conclusions and recommendations presented in this report are subject to the limitations presented in Section 7.

We appreciate the opportunity to provide geotechnical engineering services to you on this project. If you have any questions regarding this report or if we can be of further service, please do not hesitate to contact Andrea Traum at 408.595.3275, or Andy Franks, Kleinfelder's Client Account Manager for Costco at 480.650.4905.

Sincerely,

KLEINFELDER, INC.

Dan Dockendorf, EIT
Staff Professional

Andrea Traum, PE, LEED AP
Senior Project Manager



DRAFT GEOTECHNICAL STUDY
PROPOSED COSTCO WHOLESALE WAREHOUSE
AND FUEL FACILITY
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA
CW# 18-0487
KLEINFELDER PROJECT NO. 20193141.001A

NOVEMBER 5, 2019

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ONLY THE CLIENT OR ITS DESIGNATED REPRESENTATIVES MAY USE THIS DOCUMENT AND ONLY FOR THE SPECIFIC PROJECT FOR WHICH THIS REPORT WAS PREPARED.

A Report Prepared for:

Mr. Michael Okuma
Costco Wholesale
9 Corporate Park, Suite 230
Irvine, California 92606

**DRAFT GEOTECHNICAL STUDY
PROPOSED COSTCO WHOLESALE
WAREHOUSE AND FUEL FACILITY
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA
CW# 18-0487**

Prepared by:

Dan Dockendorf, EIT
Staff Professional

Reviewed by:

Brian E. Crystal, PE, GE
Principal Geotechnical Engineer

KLEINFELDER
380 North First Street, Suite A
San Jose, CA 95112
Phone: 831.755.7900

November 5, 2019
Kleinfelder Project No. 20193141.001A

Geotechnical Investigation Summary Checklist for Costco Wholesale Projects

General Information

Costco Real Estate Main Contact: Michael Okuma
 Geotechnical Main Contact: Andrea Traum (480-650-4905)
 Geotechnical Engineer of Record: Kleinfelder
 Project Location: Silva Valley Parkway
 El Dorado Hills, CA
 18-0487

CW#: _____
 Warehouse #: _____
 Report Date: November 5, 2019
 Consultant Project/Document Number: 20193141.001A/SJO19R103500
 Addendums (List): _____

Report Purpose: Preliminary Draft Final Addendum/Revision

	Yes	No or NA	Describe/ Comments	Report Section
Pre-existing Conditions/Information				
Developer provided geotechnical report (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Pre-existing development (describe)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Undeveloped land	2.1
Foundation type (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Performance Issues (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Environmental Issues (describe)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Site Grading Records (stripping, compaction test results, field reports, etc.)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Typical Building Structural Design Criteria				
Other (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>		1.1
Building size (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	152,000 square-foot warehouse, fuel facility and 2 level parking structure	1.1
Typical wall loading				
3 kips / foot* (Metal Buildings)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
4.5 kips / foot* (CMU or pre-cast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Typical column loading				
120 kips in non-snow regions	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
150 kips in snow regions	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Typical canopy loading:	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Typical floor slab loading				
500 pounds per square foot, (psf, total)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
250 psf (dead) at rack areas	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
150 psf (dead) at non-rack areas	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
350 psf (live)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Paving Design (20 year life)				
Heavy Duty paving shall accommodate 30 trucks per day (Traffic Index of 7.0)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Light Duty paving shall accommodate 6,600 cars per day (Traffic Index of 5.0)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Performance Grade (PG) binder oil identified for local climate conditions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	PG 64-10	4.9.3
Site Grading Conditions/Assumptions				
Deviations to Typical Criteria (list/describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Design Finished Floor Elevation (FFE) (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Approximately 729 feet	Figures 5-10
Basis for FFE (assumed, per Civil) (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Effects of change to assumed FFE (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Maximum anticipated cuts (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Approximately 15-20 feet	Figures 5-10
Maximum anticipated fills (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Approximately 20 feet	Figures 5-10
Cross sections prepared for sites that are not essentially flat	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Sections A-A' through F-F''	Figures 5-10
Amount of import/export anticipated (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		

	Yes	No or NA	Describe/ Comments	Report Section
Frost Depth (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Retaining walls</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Number of walls (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Height/Length of walls (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>	10-15 feet	4.7
Wall construction/type (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not provided	4.7
Cut/fill transition in pad (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>		Figures 5-10
Offsite Improvements (describe)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Fieldwork/Results				
<i>Costco Due Diligence Design Criteria</i>				
Version (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Version 2018, dated October 26, 2018	
Followed Criteria?	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Deviations to standard investigation (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Groundwater</i>				
Depth (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Perched GW encountered in TP-4/TP-6	3.3
Perched	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Perched above rock contact anticipated	3.3
Expected seasonal fluctuation (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Piezometers installed?	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Unusual/Challenging Soils conditions encountered</i>				
Moisture-sensitive soils	<input checked="" type="checkbox"/>	<input type="checkbox"/>		5.2.4
Undocumented fill	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Unsuitable soils (require removal)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Wet soils	<input checked="" type="checkbox"/>	<input type="checkbox"/>		5.3
Debris	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Bedrock/potential non-rippable conditions	<input checked="" type="checkbox"/>	<input type="checkbox"/>		5.2.7
Refusal	<input checked="" type="checkbox"/>	<input type="checkbox"/>		Appendix A
Collapsible soils	<input type="checkbox"/>	<input checked="" type="checkbox"/>		3.4.5
Expansive soils	<input type="checkbox"/>	<input checked="" type="checkbox"/>		3.4.4
Compressible soils	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Liquefaction	<input type="checkbox"/>	<input checked="" type="checkbox"/>		3.4.3
Sinkholes	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Other (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Potential Contamination Identified</i>				
Soil	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Groundwater	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Restoration of Disturbed Areas</i>				
Backfilled with soil	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Test pits backfilled with soil	Appendix A
Backfilled with grout	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Borings Backfilled with grout	Appendix A
Other (describe):	<input type="checkbox"/>	<input type="checkbox"/>		
Topsoil samples collected/analyzed	<input checked="" type="checkbox"/>	<input type="checkbox"/>		Appendix B
Corrosivity testing performed/addressed	<input checked="" type="checkbox"/>	<input type="checkbox"/>		4.10
Report				
Executive summary	<input checked="" type="checkbox"/>	<input type="checkbox"/>		E-1
Wet weather construction recommendations	<input checked="" type="checkbox"/>	<input type="checkbox"/>		5.3
Pad winterization/pad recommendations	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Frost protection recommendations	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Design Parameters				
<i>Fill material parameters provided</i>				
Structural fill (below foundations, slabs)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		5.2.5
Site grading fill (below pavements, flatwork)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		5.2.6
Select backfill	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Trench backfill	<input checked="" type="checkbox"/>	<input type="checkbox"/>		5.2.10
Drainage fill	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Frost resistant fill	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Slab base aggregate	<input checked="" type="checkbox"/>	<input type="checkbox"/>	6" minimum	4.4

	Yes	No or NA	Describe/ Comments	Report Section
<i>Limits of debris/unsuitable removal provided</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
<i>Over-excavation/recompaction required</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		5.2
Depth (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Excavate all residual/colluvial soils in fill areas; under the 4 to 6' below building pads at cut/fill transition	5.2.2
Extent (include cross-section diagram)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		Figures 5-10
<i>Pad subgrade stabilization required (describe):</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Surcharge</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Height (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Lateral extent (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Estimated duration (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Shallow Foundations</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Warehouse Foundations, Fuel Facility Canopy, Parking Structure	4.3.2
psf allowable soil bearing pressure (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3,000 psf	4.3.2
<i>Deep Foundations</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Drilled Piles	4.3.3
Type (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Light Pole Foundations	4.3.3
Options and Value Engineering Matrix provided	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Floor Slabs</i>				4.4
Unreinforced	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Reinforced (describe why)	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Subgrade modulus (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	150 pci	4.4
Base Material thickness (min 6") (describe):	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Minimum 6" Class 2 AB	4.4
<i>Seismic Conditions</i>				
Governing Building Code (IBC, UBC, other)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2019 CBC	4.2
Geologic Hazard Identified	<input checked="" type="checkbox"/>	<input type="checkbox"/>		3.4
Proximity to earthquake fault zone(s)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		3.4.1
Proximity to seismic hazard zone(s)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		3.4.1
Potential for liquefaction	<input type="checkbox"/>	<input checked="" type="checkbox"/>		3.4.3
Potential for lateral spreading	<input type="checkbox"/>	<input checked="" type="checkbox"/>		3.4.3
Potential for seismic settlement	<input type="checkbox"/>	<input checked="" type="checkbox"/>		3.4.3
Potential for slope stability/landslides	<input type="checkbox"/>	<input checked="" type="checkbox"/>		3.4.2
Potential for ground shaking or geologic hazards	<input checked="" type="checkbox"/>	<input type="checkbox"/>		3.4
<i>Retaining Walls</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Recommended Wall Types	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Recommend Kleinfelder Design	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Lateral earth pressure design values	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Prelim values, no retaining wall specifications given	4.7
Active:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	40 pcf	4.7
At-rest:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	60 pcf	4.7
Passive:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	300 pcf	4.7
Seismic:	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Backfill material, placement requirements	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Drainage requirements and cross-section drawing	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<i>Finger Drains</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Required for frost	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Recommended for long term maintenance and constructability	<input checked="" type="checkbox"/>	<input type="checkbox"/>		4.6
<i>Pavement</i>				4.9
Pavement subgrade stabilization required (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Costco asphalt mix design specified	<input checked="" type="checkbox"/>	<input type="checkbox"/>	PG 64-10	4.9.3
Heavy and light duty pavement sections specified	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Table 3	4.9.2
Alternative pavement sections identified	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Specification for offsite pavement sections included	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Data Gaps/Unknowns (describe):	<input type="checkbox"/>	<input checked="" type="checkbox"/>		

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, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them 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 herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences 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.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

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

- for a different client;
- for a different project or purpose;
- 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, the reliability of a geotechnical-engineering report can be 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 you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site 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.

Most of the “Findings” Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site’s subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement 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 through project completion to obtain 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 judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed 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 continuing 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 available 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-phase observations.

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 information 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. 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. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. 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 provide 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 obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

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, the engineer’s services were not designed, conducted, or intended to prevent 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.**



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EXECUTIVE SUMMARY

This report presents the results of Kleinfelder's geotechnical study for proposed Costco Wholesale warehouse and fuel facility (CW# 18-0487) located on Silva Valley Parkway in El Dorado Hills, California. The purpose of our geotechnical study was to evaluate soil/bedrock and groundwater conditions at the site and provide geotechnical recommendations for project design and construction. We based our study on the Costco Wholesale Development Requirements (CWDRs), Version 2018, revised October 26, 2018.

Kleinfelder understands Costco plans to purchase an approximately 17-acre, commercially-zoned site on the southwest side of Silva Valley Parkway north of Highway 50 in El Dorado Hills, California and construct an approximately 152,000-square foot warehouse and fuel facility. The building will be a single-story, steel-framed structure (30 feet in height) with concrete-masonry-unit and metal walls. Based on the CWDRs, we understand maximum column loads will be on the order of 120 kips for non-snow regions, typical wall loads will be approximately 4.5 kips per lineal foot, and the total slab load (dead plus live loads) will be approximately 500 psf.

In addition, immediately west of the warehouse facility, a two-level parking structure will be constructed, which will service the majority of the parking at the site. Structural loading is not currently available; however, based on past experience, maximum column loads for the parking structure is anticipated to be on the order of 250 kips for interior columns and 125 kips for exterior columns, respectively. Additional surface parking and landscape islands are also planned around the new fuel facility located on the northern portion of the property. Parking and drive areas will be paved with either Portland cement concrete or asphalt concrete pavement.

The site is located between Silva Valley Parkway and US Highway 50 in El Dorado Hills, California. The site is currently bounded by Silva Valley Parkway to the north and east, the southbound US Highway 50 on-ramp to the south, and Clarksville Crossing to the west. The site is undeveloped with rolling hills running from east to west with ground surface elevations between approximately 705 to 755 feet. At the time of our field exploration, much of the site was covered by low-lying vegetation (weeds and shrubs) and animal burrows. Additionally, a seasonal creek runs through the property from east to west.

Based on preliminary grading plans provided by Kier and Wright (Civil Engineer), we understand that the finished floor elevation for the warehouse building slab will be established at Elevation

729 feet. The upper level of the parking structure will match the surface grades surrounding the warehouse building at elevations ranging between 724 and 729 feet. The lower level of the parking structure will be set about 12 feet below the upper level. The warehouse building footprint is situated on a cut/fill transitional area with cuts up to approximately 20 feet in the eastern side of the building and fills up to approximately 10 to 15 feet along the western side of the building. Conversely, the proposed parking structure on the western side of the site is located mostly in fills of approximately 5 to 10 feet in depth. The preliminary grading plans show this site to be balanced. Retaining walls will be constructed on the southern and eastern sides of the warehouse building and west of the fuel facility. Retaining wall types have not been determined at this time; however, rockeries are being considered.

Subsurface conditions at the site were explored by drilling 3 borings/rock cores, excavating 26 test pits and performing a seismic refraction survey. The seismic refraction survey was used to evaluate the excavatability (rippability) of the bedrock rock material. A total of 2 boring/rock cores and 15 test pits were drilled/excavated in the warehouse building area; 1 boring/rock core and 2 test pits were excavated within the fuel facility area, 5 test pits were excavated within the future parking structure; and 4 test pits were excavated in the proposed parking lot areas. The borings were drilled using track-mounted hollow-stem-auger drilling equipment with rock coring abilities to depths of between approximately 8½ to 25 feet below the existing ground surface (bgs). The proposed exploration plan also included a fourth rock coring location (KB-2) at the northeastern corner of the new warehouse location. This location was not drilled due to very hard drilling conditions throughout the course of the field exploration.

Subsurface materials encountered during the explorations consisted of colluvium/residual soil overlying bedrock. The colluvium/residual soil consisted primarily of clayey soils with varying amounts of silt and gravel and varied in depth from approximately 1 to 5½ feet bgs. Below the colluvium/residual soil, bedrock comprised of weathered and fractured metavolcanic rock underlain by little-weathered, intact rock. The rock increased in strength and decreased in weathering and fracture amount with depth, as shown on Figures 5 through 10 and the seismic refraction survey report (Appendix C). Localized deposits of artificial fill were encountered in a few test pits. The fill consisted of sandy lean clays with variable amounts of gravel and cobbles. Perched groundwater was encountered in Test Pits TP-4 and TP-6 at depths of approximately 7 to 8 feet bgs. These test pits were located near a seasonal creek, which runs through the property. During Kleinfelder's investigation of the adjacent property in April of 2019, this creek

had been flowing rapidly and all excavated test pits encountered perched water near bedrock contact.

Based on the results of our prior field exploration, and observations during this exploration, it is our professional opinion that the proposed project is geotechnically feasible, provided the recommendations presented in the geotechnical report are incorporated into the project design and construction. We identified the following key geotechnical considerations during our study.

- The primary geotechnical consideration for site development is the excavatability of the rock and the construction of fills to achieve the finished grades. The seismic refraction survey results (Appendix C) indicate the initial weathered rock layer with compression wave velocities (V_p) ranging between 3,985 to 6,030 feet per second is located approximately 1 to 3 below existing grades and extends as deep as 30 feet below grade within the warehouse building cut. Based on Caterpillar's Handbook of Ripping (2000), rock exhibiting seismic velocities in this range are marginally rippable using a D9R dozer equipped with multi or single shank ripper(s). Underlying this layer is a less weathered rock zone with compression wave velocities ranging between 12,210 to 18,530 feet per second and is located as shallow as 5 to 10 feet below grade within eastern cut for the warehouse building and the fuel facility cut area on the northern portion of the site. Localized blasting will likely be needed to excavate less weathered rock. In addition, crushing and screening operations will likely be required to produce efficient rock fragmentation of the rock (both weathered and less weathered rock) for re-use onsite as structural fill.
- Based on the preliminary grading plan, the warehouse building footprint is situated on a bedrock cut/fill transitional area with cuts up to approximately 20 feet in the eastern side of the building and fills up to approximately 10 to 15 feet along the western side of the building. To provide uniform support for the proposed warehouse building and to reduce the adverse effects of abrupt differential settlement due the cut/fill transition and variability in fill thickness across the building pad, we recommend the bedrock should be undercut by at least 6 feet below the finished floor elevation and backfilled with structural fill. In addition, cut/fill transitions are situated below small areas of the parking structure's lower level. Beneath the parking structure, we recommend the bedrock should be undercut by at least 4 feet below the finished floor elevation and backfilled with structural fill.

- The residual soil/colluvial layer should be excavated to underlying weathered rock contact and stockpiled on site for reuse as structural fill. An estimate of the residual soil/colluvial layer thickness is shown on the cross sections (Figures 5 through 10).
- Prior to grading and subgrade preparation, all vegetation should be cut and removed from the site. Roots and vegetative matter in excess of one inch should be removed by screening or raking soils to a minimum depth of 12 inches. Other than plant roots, organic matter in the topsoil is minimal based on our laboratory testing (between one and three percent). The topsoil can be re-used on site in fills.
- Due to the composition of the bedrock, it will not reduce to a soil-like material when excavated and will not be suitable for re-use as structural fill. However, the bedrock material may be crushed, processed and re-used onsite as structural fill as described below. Rock fragments up to 12 inches in size may be used in structural fills 10 or more feet below finished subgrade elevation, but not within 10 feet of a slope face. Rock fragments greater than 6 inches in size should not be used in the upper 10 feet of site fills. Rock fragments greater than 3 inches in size should not be used in the upper 3 feet of fills below the Costco warehouse building. There may be an opportunity for larger sized rocks and boulders between 12 and 24 inches in size to be re-used at the base of slopes or in landscape areas. A rock that cannot be crushed or screened to above size criteria should be removed off site.
- Rocks up to 12 inches in size may be placed in the deeper portions of structural fills as noted above provided they are thoroughly mixed with soils to avoid excessive concentrations of rock fragments. Over-sized materials (between 6 and 12 inches) should be placed in windrows or otherwise be placed under the observation of the geotechnical engineer's representative in a manner to avoid nesting or voids. Fills should be placed in lifts slightly thicker than the largest particle size and proof-rolled with a D-9 or larger Caterpillar dozer making at least 5 complete passes over each lift. Periodic test pits should be excavated into each compacted lift to confirm the rock fill is being placed in a uniform, dense manner with no nesting or voids.
- After stripping the site and prior to filling in the seasonal creek, which runs from east to west through the site, subdrains should be installed within the creek bottom. This creek was observed to be flowing rapidly during our initial investigation of the adjacent site in April 2019.

- Rainfall will infiltrate near surface soils and collect on less permeable soil and rock at shallow depth. Therefore, perched groundwater will likely be present at or near subgrade level across the entire site during and after rainfall events.
- Although preliminary grading plans show that this site will be balanced, it is anticipated that crushing and processing the harder rock layers will prove challenging and may require soil to be imported onsite. Import materials, if required, should have a Plasticity Index of less than 10 with no less than 70 percent passing the No. 4 sieve, no more than 30 percent of the particles passing the No. 200 sieve, and no particles greater than 3 inches in maximum dimension. The maximum Plasticity Index for imported soils may be modified upon approval by Costco depending on its proposed use. The contractor should provide documentation to Costco that imported fill is free of hazardous materials, including petroleum or petroleum byproducts, chemicals and harmful minerals prior to its transportation and use on site.
- Permanent slopes should be constructed at an inclination of 2:1 (horizontal to vertical) or flatter.
- Retaining wall types have not been determined at this time; however, we understand rockeries are being considered. Kleinfelder has provided recommendations for cantilever retaining walls. Rockeries are designed and constructed by a design-build specialty contractor.
- The proposed Costco warehouse building, fuel facility canopy, and parking structure foundations may be supported on a conventional shallow foundation system. Proposed light poles located in the parking lot may be supported on short drilled pile foundations.
- Pursuant to current Costco Wholesale standard construction design practices, we have evaluated whether steel reinforcement is needed within the floor slab. Based on the geotechnical characteristics of the site, the proposed warehouse can be built with a non-reinforced slab.
- Kleinfelder typically recommends installation of a vapor barrier beneath the slab to mitigate potential moisture issues such as flooring performance and mold. However, we understand that Costco Wholesale has determined that moisture barriers are not to be used in construction of Costco Wholesale warehouses due to adverse effects on concrete curing and performance. Therefore, we have provided construction recommendations that do not include installation of a moisture barrier, with the understanding that there will be an increased risk for adverse moisture issues.

- The residual soil/colluvium is anticipated to be used near the finished subgrade levels around the site. Because this material drains poorly, we recommend radial finger drains below new pavement sections. Additionally, planters should be detailed such that water exiting from them will not seep into the foundation areas or beneath slabs and pavement.
- Based on the current grading plan and understanding of the regional geology, we classify the site as Seismic Site Class C.
- Performance grade (PG) binder oil of 64-10 should be used asphalt concrete pavements and is locally available.
- The minimum resistivity of the samples tested indicate that the soil may be corrosive towards ferrous metals. The concentrations of soluble sulfates indicate that the subsurface soils represent a Class S0 exposure to sulfate attack on concrete in contact with the soil based on ACI 318-14 Table 19.3.1.1 (ACI, 2014). Therefore, in accordance with ACI Building Code 318-14, no special provisions for selection of cement type are required.
- Based on visual soil classification and laboratory testing of the soil samples collected during our field exploration, the upper approximately 1 to 5 feet of the subsurface soils consist predominantly lean sandy clays underlain with highly fractured highly weathered metavolcanic rock. Based on the soil classification, and gradation tests, water infiltration is expected to be very low. We recommend alternatives to infiltration BMPs, such as bio-filtration/bio-retention systems (bio-swales and planter boxes), be implemented at the Costco site.

The findings, conclusions, and recommendations presented in this executive summary should not be relied upon without consulting our geotechnical report for more information. The conclusions and recommendations presented in this report are subject to the limitations presented in Section 7.

1 INTRODUCTION

This report presents the results of Kleinfelder's geotechnical study for proposed Costco Wholesale warehouse and fuel facility (CW# 18-0487) located at Silva Valley Parkway in El Dorado Hills, California. The location of the project site is presented on Figure 1, Site Location Map. The purpose of our geotechnical study was to evaluate soil/bedrock and groundwater conditions at the site and provide geotechnical recommendations for project design and construction. The scope of our services was presented in our change order and revised proposal titled, "Proposal for Geotechnical Study – New Site, Proposed Costco Wholesale Warehouse and Fuel Facility Silva Valley Parkway, El Dorado Hills, California 95762, CW#18-0487," dated August 19, 2019. We based our study on the Costco Wholesale Development Requirements (CWDRs), Version 2018, revised October 26, 2018.

This report presents a description of the services performed, a discussion of the geotechnical conditions observed at the site, and recommendations developed from our engineering analyses of field and laboratory data. Individuals using this report should read the limitations presented in Section 7.

1.1 PROJECT DESCRIPTION

Kleinfelder understands Costco plans to purchase an approximately 17-acre, commercially-zoned site on the southwest side of Silva Valley Parkway north of Highway 50 in El Dorado Hills, California and construct an approximately 152,000-square foot warehouse and fuel facility. The building will be a single-story, steel-framed structure (30 feet in height) with concrete-masonry-unit and metal walls. Based on the CWDRs, we understand maximum column loads will be on the order of 120 kips for non-snow regions, typical wall loads will be approximately 4.5 kips per lineal foot, and the total slab load (dead plus live loads) will be approximately 500 psf.

In addition, immediately west of the warehouse facility, a two-level parking structure will be constructed, which will service the majority of the parking at the site. Structural loading is not currently available; however, based on past experience, maximum column loads for the parking structure is anticipated to be on the order of 250 kips for interior columns and 125 kips for exterior columns, respectively. Additional surface parking and landscape islands are also planned around the new fuel facility located on the northern portion of the property. Parking and drive areas will be paved with either Portland cement concrete or asphalt concrete pavement.

Based on preliminary grading plans provided by Kier and Wright (Civil Engineer), we understand that the finished floor elevation for the warehouse building slab will be established at Elevation 729 feet. The upper level of the parking structure will match the surface grades surrounding the warehouse building at elevations ranging between 724 and 728 feet. The lower level of the parking structure will be set about 12 feet below the upper level. The warehouse building footprint is situated on a cut/fill transitional area with cuts up to approximately 20 feet in the eastern side of the building and fills up to approximately 10 to 15 feet along the western side of the building. Conversely, the proposed parking structure on the western side of the site is located mostly in fills of approximately 5 to 10 feet in depth. The preliminary grading plans show this site to be balanced. Retaining walls will be constructed on the southern and eastern sides of the warehouse building and west of the fuel facility. Retaining wall types have not been determined at this time; however, rockeries are being considered.

1.2 SCOPE OF SERVICES

The scope of our geotechnical study consisted of a literature review, subsurface explorations, geotechnical laboratory testing, engineering evaluation and analysis, and preparation of this report. Studies to assess environmental hazards that may affect the soil and groundwater at the site were beyond our geotechnical scope of services. The following paragraphs present a description of our services.

1.2.1 Task 1 – Background Data Review

We reviewed readily-available published and unpublished geologic literature in our files and the files of public agencies, including selected publications prepared by the California Geological Survey and the U.S. Geological Survey. Readily-available on-line photos were reviewed for past site development and use. We also reviewed readily available seismic and faulting information, including data for designated earthquake fault zones as well as our in-house database of faulting in the general site vicinity.

1.2.2 Task 2 – Field Exploration

Subsurface conditions at the site were explored by drilling 3 borings/rock cores, excavating 26 test pits and performing a seismic refraction survey. The seismic refraction survey was used to evaluate the excavatability (rippability) of the bedrock rock material. A total of 2 boring/rock cores and 15 test pits were drilled/excavated in the warehouse building area; 1 boring/rock core

and 2 test pits were excavated within the fuel facility area, 5 test pits were excavated within the future parking structure; and 4 test pits were excavated in the proposed parking lot areas. The borings were drilled using track-mounted hollow-stem-auger drilling equipment with rock coring abilities to depths of between approximately 8½ to 25 feet below the existing ground surface (bgs). The proposed exploration plan also included a fourth rock coring location (KB-2) at the northeastern corner of the new warehouse location. This location was not drilled due to very hard drilling conditions throughout the course of the field exploration. Test pits were excavated with a John Deere 50G track excavator to depths ranging from 2 to 10 feet bgs. The explorations are shown graphically on Figure 2, Exploration Location Map.

Prior to commencement of the fieldwork, Underground Service Alert (USA) was notified and various geophysical techniques were used at the boring and test pit locations to identify potential conflicts with subsurface structures. A Kleinfelder staff engineer supervised the field operations and logged the explorations. Selected samples were retrieved, placed in plastic bags or sealed, and transported to our laboratory for further evaluation. Descriptions used on the logs result from field observations and data, as well as from laboratory test data. Stratification lines on the logs represent the approximate boundary between soil and/or rock types, and the actual transition may vary and can be gradual. Appendix A presents a description of the field exploration program, exploration logs, test pit logs and a legend of terms and symbols used on the logs.

1.2.3 Task 3 – Laboratory Testing

Laboratory testing was performed on representative bulk and relatively undisturbed samples to assist in soil classification and development of engineering parameters for geotechnical design. Laboratory testing comprised moisture content, Atterberg limits, R-value, and unconfined compressive strength tests and were performed by our in-house laboratory. Corrosivity testing was performed by AP Engineering & Testing, Inc. of Pomona, California.

Analytical testing was performed on a composite topsoil sample for essential elements in accordance with CWDRs topsoil samples were tested for organic content. The topsoil analysis and organic content testing was performed by Waypoint Analytical of Anaheim, California to assess soil fertility, localized concentrations of various metals and organic content. All in-house and subcontracted laboratory test results are shown in Appendix B of this report.

1.2.4 Task 4 – Geotechnical Analyses

We analyzed field and laboratory data in conjunction with the finished grades, warehouse layout, and structural loads to provide geotechnical recommendations for design and construction. We evaluated feasible foundation systems, concrete slab support, pavement design, and earthwork. Seismic design parameters in accordance with the 2019 California Building Code (CBC) are also presented.

1.2.5 Task 5 – Report Preparation

This report summarizes the services performed, data acquired, and our findings, conclusions, and geotechnical recommendations for the design and construction of the proposed improvements. Our report includes the following items:

- Vicinity map and field exploration location map showing the approximate boring and test pit locations;
- Boring and test pit logs (Appendix A);
- Results of laboratory testing including topsoil analytical testing (Appendix B);
- Seismic refraction survey performed by Advanced Geological Services (Appendix C);
- Cross section figures detailing subsurface soils encountered and recommended overexcavation amounts across the building pad and parking lot areas;
- Discussion of general site conditions;
- Discussion of general subsurface conditions as encountered in our field exploration;
- Discussion of regional and local geology;
- Recommendations for seismic design parameters in accordance with Chapter 16 of the 2019 CBC;
- Recommendations for foundation design, allowable bearing pressures, embedment depths, and compatibility constraints under various loading conditions;
- Anticipated total and differential static settlements;
- Recommendations for site preparation, earthwork, temporary slope inclinations, fill placement, and compaction specifications, including the excavation characteristics of bedrock;
- Recommendations for support of floor slabs and slabs-on-grade;

- Recommendations for flexible and rigid pavement structural sections for light- and heavy-duty pavement based on Equivalent Single Axle loading presented in the CWDRs;
- Recommendations for design of retaining structures, including active and at-rest lateral earth pressures, passive and frictional resistance, and applicable surcharge loads; and
- Preliminary evaluation of the corrosion potential of the on-site soils

2 SITE CONDITIONS

2.1 SITE DESCRIPTION

The proposed Costco site is located between Silva Valley Parkway and US Highway 50 in El Dorado Hills, California, as presented on Figure 1. The site is currently bounded by Silva Valley Parkway to the north and east, the southbound US Highway 50 on-ramp to the south, and Clarksville Crossing to the west. The land is zoned as commercial and is located around ¼ mile south of Oak Meadow Elementary school and the Serrano residential development.

At the time of our field exploration, the site was an undeveloped field with rolling hills generally sloping from east to west with ground surface elevations ranging from approximately 705 to 755 feet. Much of the site was covered by low-lying vegetation (weeds and shrubs) and animal burrows as well as some native trees. Outcropping rocks were also visible throughout the site. Additionally, a seasonal creek separating the proposed warehouse and parking structure locations from the proposed fuel facility runs through the property from east to west. This creek was dry during our September 2019 investigation but was observed to be flowing during our initial field exploration of the adjacent property in April of 2019.

An unfinished portion (~100 feet long) of Tong Road resides on the southwest corner of the property. Based on site reconnaissance, no existing structures sat on this land prior to the investigation with no utility company easements running through the property.

3 GEOLOGY

3.1 GEOLOGIC SETTING

3.1.1 Regional Geology

The subject site is situated in the gently rolling topography that forms the western foothills of the Sierra Nevada Mountains. The western foothills are broadly tilted, dipping westward, and uplifted increasingly to the east, due to maximum uplift of the Sierra Nevada at its eastern edge. The Sierra Nevada is comprised mostly of large, north-south elongated blocks of Mesozoic granitic terrain forming the backbone of California. The foothills in the project vicinity consist of a northwest-trending belt of metamorphosed volcanic and sedimentary rock that separate the Sierran crystalline basement rock (granites) from the Central Valley sediments. These rocks are distributed within three major north-south trending, fault-bounded lithologic terrains that extend along the length of the metamorphic belt. Rocks within these terrains have been isoclinally folded and metamorphosed on a regional scale and represent a “collage” of tectonically accreted blocks emplaced during convergent plate tectonism that occurred during the Early Paleozoic and Late Jurassic. Bedding, foliation, and major faults throughout the metamorphic belt normally trend northwest and dip steeply to the east. A map of the regional geology is provided in Figure 3 of this report.

3.1.2 Site Geology

The project area is mapped by Loyd (1983 and 1984) as being underlain by Jurassic and Triassic age metavolcanic rocks (map symbol mv). This formation is almost entirely of marine origin and consist mostly of basaltic to andesitic breccias, flows, and tuffs that have been metamorphosed, but with primary volcanic features generally recognizable. The formation also contains minor associated sandstone and conglomerate, although none were encountered during our field investigation. Foliation that developed from regional metamorphism is often evident in the rock structure and typically has a north-trending direction. Locally, schistose fabric may be evident. The rock strength of the in less weathered portions of the formation is typically very high and can result in difficult excavation conditions.

3.2 SUBSURFACE CONDITIONS

Subsurface materials encountered during the explorations consisted of colluvium/residual soil overlying bedrock. The colluvium/residual soil consisted primarily of clayey soils with varying amounts of silt and gravel and varied in depth from approximately 1 to 5½ feet bgs. Below the

colluvium/residual soil, bedrock comprised of weathered and fractured metavolcanic rock underlain by little-weathered, intact rock. The rock increased in strength and decreased in weathering and fracture amount with depth, as shown on the attached figure and seismic refraction survey report. Localized deposits of artificial fill were encountered in a few test pits. The fill consisted of sandy lean clays with variable amounts of gravel and cobbles.

3.3 GROUNDWATER

Groundwater as not encountered in our explorations to the maximum depth explored of approximately 25 feet. However, perched groundwater was encountered in Test Pits TP-4 and TP-6 at depths of approximately 7 to 8 feet bgs. These test pits were located near a seasonal creek, which runs through the property. During Kleinfelder's investigation of the adjacent property in April of 2019, this creek had been flowing rapidly and all excavated test pits encountered perched water near bedrock contact.

Localized zones of perched water, increased soil moisture content and fluctuations of the groundwater level, should be anticipated during and following the rainy season. Irrigation of landscaped areas on or adjacent to the site can also cause a fluctuation of local groundwater levels.

3.4 ASSESSMENT OF POTENTIAL GEOLOGIC HAZARDS

3.4.1 Localized Faulting

According to CGS (2018), the site is not located within an Alquist-Priolo Earthquake Fault Zone and no mapped active or potentially active fault traces are known to traverse the site. The project area is situated within a region traditionally characterized by few active faults, numerous inactive faults, and low to moderate seismic activity.

An active fault is a fault that has experienced seismic activity during historic time (since roughly 1800) or exhibits evidence of surface displacement during Holocene time (Hart and Bryant 1997). The definition of "potentially active" varies. A generally accepted definition of "potentially active" is a fault showing evidence of displacement that is older than 11,000 years (Holocene age) and younger than 1.7 million years (Pleistocene age). However, "potentially active" is no longer used as criteria for zoning by the California Geologic Survey (CGS), formerly known as the Division of Mines and Geology. The terms "sufficiently active" and "well-defined" are now used by the CGS as criteria for zoning faults under the Alquist-Priolo Earthquake Fault Act. A

"sufficiently active fault" is a fault that shows evidence of Holocene surface displacement along one or more of its segments and branches, while a "well-defined fault" is a fault whose trace is clearly detectable by a trained geologist as a physical feature at or just below the ground surface. The definition "inactive" generally implies that a fault has not been active since the beginning of the Pleistocene Epoch (older than 1.7 million years old).

The nearest well-defined faults to the project are the Genoa and Cordelia faults. Both faults are located over 50 miles from the project site. A major seismic event on either of these faults is anticipated to cause weak ground shaking at the project site.

The nearest fault to the project site is the west trace of the Bear Mountain Fault Zone that strikes northwest-southeast for approximately 84 miles along the Sierra Foothill region. A fault trace within this zone is located approximately 650 feet west of the project and forms a major contact between the metavolcanics rock that underly the project and the younger Copper Hills Volcanics Formation to the west of the fault. Seismically, the mapped fault near the project is mapped as Pre-Quaternary (CGS, 2010). However, current seismic data (ANSS, 2011) shows micro-earthquakes (magnitude less than 2 or 3) are generated along the northern portion of the fault zone and UCEF3 includes the Swain Ravine – Spenceville segment of the Bear Mountains Fault Zone in their probability model (USGS, 2013). This low seismic activity is not expected to impact the project.

3.4.2 Landsliding

The majority of the project site is characterized by slope gradients of 5:1 (horizontal to vertical) and shallower (less steep). Given the elevation differential and shallow gradients the potential for slope instability is considered low. However, it should be noted that the exception to this condition are the approximately 2:1 permanent cut slopes for the roadways that form the northern and southern portions of the site. These slopes were excavated into highly weathered rock that historically can develop shallow debris flows and slumps during wet weather. Given the height of the slopes and extent of exposed rock, the potential for shallow slope instability events in this area is considered moderate.

3.4.3 Liquefaction and Seismic Compression

The term liquefaction describes a phenomenon in which saturated, cohesionless soils temporarily lose shear strength (liquefy) due to increased pore water pressures induced by strong, cyclic

ground motions during an earthquake. Structures founded on or above potentially liquefiable soils may experience bearing capacity failures due to the temporary loss of foundation support, vertical settlements (both total and differential), and/or undergo lateral spreading. The factors known to influence liquefaction potential include soil type, relative density, grain size, confining pressure, depth to groundwater, and the intensity and duration of the seismic ground shaking. Liquefaction is most prevalent in loose to medium dense, silty, sandy, and gravelly soils below the groundwater table. Based on our review of available groundwater well data, it is our opinion that the regional groundwater is deep. Therefore, based on the results of the subsurface explorations and review data, the potential for liquefaction and its adverse effects (i.e., seismic settlement and lateral spreading) is not considered a hazard at the site.

Seismic compression results from the accumulation of contractive volumetric strains in unsaturated soil during earthquake shaking. Loose to medium dense granular material with no fines or with low plasticity fines are most susceptible to seismic compression. Based on the density and composition of the underlying soil/bedrock, seismic compression (dynamic dry settlement) is considered a hazard at the site.

3.4.4 Expansive Soils

Expansive soils are characterized by their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade. The surficial soils are generally low-medium plastic fines; therefore, the expansion potential is considered low.

3.4.5 Collapsible Soils

Collapsible soils are characterized by their ability to undergo significant shrinkage (collapse) during inundation. Inundation in soils can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade. Based on the results of laboratory testing, the soil encountered are not expected to collapse during inundation, so the impact of collapsible soils for this site is considered low.

3.4.6 Subsidence

The site is not located in an area of known significant ground subsidence due to the withdrawal of subsurface fluids. Subsidence may be present but adverse impacts have not been recorded. Therefore, the potential for subsidence occurring at the site due to the withdrawal of oil, gas, or water is considered low.

3.4.7 Flooding

The Flood Insurance Rate Map prepared by the Federal Emergency Management Agency (FEMA) was reviewed to identify the potential flood hazard for the project. This map indicates the site is within Zone X which is defined as being an area with a 0.2-percent-annual-chance-flood and an area of 1-percent-annual-chance flood with average depths of less than 1 foot. Based on this information the potential for the project site to be impacted by regional flooding is considered low. However, the accuracy of this information should be confirmed by a qualified civil engineer/hydrologist. The need and/or method for mitigation of potential flooding should also be addressed.

3.4.8 Oil and Gas Fields

Upon review of the California Division of Oil, Gas & Geothermal Resources (2016) interactive well-finder map accessed at <https://maps.conservation.ca.gov/doggr/wellfinder>, the El Dorado Hills region does not contain any known abandoned oil wells. Additionally, no active wells are known to exist within the project boundary.

3.4.9 Naturally Occurring Asbestos

Naturally occurring asbestos (NOA) has been identified as a source of potentially hazardous airborne asbestos fibers when disturbed by mining or earthwork activities, if present (Clinkenbeard et al. 2002). NOA generally occurs within mafic or ultramafic metamorphic rock units in which one of the asbestiform minerals defined by the California Air Resources Board (CARB 2002) are present. These NOA minerals have unique flexibility and strength characteristics and include asbestiform varieties of the six minerals chrysotile, amosite, crocidolite, tremolite actinolite, and anthophyllite. It was not part of this project's scope to quantitatively evaluate NOA concentrations along the project alignment. However, review of existing NOA maps produced by the CGS (Churchill 2000 and Higgins 2006) and presented on

Figure 4 provides general guidelines as to the likelihood of encountering NOA for both El Dorado and Sacramento counties.

In addition, based on numerous NOA studies Kleinfelder has performed in the project area, typical NOA concentration level ranges (measured as a percent volume using the polarized light microscopy identification method [PLM]) can be identified for the rock types / geologic units present along the project alignment. These typical values can be compared to the threshold limits established by CARB's Airborne Toxic Control Measures (ATCM) for Construction Grading, Quarrying, and Surface Mining Operation (CARB 2002) to identify whether mitigative measurements need to be implemented during excavation of the foundation towers and how the excavation spoils are to be handled relative to disposal and off-haul. Generally, the metavolcanic rock has concentration levels at or below the threshold level of 0.25 percent. Where NOA levels are at or above 0.25 percent, contractors are required to implement mitigation practices to protect workers and the public from airborne NOA particles generated during earthwork operations. NOA levels at or above 1 percent is considered a hazardous material and will require special handling during transportation and will need to be disposed of at an approved site. The Asbestos Review Areas map (Churchill, 2000) indicates the project site is in an area that has been removed as mappable NOA bearing unit based on geologic evaluation. Based on this data the potential for NOA to be encountered at levels at or exceeding regulatory threshold levels is considered low. However, testing by Costco could be performed to further define NOA concentrations across the project area in order to assist Costco with identifying their risk associated with this hazard. Should levels be equal to or exceed regulatory threshold levels mitigation procedures will need to be implemented. Mitigation alternatives will need to be consistent with guidelines outlined in the CARB's current ATCM and Occupational Safety and Health Administration (OSHA) standards for the handling of NOA.

4 GEOTECHNICAL DESIGN RECOMMENDATIONS

4.1 GENERAL

Based on the results of our field exploration, laboratory testing and engineering analyses conducted during this study, it is our professional opinion the proposed project is geotechnically feasible, provided the design and construction recommendations presented in this report are incorporated into the project. We identified the following key geotechnical considerations during our study.

- The primary geotechnical consideration for site development is the excavatability of the rock and the construction of fills to achieve the finished grades. The seismic refraction survey results (Appendix C) indicate the initial weathered rock layer with compression wave velocities (V_p) ranging between 3,985 to 6,030 feet per second is located approximately 1 to 3 below existing grades and extends as deep as 30 feet below grade within the warehouse building cut. Based on Caterpillar's Handbook of Ripping (2000), rock exhibiting seismic velocities in this range are marginally rippable using a D9R dozer equipped with multi or single shank ripper(s). Underlying this layer is a less weathered rock zone with compression wave velocities ranging between 12,210 to 18,530 feet per second and is located as shallow as 5 to 10 feet below grade within eastern cut for the warehouse building and the fuel facility cut area on the northern portion of the site. Localized blasting will likely be needed to excavate less weathered rock. In addition, crushing and screening operations will likely be required to produce efficient rock fragmentation of the rock (both weathered and less weathered rock) for re-use onsite as structural fill.
- Based on the preliminary grading plan, the warehouse building footprint is situated on a bedrock cut/fill transitional area with cuts up to approximately 20 feet in the eastern side of the building and fills up to approximately 10 to 15 feet along the western side of the building. To provide uniform support for the proposed warehouse building and to reduce the adverse effects of abrupt differential settlement due the cut/fill transition and variability in fill thickness across the building pad, we recommend the bedrock should be undercut by at least 6 feet below the finished floor elevation and backfilled with structural fill. In addition, cut/fill transitions are situated below small areas of the parking structure's lower level. Beneath the parking structure, we recommend the bedrock should be undercut by at least 4 feet below the finished floor elevation and backfilled with structural fill.

- The residual soil/colluvial layer should be excavated to underlying weathered rock contact and stockpiled on site for reuse as structural fill. An estimate of the residual soil/colluvial layer thickness is shown on the cross sections (Figures 5 through 10).
- Prior to grading and subgrade preparation, all vegetation should be cut and removed from the site. Roots and vegetative matter in excess of one inch should be removed by screening or raking soils to a minimum depth of 12 inches. Other than plant roots, organic matter in the topsoil is minimal based on our laboratory testing (between one and three percent). The topsoil can be re-used on site in fills.
- Due to the composition of the bedrock, it will not reduce to a soil-like material when excavated and will not be suitable for re-use as structural fill. However, the bedrock material may be crushed, processed and re-used onsite as structural fill as described below. Rock fragments up to 12 inches in size may be used in structural fills 10 or more feet below finished subgrade elevation, but not within 10 feet of a slope face. Rock fragments greater than 6 inches in size should not be used in the upper 10 feet of site fills. Rock fragments greater than 3 inches in size should not be used in the upper 3 feet of fills below the Costco warehouse building. There may be an opportunity for larger sized rocks and boulders between 12 and 24 inches in size to be re-used at the base of slopes or in landscape areas. A rock that cannot be crushed or screened to above size criteria should be removed off site.
- Rocks up to 12 inches in size may be placed in the deeper portions of structural fills as noted above provided they are thoroughly mixed with soils to avoid excessive concentrations of rock fragments. Over-sized materials (between 6 and 12 inches) should be placed in windrows or otherwise be placed under the observation of the geotechnical engineer's representative in a manner to avoid nesting or voids. Fills should be placed in lifts slightly thicker than the largest particle size and proof-rolled with a D-9 or larger Caterpillar dozer making at least 5 complete passes over each lift. Periodic test pits should be excavated into each compacted lift to confirm the rock fill is being placed in a uniform, dense manner with no nesting or voids.
- After stripping the site and prior to filling in the seasonal creek, which runs from east to west through the site, subdrains should be installed within the creek bottom. This creek was observed to be flowing rapidly during our initial investigation of the adjacent site in April 2019.

- Rainfall will infiltrate near surface soils and collect on less permeable soil and rock at shallow depth. Therefore, perched groundwater will likely be present at or near subgrade level across the entire site during and after rainfall events.
- Although preliminary grading plans show that this site will be balanced, it is anticipated that crushing and processing the harder rock layers will prove challenging and may require soil to be imported onsite. Import materials, if required, should have a Plasticity Index of less than 10 with no less than 70 percent passing the No. 4 sieve, no more than 30 percent of the particles passing the No. 200 sieve, and no particles greater than 3 inches in maximum dimension. The maximum Plasticity Index for imported soils may be modified upon approval by Costco depending on its proposed use. The contractor should provide documentation to Costco that imported fill is free of hazardous materials, including petroleum or petroleum byproducts, chemicals and harmful minerals prior to its transportation and use on site.
- Permanent slopes should be constructed at an inclination of 2:1 (horizontal to vertical) or flatter.
- Retaining wall types have not been determined at this time; however, we understand rockeries are being considered. Kleinfelder has provided recommendations for cantilever retaining walls. Rockeries are designed and constructed by a design-build specialty contractor.
- The proposed Costco warehouse building, fuel facility canopy, and parking structure foundations may be supported on a conventional shallow foundation system. Proposed light poles located in the parking lot may be supported on short drilled pile foundations.
- The residual soil/colluvium is anticipated to be used near the finished subgrade levels around the site. Because this material drains poorly, we recommend radial finger drains below new pavement sections. Additionally, planters should be detailed such that water exiting from them will not seep into the foundation areas or beneath slabs and pavement.
- The minimum resistivity of the sample indicates that the soil may be moderately corrosive to corrosive to ferrous metals. The concentrations of soluble sulfates indicate that the subsurface soils represent a Class S0 exposure to sulfate attack on concrete in contact with the soil based on ACI 318-14 Table 19.3.1.1 (ACI, 2014). Therefore, in accordance with ACI Building Code 318-14, no special provisions for selection of cement type are required.
- Based on visual soil classification and laboratory testing of the soil samples collected during our field exploration, the upper approximately 1 to 5 feet of the subsurface soils consist

predominantly lean sandy clays underlain with highly fractured highly weathered metavolcanic rock. Based on the soil classification, and gradation tests, water infiltration is expected to be very low. We recommend alternatives to infiltration BMPs, such as bio-filtration/bio-retention systems (bio-swales and planter boxes), be implemented at the Costco site.

The following opinions, conclusions, and recommendations are based on the properties of the materials encountered in the borings and test pits, the results of the laboratory-testing program, and our engineering analyses performed, and should be incorporated into project design and construction.

4.2 2019 CALIFORNIA BUILDING CODE

We have also provided the seismic design parameters for ASCE 7-16, as the project will be designed after adoption of the 2019 California Building Code (CBC) on January 1, 2020. Based on the current grading plan and understanding of the regional geology and on our interpretation of the CBC criteria, we classify the site as Seismic Site Class C. Approximate coordinates for the site are noted below.

- Latitude: 38.66020 °N
- Longitude: 121.05699 °W

In accordance with Section 11.4.8 of ASCE 7-16, a site-specific ground motion analysis may be required for Site Class D sites with an S_1 greater than 0.2g. However, a site-specific ground motion analysis is not required if the seismic response coefficient (C_s) is determined in accordance with requirements of Chapter 12 and the exceptions noted in Section 11.4.8. The assumption that C_s will be determined in accordance with the requirements of Chapter 12 and the exceptions noted in Section 11.4.8 should be verified by the project structural engineer during final design. The 2019 CBC (non site-specific) for these structures are summarized in Table 1.

**TABLE 1
2019 CBC SEISMIC DESIGN PARAMETERS**

Design Parameter	Recommended Value
Site Class	C
S_s (g)	0.404
S_1 (g)	0.207
F_a	1.300
F_v	1.500
S_{MS} (g)	0.525
S_{M1} (g)	0.311
S_{DS} (g)	0.350
S_{D1} (g)	0.207
PGA_M (g)	0.211

4.3 FOUNDATIONS

4.3.1 General

Based on the results of our field exploration, laboratory testing, and geotechnical analyses, the proposed warehouse building and parking structure may be supported on conventional shallow spread footing foundations founded on subgrade prepared in accordance with Section 5.2.2. We understand that new spread footing foundations for the fuel facility canopy will be embedded approximately 6 to 7 feet below the finished grade. Spread footings may be founded entirely on bedrock or on structural fill.

Proposed light poles in the parking lot may be supported on short drilled pile foundations. Recommendations for the design and construction of shallow foundations and drilled pile foundations are presented below.

4.3.2 Shallow Foundations

Allowable Soil Bearing Pressure

Footings may be designed for a net allowable soil bearing pressure of 3,000 pounds per square foot (psf) for dead plus sustained live loads. Footings should be embedded at least 24 inches below the lowest adjacent exterior grade. The footing dimension and reinforcement should be designed by the structural engineer; however, continuous and isolated spread footings

should have minimum widths of 18 and 24 inches, respectively. A one-third increase in the above bearing pressures can be used for transient wind or seismic loads.

Estimated Settlements

We estimate total static settlement for foundations designed and constructed in accordance with the recommendations presented above to be less than 1 inch. Differential static settlement between similarly loaded footings is estimated to be less than ½ inches over 50 feet.

Lateral Resistance

Lateral load resistance may be derived from passive resistance along the vertical sides of the footings, friction acting at the base of the footing, or a combination of the two. An allowable passive resistance of 300 psf per foot of depth may be used for design. Allowable passive resistance values should not exceed 3,000 psf. An allowable coefficient of friction of 0.4 between the base of the footings and the structural fill soils can be used for sliding resistance using the dead load normal stresses. Friction and passive resistance may be combined without reduction. We recommend that the first foot of soil cover be neglected in the passive resistance calculations if the ground surface is not protected from erosion or disturbance by a slab, pavement or in a similar manner. Where passive soil resistance is used for design of retaining walls, the area within 5 feet of the front of the wall footing should not be disturbed by excavation or other means.

4.3.3 Drilled Pile Foundations (Light Pole Foundations)

Axial Capacity

The compressive axial capacity of drilled piles may be estimated based on an allowable skin friction capacity of 200 pounds per square foot. The upper one foot of the skin friction capacity should be ignored. The uplift capacity may be estimated as 70 percent of the allowable compressive axial capacity. A one-third increase in the allowable capacities may be used for transient loading conditions such as wind or seismic loads.

Settlement

Settlement of the proposed canopy supported on drilled piles, as recommended, is estimated to be less than ½ inch.

Lateral Resistance

The drilled pile foundations lateral resistance can be designed in general accordance with Section 1807.3 of the 2016 CBC. We recommend a lateral soil bearing pressure of 300 psf per foot of depth below grade. The lateral soil bearing pressure should not exceed 3,000 psf. Since drilled piles will act as isolated pole foundations, the allowable lateral soil bearing pressure may be increased by a factor of two for short-term lateral loads provided the structure will not be adversely affected by ½ inch of lateral movement at the ground surface.

4.4 BUILDING SLAB-ON-GRADE

Concrete slab-on-grade floors are appropriate for the proposed warehouse, provided subgrade is prepared in accordance with Section 5.2.2. In accordance with the CWDRs, we recommend the slab be a minimum nominal thickness of 6 inches and underlain by at least 6 inches of aggregate base material. Aggregate base materials should meet current Caltrans specifications for Class 2 aggregate base. Please note that Caltrans Class 2 aggregate base may utilize recycled materials. Costco typically does not allow the use of recycled materials within the building pad.

A modulus of subgrade reaction of 150 pounds per cubic inch may be used for design of slabs underlain 6 inches of aggregate base material. Pursuant to current Costco Wholesale standard construction design practices, we have evaluated whether steel reinforcement is needed in the floor slab. Based on the geotechnical characteristics of the site, the proposed warehouse can be built with a non-reinforced slab.

Floor slab control joints should be used to reduce damage due to shrinkage cracking. Control joint spacing is a function of slab thickness, aggregate size, slump and curing conditions. The requirements for concrete slab thickness, joint spacing, and reinforcement should be established by the designer, based on experience, recognized design guidelines and the intended slab use. Placement and curing conditions will have a strong impact on the final concrete slab integrity.

Kleinfelder typically recommends installation of a vapor barrier beneath the slab to mitigate potential moisture issues such as flooring performance and mold. However, we understand that Costco Wholesale has determined that moisture barriers are not to be used in construction of Costco Wholesale warehouses due to adverse effects on concrete curing and performance. Therefore, we have provided construction recommendations that do not include installation of a

moisture barrier, with the understanding that there will be an increased risk for adverse moisture issues.

4.5 EXTERIOR FLATWORK

Exterior concrete slabs for pedestrian traffic or landscape outside of the building pad limits should be at least four inches thick. Weakened plane joints in sidewalks should be located at intervals of about 6 feet. Careful control of the water/cement ratio should be performed to avoid shrinkage cracking due to excess water or poor concrete finishing or curing. Unreinforced slabs should not be built in areas where further saturation may occur following construction. The subgrade should be prepared in accordance with Section 5.2.2.

4.6 SITE DRAINAGE

Foundation and slab performance depends greatly on proper irrigation and how well runoff water drains from the site. This drainage should be maintained both during construction and over the entire life of the project. The ground surface around structures should be graded such that water drains away from structures without ponding. The surface gradient needed to do this depends on the landscaping type. Surface gradients should conform to current Costco Wholesale standards and the 2019 CBC.

After the initial excavation of the residual/colluvial soils onsite. It is recommended that a perforated subdrain be installed within the creek bottom running from east to west through the project site. The drain may be “burrito wrapped” with filter fabric and surrounded by permeable drain rock prior to rock backfill operations onsite. Slope drains should also be installed within the fill slopes as discussed in Section 4.8. Figures 11 and 12 show typical details for slope and canyon drains.

The residual soil/colluvium is anticipated to be used near the finished subgrade levels around the site. Because this material drains poorly, we recommend radial finger drains below new pavement sections as shown in Detail 16_16 of the CWDRs. Drains should be designed and constructed per Costco’s standard details and laterals should extend at least 15 feet from the catch basins. Planters should be detailed such that water exiting from them will not seep into the foundation areas or beneath slabs and pavement. We recommend that perimeter foundation drains be implemented in accordance with Costco’s development requirements in areas adjacent to landscaping planters.

Where slabs or pavement areas abut landscaped areas, the aggregate base and subgrade soil should be protected against saturation. Vertical cut off structures are recommended to reduce lateral seepage under slabs from adjacent landscaped areas. Vertical cut-off structures may consist of deepened concrete perimeters, or equivalent, extending at least three inches below the base/subgrade interface. Vertical cut-off structures should be poured neat against undisturbed native soil or compacted fill. The cut-off structures should be continuous.

Operations personnel should be instructed to limit irrigation to the minimum level necessary to properly sustain landscaping plants. Should excessive irrigation, waterline breaks or unusually high rainfall occur, saturated zones and “perched” groundwater may develop, which could soften subgrade and reduce pavement life, and could also create potholes. We also recommend that the downspouts from roof drains be connected to a designed subsurface drainage system such as a storm sewer, etc. to avoid discharging water onto pavement areas as well as backfill zones around the warehouse.

Potential sources of water such as water pipes, drains, and the like should be frequently examined for signs of leakage or damage. Any such leakage or damage should be promptly repaired. Sewer lines beneath the warehouse should have a sufficient slope (at least 1 percent). Plumbing and utility lines should be provided with flexible joints or oversized sleeves where they penetrate floor slabs to prevent breakage caused by different slab movement.

4.7 RETAINING STRUCTURES

Retaining wall types have not been determined at this time; however, we understand rockeries are being considered. Recommendations for cantilever retaining walls are provided below. Rockeries are designed and constructed by a design-build specialty contractor.

Design earth pressures for retaining structures depend primarily on the allowable wall movement, wall inclination, type of backfill materials, backfill slopes, surcharges, and drainage. Earth pressures provided assume that granular (sandy) soils will be used as backfill. The on-site residual soil/colluvium should not be used as retaining wall backfill. The granular backfill, which should meet the requirements for imported fill as defined in Section 5.2.6, should extend behind walls a horizontal distance of at least one-half the height of the wall. Determination of whether the active or at-rest condition is appropriate for design will depend on the flexibility of the walls. Walls that are free to rotate at least 0.002 radians (deflection at the top of the wall of at least $0.002 \times H$,

where H is the unbalanced wall height) may be designed for the active condition. Walls that are not capable of this movement should be assumed rigid and designed for the at-rest condition. Walls that are not capable of this movement should be assumed rigid and designed for the at-rest condition. The recommended active and at-rest earth pressures and passive resistance values are provided in Table 2.

**TABLE 2
LATERAL EARTH PRESSURES FOR RETAINING STRUCTURES
(GRANULAR BACKFILL)**

Wall Movement	Backfill Condition	Equivalent Fluid Pressure (pcf)	Seismic Increment (pcf)
Free to Deflect (active condition)	Level	40	5H*
Restrained (at-rest condition)		60	N/A**

Note: * Walls supporting more than 6 feet of backfill should be designed to support an incremental seismic lateral pressure, which is applied as a triangular pressure distribution with a maximum pressure at the bottom of the wall, not inverted, and H is the height of the wall.

** for restrained wall, use the static active earth pressure and seismic increment to check the seismic condition; use at-rest earth pressure only to check the static condition; the larger loading of both cases should be used for the design of restrained wall.

The above lateral earth pressures do not include the effects of surcharges (e.g., traffic, footings), compaction, or truck-induced wall pressures. Any surcharge (live, including traffic, or dead load) located within a 1:1 (horizontal to vertical) plane drawn upward from the base of the excavation should be added to the lateral earth pressures. The lateral contribution of a uniform surcharge load located immediately behind walls may be calculated by multiplying the surcharge by 0.33 for cantilevered walls under active conditions and 0.50 for restrained walls under at-rest conditions. Walls immediately adjacent to areas subject to vehicular traffic should be designed for a 2-foot equivalent soil surcharge (250 psf). Lateral load contributions from other surcharges located behind walls may be provided once the load configurations and layouts are known.

Walls should be properly drained or designed to resist hydrostatic pressures. Adequate drainage is essential to provide a free-drained backfill condition so that there is no hydrostatic buildup behind the wall. Walls should also be appropriately waterproofed to reduce the potential for staining. Drainage behind loading dock walls can consist of weep holes placed along the base of the wall. Weep holes should be spaced 10 to 15 feet apart and connected with a gravel drain consisting of approximately 2 cubic feet of clean gravel per foot of wall length wrapped with filter fabric. Other types of retaining walls should have a continuous back drain as described below.

For backfill of walls with a continuous back drain, except for the upper 2 feet, the backfill immediately behind retaining walls (minimum horizontal distance of 2 feet measured perpendicular to the wall) should consist of free-draining $\frac{3}{4}$ -inch crushed rock wrapped with filter fabric. The upper 2 feet of cover backfill should consist of relatively impervious material. A 4-inch-diameter perforated PVC pipe, placed perforations down at the bottom of the rock layer leading to a suitable gravity outlet, should be installed at the base of the walls.

As an alternative to the gravel drain noted above, a manufactured drain panel may be utilized behind retaining walls in addition to normal waterproofing. This system generally consists of a prefabricated drain panel lined with filter fabric. At the wall base, we recommend that a gravel drain be installed to collect and discharge drainage to a suitable outlet. The drain should consist of a 4-inch-diameter perforated PVC pipe, placed perforations down at the bottom of approximately 2 cubic feet of clean gravel per foot of wall length. The gravel drain should be wrapped in filter fabric (Mirafi 140N or equivalent). The pipe should be sloped to drain to a suitable outlet and cleanouts should be provided at appropriate intervals.

If drainage behind the wall is omitted, the wall should be designed for full hydrostatic pressure. The design of any drain system should be submitted to Kleinfelder for review to check that our recommendations have been properly incorporated into the design. Installation of the drainage system should be reviewed and documented by a Kleinfelder representative.

4.8 PERMANENT SLOPES

Preliminary grading plans from the civil engineer have been provided show cut and fill slopes between 2:1 and 6:1 (horizontal to vertical) around the project site. Permanent slopes should be constructed at an inclination of 2:1 or flatter. Slopes will be subject to erosion and should be planted as soon as practicable.

For areas above slopes, positive drainage should be established away from the top of slopes. This may be accomplished utilizing a brow ditch placed at the top of cut slopes to redirect surface runoff away from the slope face where drainage devices are not otherwise available. Site runoff should not be permitted to flow over the tops of slopes. Slope drains should also be installed within the fill slopes. Figures 11 and 12 show typical details for slope and canyon drains.

4.9 PAVEMENT SECTIONS

The required pavement structural sections will depend on the expected wheel loads, volume of traffic, and subgrade soils. We have provided asphalt concrete pavement sections for traffic indices provided in the CWDRs (Costco, 2018). Positive drainage of the paved areas should be provided since moisture infiltration into the subgrade may decrease the life of pavements. Curbing located adjacent to paved areas should be founded in the subgrade, not the aggregate base, in order to provide a cutoff, which reduces water infiltration into the base course.

The following pavement sections provided above are based on the soil conditions encountered during our field exploration, our assumptions regarding final site grades, and limited laboratory testing.

4.9.1 Costco Pavement Design Parameters

We developed pavement design recommendations using traffic loading parameters provided in the Costco Wholesale Development Requirements and the following test data:

- A 20-year pavement design life;
- Light-duty pavements subject to 6,600 passenger vehicle trips per day (Traffic Index of 5.0);
- Heavy-duty pavements subject to 30 tractor-trailer truck tips per day (Traffic Index of 7.0);
- For asphalt concrete pavements, a design R-value of 50; and
- For Portland cement concrete (PCC) Pavements, a 28-day flexural strength (modulus of rupture determined by the third-point method) of at least 550 pounds per square inch (psi) (approximate compressive strength of 4,000 psi); a modulus of subgrade reaction (k value) of 200 pounds per cubic inch (pci) for native subgrade; and interlock at the control joints.

4.9.2 Asphalt Concrete Pavement

We designed asphalt concrete pavement, also referred to as Hot Mix Asphalt (HMA), in accordance with the Caltrans Highway Design Manual. Prior to placement of aggregate base, pavement subgrade should be prepared in accordance with Section 5.2.2.

**TABLE 3
RECOMMENDED MINIMUM ASPHALT CONCRETE PAVEMENT SECTIONS**

TRAFFIC USE	TRAFFIC INDEX, TI	DESIGN METHOD	ASPHALT CONCRETE * (INCHES)	AGGREGATE BASE (INCHES)
Light-Duty Pavement	5.0	CALTRANS	3.0	4.0
Heavy-Duty Pavement	7.0	CALTRANS	4.0	5.0

* Rounded to the closest ½ inch.

4.9.3 Asphalt Performance Grade Binder

An asphalt performance grade (PG) binder of 64-10 should be used for the project and is locally available. This recommendation was developed in accordance with Costco Wholesale Asphalt Paving Specification Section 321216. Air temperature data nearest the project site was used with the MERRA Climate Data option and the PG binder was selected using the FHWA program LTTTPBind Online web-based tool based on the AASHTO M323-13 standard. The high-end and low-end temperature rating was selected to provide a reliability of at least 98 and 90 percent, respectively.

4.9.4 Portland Cement Concrete Pavement

We designed PCC pavement in accordance with the Portland Cement Association (PCA) Thickness Design for Concrete Pavements (PCA, 1984) using the design parameters stated above. For heavy-duty pavements, we recommend that PCC pavement section should be comprised of 7.0 inches of PCC with 4.0 inches of aggregate base. We understand that Costco is considering paving the American Disability Act (ADA) access area in front of the main entry with PCC pavement. For ADA access area, we recommend that PCC pavement section should be comprised of 6.0 inches of PCC over 6.0 inches of aggregate base.

Longitudinal and transverse joint spacing should not exceed 12 feet and 15 feet, respectively. Joint details should conform to PCA guidelines. Expansion joints in concrete slabs should be sealed with petroleum resistant sealant to prevent minor releases from impacting subsurface soil.

4.9.5 Aggregate Base

Aggregate base materials should meet current Caltrans specifications for Class 2 aggregate base and be compacted to at least 95 percent relative compaction (ASTM D1557). Caltrans Class 2 aggregate base utilizes recycled materials and require Costco’s approval prior to use.

4.9.6 Pavement Maintenance

Pavements may undergo movement due to changes in subgrade moisture content. This movement tends to accelerate pavement deterioration. A crack sealing program should be performed annually to slow pavement deterioration. Any areas where surface water stands on the surface should be remediated. Over time as cracking becomes more pronounced, a slurry seal coat should be applied.

4.10 SOIL CORROSIVITY

We performed laboratory testing for parameters commonly used to evaluate corrosivity of soils, including pH, minimum resistivity, chloride and soluble sulfate content. Table 4 presents the results.

**TABLE 4
CORROSION TEST RESULTS**

Location	Depth (ft)	Minimum Resistivity (ohm-cm)	pH	Soluble Sulfate Content (ppm)	Soluble Chloride Content (ppm)
TP-1	0-2	3,848	5.2	36	35
TP-10	0-2	5,324	6.1	38	39
TP-14	0-2	6,453	6.0	34	34
TP-21	0-1.5	5,012	5.7	41	55

These tests are a generalized indicator of soil corrosivity for the sample tested. Other soils on site may be more, less, or similarly corrosive in nature. Imported fill materials should be tested to confirm that their corrosion potential is not more severe than those noted.

Although Kleinfelder does not practice corrosion engineering, resistivity values between 3,000 and 5,000 ohm-cm are considered corrosive to buried ferrous metals (NACE, 2006). The concentrations of soluble sulfates indicate that the subsurface soils represent a Class S0

exposure to sulfate attack on concrete in contact with the soil based on ACI 318-14 Table 19.3.1.1 (ACI, 2014). Therefore, in accordance with ACI Building Code 318-14, no special provisions for selection of cement type are required.

Concrete and the reinforcing steel within it are at risk of corrosion when exposed to water-soluble chloride in the soil or groundwater. The project structural engineer should review this data to determine if remedial measures are necessary for the concrete reinforcing steel.

4.11 STORMWATER MANAGEMENT

We have assessed the potential for storm water infiltration into the subgrade soils at the subject project site. Our assessment is based on the data collected during our field exploration (borings and test pits) and laboratory testing.

Based on visual soil classification and laboratory testing of the soil samples collected during our field exploration, the upper approximately 1 to 5 feet of the subsurface soils consist predominantly lean sandy clays underlain with highly fractured highly weathered metavolcanic rock. Based on the soil classification, and gradation tests, water infiltration is expected to be very low.

We recommend alternatives to infiltration BMPs, such as bio-filtration/bio-retention systems (bio-swales and planter boxes), be implemented at the Costco site. If bio-filtration/bio-retention systems are employed, we recommend that the BMPs be built such that water exiting from them will not seep into the foundation areas or beneath slabs and pavement. If planters are located within 10 feet of the building or building foundations, or adjacent to slabs and pavements, then some means of diverting water away from the building, building foundation soils, or soils that support slabs and pavements would be required, such as lining the planters.

5 CONSTRUCTION RECOMMENDATIONS

5.1 GENERAL

The following recommendations should be used by the contractor for construction of the project attention to excavatability and perched groundwater should be noted.

5.2 EARTHWORK

5.2.1 General

Site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations and other local, state or federal specifications, and the recommendations included in this report. References to maximum dry unit weights are established in accordance with the latest version of ASTM Test Method D1557 (modified Proctor). The earthwork operations should be observed and tested by a representative of Kleinfelder.

5.2.2 Site Preparation

Abandoned utilities and other existing features within the proposed development areas (if any are encountered) should be removed and the excavation(s) backfilled with structural fill. Debris produced by demolition operations, including wood, steel, piping, plastics, etc., should be separated and disposed of off-site. Existing utility pipelines or conduits that extend beyond the limits of the proposed construction and are to be abandoned in place, should be plugged with non-shrinking cement grout to prevent migration of soil and/or water. Demolition, disposal and grading operations should be observed and tested by a representative of Kleinfelder.

Prior to grading and subgrade preparation, all vegetation should be cut and removed from the site. Roots and vegetative matter in excess of one inch should be removed by screening or raking soils to a minimum depth of 12 inches. Other than plant roots, organic matter in the topsoil is minimal based on our laboratory testing (between one and three percent). The topsoil can be re-used in site fills. The residual soil/colluvial layer should be excavated to underlying weathered rock contact and stockpiled on site for reuse as structural fill. An estimate of the residual soil/colluvial layer thickness is shown on the attached cross sections (Figures 5 through 10).

Based on the preliminary grading plan, the warehouse building footprint is situated on a bedrock cut/fill transitional area with cuts up to approximately 20 feet in the eastern side of the building and fills up to approximately 10 to 15 feet along the western side of the building. To provide

uniform support for the proposed warehouse building and to reduce the adverse effects of abrupt differential settlement due the cut/fill transition and variability in fill thickness across the building pad, we recommend the bedrock should be undercut by at least 6 feet below the finished floor elevation and backfilled with structural fill. In addition, cut/fill transitions are situated below small area of the parking structure's lower level. Beneath the parking structure, we recommend the bedrock should be undercut by at least 4 feet below the finished floor elevation and backfilled with structural fill.

5.2.3 Permanent Slopes

Permanent slopes should be constructed at 2:1 (horizontal to vertical) or flatter. Slopes will be subject to erosion and should be planted as soon as practicable. Where new fill slopes are to be constructed on hillsides or existing slopes, the topsoil, colluvial soils, and other materials considered unsuitable should be removed. Where the exposed slope is steeper than 5:1, or where recommended by personnel by our firm, the original ground on which fill is to be placed should be keyed and benched. The benches should extend in the underlying bedrock. Key should be at least 8 feet wide and sloped a minimum of 2% towards the slope. Benches should be at least 4 feet wide and not exceed 4 feet in height. Fill slopes should be overbuilt by 2 feet then cut back to facilitate compaction at the face. Fill and cut slopes should be observed by our firm during grading to evaluate the anticipated geologic conditions and make any necessary modifications. Slope drains should also be installed within the fill slopes to prevent building up hydrostatic pressures behind slopes, especially in areas of observed seepage. Figures 11 and 12 show typical details for slope and canyon drains.

5.2.4 Temporary Excavations

All excavations must comply with applicable local, state, and federal safety regulations, including OSHA requirements. The responsibility for excavation safety and stability of temporary construction slopes lies solely with the contractor. We are providing this information below solely as a service to our client. Under no circumstances should this information provided be interpreted to mean that Kleinfelder is assuming responsibility for final engineering of excavations or shoring, construction site safety, or the contractors' activities; such responsibility is not being implied and should not be inferred.

Minor sloughing and/or raveling of slopes should be anticipated as they dry out. Where space for sloped embankments is not available, shoring will be necessary. In addition, excavations within a

1:1 plane extending downward from a horizontal distance of 2 feet beyond the bottom outer edge of existing improvements should not be attempted without bracing and/or underpinning the footings, as discussed above. The geotechnical engineer or their field representative should observe the excavations so that modifications can be made to the excavations, as necessary, based on variations in the encountered soil conditions. All applicable excavation safety requirements and regulations, including OSHA requirements, should be met.

All trench excavations should be braced and shored in accordance with good construction practice and all applicable safety ordinances and codes. Stockpiled (excavated) materials should be placed no closer to the edge of an excavation than a distance equal to the depth of the excavation, but no closer than 4 feet.

5.2.5 Excavation Characteristics

The seismic refraction survey results indicate the initial weathered rock layer with compression wave velocities (V_p) ranging between 3,985 to 6,030 feet per second is located approximately 1 to 3 below existing grades and extends as deep as 30 feet below grade within the warehouse building cut. Based on Caterpillar's Handbook of Ripping (2000), rock exhibiting seismic velocities in this range are marginally rippable using a D9R dozer equipped with multi or single shank ripper(s). Underlying this layer is a less weathered rock zone with compression wave velocities ranging between 12,210 to 18,530 feet per second and is located as shallow as 5 to 10 feet below grade within eastern cut for the warehouse building and the fuel facility cut area on the northern portion of the site. Localized blasting will likely be needed to excavate less weathered rock. In addition, crushing and screening operations will likely be required to produce efficient rock fragmentation of the rock (both weathered and less weathered rock) for re-use onsite as structural fill. The results of the seismic refraction survey are presented in Appendix C of this report.

5.2.6 Foundation Excavations

Shallow Foundations

Following excavation to the foundation subgrade elevations, the exposed subgrade should be observed by a representative of the geotechnical engineer to evaluate the presence of satisfactory materials at design elevations. If unsatisfactory material, such as soft or disturbed soil, debris or otherwise unsuitable soil is present at the base of footing excavations, it should be overexcavated

and replaced with structural concrete, 2-sack sand-cement slurry, or structural fill to the depth determined by the geotechnical engineer.

We understand that new spread footing foundations for the fuel facility canopy will be embedded approximately 6 to 7 feet below the finished grade. If a bedrock cut/fill transition is encountered at the footing bottom for the canopy, the bedrock should be undercut by at least 3 feet and backfilled with structural fill to provide uniform support. It should be noted that fuel facility canopy spread foundation excavation may encounter the harder, less weathered bedrock layer and may require blasting to achieve proper foundation depth.

Drilled Pile Foundations

The performance and capacities of piles can be influenced significantly by the selected construction methods and procedures used. Construction methods that create large zones of disturbance around the drilled shafts can lead to lower than expected skin friction due to excessive stress relief around the shaft length. At grade parking lots are planned north of the warehouse footprint. Per Kleinfelder's seismic refraction survey, these drilled piers will encounter the weathered bedrock layer during drilling. Drilling should be completed with heavy-duty equipment with rock coring capabilities.

Concrete should be placed immediately after drilling of the hole is complete. The concrete should be pumped to the bottom of the drilled shaft using a down-hole tremie. If the tremie method is used to place concrete below the polymer slurry level, we recommend it have a slump of at least 8 inches. If steel casing is used, the casing should be removed as the concrete is placed but the bottom of the casing should be kept at least 5 feet below the top of the concrete.

5.2.7 Fill Material and Compaction Criteria

The on-site soils, minus debris, organic matter, or other deleterious materials may be used as structural fill. Due to the composition of the bedrock, it will not reduce to a soil-like material when excavated. The bedrock material may be crushed, processed and re-used onsite as structural fill. Rock fragments up to 12 inches in size may be used in structural fills 10 or more feet below finished subgrade elevation, but not within 10 feet of a slope face. Rock fragments greater than 6 inches in size should not be used in the upper 10 feet of site fills. Rock fragments greater than 3 inches in size should not be used in the upper 3 feet of fills below the Costco warehouse building. There may be an opportunity for larger sized rocks and boulders between 12 and 24 inches in

size to be re-used at the base of slopes or in landscape areas. A rock that cannot be crushed or screened to above size criteria should be removed off site.

Rocks up to 12 inches in size may be placed in the deeper portions of structural fills as noted above provided they are thoroughly mixed with soils to avoid excessive concentrations of rock fragments. Over-sized materials (between 6 and 12 inches) should be placed in windrows or otherwise be placed under the observation of the geotechnical engineer's representative in a manner to avoid nesting or voids. Fills should be placed in lifts slightly thicker than the largest particle size and proof-rolled with a D-9 or larger Caterpillar dozer making at least 5 complete passes over each lift. Periodic test pits should be excavated into each compacted lift to confirm the rock fill is being placed in a uniform, dense manner with no nesting or voids.

Compaction of rocky fill should be performed by at least 8 to 10 passes of either a self-propelled, vibratory roller applying at least 20 tons force (dynamic) or a sheepsfoot roller weighing at least 30 tons (static) where at least 90 percent relative compaction is specified. Verification of consolidated material by pot holing during fill/backfill activities should be performed for each lift of compacted rocky fill to confirm a dense fill with no void is being achieved. Additional fill lifts should not be placed if the previous fill lift did not meet the minimum required relative compaction or if fill conditions are not stable. Disking, cross ripping, and/or blending may be required to uniformly moisture-condition soils used for engineered fill.

Although preliminary grading plans show that this site will be balanced, it is anticipated that crushing and processing the harder rock layers will prove challenging and may require soil to be imported onsite. Import materials, if required, should have a Plasticity Index of less than 10 with no less than 70 percent passing the No. 4 sieve, no more than 30 percent of the particles passing the No. 200 sieve, and no particles greater than 3 inches in maximum dimension. The maximum Plasticity Index for imported soils may be modified upon approval by Costco depending on its proposed use. The contractor should provide documentation to Costco that imported fill is free of hazardous materials, including petroleum or petroleum byproducts, chemicals and harmful minerals prior to its transportation and use on site

We recommend soils compacted to at least 95 percent of the maximum dry unit weight (ASTM D1557) in accordance with the CWDRs. Fill should be placed in loose horizontal lifts not more than 8 inches thick (loose measurement). The moisture content of the fill should be maintained at

around optimum for sandy soils and at least above optimum for clayey soils during compaction. Table 5 presents structural fill placement and compaction criteria.

**TABLE 5
STRUCTURAL FILL PLACEMENT AND COMPACTION CRITERIA**

Fill Location/Use	Material Type	Relative Compaction¹ (ASTM D1557)	Moisture Content Range	Minimum Compaction Testing Frequency Per Lift
Aggregate base for pavements and concrete slabs	Aggregate Base	95 percent	-2 to +2% of optimum	10,000 Square Feet
Structural Areas (Warehouse Building Pad)	On-site Fill or Imported Material	95 percent	-2 to +2% of optimum for granular soil 0 to +2% of optimum for on-site clayey soils	10,000 Square Feet
Subgrade for Pavements, Sidewalks and Other Flatwork Areas	On-site Fill or Imported Material	95 percent	-2 to +2% of optimum for granular soil 0 to +2% of optimum for on-site clayey soils	15,000 Square Feet
Retaining Wall backfill	Granular Backfill	95 percent	-2 to +2% of optimum	1,000 Square Feet
Utility trenches backfill	On-site Rock Fill or Imported Material	95 percent	-2 to +2% of optimum for granular soil 0 to +2% of optimum for on-site clayey soils	150 Linear Feet
Lawns or Unimproved areas	Imported Material	At least 90 percent	-2 to +2% of optimum for granular soil 0 to +2% of optimum for on-site clayey soils	20,000 Square Feet

5.2.8 Groundwater Impacts

Rainfall will infiltrate near surface soils and collect on less permeable soil and rock at shallow depth. Perched groundwater above the bedrock was encountered in the test pits that were may be encountered during construction. This is most likely to occur following periods of rainfall and in the winter and spring months. If encountered, excavations which extend below the perched

groundwater level (currently estimated to be at approximately 2 to 5 feet below existing site grade) will need to be dewatered. In our opinion, dewatering of narrow trench excavations, which penetrate less than a few feet below the groundwater level and do not encounter loose and/or cohesionless soils, may be possible by directing inflow to a sump where water can be removed by a pump. Temporary dewatering of wider, deeper, and/or more extensive excavations may require well points, deep wells, and/or deep sumps. To help maintain bottom stability of wider, deeper, and/or more extensive excavations, groundwater levels should be drawn-down a minimum of 2 feet below the lowest portion of the excavation. Since temporary dewatering will impact and be dependent on construction methods and scheduling, the contractor will be solely responsible for the design, installation, maintenance, and performance of all temporary dewatering systems.

Perched groundwater levels can fluctuate depending on rainfall, runoff conditions, or other factors. Therefore, water levels presented in this report may not be representative of those encountered at the time of construction. We recommend the contractor verify perched groundwater conditions and evaluate dewatering requirements prior to bidding and/or construction.

Depending on the depth of excavation below perched groundwater, soil conditions encountered along the excavation face, and slope inclination, caving or sloughing of excavation slopes is likely within the vicinity of a sump dewatering system. Sloughing or caving of excavation slopes could endanger personnel working within or adjacent to the excavation as well as nearby equipment, structures, or other existing improvements. The Contractor should be aware of the potential for caving and take appropriate precautions to ensure the safety of site personnel as well as the integrity of the excavation slopes and any existing, nearby structures or other improvements.

5.2.9 Trench Backfill

Pipe zone backfill (i.e. material beneath and in the immediate vicinity of the pipe) should consist of imported soil less than $\frac{3}{4}$ -inch in maximum dimension. Trench zone backfill (i.e., material placed between the pipe zone backfill and finished subgrade) may consist of onsite soil or imported fill that meets the requirements for structural fill provided above.

If imported material is used for trench zone backfill, we recommend it consist of silty sand. In general, gravel should not be used for trench zone backfill due to the potential for soil migration

into the relatively large void spaces present in this type of material and water seepage along trenches backfilled with coarse-grained sand and/or gravel.

Recommendations provided above for pipe zone backfill are minimum requirements only. More stringent material specifications may be required to fulfill local building requirements and/or bedding requirements for specific types of pipes. We recommend the project civil engineer develop these material specifications based on planned pipe types, bedding conditions, and other factors beyond the scope of this study.

Trench backfill should be placed and compacted in accordance with recommendations provided for structural fill in Section 5.2.7. Mechanical compaction is recommended; ponding or jetting should be avoided, especially in areas supporting structural loads or beneath concrete slabs supported on grade, pavements, or other improvements.

5.3 UNSTABLE SUBGRADE CONDITIONS

Pumping subgrade conditions may be encountered during site grading activities in the residual/colluvium soils, and the subgrade may need to be stabilized. Should grading be performed during or following extended periods of rainfall, the moisture content of the near-surface soils will also be significantly above the optimum moisture content. These conditions could seriously impede grading by causing an unstable subgrade condition. Typical remedial measures include the following:

- Drying: Drying unstable subgrade involves disking or ripping wet subgrade to a depth of approximately 18 to 24 inches and allowing the exposed soil to dry. Multiple passes of the equipment (likely on a daily basis) will be needed because as the surface of the soil dries, a crust forms that reduces further evaporation. Frequent disking will help prevent the formation of a crust and will promote drying. This process could take several days to several weeks depending on the material, the depth of ripping, the number of passes, and the weather.
- Removal and Replacement with Crushed Rock and Geotextile Fabric: Unstable subgrade could be overexcavated 12 to 24 inches below existing grade and replaced with $\frac{3}{4}$ - or 1-inch crushed rock underlain by geotextile fabric. The geotextile fabric should consist of a woven geotextile, such as Mirafi HP series or equivalent. The final depth of removal will depend upon the conditions observed in the field once overexcavation begins. The

geotextile fabric should be placed in accordance with the manufacturer's recommendations.

- Chemical Treatment: Unstable subgrade could be stabilized by mixing the upper 12 to 18 inches of the subgrade with Portland cement, Class C fly ash or lime. For estimating purposes, an application rate of 10 to 12 percent Class C fly ash, 3 to 4 percent for high calcium quick lime, or 4 to 5 percent Portland cement may be used. Final application rates should be determined in the field at the time of construction in consultation with the geotechnical engineer. Chemical treatment should be performed by a specialty contractor experienced in this work and should be performed in accordance with Caltrans Standard Specifications. Since lime treatment uses the on-site soil, the expense of importing material can be avoided. Chemically treated areas will have a high pH level (pH over 10) that will need to be removed from landscape areas.

5.4 EXTERIOR FLATWORK

Prior to casting exterior flatwork, the subgrade soils should be moisture conditioned and recompacted or over-excavated, as recommended in Section 5.2.2. If encountered, the moisture content of the clayey subgrade soils should be maintained at least above optimum prior to the placement of any flatwork. In the event that these subgrade soils are allowed to dry out, the exposed subgrade should be re-moisture conditioned. Careful control of the water/cement ratio should be performed to avoid shrinkage cracking due to excess water or poor concrete finishing or curing.

5.5 PAVEMENTS

5.5.1 HMA Design

Hot Mix Asphalt (HMA) should conform to requirements of the Costco Wholesale Specification Section 321216, Asphalt Paving. Section 1.3.C of the HMA specification requires that the HMA section be placed in at least two lifts. The HMA specification allows the use of 1/2- or 3/4-inch Nominal Maximum Aggregate Size (NMAS) mixes for the base course and 3/8- or 1/2-inch NMAS mixes for surface course. Maximum and minimum HMA compacted lift thicknesses are provided in Table 3.1 in Section 3.3.B of the HMA specification.

5.5.2 Construction Considerations

The pavement sections provided above are contingent on the following recommendations being implemented during construction.

- Pavement subgrade should be prepared as recommended in Section 5.2.2.
- Subgrade soils should be in a stable, non-pumping condition at the time the aggregate base materials are placed and compacted.
- Aggregate base materials should be compacted to at least 95 percent relative compaction (ASTM D1557).
- Asphalt paving materials and placement methods should meet current Costco Wholesale Specifications Section 321216.
- Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils and aggregate base materials are not allowed to become wet.

Note that pavement materials and construction must be completed in strict accordance with the Costco's specifications that contain very specific pavement material (asphalt, aggregate and concrete) criteria and construction practices to be used (compaction and material sampling). The general contractor and pavement construction subcontractor should be aware that asphalt and concrete mix designs must be submitted to the design architect and Kleinfelder at least 45 days prior to the scheduled production and laydown for review and approval.

6 ADDITIONAL SERVICES

6.1 PLANS AND SPECIFICATIONS REVIEW

We recommend Kleinfelder perform a review of geotechnical related portions of the project plans and specifications before they are finalized to see that geotechnical recommendations have been properly interpreted and implemented during design. If we are not accorded the privilege of performing this review, we can assume no responsibility for misinterpretation of our recommendations.

6.2 CONSTRUCTION OBSERVATION AND TESTING

The construction process is an integral design component with respect to the geotechnical aspects of a project. Because geotechnical engineering is an inexact science due to the variability of natural processes, and because we sample only a limited portion of the soils affecting the performance of the proposed structure, unanticipated or changed conditions can be encountered during grading. Proper geotechnical observation and testing during construction are imperative to allow the geotechnical engineer the opportunity to verify assumptions made during the design process. Therefore, we recommend that Kleinfelder be retained during the construction of the proposed improvements to observe compliance with the design concepts and geotechnical recommendations, and to allow design changes in the event that subsurface conditions or methods of construction differ from those assumed while completing this study.

Our services are typically needed at the following stages of grading:

- After demolition and grubbing;
- During grading;
- After the overexcavation, but prior to subgrade preparation;
- During utility trench backfill;
- During base placement and site paving; and
- After excavation for foundations.

7 LIMITATIONS

This geotechnical study has been prepared for the exclusive use of Costco Wholesale and their agents for specific application to the proposed Costco Wholesale warehouse and fuel facility located on Silva Valley Parkway in El Dorado Hills, California. The findings, conclusions and recommendations presented in this report were prepared in accordance with generally accepted geotechnical engineering practice. No other warranty, express or implied, is made.

The scope of services was limited to a background data review and the field exploration described in Section 1.2. It should be recognized that definition and evaluation of subsurface conditions are difficult. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions present due to the limitations of data from field studies. The conclusions of this assessment are based on our field exploration and laboratory testing programs, and engineering analyses.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service, which provide information for their purposes at acceptable levels of risk. The client and key members of the design team should discuss the issues covered in this report with Kleinfelder, so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk and expectations for future performance and maintenance.

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. It is possible that soil or groundwater conditions could vary between or beyond the points explored. If soil or groundwater conditions are encountered during construction that differ from those described herein, the client is responsible for ensuring that Kleinfelder is notified immediately so that we may reevaluate the recommendations of this report. If the scope of the proposed construction, including the estimated Traffic Index or locations of the improvements, changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid until the changes are reviewed, and the conclusions of this report are modified or approved in writing, by Kleinfelder.

The scope of services for this subsurface exploration and geotechnical report did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil, surface water, or groundwater at this site.

Kleinfelder cannot be responsible for interpretation by others of this report or the conditions encountered in the field. Kleinfelder must be retained so that all geotechnical aspects of construction will be monitored on a full-time basis by a representative from Kleinfelder, including site preparation, preparation of foundations, and placement of structural fill and trench backfill. These services provide Kleinfelder the opportunity to observe the actual soil and groundwater conditions encountered during construction and to evaluate the applicability of the recommendations presented in this report to the site conditions. If Kleinfelder is not retained to provide these services, we will cease to be the engineer of record for this project and will assume no responsibility for any potential claim during or after construction on this project. If changed site conditions affect the recommendations presented herein, Kleinfelder must also be retained to perform a supplemental evaluation and to issue a revision to our original report.

This report, and any future addenda or reports regarding this site, may be made available to bidders to supply them with only the data contained in the report regarding subsurface conditions and laboratory test results at the point and time noted. Bidders may not rely on interpretations, opinion, recommendations, or conclusions contained in the report. Because of the limited nature of any subsurface study, the contractor may encounter conditions during construction which differ from those presented in this report. In such event, the contractor should promptly notify the owner so that Kleinfelder's geotechnical engineer can be contacted to confirm those conditions. We recommend the contractor describe the nature and extent of the differing conditions in writing and that the construction contract include provisions for dealing with differing conditions. Contingency funds should be reserved for potential problems during earthwork and foundation construction.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance, but in no event later than one year from the date of the report. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party, other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of this report and the nature of the new project, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the

client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party and the client agrees to defend, indemnify, and hold harmless Kleinfelder from any claims or liability associated with such unauthorized use or non-compliance.

8 REFERENCES

Advanced National Seismic System (ANSS), 2011, <http://www.quake.geo.berkeley.edu/cass>

American Concrete Institute (ACI), 2014. Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI318-14R).

American Society of Civil Engineers (ASCE), 2016. Minimum Design Load for Buildings and Other Structures (ASCE/SEI 7-16).

Asphalt Institute, 2001. Thickness Design: Asphalt Pavements for Highways and Streets, Manual Series 1 (MS1), 9th Edition.

Blackburn Consulting, "Geotechnical Report, EDH 52 Silva Valley Parkway at US 50, Rough Grading and Preliminary Foundation Design, El Dorado Hills, CA" dated March 2013.

California Department of Conservation, Division of Oil, Gas and Geothermal Resources (DOGGR), 2016. interactive oil well location map, available at website: <http://maps.conservation.ca.gov/doggr/index.html>.

California Department of Water Resources (DWR), 2016, interactive water well location map, available at website: <http://well.water.ca.gov/>.

California Geological Survey (CGS), 2010, Fault Activity Map of California (2010) available at website: <http://maps.conservation.ca.gov/cgs/fam/>

California Geological Survey (CGS), 2018, Earthquake Fault Zones – A Guide for Government Agencies, Property Owners/Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California: California Geological Survey Special Publication 42, 83p.

CARB (California Air Resources Board), (2002), Asbestos Airborne Toxic Control Measures (ATCM) for Construction, Grading, Quarrying, and Surface Mining Operations.

Caterpillar, (2000) Caterpillar Performance Handbook, 12th Edition available at website: <https://www.wagnerequipment.com/caterpillar-performance-handbook-no-45/>

- Churchill, R. K., Higgins, C. T., and Hill, B. (2000), Areas More Likely to Contain Natural Occurrences of Asbestos in Western El Dorado County, California, California Geological Survey, Open-File Report 2000-002.
- Clinkenbeard, J.P., Churchill, R.K., and Lee, K. (2002), Special Publication 124 – Guidelines for Geologic Investigations of Naturally Occurring Asbestos in California.
- Costco, 2018. Costco Wholesale Development Requirements, Version 2018, dated October 26, 2018.
- David Babcock and Associates, “El Dorado Concept Site Plan 3.0” Sheet 1 of 1 dated July 3, 2019.
- Edelman, S. and Sharp, W. (1989), Terranes, Early Faults, and Pre-Late Jurassic Amalgamation of the Western Sierra Nevada Metamorphic Belt, California, in Geological Society of America Bulletin volume 101, pp 1420-1433.
- Federal Emergency Management Agency (FEMA), 2008, FIRM, Flood Insurance Rate Map, El Dorado County, California and incorporated areas, Panel 725 of 1125, Map number 06017C0725E, effective dated September 28, 2008.
- Gutierrez, C.I., 2011, Preliminary Geologic Map of the Sacramento 30' x 60' Quadrangle, California. CGS, 1: 100,000
- Hart, E.W. and Bryant, W.A., 1997 (revised), Fault-rupture hazard zones in California: California Department of Conservation, Division of Mines and Geology Special Publication 42, 38 p. (Revised periodically; information on state law and zoning program for regulating development near hazardous faults.)
- Higgins, C., and Clinkenbeard J.P. (2006), Relative Likelihood for The Presence of Naturally Occurring Asbestos in Eastern Sacramento County, California, California Geological Survey, Special Report 192
- International Code Council, Inc., 2019 California Building Code.

Kier and Wright. "Preliminary Grading and Drainage Plan of El Dorado Hills Costco for Costco Wholesale Corporation, El Dorado Hills, California, Sheets C-1 through C-4 dated September 20, 2019

Loyd, R., Anderson, T, and Bushnell, et all (1983), Mineral Land Classification of the Placerville 15-minute Quadrangle, El Dorado and Amador Counties, California, California Geological Survey (formerly California Division of Mines and Geology) Open File Report 83-29 SAC.

Loyd, R. (1984) Mineral Land Classification of the Folsom 15-minute Quadrangle, Sacramento, El Dorado Placer, and Amador Counties, California, California Geological Survey (formerly California Division of Mines and Geology) Open File Report 84-50 SAC.

National Association of Corrosion Engineers (NACE), 2006. "Corrosion Basics, An Introduction, 2nd Edition" National Association of Corrosion Engineers.

Portland Cement Association (PCA), 1984, Thickness Design for Concrete Highway and Street Pavements, Skokie, Illinois: Portland Cement Association.

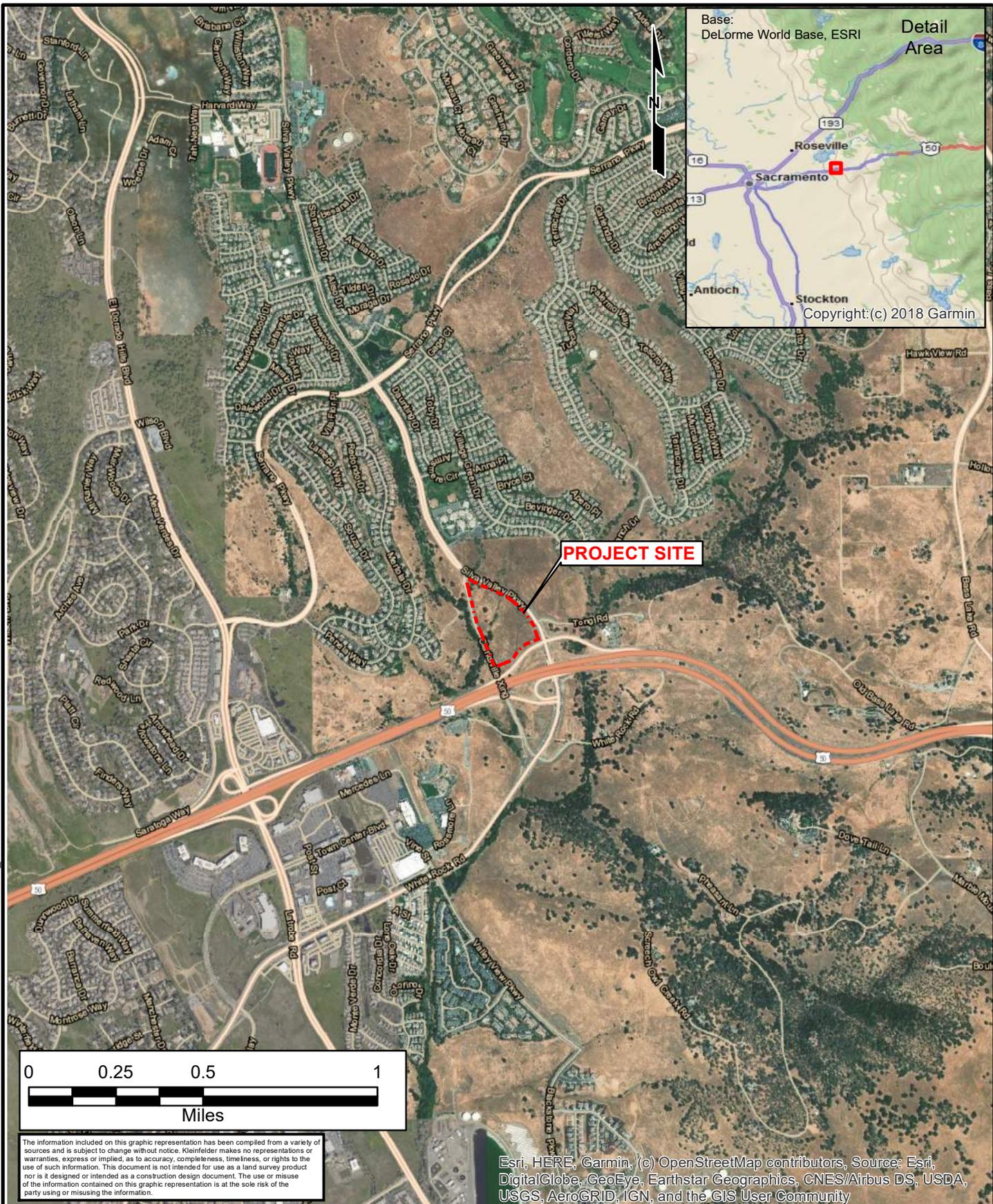
Portland Cement Association, 1988. Design and Control of Concrete Mixtures, Portland Cement Association, Skokie, Illinois.

United States Geological Survey (USGS), 2013, The Uniform California Rupture Forecast, Version 3 (UCERF3) – The Time-Independent Model, USGS Open File Report 2013-1165



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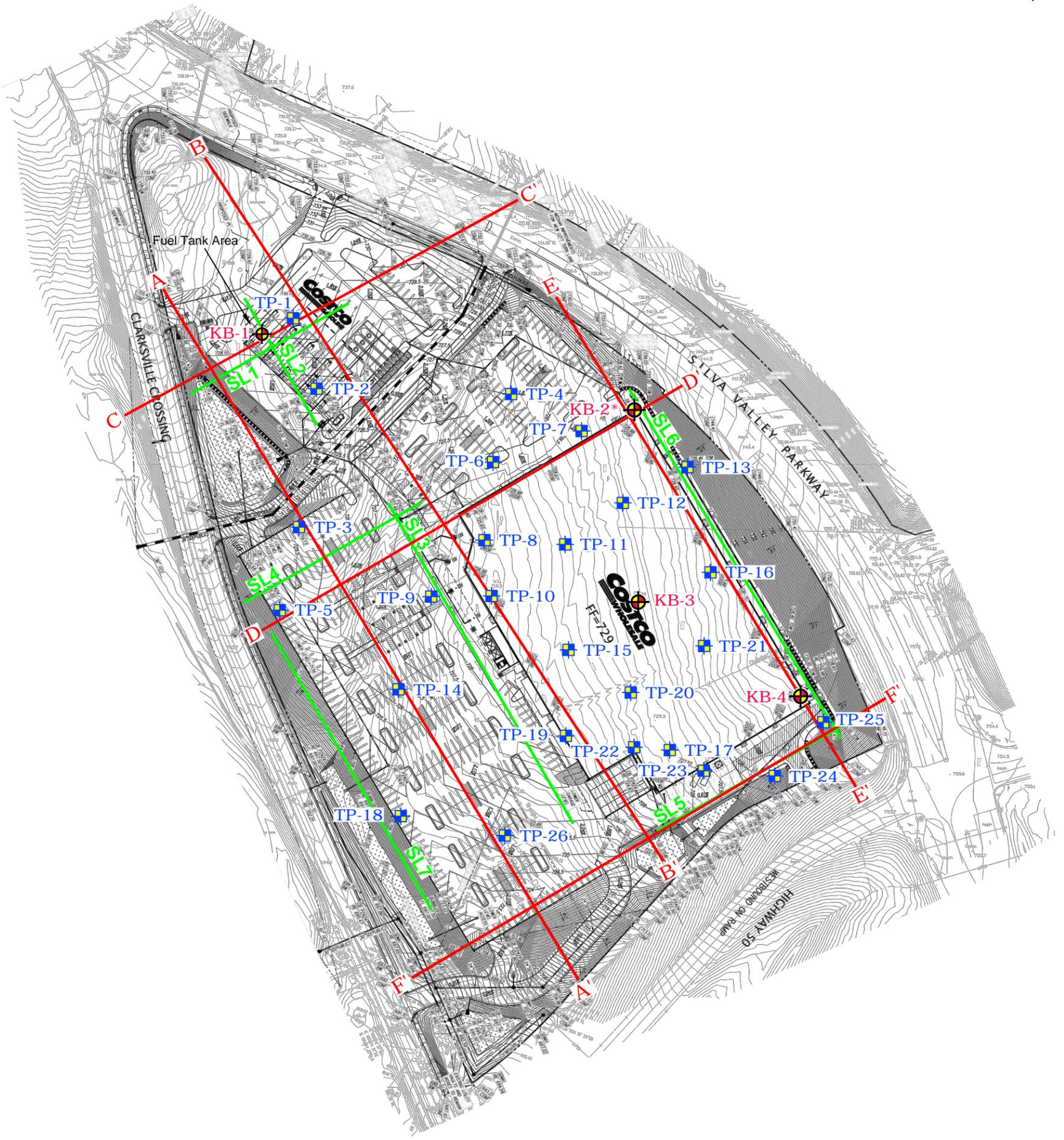
Esri, HERE, Garmin, (c) OpenStreetMap contributors, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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PROJECT NO. 20193141.001A
DRAWN: 9/17/2019
DRAWN BY: D. Ross
CHECKED BY: D. Dockendorf
FILE NAME: 20193141_SVM.mxd

SITE LOCATION MAP
CSM COSTCO EL DORADO HILLS SILVA VALLEY PARKWAY EL DORADO HILLS, CALIFORNIA

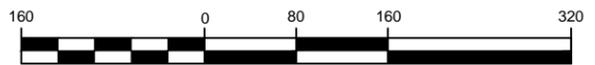
FIGURE
1



LEGEND

-  Rock Core Boring Location
-  Test Pit Location
-  Seismic Refraction Lines
-  Cross Section Lines

*Rock Core Boring Location KB-2 was not drilled due to very hard drilling conditions throughout the site.



APPROXIMATE SCALE: 1 inch = 160 feet

Site Plan Reference: ELDORADO HILLS CONCEPTUAL SITE PLAN - OPTION 2.0, by David Babcock & Associates, Sheet 1 of 1, dated April 11, 2019.

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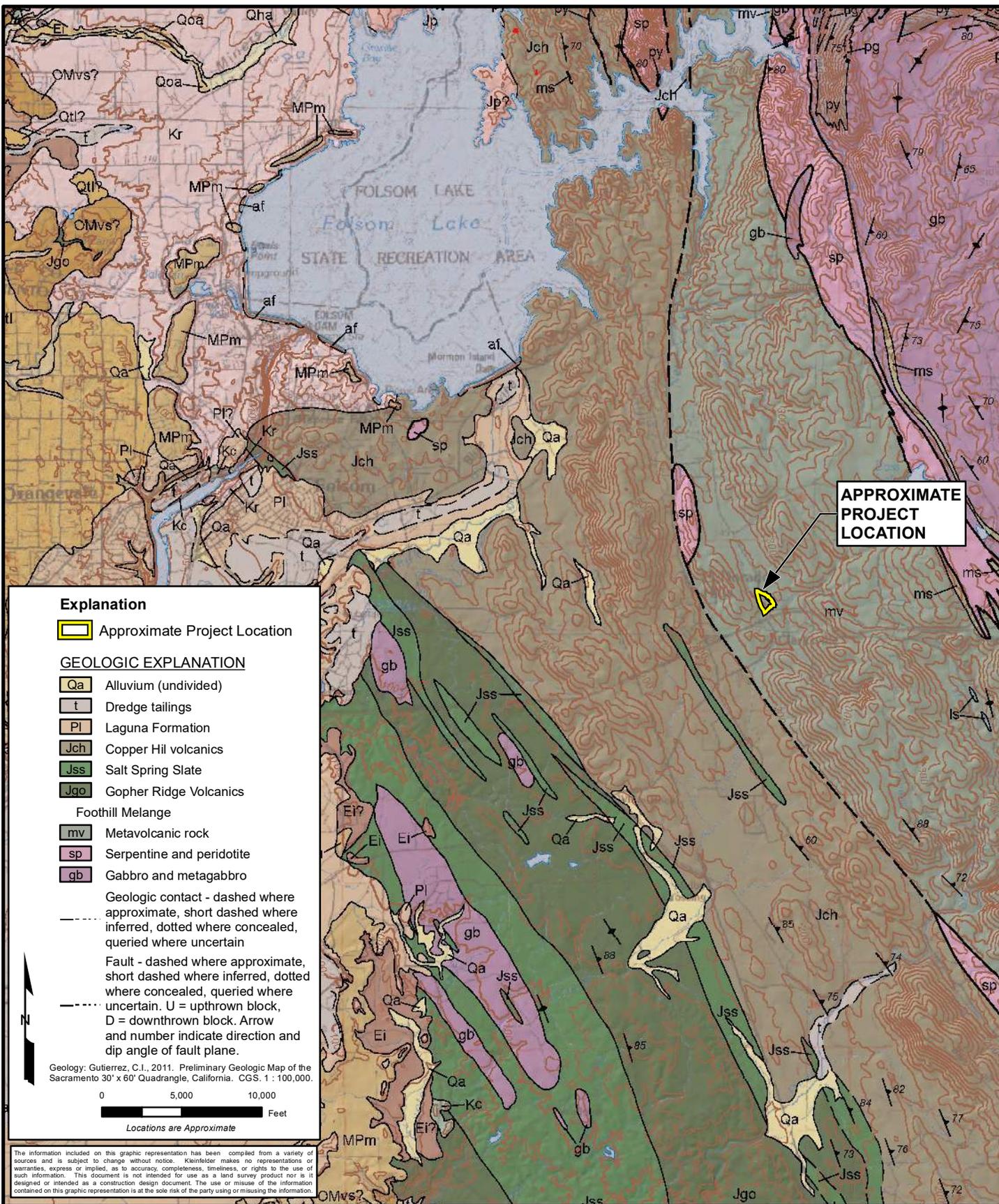
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DRAWN:	10/23/2019
DRAWN BY:	D. Ross
CHECKED BY:	D. Dockendorf
FILE NAME:	20193141_2.dwg

EXPLORATION LOCATION MAP

**CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA**

FIGURE

2



Explanation

Approximate Project Location

GEOLOGIC EXPLANATION

Qa Alluvium (undivided)

t Dredge tailings

Pl Laguna Formation

Jch Copper Hill volcanics

Jss Salt Spring Slate

Jgo Gopher Ridge Volcanics

Foothill Melange

mv Metavolcanic rock

sp Serpentine and peridotite

gb Gabbro and metagabbro

Geologic contact - dashed where approximate, short dashed where inferred, dotted where concealed, queried where uncertain

Fault - dashed where approximate, short dashed where inferred, dotted where concealed, queried where uncertain. U = upthrown block, D = downthrown block. Arrow and number indicate direction and dip angle of fault plane.

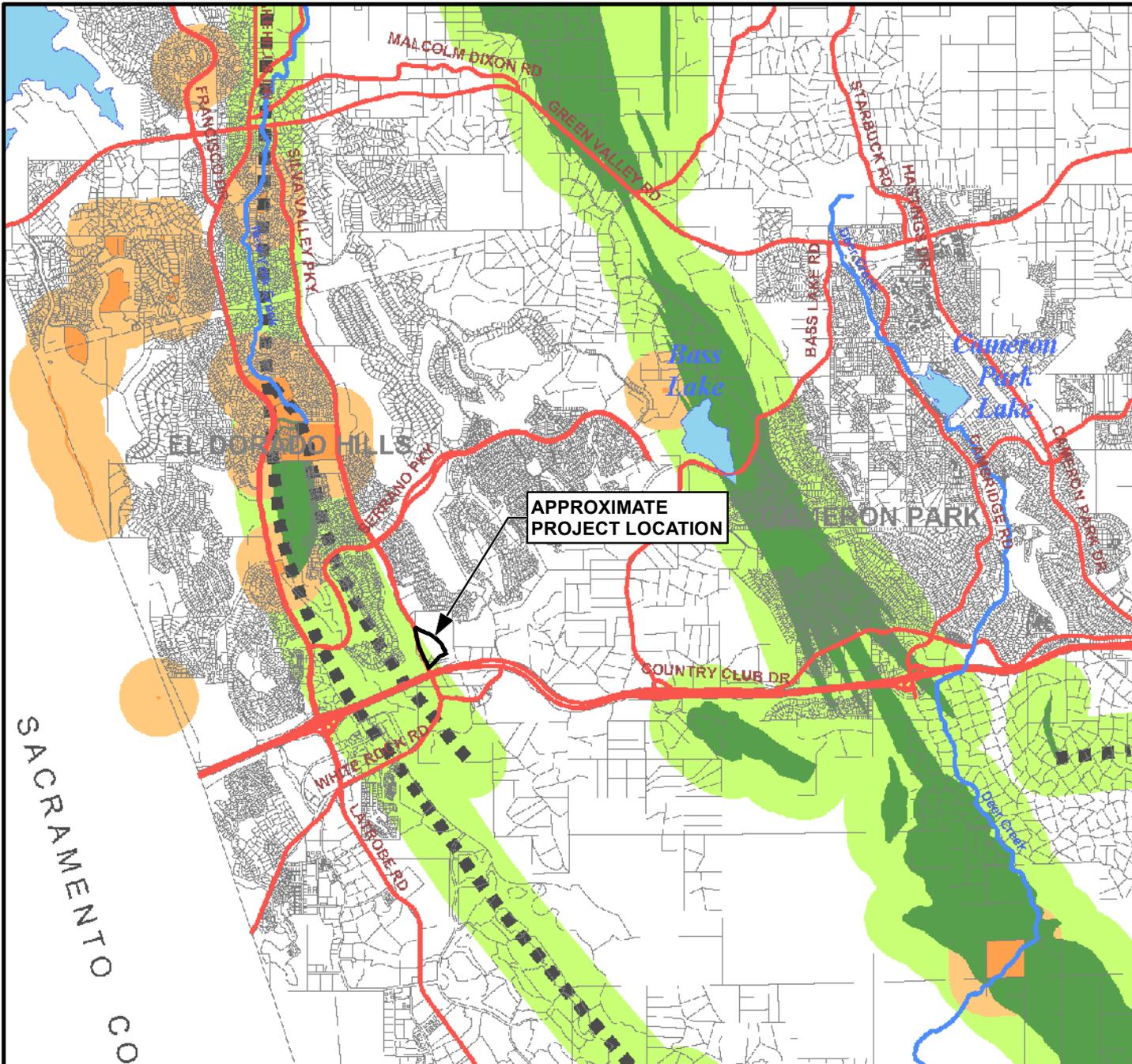
Geology: Gutierrez, C.I., 2011. Preliminary Geologic Map of the Sacramento 30' x 60' Quadrangle, California. CGS. 1 : 100,000.

0 5,000 10,000 Feet

Locations are Approximate

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	PROJECT: 20193141	REGIONAL GEOLOGY MAP	FIGURE
	DRAWN: OCT 2019		
	DRAWN BY: KFH	CSM COSTCO EL DORADO HILLS SILVA VALLEY PARKWAY EL DORADO HILLS, CALIFORNIA	3
	CHECKED BY: DD		
FILE NAME: Fig3_Geo.mxd			



Explanation

- Approximate Project Location
- Found Area of NOA
- Quarter Mile Buffer for Found Area of NOA
- More Likely To Contain Asbestos (Dept of Conservation Mines & Geology OPEN-FILE REPORT 2000-002)
- Quarter Mile Buffer for More Likely To Contain Asbestos or Fault Line
- Fault Line (Dept of Conservation Mines & Geology OPEN-FILE REPORT 2000-002)
- Parcel Base
- Major Roads
- Rivers & Creeks

0 0.5 1 Miles
Locations are Approximate

Source: El Dorado County, 2015. Asbestos Review Areas, Western Slope, County of El Dorado, State of California. 1 : 63,360.

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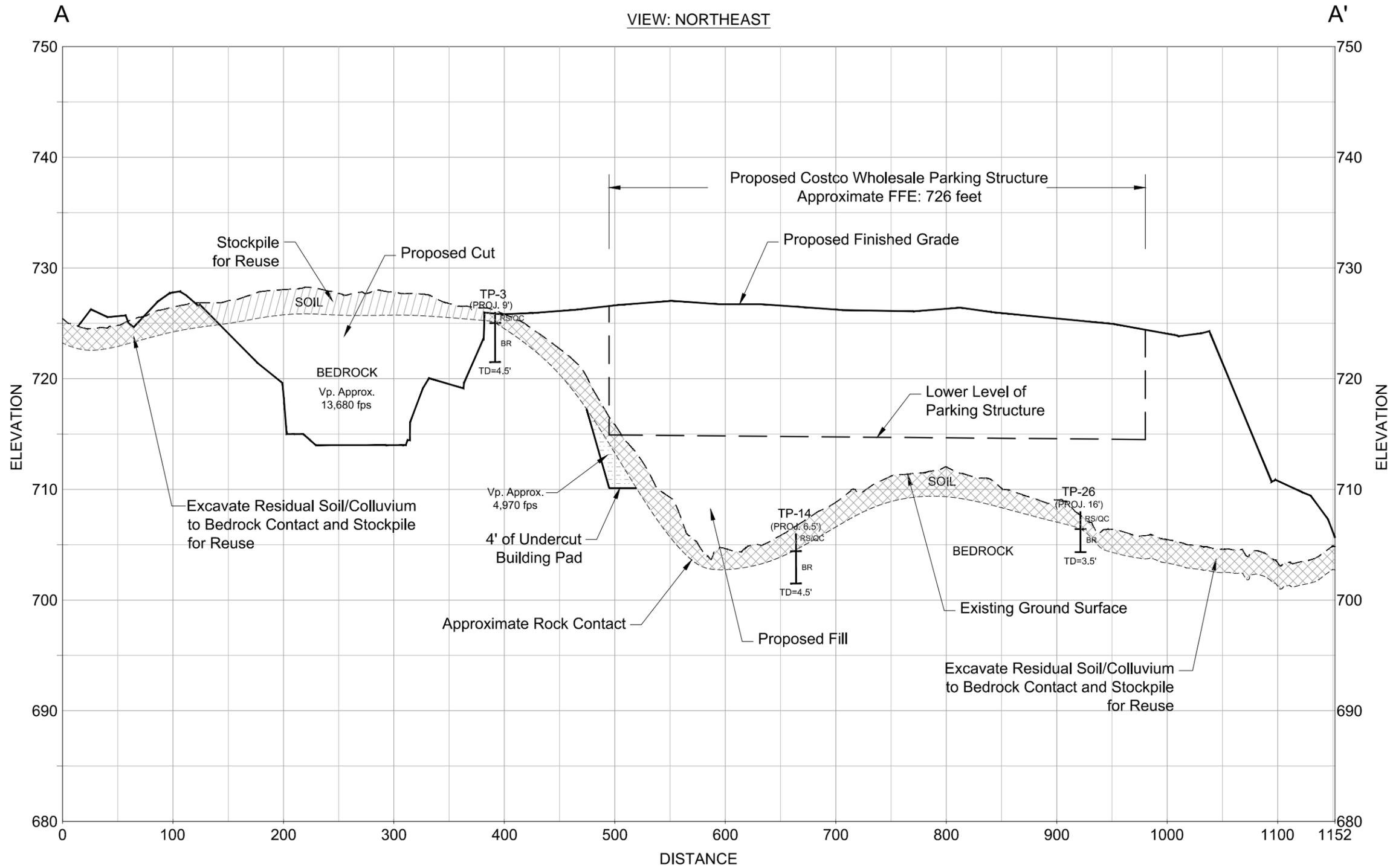


PROJECT:	20193141
DRAWN:	OCT 2019
DRAWN BY:	KFH
CHECKED BY:	DD
FILE NAME:	Fig4_NOA.mxd

NATURALLY OCCURING ASBESTOS MAP

CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

FIGURE
4



LEGEND
 RS/QC Residual Soil and/or Colluvium
 BR Bedrock



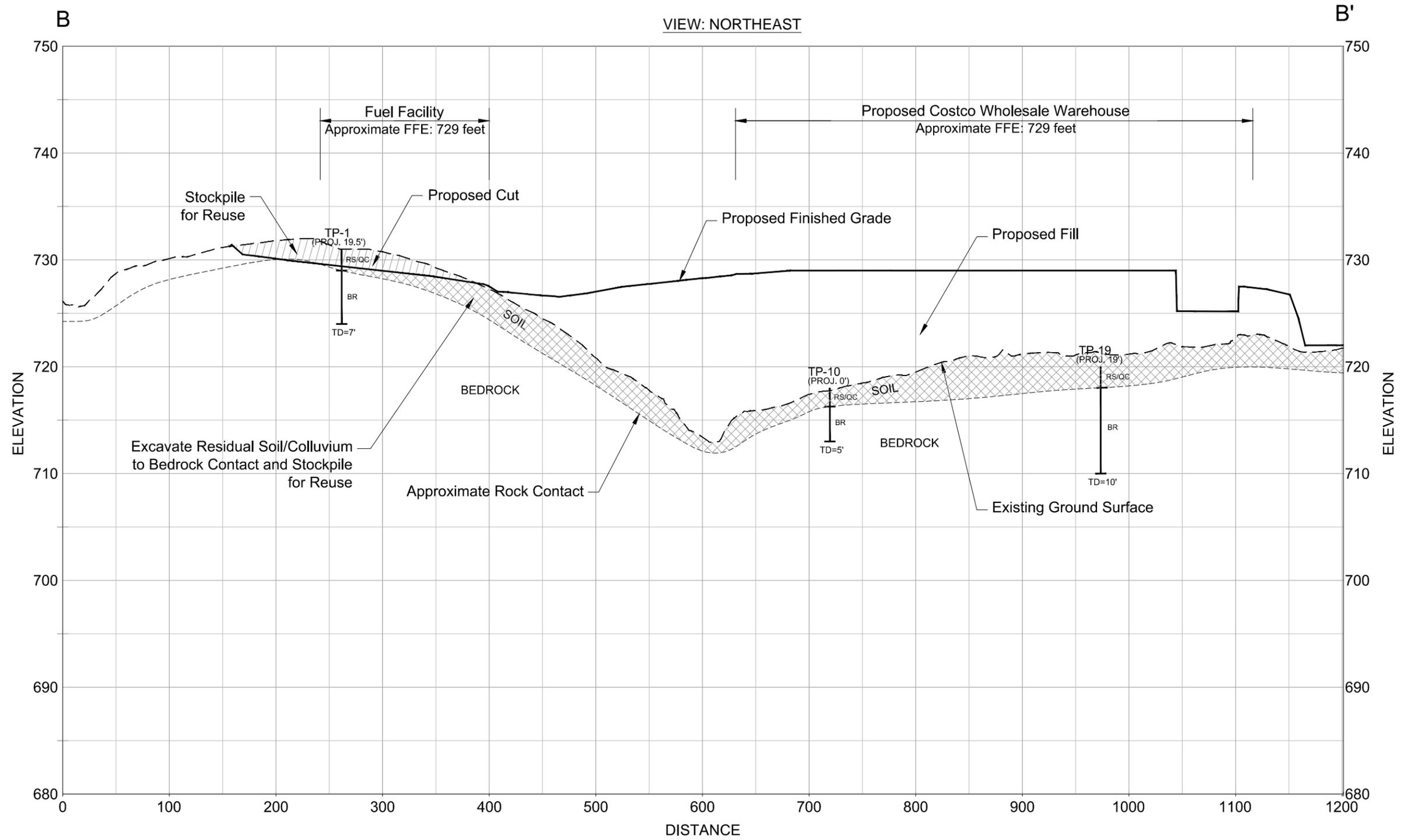
PROJECT NO.	20193141.001A
DRAWN:	10/24/2019
DRAWN BY:	D. Ross
CHECKED BY:	B. Anderson
FILE NAME:	CROSS SECTIONS.dwg

CROSS SECTION A - A'

CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

FIGURE
5

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LEGEND
 RS/QC Residual Soil and/or Colluvium
 BR Bedrock



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DRAWN:	10/24/2019
DRAWN BY:	D. Ross
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FILE NAME:	CROSS SECTIONS.dwg

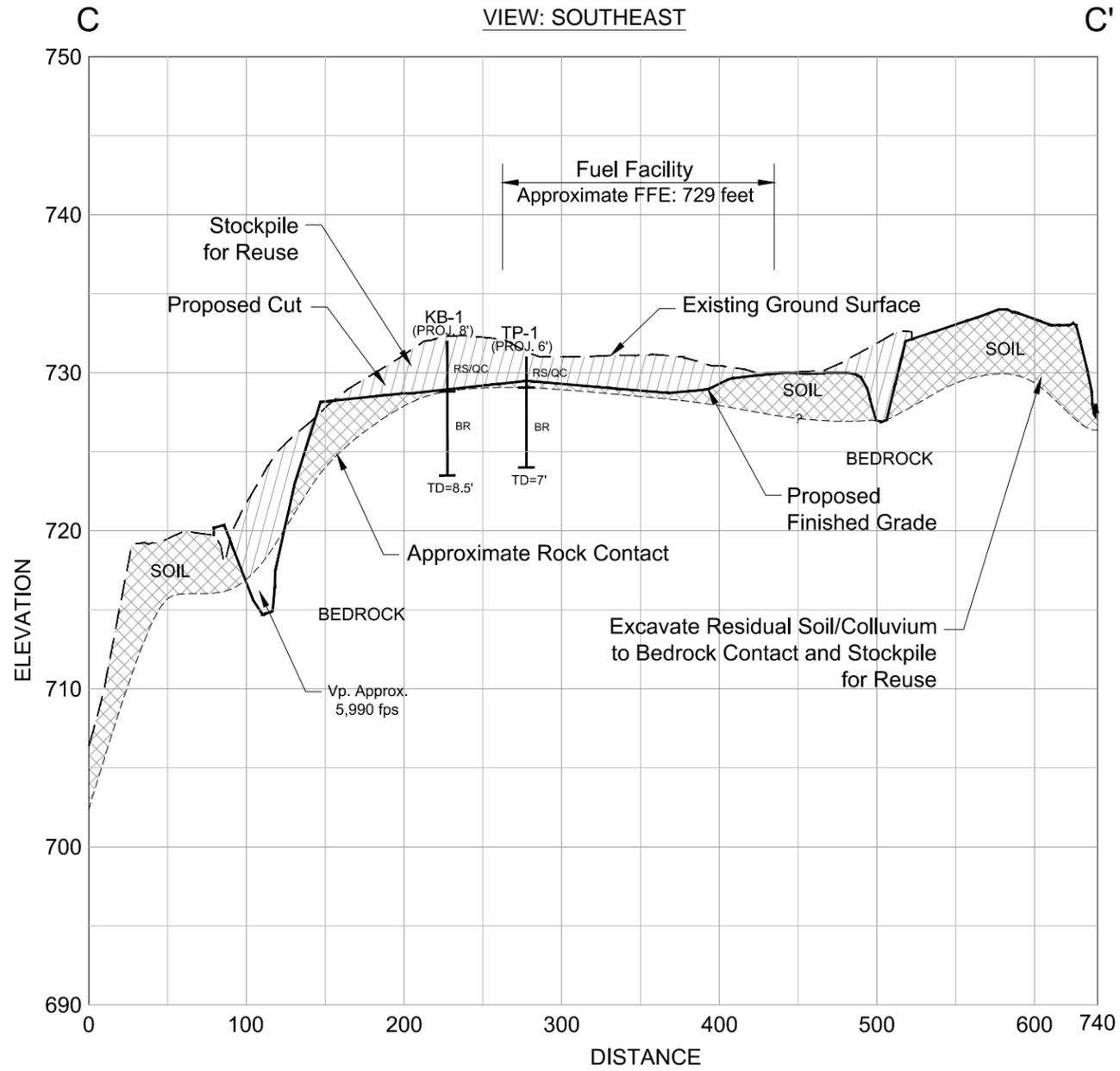
CROSS SECTION B - B'

**CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA**

FIGURE

6

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LEGEND

- RS/QC Residual Soil and/or Colluvium
- BR Bedrock

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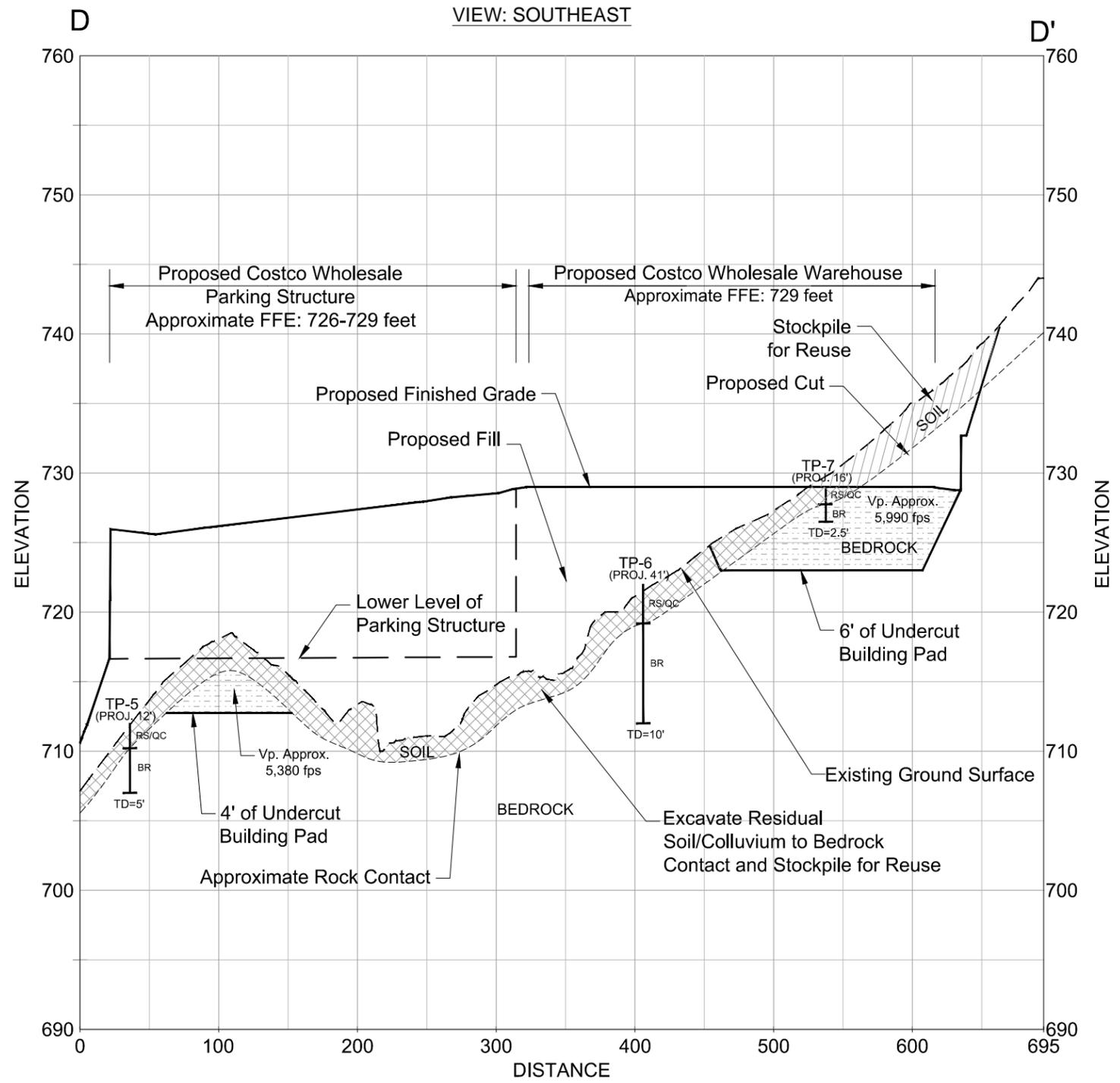
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FILE NAME:	CROSS SECTIONS.dwg

CROSS SECTION C - C'

**CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA**

FIGURE

7



LEGEND
 RS/QC Residual Soil and/or Colluvium
 BR Bedrock

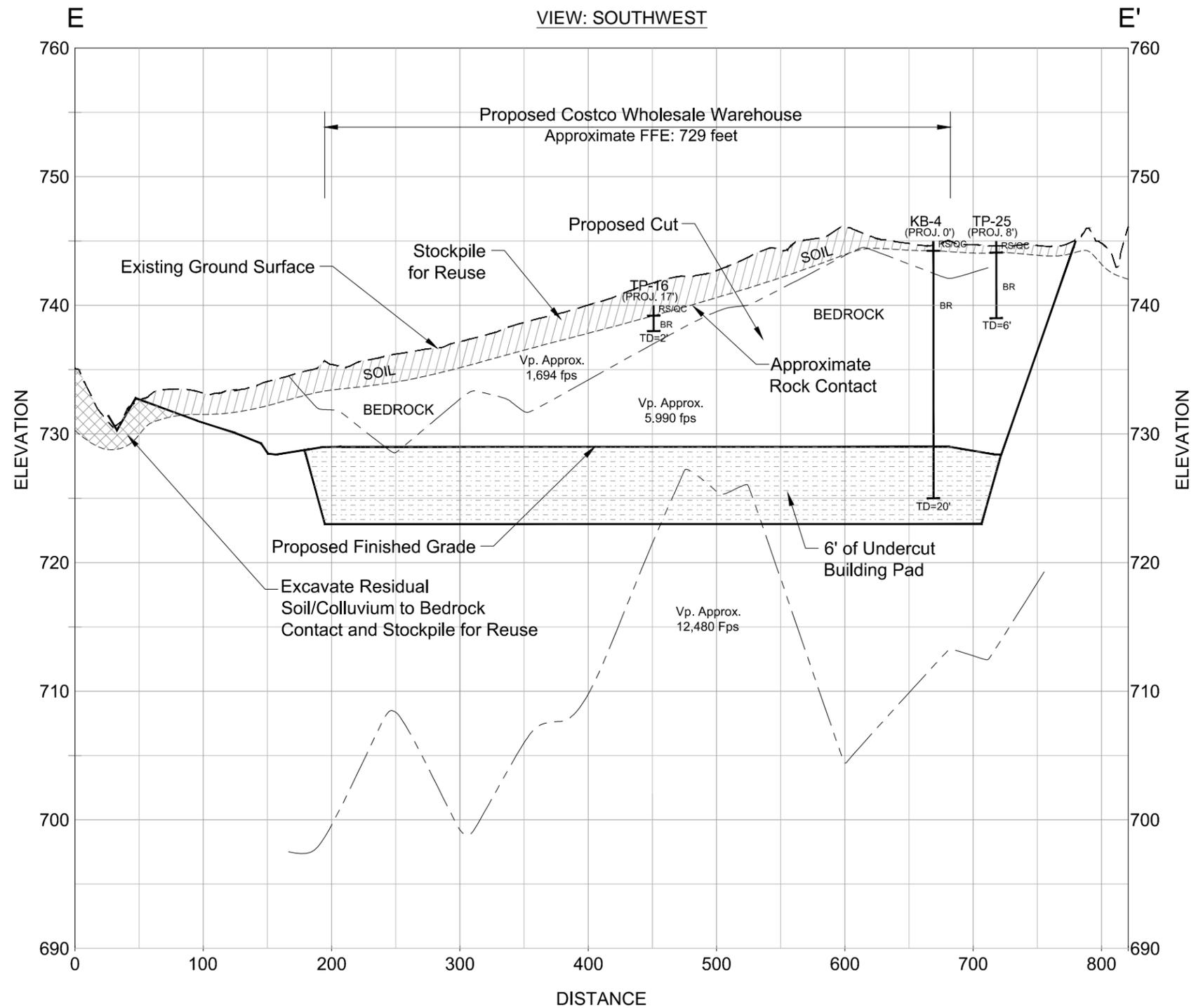
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FILE NAME:	CROSS SECTIONS.dwg

CROSS SECTION D - D'
CSM COSTCO EL DORADO HILLS SILVA VALLEY PARKWAY EL DORADO HILLS, CALIFORNIA

FIGURE
8



LEGEND

- RS/QC Residual Soil and/or Colluvium
- BR Bedrock
- Seismic Refraction Layer Contact with Layer Velocity

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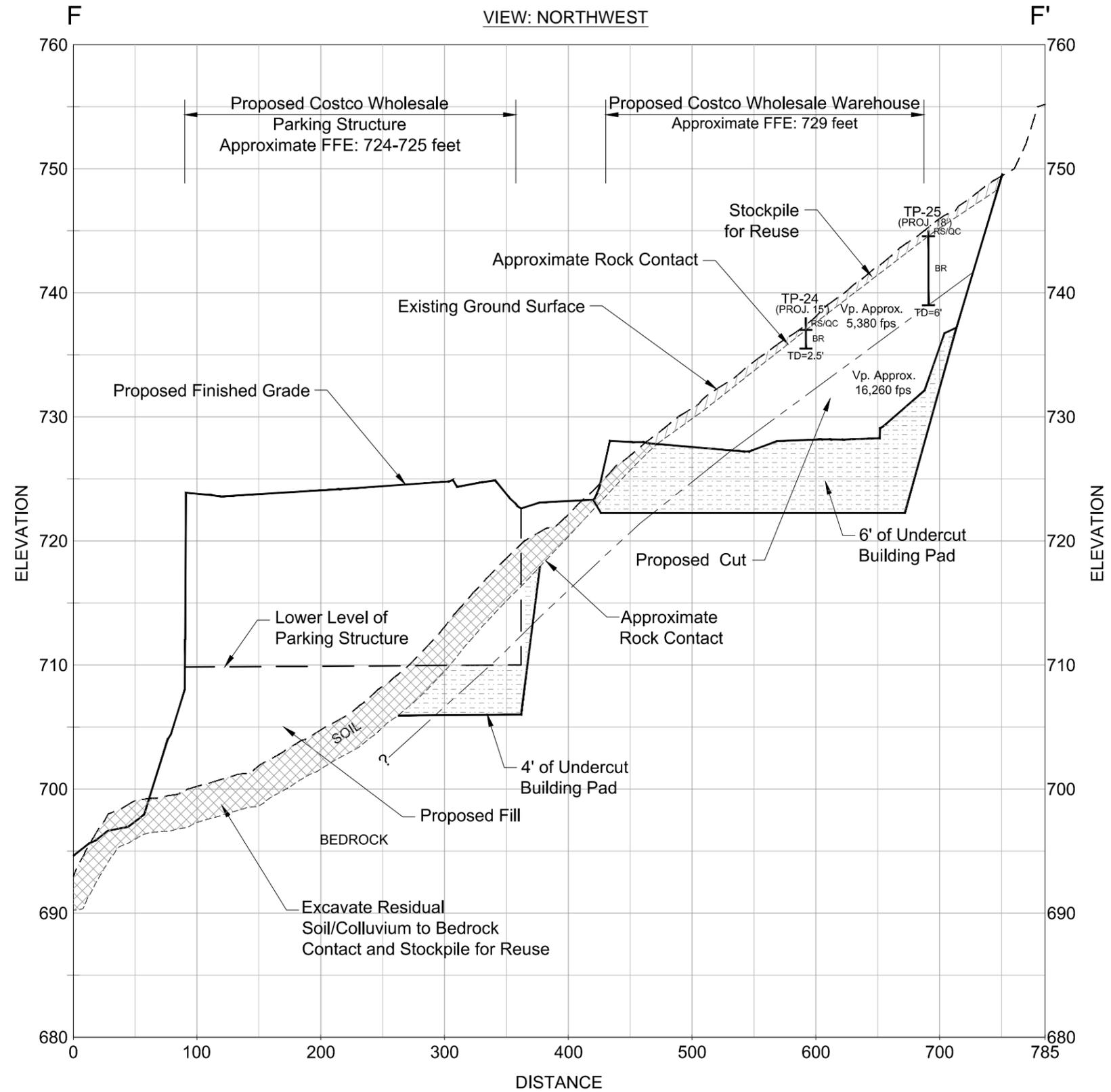
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FILE NAME:	CROSS SECTIONS.dwg

CROSS SECTION E - E'

**CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA**

FIGURE

9



LEGEND

RS/QC	Residual Soil and/or Colluvium
BR	Bedrock
---	Seismic Refraction Layer with Layer Velocity



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DRAWN:	10/24/2019
DRAWN BY:	D. Ross
CHECKED BY:	B. Anderson
FILE NAME:	CROSS SECTIONS.dwg

CROSS SECTION F - F'

**CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA**

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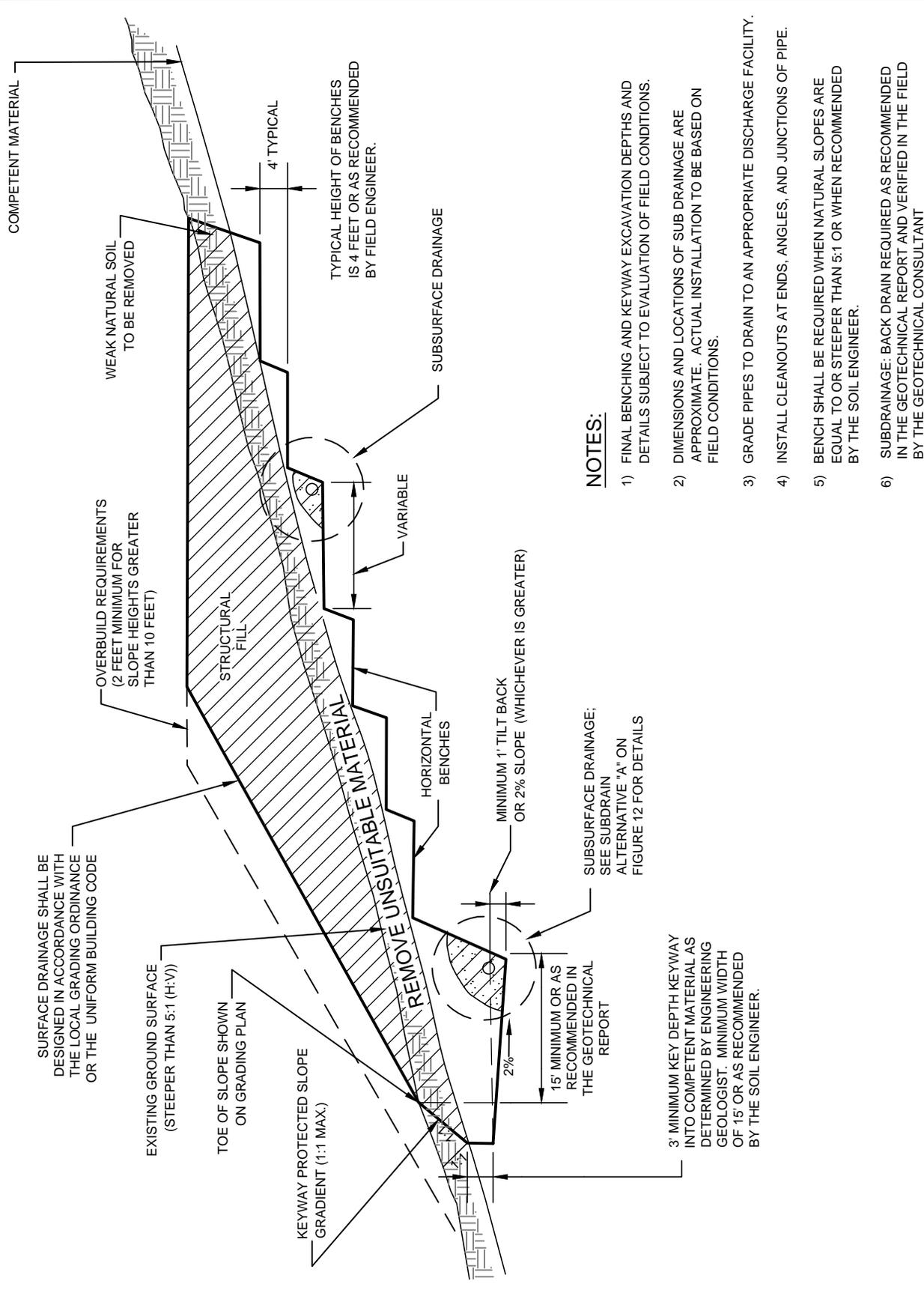


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DRAWN:	04/2017
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CHECKED BY:	RFE
FILE NAME:	Details.dwg

**TYPICAL ENGINEERED
FILL SLOPE/BENCHING DETAIL**

CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

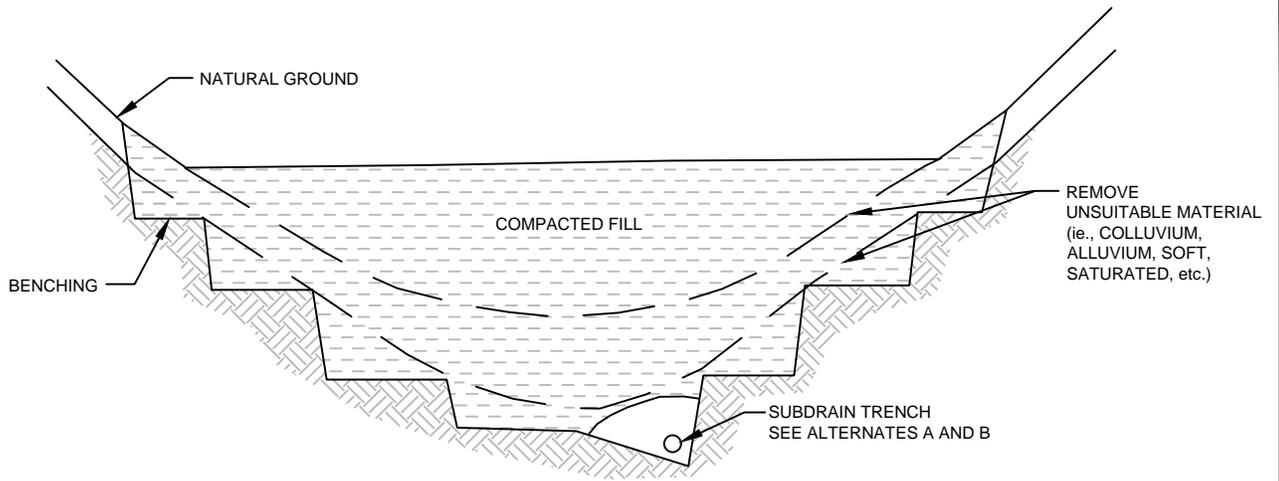
FIGURE
11



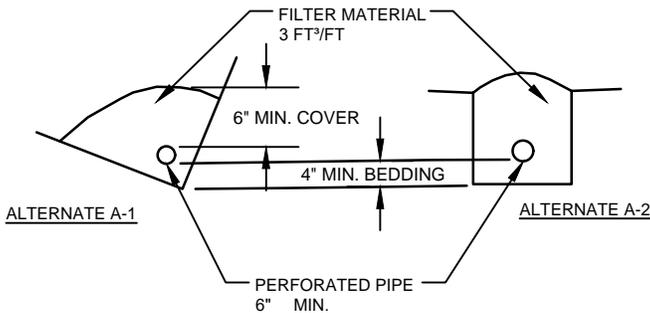
NOTES:

- 1) FINAL BENCHING AND KEYWAY EXCAVATION DEPTHS AND DETAILS SUBJECT TO EVALUATION OF FIELD CONDITIONS.
- 2) DIMENSIONS AND LOCATIONS OF SUB DRAINAGE ARE APPROXIMATE. ACTUAL INSTALLATION TO BE BASED ON FIELD CONDITIONS.
- 3) GRADE PIPES TO DRAIN TO AN APPROPRIATE DISCHARGE FACILITY.
- 4) INSTALL CLEANOUTS AT ENDS, ANGLES, AND JUNCTIONS OF PIPE.
- 5) BENCH SHALL BE REQUIRED WHEN NATURAL SLOPES ARE EQUAL TO OR STEEPER THAN 5:1 OR WHEN RECOMMENDED BY THE SOIL ENGINEER.
- 6) SUBDRAINAGE: BACK DRAIN REQUIRED AS RECOMMENDED IN THE GEOTECHNICAL REPORT AND VERIFIED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT

CANYON SUBDRAIN DETAIL



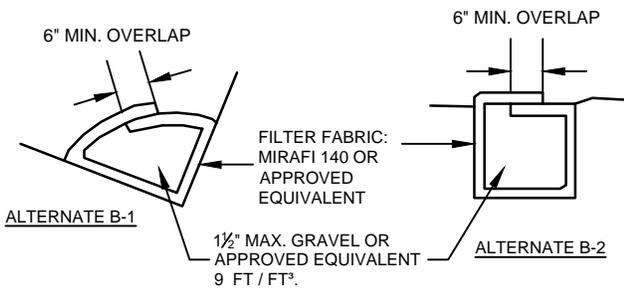
SUBDRAIN ALTERNATE A:
PERFORATED PIPE SURROUNDED BY FILTER MATERIAL



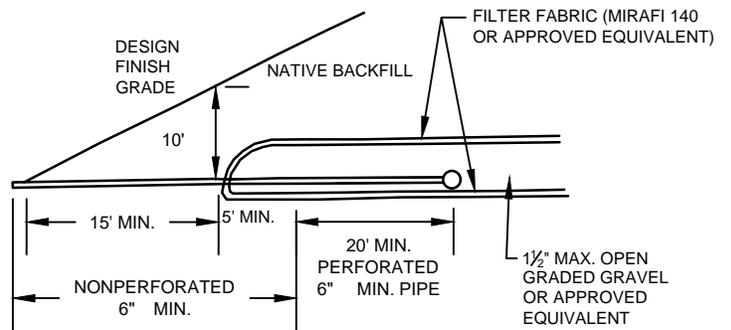
FILTER MATERIAL:
Filter material shall be class 2 permeable material per State of California Standards Specifications, or an approved alternate. Class 2 grading as follows:

SIEVE SIZE	PERCENT PASSING
1"	100
¾"	90-100
⅝"	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:
1½" GRAVEL WRAPPED IN FILTER FABRIC.
6" MIN. OVERLAP



DETAIL OF CANYON SUBDRAIN TERMINOUS



SUBDRAIN INSTALLATION: SUBDRAIN PIPE SHALL BE INSTALLED WITH PERFORATIONS DOWN, OR AT LOCATIONS DESIGNATED BY THE GEOTECHNICAL CONSULTANT. OUTLET PIPE SHALL BE NON-PERFORATED PIPE.

SUBDRAIN TYPE: SUBDRAIN TYPE SHALL BE SCHEDULE 40 PVC PIPE OR AN APPROVED EQUIVALENT.

PLOTTED: 20 Apr 2017, 3:14pm, DFahrney

LAYOUT: 4

CAD FILE: U:\Projects\CADD\CADD ORACLE\ORACLE-2017\136238\Beaumont\

ATTACHED IMAGES:
ATTACHED XREFS:
RIVERSIDE, CA



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FILE NAME:	Details.dwg

CANYON SUBDRAIN DETAIL

CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

FIGURE

12



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APPENDIX A FIELD EXPLORATIONS

GENERAL

We explored subsurface conditions at the site by drilling 3 borings and excavating 26 test pits. The borings were drilled by Gulf Shore Drilling of Sacramento, California using track-mounted, hollow-stem auger drilling equipment with rock coring abilities to depths of between approximately 8½ to 25 feet below the existing ground surface (bgs). The proposed exploration plan also included a fourth rock coring location (KB-2) on the northeastern corner of the new warehouse location. This location was not drilled due to very hard drilling conditions throughout the course of the field exploration.

The test pits were excavated by Iron Works Excavation of Sacramento, California using a John Deere 50G track-mounted excavator to excavate to depths ranging from 2 to 10 feet bgs. The approximate locations of the borings and test pits are presented on Figure 2.

Prior to commencement of the fieldwork, Underground Service Alert (USA) was notified and various geophysical techniques were used at the boring locations to identify potential conflicts with subsurface structures.

The boring and test pit logs are presented as Figures A-4 through A-32. An explanation to the log is presented as Figures A-1 through A-3. The Boring/Test Pit Log describes the earth materials encountered, samples obtained and show field and laboratory tests performed. The log also shows the location, boring/test pit number, drilling/excavation date and the name of the drilling/excavation subcontractor. The borings and test pits were logged by a Kleinfelder engineer using the Unified Soil Classification System. The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual. Bulk and drive samples of selected earth materials were obtained from the borings and test pits.

Bulk and grab samples of the near-surface soils were directly retrieved from the auger cuttings from the borings and the excavated material in the test pits.

SAMPLER AND DRILLING METHOD GRAPHICS

	BULK / GRAB / BAG SAMPLE
	MODIFIED CALIFORNIA SAMPLER (2 or 2-1/2 in. (50.8 or 63.5 mm.) outer diameter)
	CALIFORNIA SAMPLER (3 in. (76.2 mm.) outer diameter)
	STANDARD PENETRATION SPLIT SPOON SAMPLER (2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)
	HQ CORE SAMPLE (2.500 in. (63.5 mm.) core diameter)
	SHELBY TUBE SAMPLER
	PUSH TYPE SAMPLER
	SONIC CONTINUOUS SAMPLER
	HAND AUGER
	AUGER CUTTINGS

GROUND WATER GRAPHICS

	WATER LEVEL (level where first observed)
	WATER LEVEL (level after exploration completion)
	WATER LEVEL (additional levels after exploration)
	OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

ABBREVIATIONS

WOH - Weight of Hammer
WOR - Weight of Rod

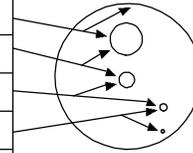
UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

GRAVELS (More than half of coarse fraction is larger than the #200 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu ≥ 4 and 1 ≤ Cc ≤ 3		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES	
		Cu < 4 and/or 1 > Cc > 3		GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES	
	GRAVELS WITH 5% TO 12% FINES	Cu ≥ 4 and 1 ≤ Cc ≤ 3		GW-GM	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES	
				GW-GC	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES	
		Cu < 4 and/or 1 > Cc > 3		GP-GM	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES	
				GP-GC	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES	
	GRAVELS WITH > 12% FINES			GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES	
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	
				GC-GM	CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES	
	SANDS (Half or more of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	Cu ≥ 6 and 1 ≤ Cc ≤ 3		SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			Cu < 6 and/or 1 > Cc > 3		SP	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH 5% TO 12% FINES	Cu ≥ 6 and 1 ≤ Cc ≤ 3		SW-SM	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SW-SC	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES	
Cu < 6 and/or 1 > Cc > 3				SP-SM	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES	
				SP-SC	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES	
SANDS WITH > 12% FINES				SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES	
				SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES	
				SC-SM	CLAYEY SANDS, SAND-SILT-CLAY MIXTURES	
FINE GRAINED SOILS (Half or more of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)		ML	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY		
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
			CL-ML	INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
	SILTS AND CLAYS (Liquid Limit 50 or greater)		OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY		
			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT		
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
		OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY			

 Bright People. Right Solutions.	PROJECT NO.: 20193141 DRAWN BY: JDS CHECKED BY: DD DATE: 9/11/2019 REVISED: 10/4/2019	GRAPHICS KEY CSM COSTCO EL DORADO HILLS SILVA VALLEY PARKWAY EL DORADO HILLS, CALIFORNIA	FIGURE A-1
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GRAIN SIZE

DESCRIPTION	SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders	>12 in. (304.8 mm.)	>12 in. (304.8 mm.)	Larger than basketball-sized
Cobbles	3 - 12 in. (76.2 - 304.8 mm.)	3 - 12 in. (76.2 - 304.8 mm.)	Fist-sized to basketball-sized
Gravel	coarse 3/4 -3 in. (19 - 76.2 mm.)	3/4 -3 in. (19 - 76.2 mm.)	Thumb-sized to fist-sized
	fine #4 - 3/4 in. (#4 - 19 mm.)	0.19 - 0.75 in. (4.8 - 19 mm.)	Pea-sized to thumb-sized
Sand	coarse #10 - #4	0.079 - 0.19 in. (2 - 4.9 mm.)	Rock salt-sized to pea-sized
	medium #40 - #10	0.017 - 0.079 in. (0.43 - 2 mm.)	Sugar-sized to rock salt-sized
	fine #200 - #40	0.0029 - 0.017 in. (0.07 - 0.43 mm.)	Flour-sized to sugar-sized
Fines	Passing #200	<0.0029 in. (<0.07 mm.)	Flour-sized and smaller



SECONDARY CONSTITUENT

Term of Use	AMOUNT	
	Secondary Constituent is Fine Grained	Secondary Constituent is Coarse Grained
Trace	<5%	<15%
With	≥5 to <15%	≥15 to <30%
Modifier	≥15%	≥30%

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

CEMENTATION

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT - N ₆₀ (# blows / ft)	Pocket Pen (tsf)	UNCONFINED COMPRESSIVE STRENGTH (Q _u)(psf)	VISUAL / MANUAL CRITERIA
Very Soft	<2	PP < 0.25	<500	Thumb will penetrate more than 1 inch (25 mm). Extrudes between fingers when squeezed.
Soft	2 - 4	0.25 ≤ PP <0.5	500 - 1000	Thumb will penetrate soil about 1 inch (25 mm). Remolded by light finger pressure.
Medium Stiff	4 - 8	0.5 ≤ PP <1	1000 - 2000	Thumb will penetrate soil about 1/4 inch (6 mm). Remolded by strong finger pressure.
Stiff	8 - 15	1 ≤ PP <2	2000 - 4000	Can be imprinted with considerable pressure from thumb.
Very Stiff	15 - 30	2 ≤ PP <4	4000 - 8000	Thumb will not indent soil but readily indented with thumbnail.
Hard	>30	4 ≤ PP	>8000	Thumbnail will not indent soil.

REACTION WITH HYDROCHLORIC ACID

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

FROM TERZAGHI AND PECK, 1948; LAMBE AND WHITMAN, 1969; FHWA, 2002; AND ASTM D2488

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT-N ₆₀ (# blows/ft)	MODIFIED CA SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	RELATIVE DENSITY (%)
Very Loose	<4	<4	<5	0 - 15
Loose	4 - 10	5 - 12	5 - 15	15 - 35
Medium Dense	10 - 30	12 - 35	15 - 40	35 - 65
Dense	30 - 50	35 - 60	40 - 70	65 - 85
Very Dense	>50	>60	>70	85 - 100

FROM TERZAGHI AND PECK, 1948

PLASTICITY

DESCRIPTION	LL	FIELD TEST
Non-plastic	NP	A 1/8-in. (3 mm.) thread cannot be rolled at any water content.
Low (L)	< 30	The thread can barely be rolled and the lump or thread cannot be formed when drier than the plastic limit.
Medium (M)	30 - 50	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump or thread crumbles when drier than the plastic limit.
High (H)	> 50	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump or thread can be formed without crumbling when drier than the plastic limit.

STRUCTURE

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness.
Laminated	Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.

ANGULARITY

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.



PROJECT NO.: 20193141
DRAWN BY: JDS
CHECKED BY: DD
DATE: 9/11/2019
REVISED: 10/4/2019

SOIL DESCRIPTION KEY

CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

FIGURE

A-2

INFILLING TYPE

NAME	ABBR	NAME	ABBR
Albite	Al	Muscovite	Mus
Apatite	Ap	None	No
Biotite	Bi	Pyrite	Py
Clay	Cl	Quartz	Qz
Calcite	Ca	Sand	Sd
Chlorite	Ch	Sericite	Ser
Epidote	Ep	Silt	Si
Iron Oxide	Fe	Talc	Ta
Manganese	Mn	Unknown	Uk

DENSITY/SPACING OF DISCONTINUITIES

DESCRIPTION	SPACING CRITERIA
Unfractured	>6 ft. (>1.83 meters)
Slightly Fractured	2 - 6 ft. (0.061 - 1.83 meters)
Moderately Fractured	8 in - 2 ft. (203.20 - 609.60 mm)
Highly Fractured	2 - 8 in (50.80 - 203.30 mm)
Intensely Fractured	<2 in (<50.80 mm)

ADDITIONAL TEXTURAL ADJECTIVES

DESCRIPTION	RECOGNITION
Pit (Pitted)	Pinhole to 0.03 ft. (3/8 in.) (>1 to 10 mm.) openings
Vug (Vuggy)	Small openings (usually lined with crystals) ranging in diameter from 0.03 ft. (3/8 in.) to 0.33 ft. (4 in.) (10 to 100 mm.)
Cavity	An opening larger than 0.33 ft. (4 in.) (100 mm.), size descriptions are required, and adjectives such as small, large, etc., may be used
Honeycombed	If numerous enough that only thin walls separate individual pits or vugs, this term further describes the preceding nomenclature to indicate cell-like form.
Vesicle (Vesicular)	Small openings in volcanic rocks of variable shape and size formed by entrapped gas bubbles during solidification.

ADDITIONAL TEXTURAL ADJECTIVES

DESCRIPTION	CRITERIA
Unweathered	No evidence of chemical / mechanical alteration; rings with hammer blow.
Slightly Weathered	Slight discoloration on surface; slight alteration along discontinuities; <10% rock volume altered.
Moderately Weathered	Discoloring evident; surface pitted and alteration penetration well below surface; Weathering "halos" evident; 10-50% rock altered.
Highly Weathered	Entire mass discolored; Alteration pervading most rock, some slight weathering pockets; some minerals may be leached out.
Decomposed	Rock reduced to soil with relic rock texture/structure; Generally molded and crumbled by hand.

RELATIVE HARDNESS / STRENGTH DESCRIPTIONS

GRADE	UCS (Mpa)	FIELD TEST
R0	Extremely Weak	0.25 - 1.0
R1	Very Weak	1.0 - 5.0
R2	Weak	5.0 - 25
R3	Medium Strong	25 - 50
R4	Strong	50 - 100
R5	Very Strong	100 - 250
R6	Extremely Strong	> 250

ROCK QUALITY DESIGNATION (RQD)

DESCRIPTION	RQD (%)
Very Poor	0 - 25
Poor	25 - 50
Fair	50 - 75
Good	75 - 90
Excellent	90 - 100

APERTURE

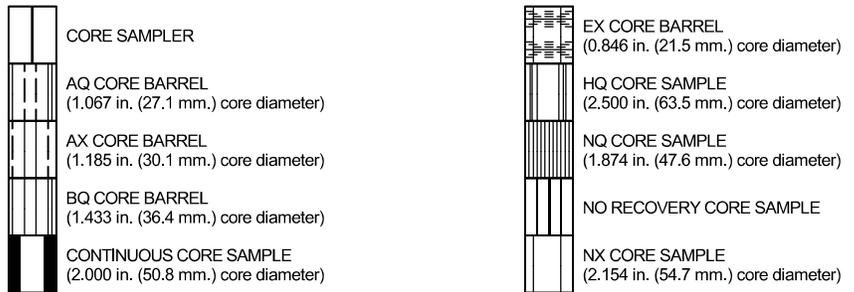
DESCRIPTION	CRITERIA [in (mm)]
Tight	<0.04 (<1)
Open	0.04 - 0.20 (1 - 5)
Wide	>0.20 (>5)

BEDDING CHARACTERISTICS

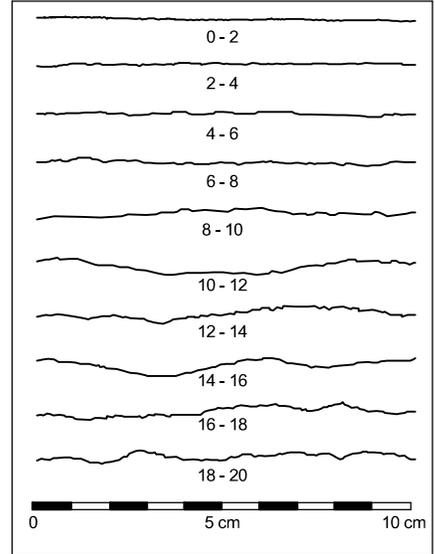
DESCRIPTION	Thickness [in (mm)]
Very Thick Bedded	>36 (>915)
Thick Bedded	12 - 36 (305 - 915)
Moderately Bedded	4 - 12 (102 - 305)
Thin Bedded	1 - 4 (25 - 102)
Very Thin Bedded	0.4 - 1 (10 - 25)
Laminated	0.1 - 0.4 (2.5 - 10)
Thinly Laminated	<0.1 (<2.5)

Bedding Planes Planes dividing the individual layers, beds, or stratigraphy of rocks.
 Joint Fracture in rock, generally more or less vertical or traverse to bedding.
 Seam Applies to bedding plane with unspecified degree of weather.

CORE SAMPLER TYPE GRAPHICS



JOINT ROUGHNESS COEFFICIENT (JRC)



From Barton and Choubey, 1977

RQD Rock-quality designation (RQD) Rough measure of the degree of jointing or fracture in a rock mass, measured as a percentage of the drill core in lengths of 10 cm. or more.



PROJECT NO.: 20193141
 DRAWN BY: JDS
 CHECKED BY: DD
 DATE: 9/11/2019
 REVISED: 10/4/2019

ROCK DESCRIPTION KEY

CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-3

Date Begin - End: 9/13/2019 **Drilling Company:** Gulf Shore
Logged By: R. Schmidt **Drill Crew:** Carlos, Raj
Hor.-Vert. Datum: Not Available **Drilling Equipment:** CME 75 LAR
Plunge: -90 degrees **Coring Method:** Coring
Weather: Sunny **Core Bit Type:** HQ Core

ROCK CORING INFORMATION

Depth (feet)	Graphical Log	ROCK CORING INFORMATION							Discontinuity Description Fracture#: (Depth), Type, Relative Dip, Density or Spacing. Degree of Infilling, Infilling Type, Aperture, Surface Weathering, JRC
		Box Number	Run Number	Sample Type	Recovery (NR=No Recovery)	Drill Rate (min/ft)	RQD (%)	Relative Strength	
		Latitude: 38.66101° Longitude: -121.05820° Ground Surface Elevation Not Available							
		Formation and Rock Type, Color, Grain/Particle Size, Weathering, Bedding, Density or Spacing							
					NR		0		
5					NR		0		
					2"		25		

The exploration was terminated at approximately 8.5 ft. below ground surface. The exploration was backfilled with grout on September 13, 2019. Rock was encountered at a depth of 3 ft. during this exploration.



PROJECT NO.: 20193141
 DRAWN BY: DR
 CHECKED BY: DD
 DATE: 9/16/2019
 REVISED: 10/4/2019

BORING LOG KB-(1)

 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-4

Date Begin - End: 9/11/2019 - 9/12/2019 **Drilling Company:** Gulf Shore
Logged By: D. Stemberger **Drill Crew:** Carlos, Raj
Hor.-Vert. Datum: Not Available **Drilling Equipment:** CME 75 LAR
Plunge: -90 degrees **Coring Method:** Coring
Weather: Sunny **Core Bit Type:** HQ Core

ROCK CORING INFORMATION

Depth (feet)	Graphical Log	ROCK CORING INFORMATION							Discontinuity Description Fracture#: (Depth), Type, Relative Dip, Density or Spacing. Degree of Infilling, Infilling Type, Aperture, Surface Weathering, JRC
		Box Number	Run Number	Sample Type	Recovery (NR=No Recovery)	Drill Rate (min/ft)	RQD (%)	Relative Strength	
		Latitude: 38.65994° Longitude: -121.05633° Ground Surface Elevation Not Available							
		Formation and Rock Type, Color, Grain/Particle Size, Weathering, Bedding, Density or Spacing							
0 - 4.5					66%	25.00	17		
4.5 - 25					83%	16.00	48	R2	1: (4.5'), joint, 0°, surface stain, Cl/Sd, open, JRC=0-2
								R2	2: (5'), joint, 90°, surface stain, Cl/Sd, tight, JRC=10-12
								R0-R1	3: (6'), joint, 35°, partially filled, Sd, JRC=16-18 4: (7'), joint, 15°, partially filled, Sd, JRC=0-2
					58%	19.00	43		5: (9.5'), joint, 10°, partially filled, Sd/Cl, JRC=0-2
					33%	14.00	13	R3	6: (13.5'), joint, 60°, partially filled, Sd 7: (14.5'), joint, 15°, filled, Sd
					77%	21.25	18	R2	8: (16'), joint, 70°, surface stain, Fe/Cl
								R3 R4	9: (20'), joint, 45°, partially filled, Sd/Fe, JRC=14-16 10: (21'), joint, 55°, partially filled, Sd/Fe, JRC=8-10
									11: (23.5'), joint, 45°, surface stain, Fe, tight, JRC=0-2
									12: (25'), joint, 45°, surface stain, Fe, tight, JRC=0-2
<p>The exploration was terminated at approximately 25 ft. below ground surface. The boring was backfilled with grout on September 12, 2019. Rock was encountered at a depth of 4.5 ft. during this exploration.</p>									



PROJECT NO.: 20193141
 DRAWN BY: DR
 CHECKED BY: DD
 DATE: 9/16/2019
 REVISED: 10/4/2019

BORING LOG KB-(3)
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE
A-5
 PAGE: 1 of 1

Date Begin - End: 9/10/2019 **Drilling Company:** Gulf Shore
Logged By: J. Annand **Drill Crew:** Carlos, Raj
Hor.-Vert. Datum: Not Available **Drilling Equipment:** CME 75 LAR
Plunge: -90 degrees **Coring Method:** Coring
Weather: Sunny **Core Bit Type:** HQ Core

ROCK CORING INFORMATION

Depth (feet)	Graphical Log	ROCK CORING INFORMATION							Discontinuity Description	
		Box Number	Run Number	Sample Type	Recovery (NR=No Recovery)	Drill Rate (min/ft)	RQD (%)	Relative Strength		
									Latitude: 38.65956° Longitude: -121.05552° Ground Surface Elevation Not Available Formation and Rock Type, Color, Grain/Particle Size, Weathering, Bedding, Density or Spacing	Fracture#: (Depth), Type, Relative Dip, Density or Spacing, Degree of Infilling, Infilling Type, Aperture, Surface Weathering, JRC
0-1.0			1		27%		0	R3		
1.0-5.0										
5.0-6.6			2		100%		30	R3	1: (4.5'), joint, 25°, surface stain, Cl/Fe, tight, JRC=12-14	
6.6-7.0	intensely fractured								2: (5.6'), joint, 50°, filled, Cl, open, JRC=2-4	
7.0-7.7	intensely fractured								3: (6.2'), joint, 65°, surface stain, Fe/Cl, tight, JRC=0-2	
7.7-8.3	intensely fractured								4: (7'), joint, 48°, filled, Cl, open, JRC=10-12	
8.3-10.2									5: (8.2'), joint, 46°, filled, Fe/Cl, open, JRC=10-12	
10.2-10.8	massive bedding, intensely fractured		3		100%		29	R4	6: (10.8'), joint, 25°, surface stain, Fe/Cl, open, JRC=12-14	
10.8-13.0									7: (11.9'), joint, 40°, surface stain, Fe/Cl, open, JRC=6-8	
13.0-14.0	insensely fractured								8: (12.6'), joint, 40°, surface stain, Fe/Cl, open, JRC=6-8	
14.0-16.3	Moderately weathered, moderately fractured		4		100%		65	R5	9: (14'), joint, 50°, filled, Cl, open, JRC=6-8	
16.3-16.6	intensely fractured								10: (14.7'), joint, 65°, surface stain, Cl, tight, JRC=14-16	
16.6-18.3									11: (15.6'), joint, 70°, healed	
18.3-20.0	Moderately weathered, highly fractured		5		100%		38	R5	12: (16.6'), joint, 10°, surface stain, Cl, tight, JRC=2-4	
									13: (17.5'), joint, 28°, surface stain, Fe/Cl, open, JRC=6-8	
									14: (18.5'), joint, 28°, surface stain, Fe/Cl, open, JRC=2-4	
									15: (19.1'), joint, 20°, filled, Cl, tight, JRC=16-18	

The exploration was terminated at approximately 20 ft. below ground surface. The exploration was backfilled with grout on September 10, 2019. Rock was encountered at a depth of 1 ft. during this exploration.



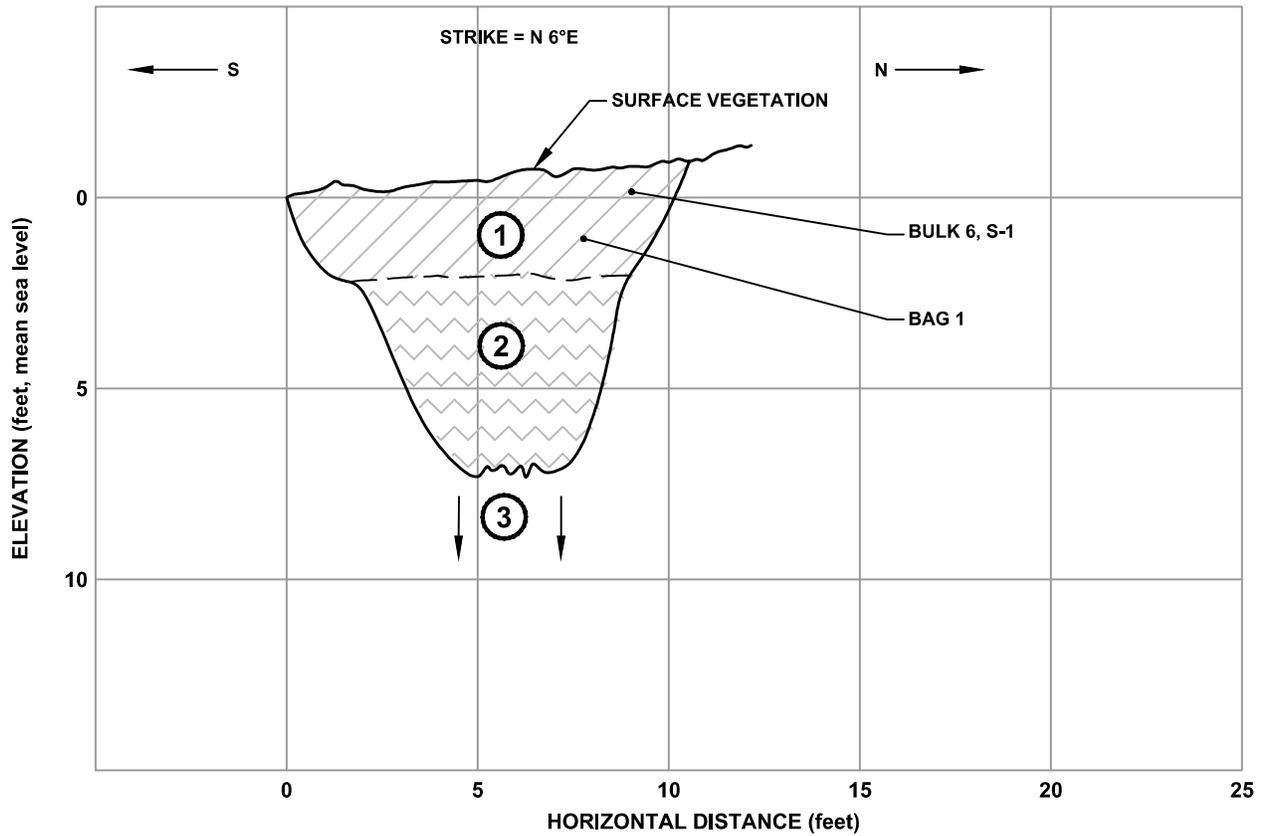
PROJECT NO.: 20193141
 DRAWN BY: DR
 CHECKED BY: DD
 DATE: 9/11/2019
 REVISED: 10/4/2019

BORING LOG KB-(4)

 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-6



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY (CL) - brownish red, dry, medium plasticity, fine to medium sand, trace coarse sand, trace subangular gravel, rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray, dry, medium dense, highly weathered, medium strong to weak, slight foliation, similar to CLAYEY SAND with Gravel and Cobbles (SC); subangular METAVOLCANIC ROCK fragments up to 7"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong to medium strong, moderately to highly fractured, slight foliation, refusal at 7' depth
Latitude: 38.661071 Longitude: -121.05804	

LOGGED BY: Jordan Annand

DATE: 8/20/19

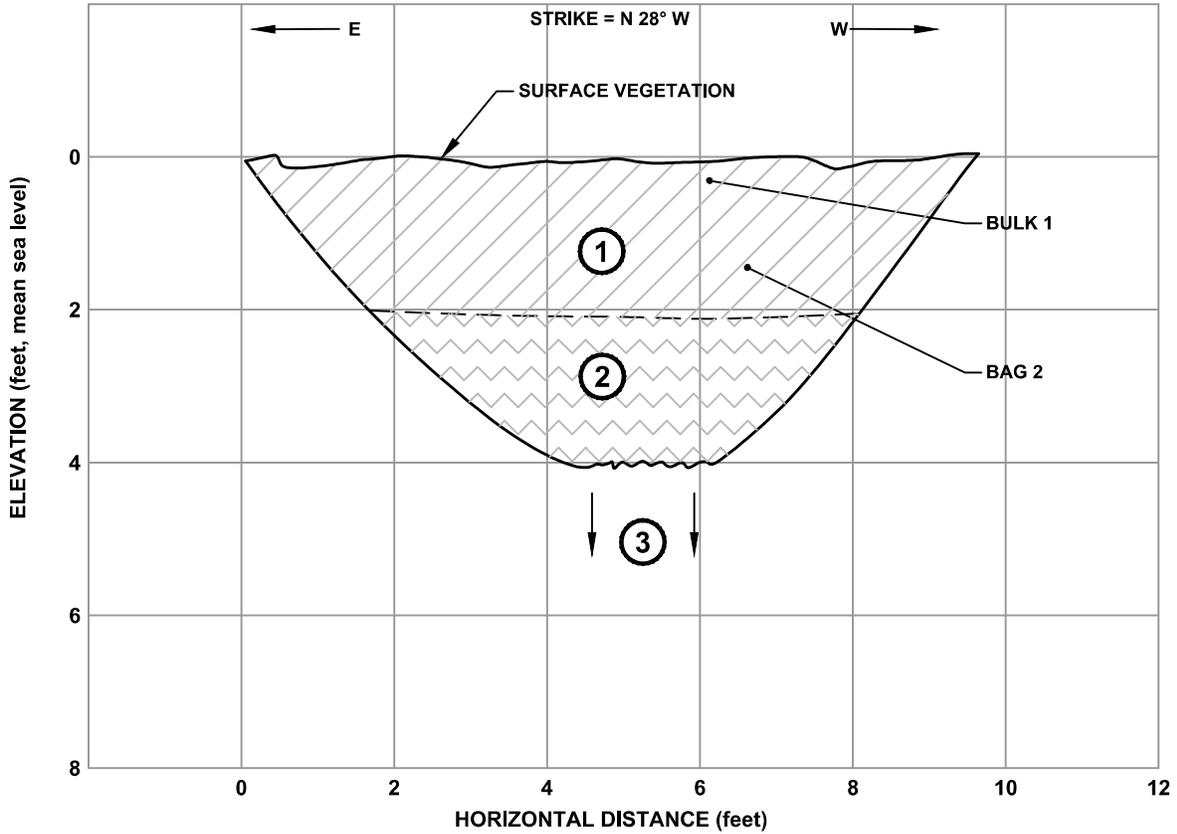
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PROJECT NO. 20193141
 ENTRY BY: D. Ross
 CHECKED BY: J. Annand
 DATE: 08/27/2019

TEST PIT LOG
 TP-1
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE
 A-7



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY with Gravel, Cobbles and Boulders (CL) - brownish red, dry, medium plasticity, fine to coarse sand, subangular gravel and boulders up to 14", rootlets (FILL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry, highly fractured, well defined foliation, similar to CLAYEY SAND with Gravel and Cobbles (SC); fine to coarse sand, subangular METAVOLCANIC GRAVELS AND COBBLES up to 11"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, well defined foliation, refusal at 4' depth

Latitude: 38.660793
Longitude: -121.057927

LOGGED BY: Jordan Annand

DATE: 8/20/19

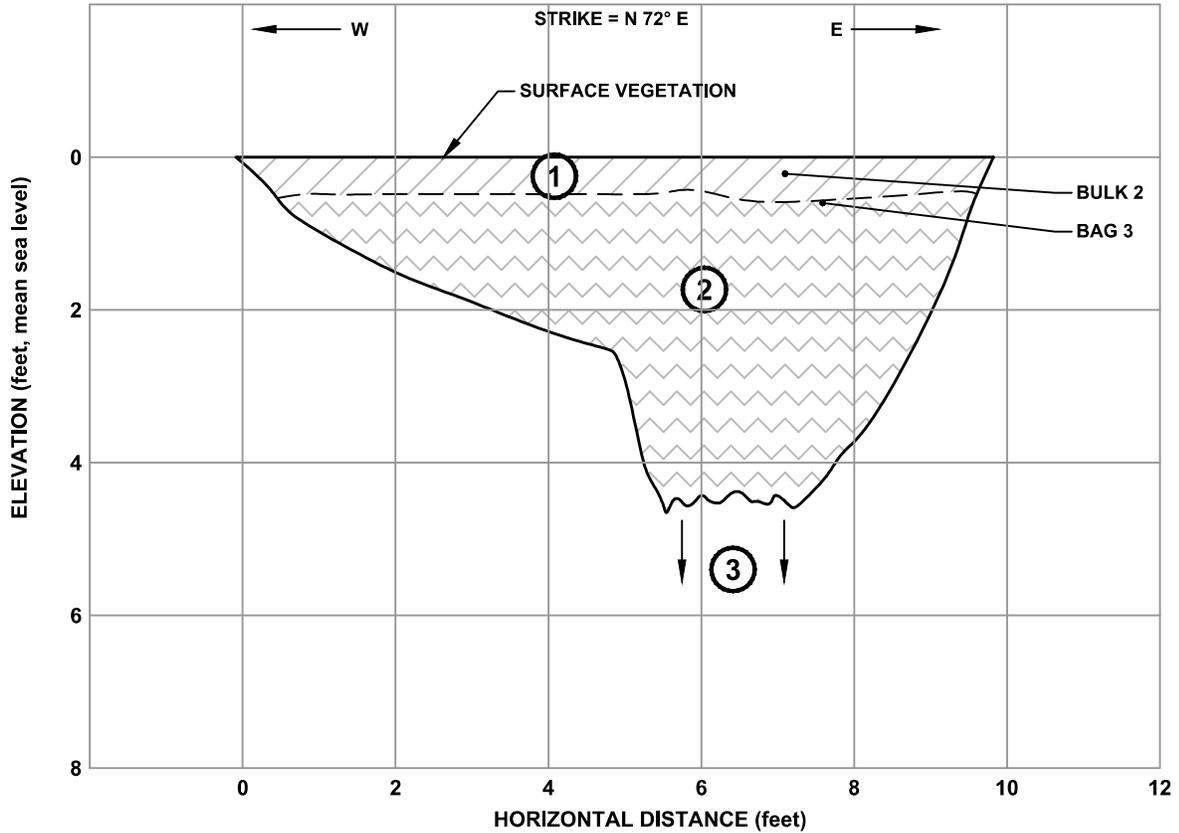
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ENTRY BY: D. Ross
CHECKED BY: J. Annand
DATE: 08/27/2019

TEST PIT LOG
TP-2
CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

FIGURE
A-8



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY (CL) - brownish red, dry, medium plasticity, fine to medium sand, trace fine gravel, rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry, highly weathered with moderately weathered sections, strong to medium strong/weak, highly to moderately fractured, well defined foliation, similar to CLAYEY SAND with Gravel, Cobbles, and Boulders (SC); fine to coarse sand, subangular METAVOLCANIC ROCK fragments up to 16"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, refusal at 4.5' depth Latitude: 38.660246 Longitude: -121.058017

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DATE: 8/20/19

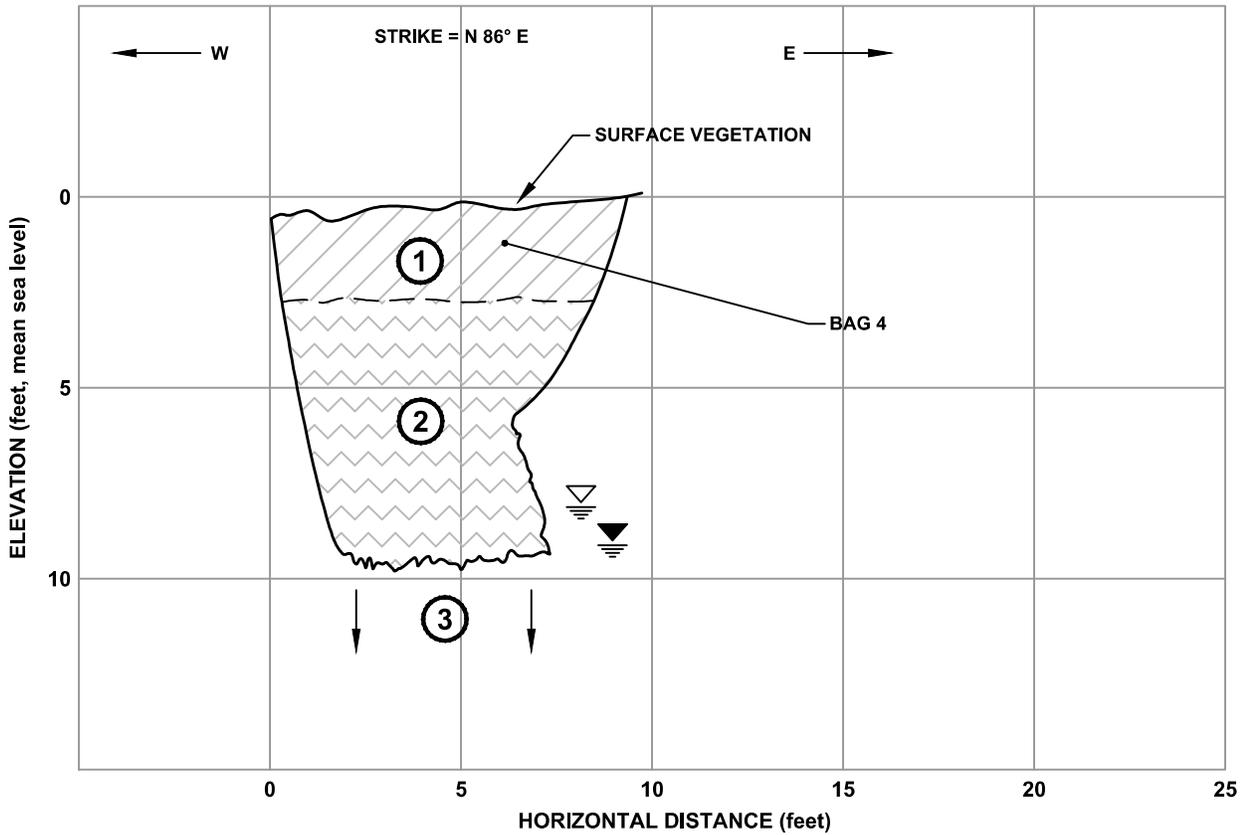
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TEST PIT LOG
 TP-3
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE
 A-9



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY (CL) - brownish red, dry, medium plasticity, fine to coarse sand, trace subangular gravels up to 1.5", rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry, highly weathered, medium strong, highly fractured, slight foliation, similar to CLAYEY SAND with Gravels, Cobbles, and Boulders (SC); fine to coarse sand, subangular METAVOLCANIC ROCK fragments up to 13",
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, refusal at 9.5' depth (Perched Groundwater hit at 8 feet deep, settled at 9 feet deep after excavation) Latitude: 38.660756 Longitude: -121.056944

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DATE: 8/20/19

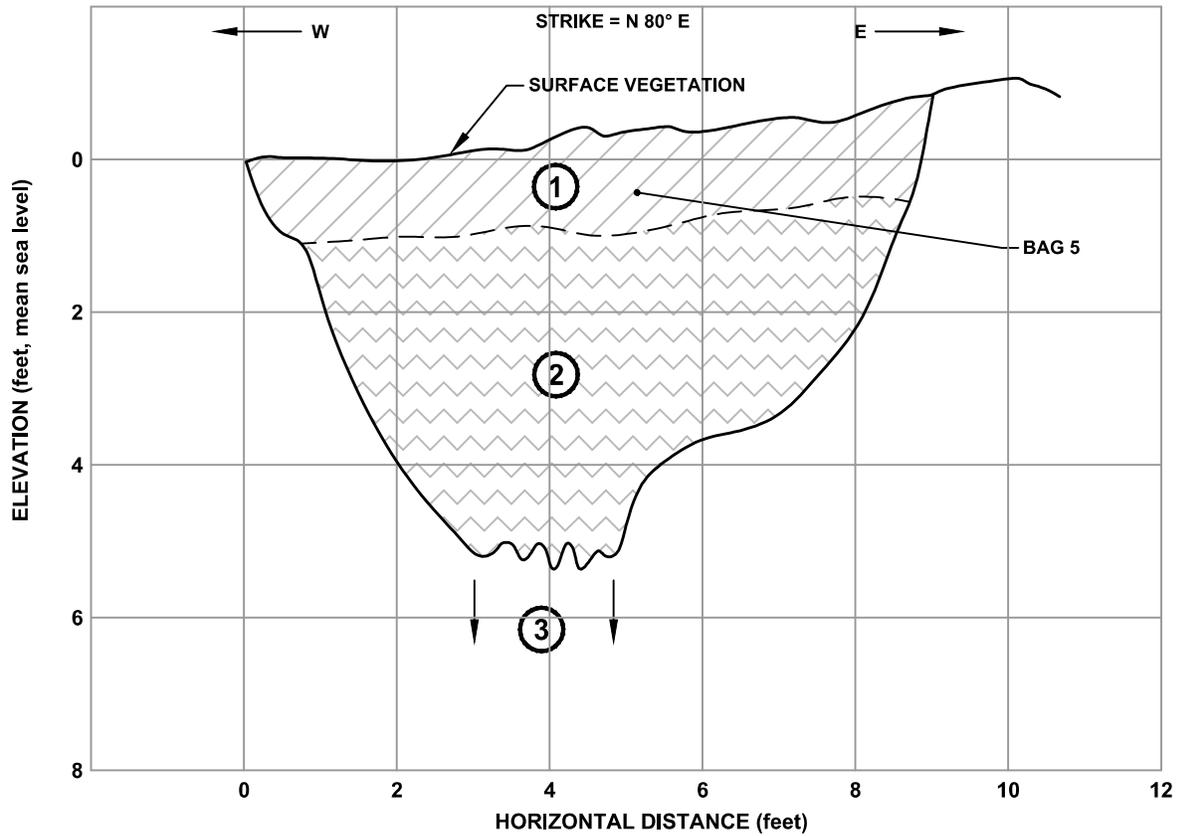
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TEST PIT LOG
 TP-4
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE
 A-10



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY (CL) - brownish red, dry, medium plasticity, fine to medium sand, trace gravel, rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry, highly weathered, medium strong to strong, highly fractured, well defined foliation, similar to CLAYEY SAND with Gravel and Cobbles (SC); fine to coarse sand, subangular METAVOLCANIC ROCK fragments up to 12"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, well defined foliation, refusal at 5' depth Latitude: 38.659916 Longitude: -121.058112

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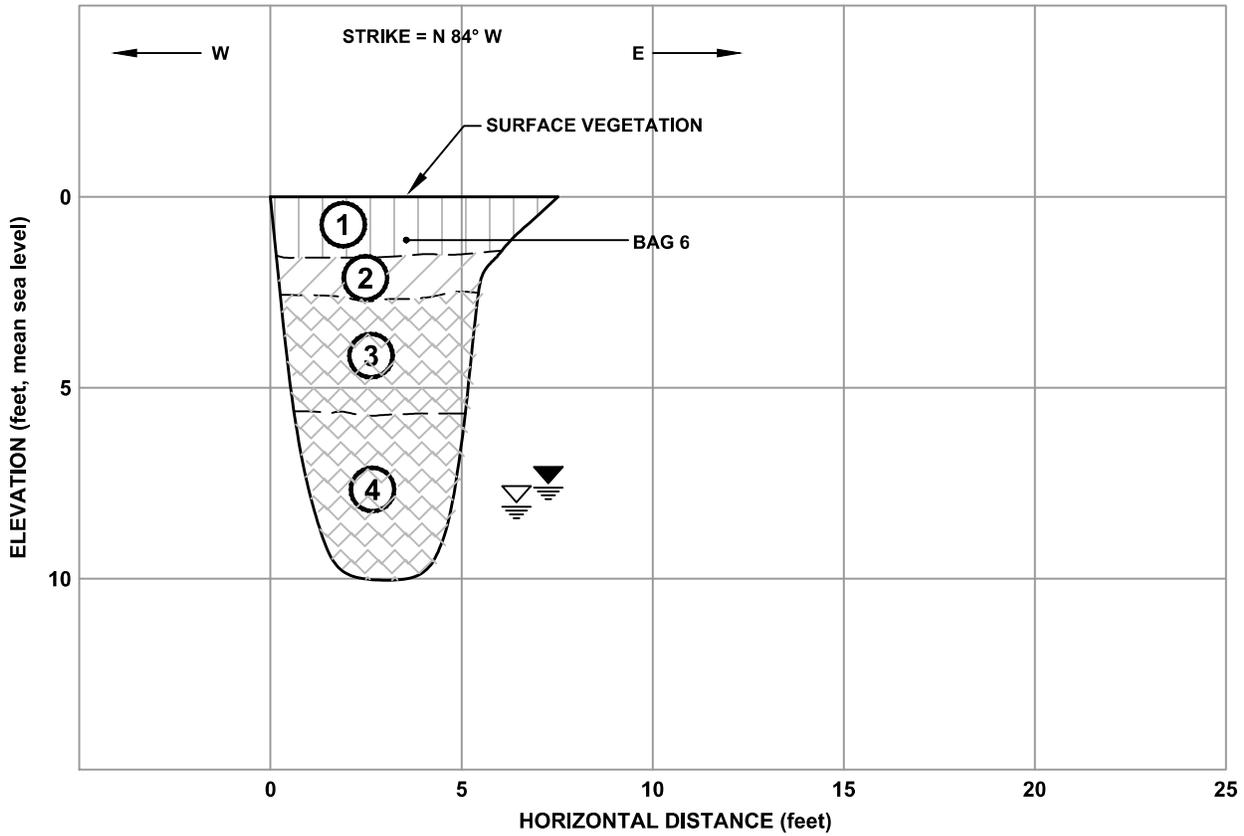


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 DATE: 08/27/2019

TEST PIT LOG
 TP-5
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-11



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY SILT (ML) - dark brown, dry, non-plastic, subangular fine to coarse sand, trace gravels up to 1", rootlets (RESIDUAL SOIL)
②	LEAN CLAY with Sand (CL) - brownish red, dry, medium plasticity, fine to coarse sand, trace coarse gravels up to 2", rootlets (COLLUVIUM)
③	METAVOLCANIC ROCK - mottled dark olive, moist, dark reddish brown, and bluish gray, decomposed, similar to FAT CLAY (CH); high plasticity, trace fine sand
④	METAVOLCANIC ROCK - bluish gray, yellowish brown, and brownish red, moist, highly weathered, weak, highly to intensely fractured, slight foliation, similar to CLAYEY SAND with Gravel and Cobble (SC); fine to coarse sand, subangular METAVOLCANIC ROCK fragments up to 7"
	(Perched Groundwater hit at 8 feet deep, settled at 7.75 feet deep after excavation)
	Latitude: 38.660489 Longitude: -121.057038

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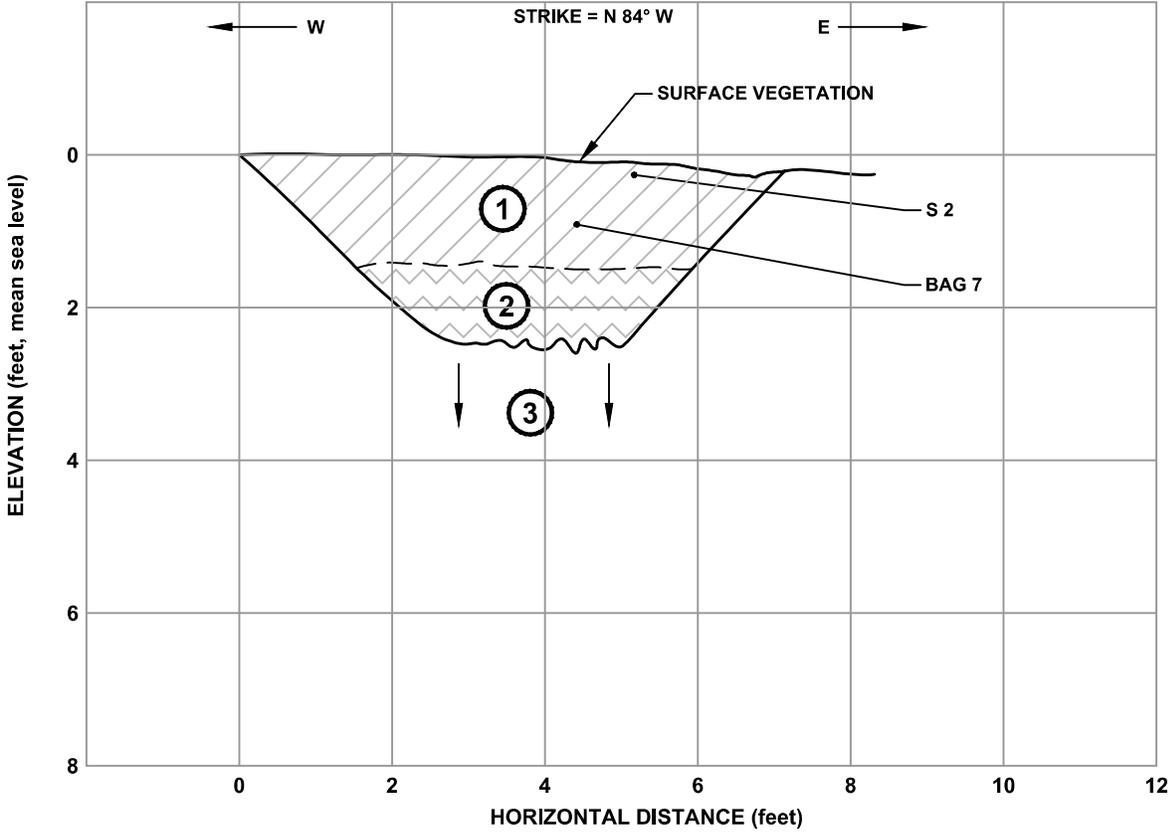
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TEST PIT LOG
TP-6
CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

FIGURE
A-12



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY with Gravel, Cobble and Boulders (CL) - brownish red, dry, medium plasticity, fine to coarse sand, subangular gravel and boulders up to 14", rootlets (FILL)
②	METAVOLCANIC ROCK - bluish gray and olive, moist, decomposed, similar to SAND LEAN CLAY (CL); fine to coarse sand, trace fine gravel, hard (PP = >4.5 tsf)
③	METAVOLCANIC ROCK - bluish gray, highly to mderately weathered, medium strong to strong, moderately fractured, slight foliation, refusal at 2.5' depth Latitude: 38.660608 Longitude: -121.056594

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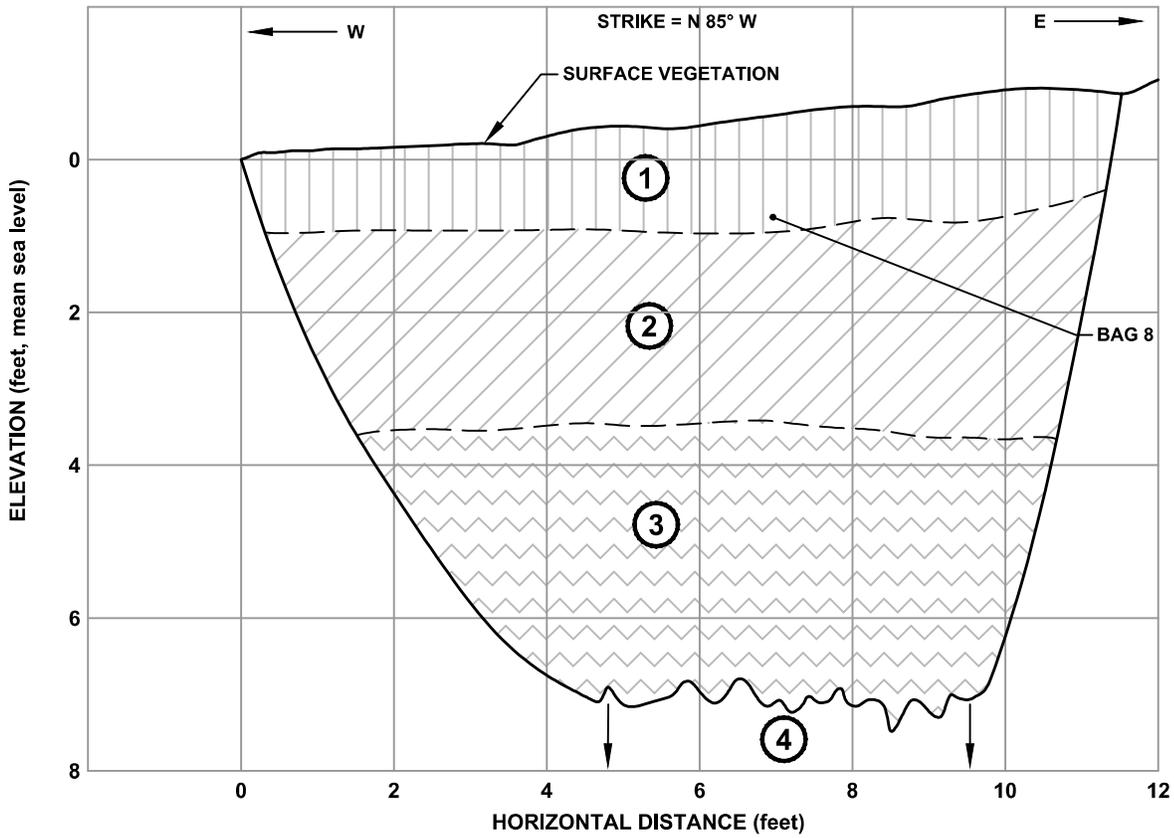


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TEST PIT LOG
 TP-7
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-13



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY SILT (ML) - dark brown, dry, non-plastic, fine to coarse sand, trace gravel up to 3/4", rootlets (COLLUVIUM)
②	LEAN CLAY with SAND (CL) - dark reddish brown, dry, medium plasticity, fine to coarse sand, subangular gravels up to 3", rootlets (COLLUVIUM)
③	METAVOLCANIC ROCK - bluish gray, yellowish brown, and brownish red, dry to moist, highly weathered, weak to medium strong, highly to intensely fractured, well defined foliation, similar to CLAYEY SAND with Gravel and Cobble (SC); fine to coarse sand, subangular METAVOLCANIC ROCK fragments up to 9"
④	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, refusal at 7' depth Latitude: 38.660183 Longitude: -121.057085

LOGGED BY: Jordan Annand

DATE: 8/20/19

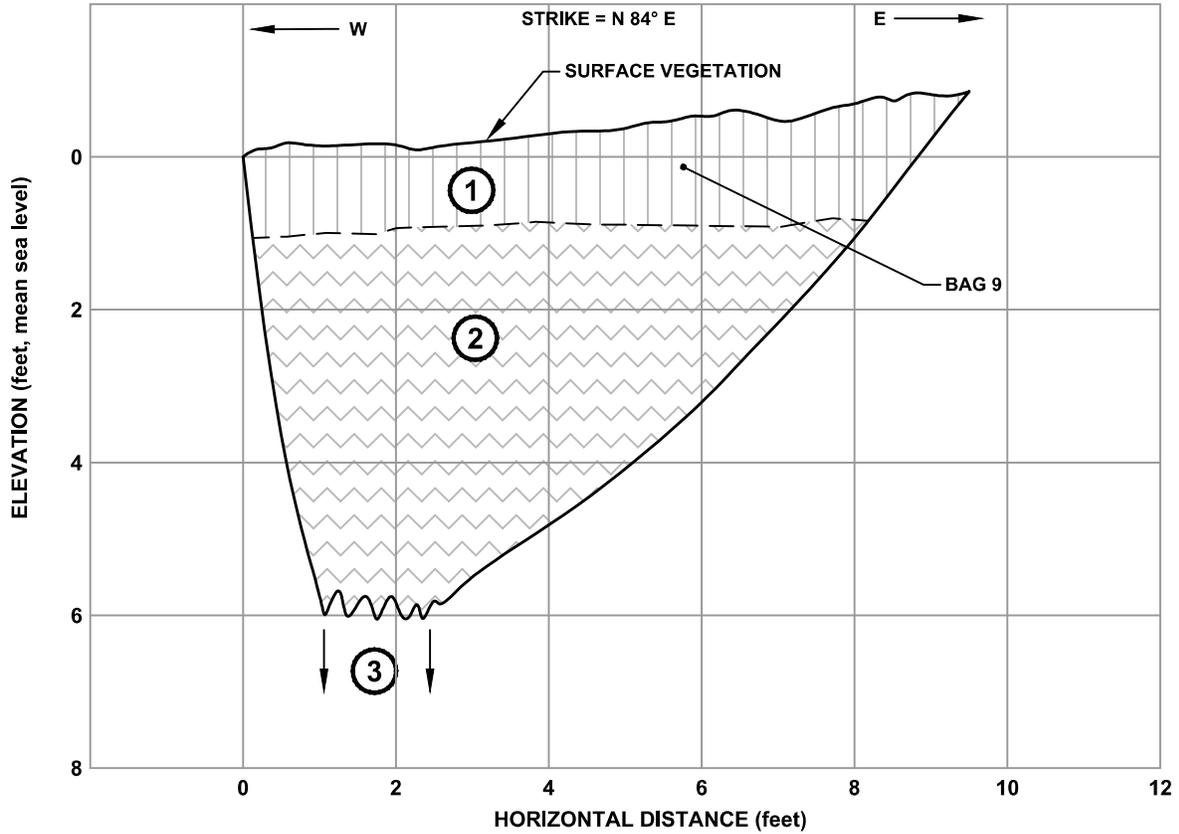
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TEST PIT LOG
TP-8
CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

FIGURE
A-14



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY SILT (ML) - dark brown and reddish brown, dry, non-plastic, fine to coarse sand, trace gravels up to 1", rootlets (COLLUVIUM)
②	METAVOLCANIC ROCK - bluish gray and olive, dry to moist, highly to moderately weathered, medium strong, highly fractured, slight foliation, similar to CLAYEY SAND with Gravel, Cobbles, and Boulders (SC); fine to coarse sand, subangular gravel, cobbles, and boulders up to 6"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, slight foliation, moderately fractured, refusal at 6' depth Latitude: 38.659967 Longitude: -121.057360

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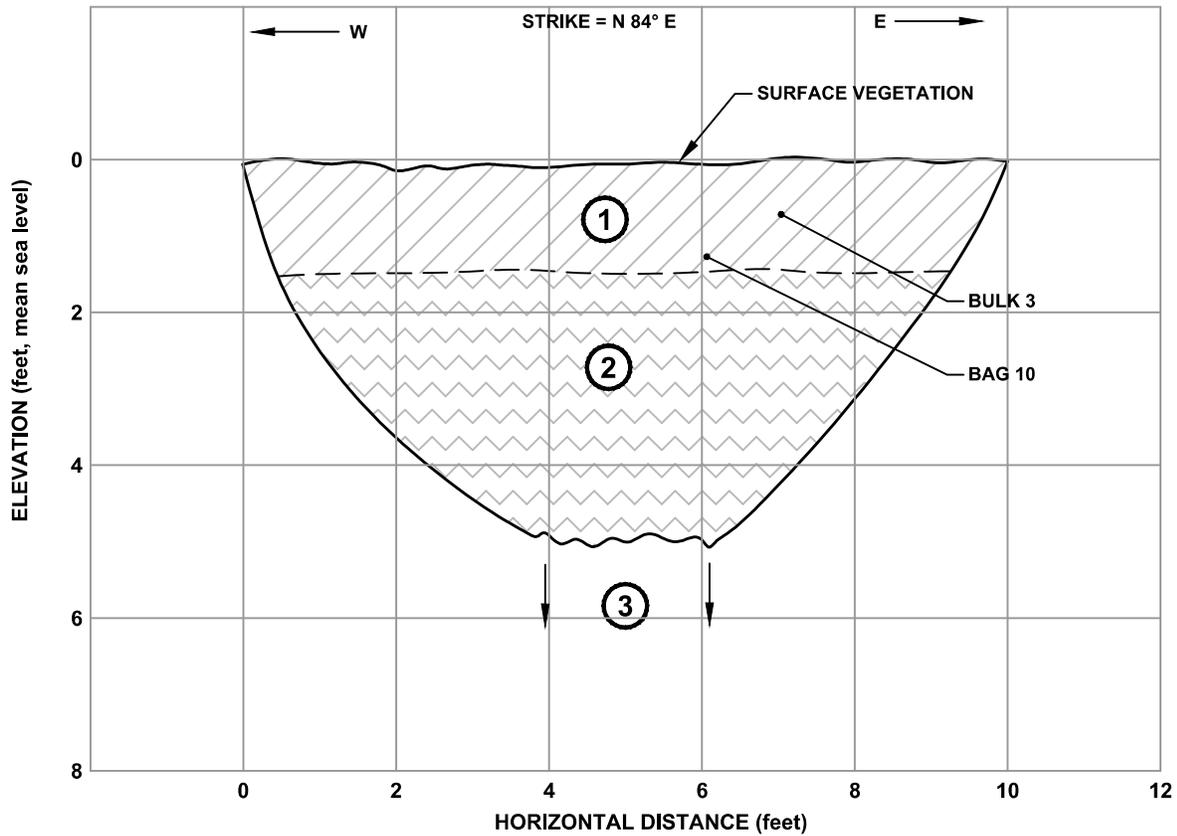


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TEST PIT LOG
 TP-9
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-15



UNIT NO.	MATERIALS DESCRIPTION
①	LEAN CLAY with Sand (CL) - brownish red, dry, medium plasticity, fine to coarse sand, trace subangular fine gravel, rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry, highly weathered, weak, highly fractured, slight foliation, similar to CLAYEY SAND with Gravel and Cobble (SC); fine to coarse sand, subangular METAVOLCANIC ROCK fragments up to 10"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, slight foliation, moderately fractured, refusal at 5' depth Latitude: 38.659963 Longitude: -121.057053

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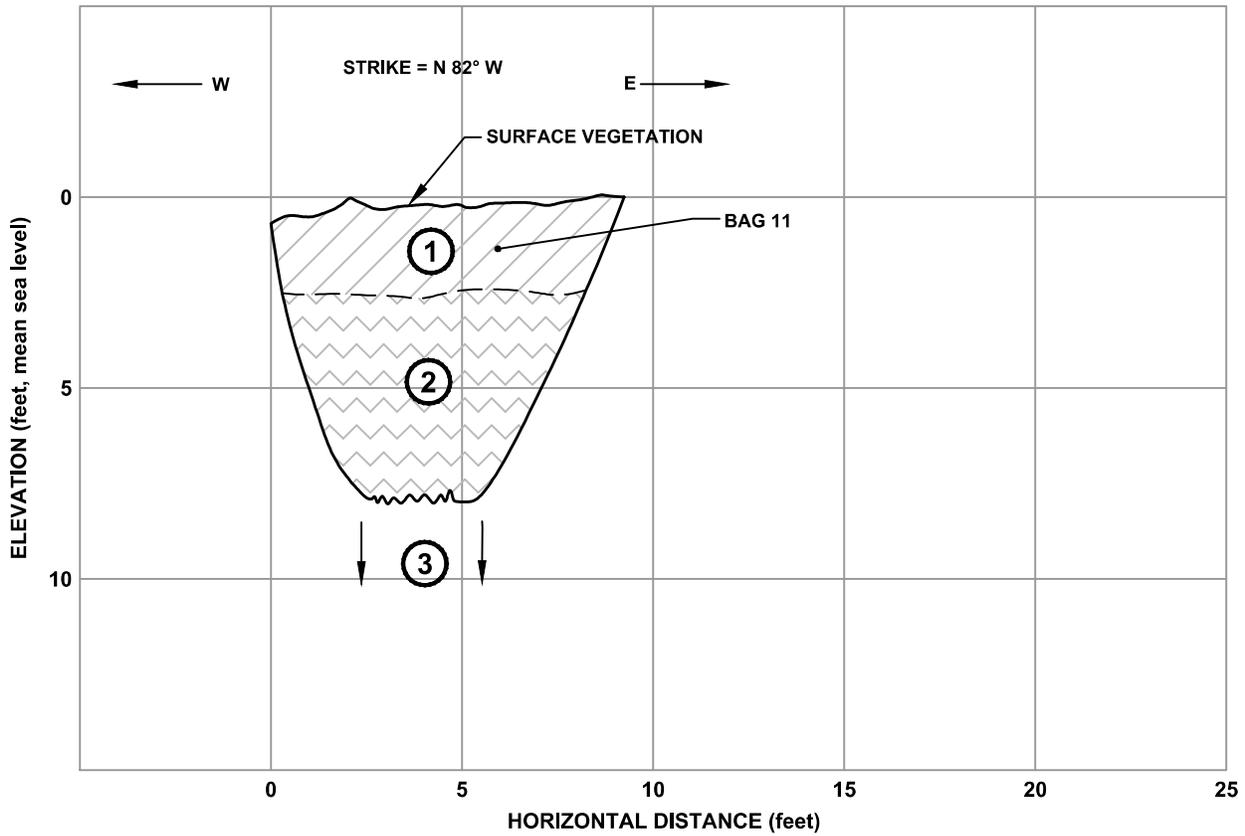
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TEST PIT LOG
 TP-10
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE
 A-16



UNIT NO.	MATERIALS DESCRIPTION
①	LEAN CLAY with Sand (CL) - brownish red, dry, medium plasticity, fine to medium sand, trace coarse sand and fine gravels, rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry, highly weathered, medium strong to weak, highly fractured, slight foliation, similar to CLAYEY SAND with Gravel and Cobbles (SC); fine to coarse sand, subangular METAVOLCANIC ROCK fragments up to 11"
③	METAVOLCANIC ROCK - bluish gray, moist, moderately weathered, strong, moderately fractured, refusal at 8' depth Latitude: 38.660167 Longitude: -121.056687

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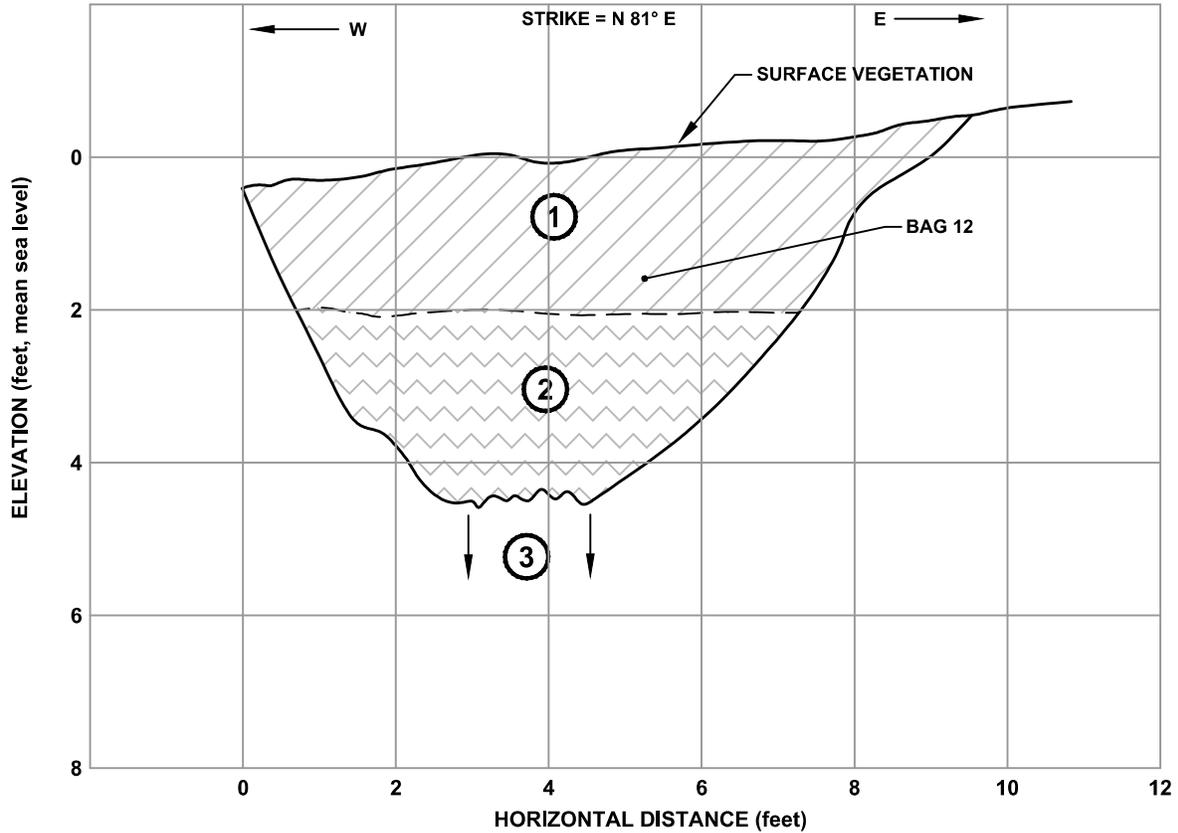


PROJECT NO. 20193141
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 DATE: 08/27/2019

TEST PIT LOG
 TP-11
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-17



UNIT NO.	MATERIALS DESCRIPTION
①	LEAN CLAY with Sand (CL) - brownish red, dry, medium plasticity, fine to medium sand, trace coarse sand and coarse gravels up to 1.75", rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, moist, decomposed, simialr to SANDY LEAN CLAY (CL); hard, medium plasticity, fine to coarse sand, trace fine gravels (PP = 4.0 tsf)
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, refusal at 4.5' depth Latitude: 38.660328 Longitude: -121.056397

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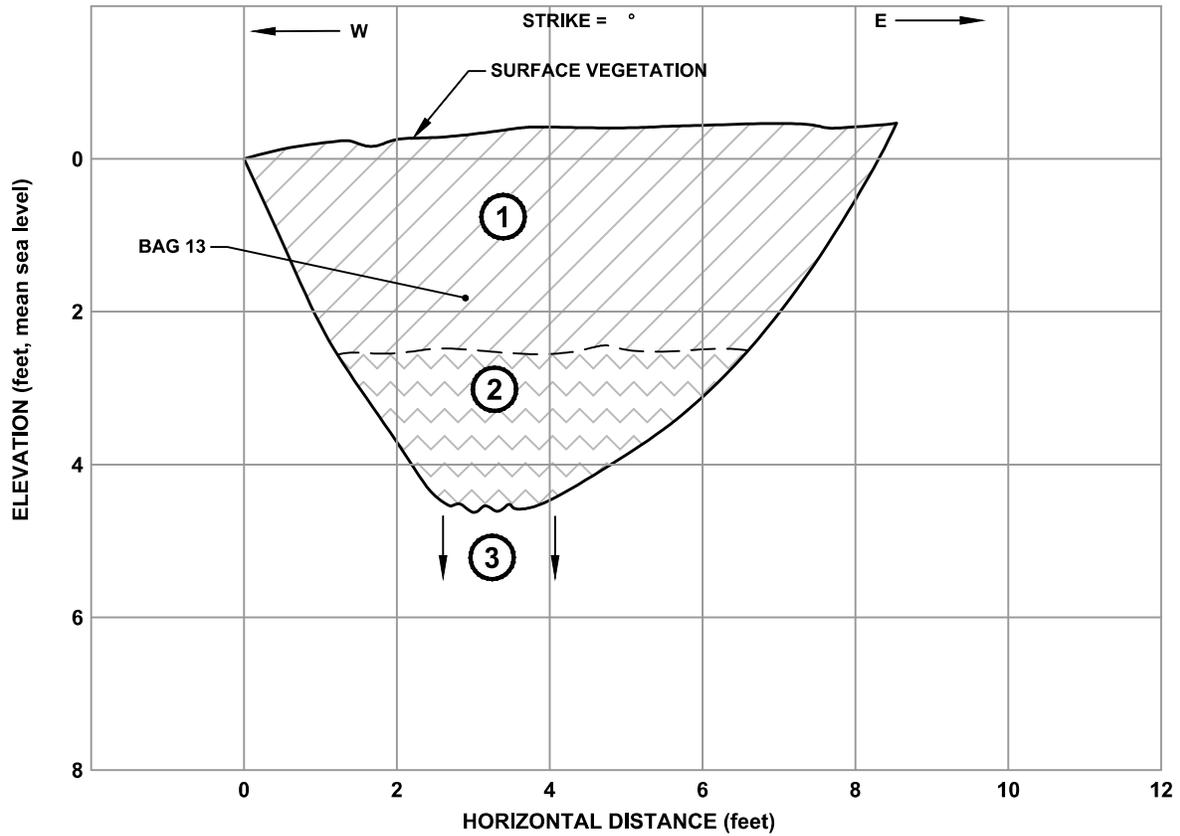


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 DATE: 08/27/2019

TEST PIT LOG
 TP-12
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-18



UNIT NO.	MATERIALS DESCRIPTION
①	LEAN CLAY with Sand (CL) - brownish red, dry, medium plasticity, fine to medium sand, trace coarse sand, trace subangular gravels up to 1", rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, moist, highly weathered, medium strong to weak, highly fractured, well defined foliation, similar to CLAYEY SAND with Gravel and Cobble (SC); fine to coarse sand, subangular METAVOLCANIC ROCK fragments up to 10"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, medium strong, moderately fractured, well defined foliation, refusal at 4.5' depth
Latitude: 38.660466 Longitude: -121.056072	

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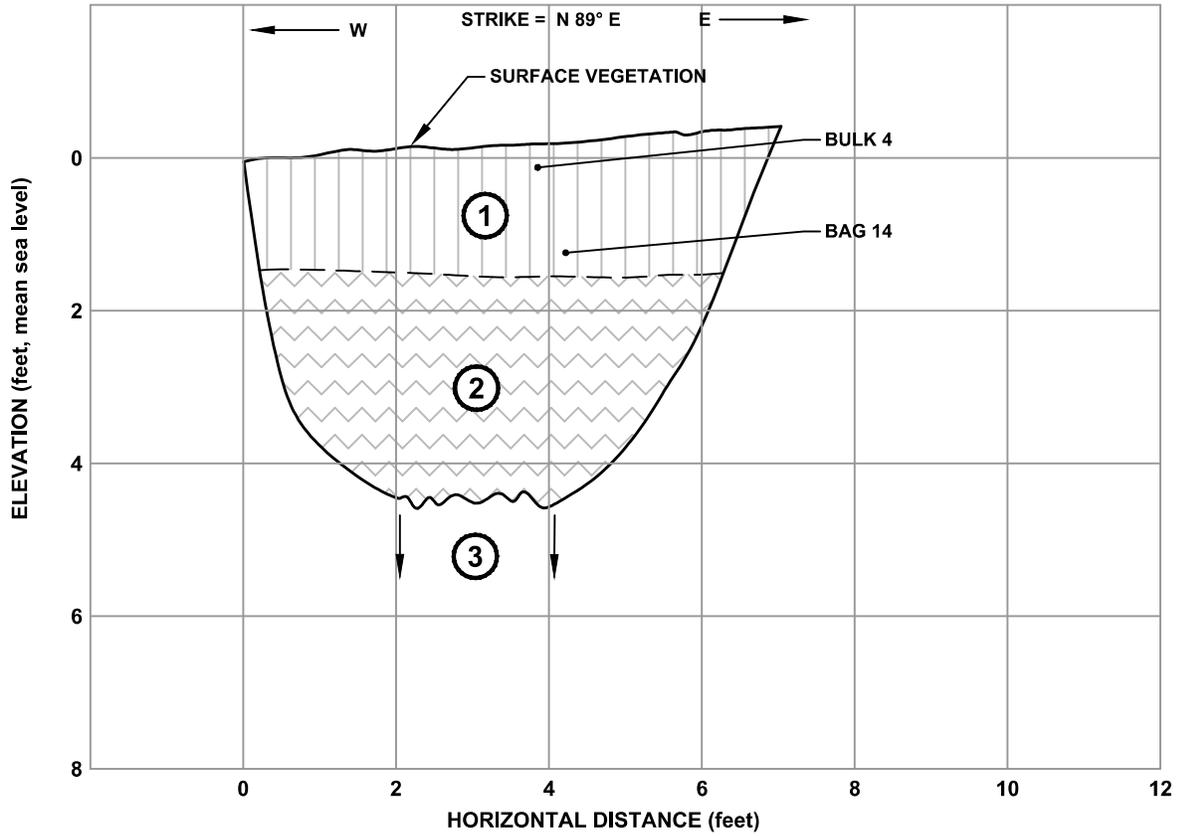


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TEST PIT LOG
 TP-13
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-19



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY SILT (ML) - dark brown, dry, low plasticity, fine to coarse sand, trace subangular gravels up to 1", rootlets (COLLUVIUM)
②	METAVOLCANIC ROCK - bluish gray and olive, dry, highly weathered, weak to medium strong, highly fractured, well defined foliation, similar to CLAYEY SAND with Gravel, Cobble, and Boulders (SC); fine to coarse sand, subangular METAVOLCANIC ROCK fragments up to 12"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, refusal at 4.5' depth Latitude: 38.659608 Longitude: -121.057533

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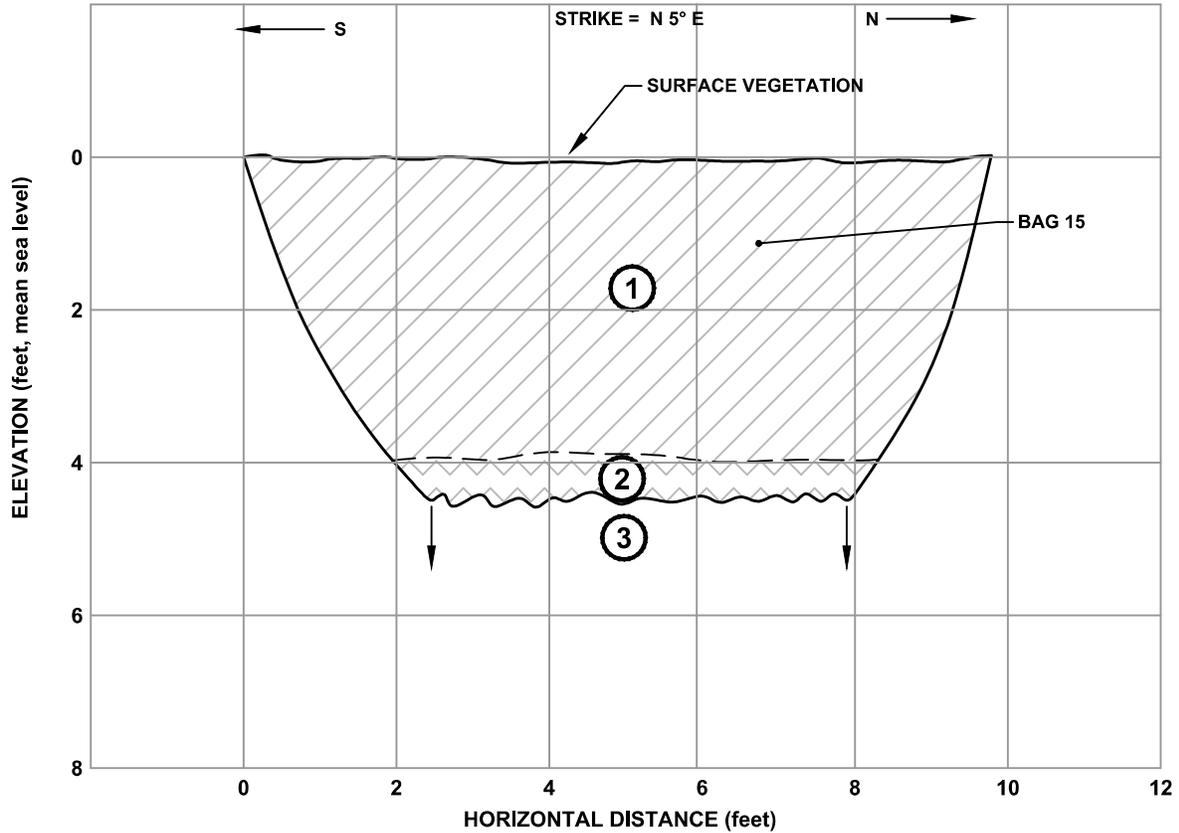


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 DATE: 08/27/2019

TEST PIT LOG
 TP-14
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-20



UNIT NO.	MATERIALS DESCRIPTION
①	LEAN CLAY with SAND (CL) - brownish red, dry, medium plasticity, fine to medium sand, trace coarse sand, trace subangular gravels up to 4" (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry to moist, highly weathered, medium strong, highly fractured, similar to CLAYEY SAND with Gravel and Cobble (SC); fine to coarse sand, subangular to angular METAVOLCANIC ROCK fragments up to 10"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, refusal at 4.5' depth Latitude: 38.659756 Longitude: -121.056681

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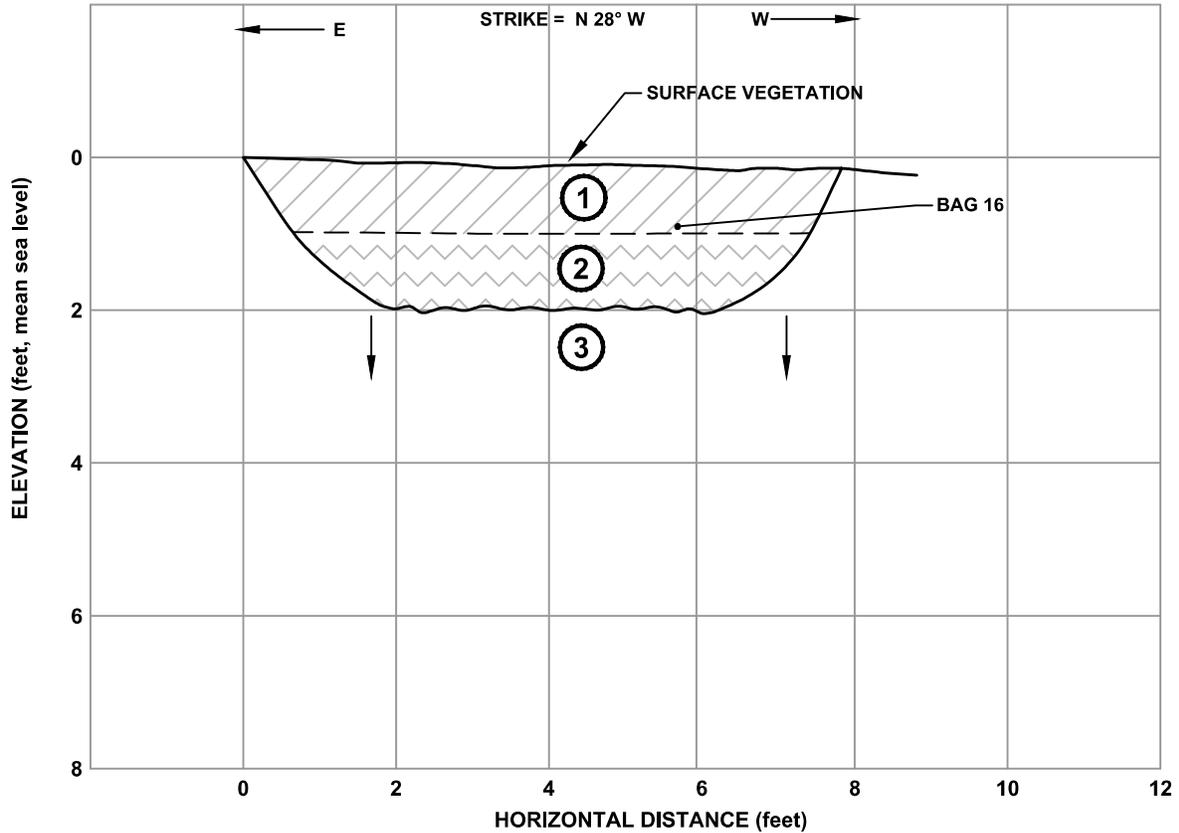


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TEST PIT LOG
 TP-15
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-21



UNIT NO.	MATERIALS DESCRIPTION
①	LEAN CLAY with SAND (CL) - brownish red, dry, medium plasticity, fine to medium sand, trace coarse sand, trace coarse gravels up to 1.5", rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry, highly weathered, medium strong, highly fractured, slight foliation, similar to CLAYEY SAND with Gravel and Cobble (SC); fine to coarse sand, METAVOLCANIC COBBLES up to 8"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, refusal at 2' depth Latitude: 38.660051 Longitude: -121.055962

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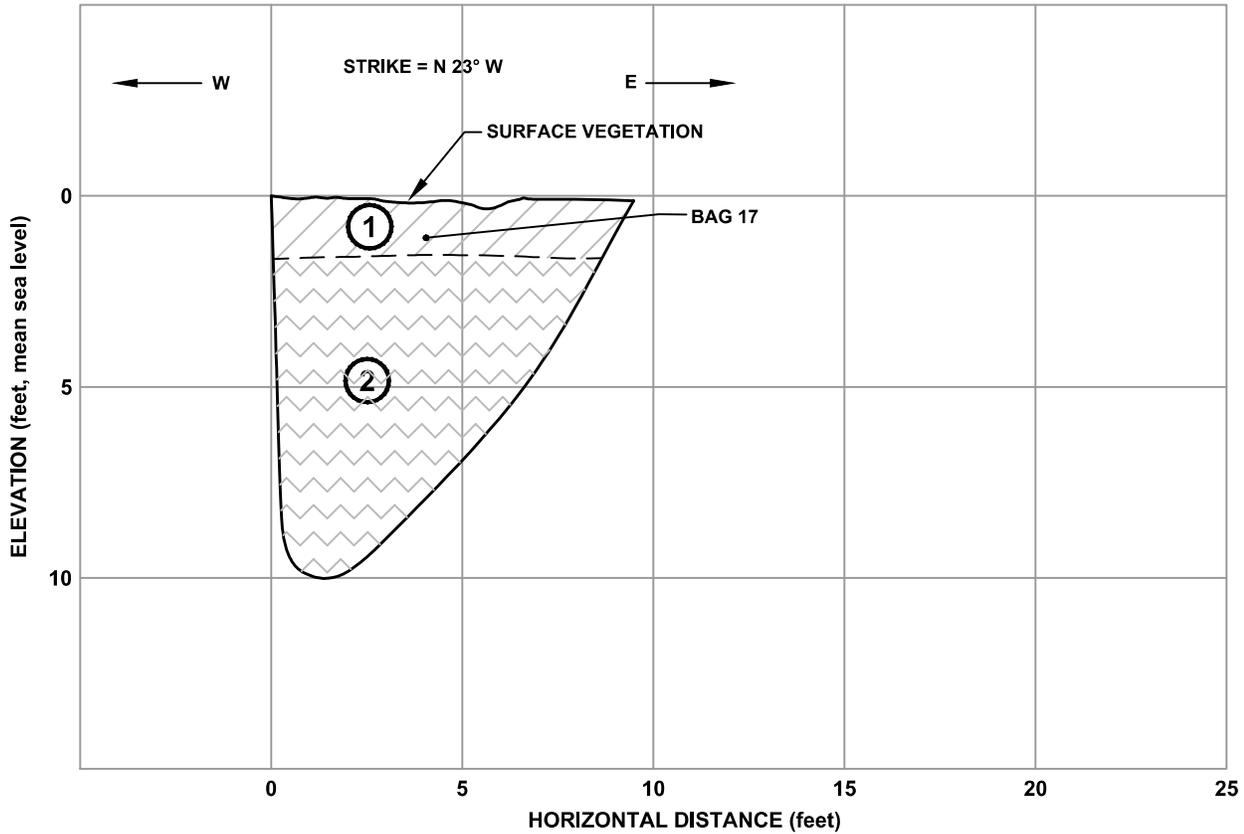


PROJECT NO. 20193141
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 DATE: 08/27/2019

TEST PIT LOG
 TP-16
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-22



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY with Gravel and Cobble (CL) - brownish red, dry, medium plasticity, fine to coarse sand, subangular gravel/cobble up to 4", rootlets (FILL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry, highly weathered, medium strong, highly fractured, well defined foliation, similar to CLAYEY SAND with Gravel and Cobbles (SC); fine to coarse sand, subangular METAVOLCANIC GRAVELS and COBBLES up to 6"

Latitude: 38.659358
Longitude: -121.056180

LOGGED BY: Jordan Annand

DATE: 8/19/19

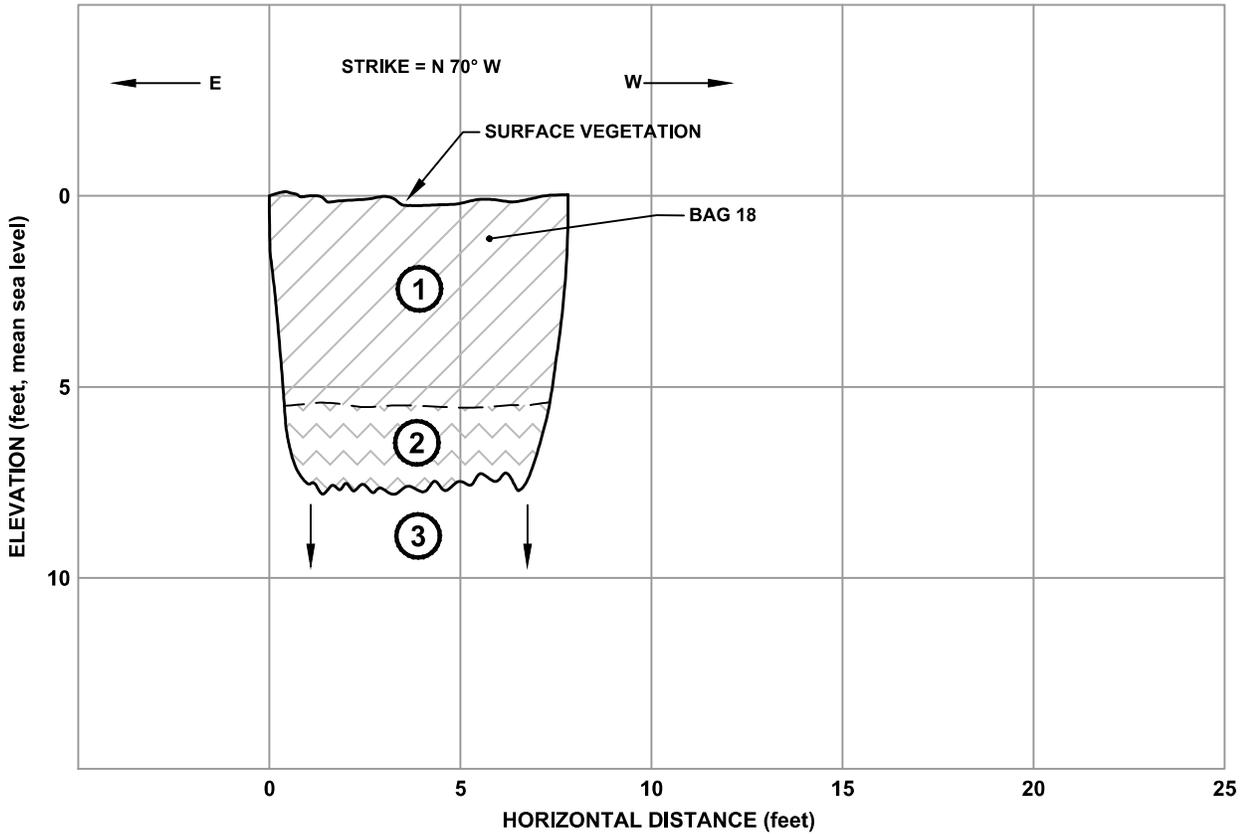
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TEST PIT LOG
TP-17
CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

FIGURE
A-23



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY with Gravel, Cobble, and Boulders (CL) - reddish brown, dry, medium plasticity, subangular to rounded fine sand to boulder sized particles up to 2' (FILL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry, highly weathered, medium strong, highly fractured, similar to CLAYEY SAND with Gravel and Cobbles (SC); fine to coarse sand, subangular METAVOLCANIC COBBLES up to 8"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, well defined foliation, refusal at 7.3' depth Latitude: 38.659105 Longitude: -121.057523

LOGGED BY: Jordan Annand

DATE: 8/19/19

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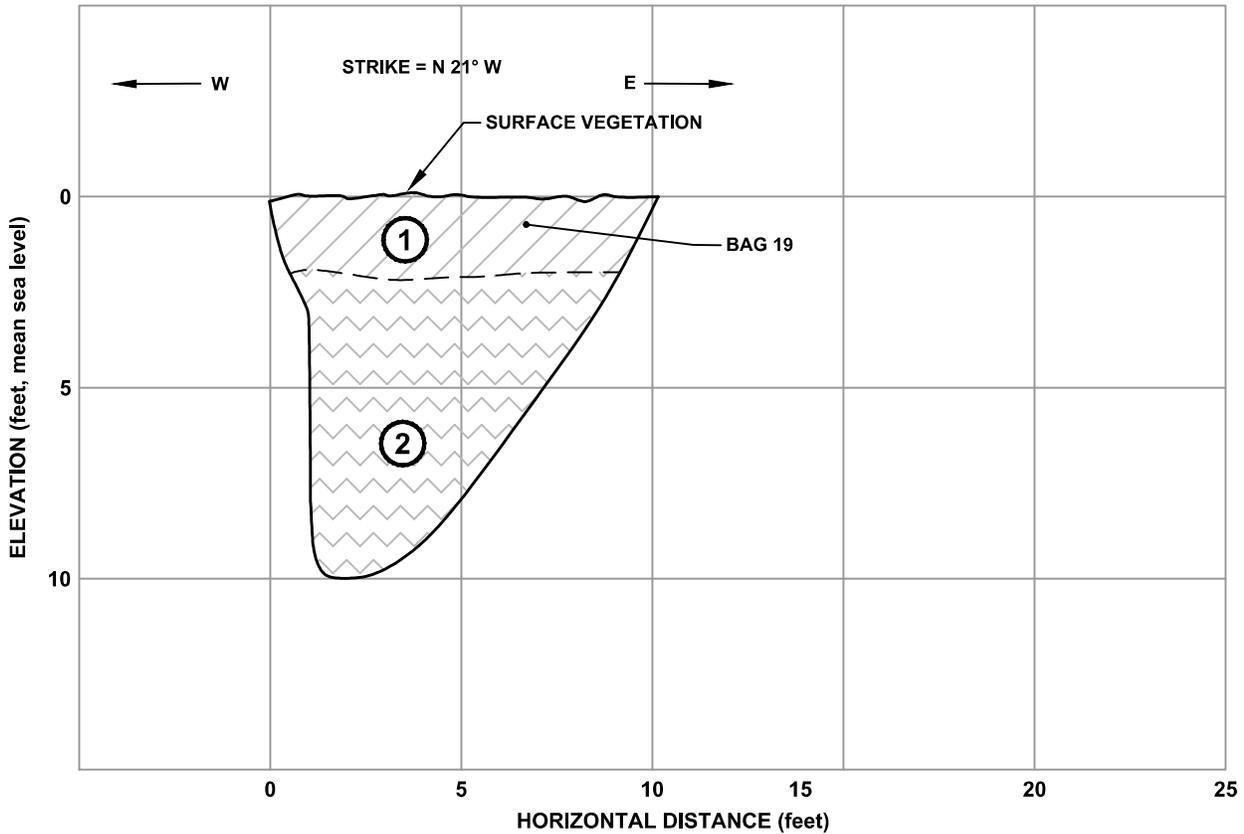


PROJECT NO. 20193141
 ENTRY BY: D. Ross
 CHECKED BY: J. Annand
 DATE: 08/27/2019

TEST PIT LOG
 TP-18
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-24



UNIT NO.	MATERIALS DESCRIPTION
①	LEAN CLAY with Sand (CL) - brownish red, dry, medium plasticity, fine to medium sand, trace subangular gravels up to 2", rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry to moist, highly weathered, weak to medium strong, highly fractured, slight foliation, similar to CLAYEY SAND with Gravel and Cobble(SC); fine to coarse sand, subangular METAVOLCANIC ROCK fragments up to 5"

Latitude: 38.659418
Longitude: -121.056699

LOGGED BY: Jordan Annand DATE: 8/19/19

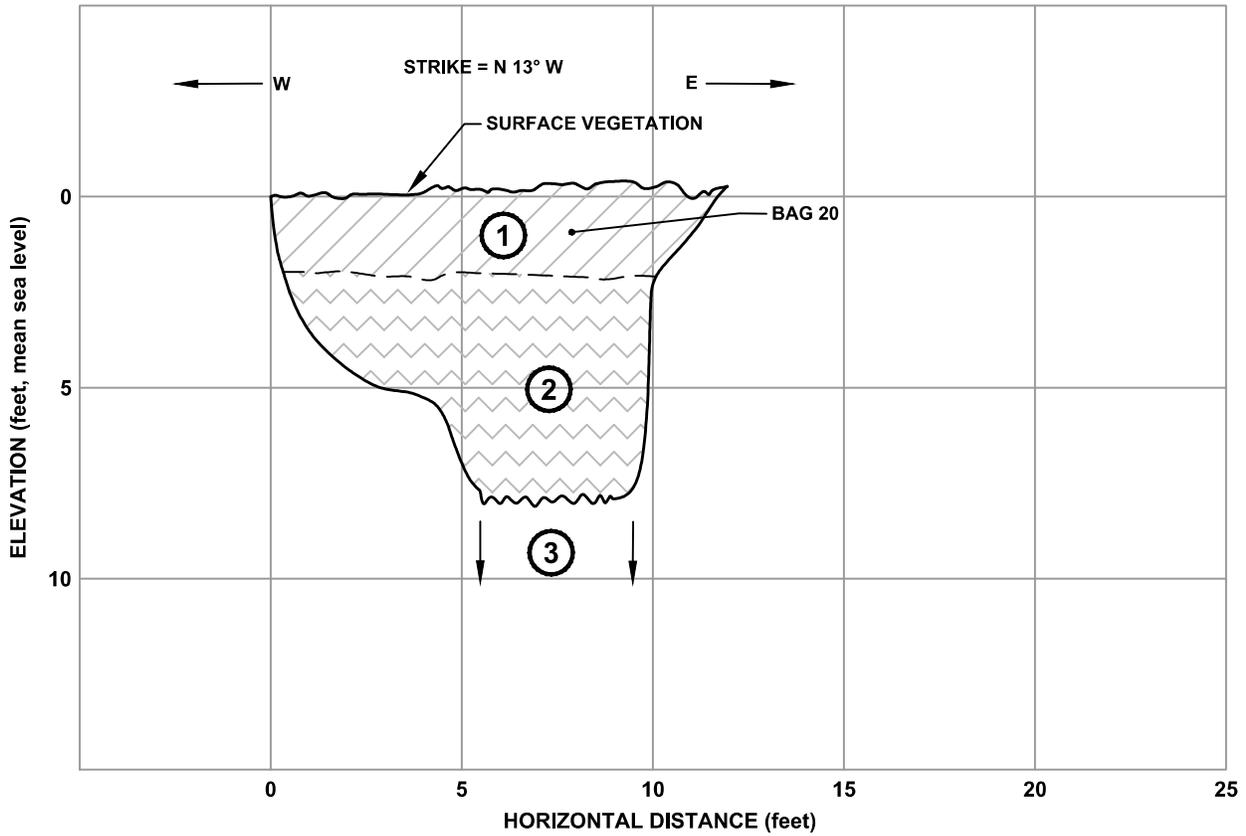
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PROJECT NO. 20193141
ENTRY BY: D. Ross
CHECKED BY: J. Annand
DATE: 08/27/2019

TEST PIT LOG
TP-19
CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

FIGURE
A-25



UNIT NO.	MATERIALS DESCRIPTION
①	LEAN CLAY with Sand (CL) - brownish red, dry, medium plasticity, fine to medium subangular sand, trace fine gravels, rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - light bluish gray, dry, highly weathered, medium strong, highly fractured, well defined foliation, similar to CLAYEY SAND with Gravel, Cobble, and Boulders (SC); fine to coarse sand, subangular ROCK fragments up to 13"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, well defined foliation, refusal at 7.5' depth Latitude: 38.659582 Longitude: -121.056399

LOGGED BY: Jordan Annand

DATE: 8/19/19

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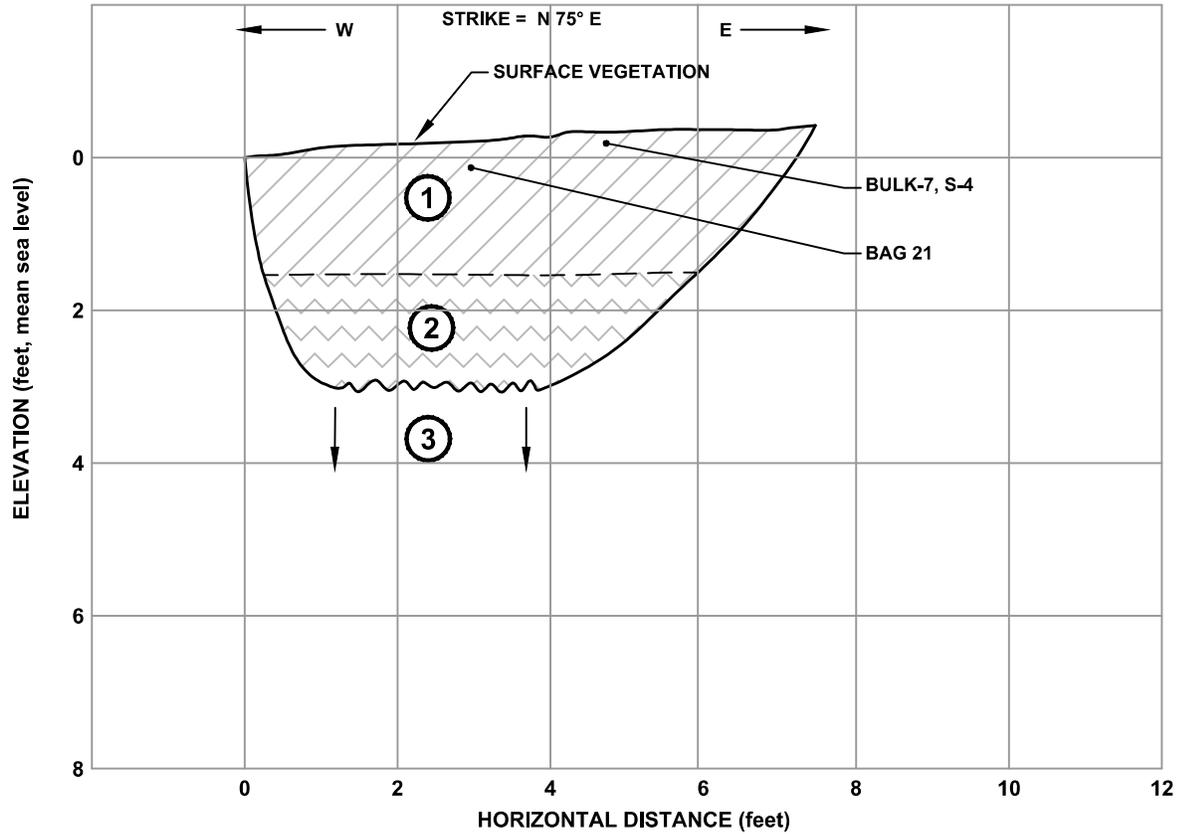


PROJECT NO. 20193141
 ENTRY BY: D. Ross
 CHECKED BY: J. Annand
 DATE: 08/27/2019

TEST PIT LOG
 TP-20
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-26



UNIT NO.	MATERIALS DESCRIPTION
①	LEAN CLAY with SAND (CL) - brownish red, dry, medium plasticity, subangular fine to medium sand, trace fine gravels, rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry, highly weathered, medium strong, highly fractured, similar to POORLY GRADED SAND with Clay, Gravel, and Cobble (SP-SC); fine to coarse sand and gravel subrounded cobbles up to 6"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, highly fractured, slight foliation, refusal at 3' depth Latitude: 38.659766 Longitude: -121.056003

LOGGED BY: Jordan Annand DATE: 8/19/19

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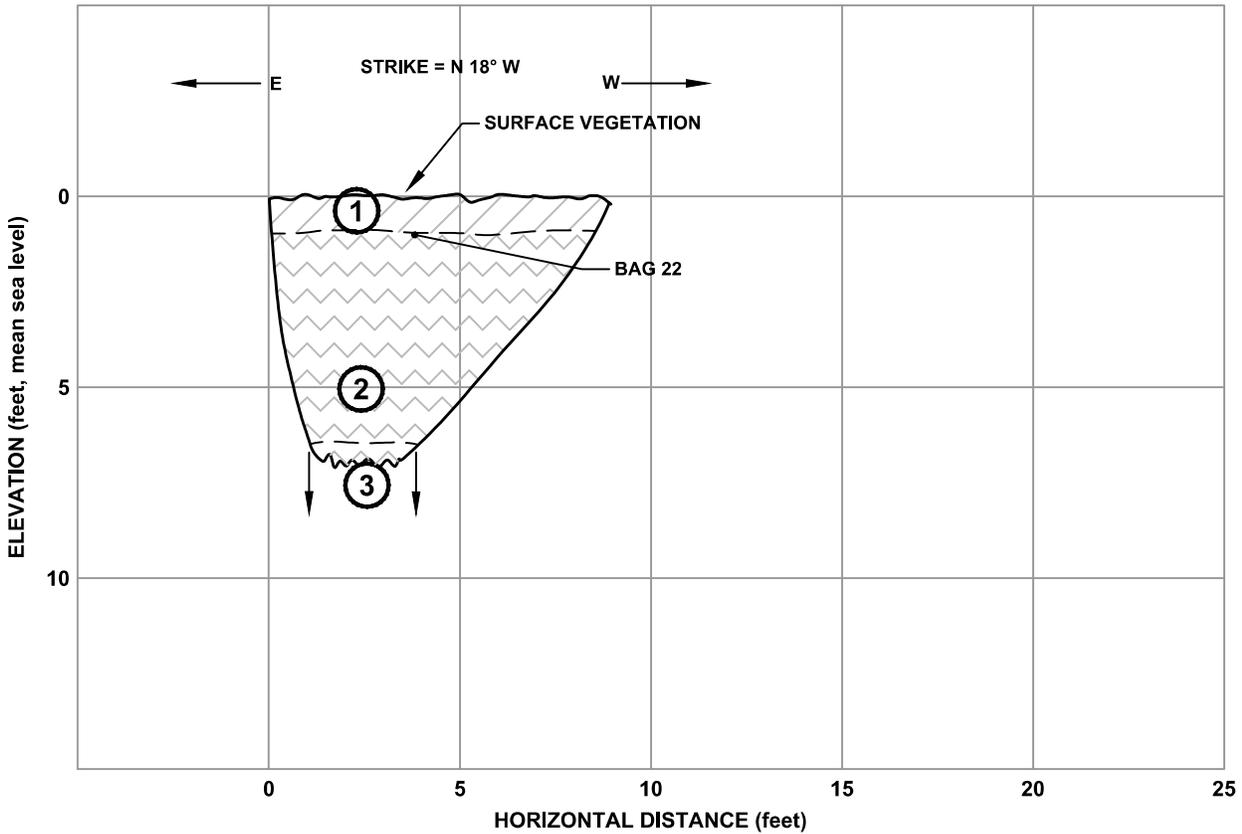


PROJECT NO. 20193141
 ENTRY BY: D. Ross
 CHECKED BY: J. Annand
 DATE: 08/27/2019

TEST PIT LOG
 TP-21
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-27



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY (CL) - brownish red, dry, medium plasticity, fine to medium sand, trace subangular gravels up to 1", rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry to moist, highly weathered, medium strong, highly fractured, slight foliation, similar to CLAYEY SAND with Gravel, Cobble, and Boulders (SC); fine to coarse sand, subangular gravel, cobbles, and boulders up to 15"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, slight foliation, refusal at 7' depth Latitude: 38.659371 Longitude: -121.056358

LOGGED BY: Jordan Annand

DATE: 8/19/19

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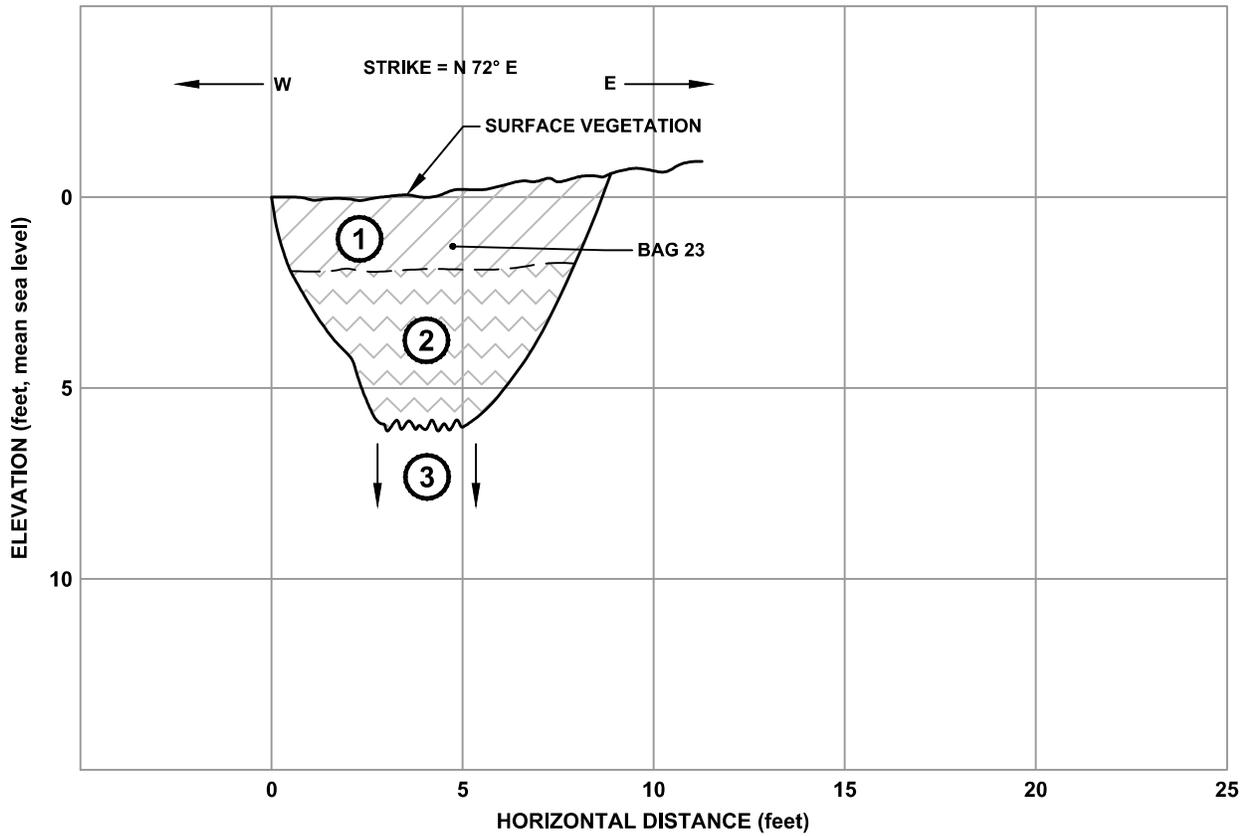


PROJECT NO. 20193141
 ENTRY BY: D. Ross
 CHECKED BY: J. Annand
 DATE: 08/27/2019

TEST PIT LOG
 TP-22
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-28



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY (CL) - brownish red, dry, medium plasticity, fine to medium sand, trace subangular coarse gravels up to 1.5", rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry, highly weathered, weak to strong, highly fractured, slight foliation, similar to CLAYEY SAND with Gravel and Cobble, fine to coarse sand, subangular METAVOLCANIC ROCK fragments up to 10"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, refusal at 6' depth Latitude: 38.659276 Longitude: -121.056011

LOGGED BY: Jordan Annand DATE: 8/19/19

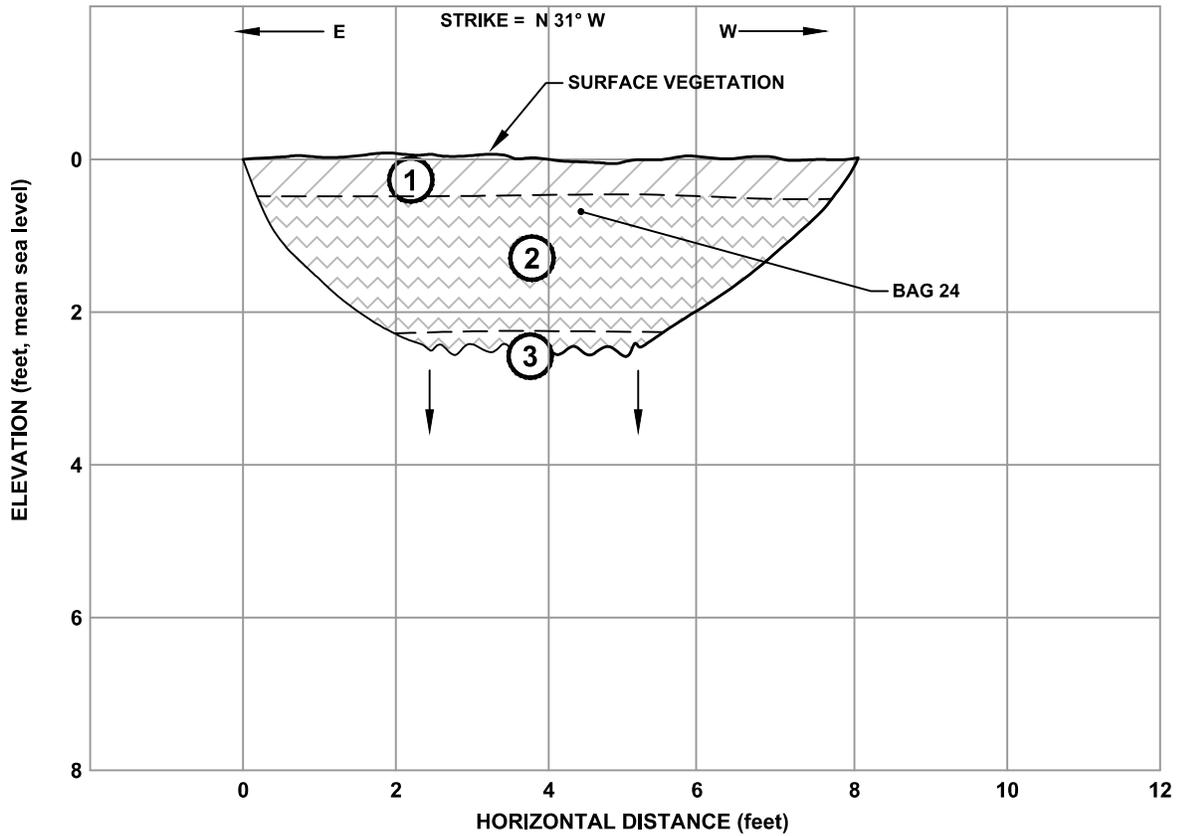
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 ENTRY BY: D. Ross
 CHECKED BY: J. Annand
 DATE: 08/27/2019

TEST PIT LOG
 TP-23
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE
 A-29



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY (CL) - brownish red, dry, medium plasticity, fine to medium sand, trace fine coarse sand, trace fine gravel, rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry, highly weathered, weak to medium strong, highly fractured, well defined foliation, similar to CLAYEY SAND with Gravel, Cobbles, and Boulders (SC); fine to coarse sand, subangular gravels and cobbles up to 14"
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, well defined foliation, refusal at 2.5' depth Latitude: 38.659248 Longitude: -121.055652

LOGGED BY: Jordan Annand

DATE: 8/19/19

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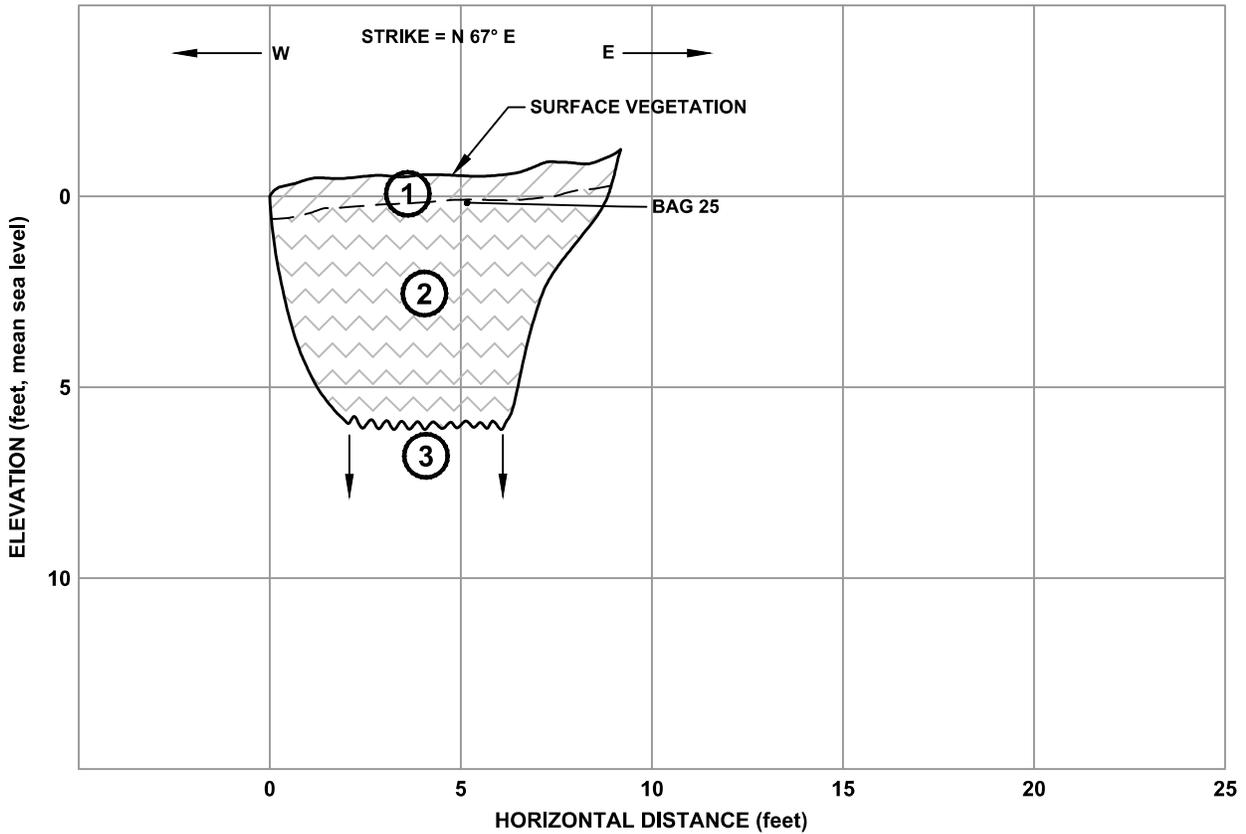
PROJECT NO. 20193141
ENTRY BY: D. Ross
CHECKED BY: J. Annand
DATE: 08/27/2019

TEST PIT LOG
TP-24

CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

FIGURE

A-30



UNIT NO.	MATERIALS DESCRIPTION
①	SANDY LEAN CLAY (CL) - brownish red, dry, medium plasticity, subangular fine to medium sand, trace fine gravel, rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - light bluish gray, dry, highly weathered, medium strong, highly fractured, slight foliation, similar to POORLY GRADED SAND with Clay, Gravel, Cobble, and Boulders (SP-SC); fine to coarse sand, subangular gravel, cobble, and boulders up to 14"
③	METAVOLCANIC ROCK - light bluish gray, moderately weathered, strong, highly fractured, slight foliation, refusal at 6' depth Latitude: 38.659457 Longitude: -121.055406

LOGGED BY: Jordan Annand

DATE: 8/19/19

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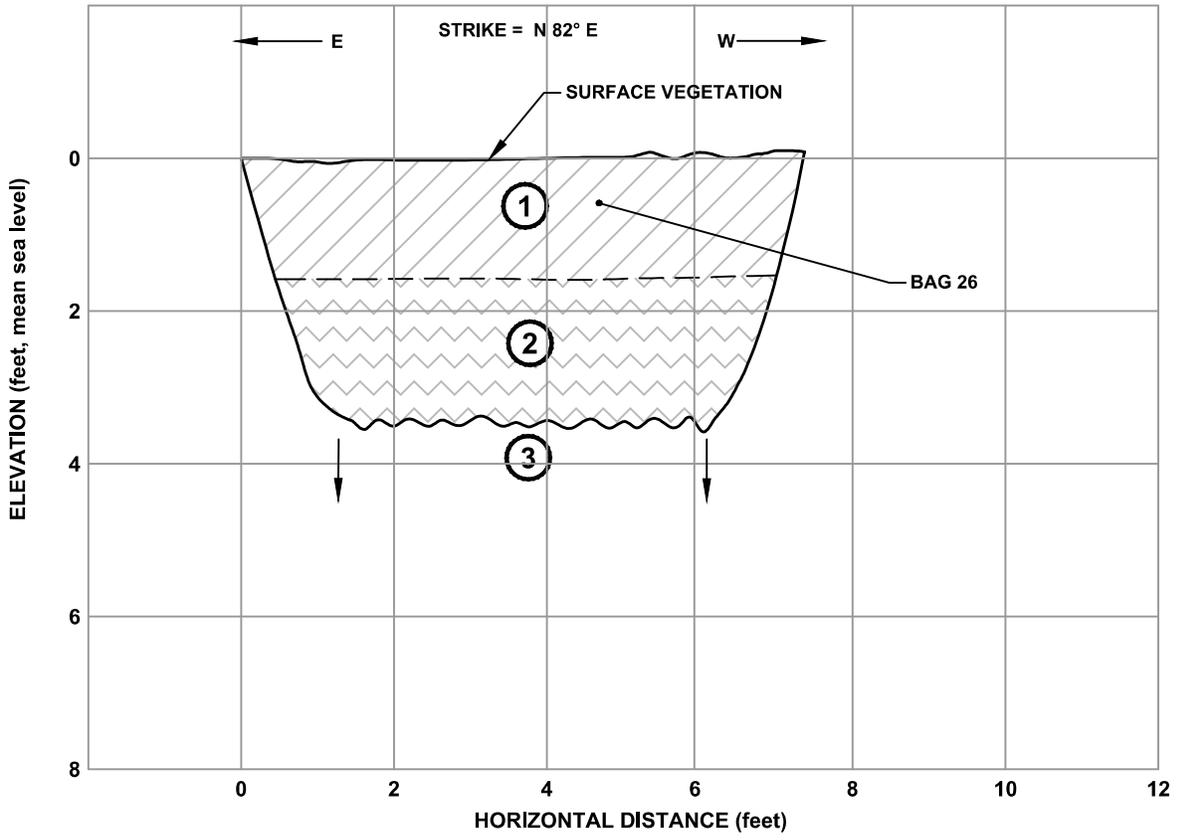


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 ENTRY BY: D. Ross
 CHECKED BY: J. Annand
 DATE: 08/27/2019

TEST PIT LOG
 TP-25
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-31



UNIT NO.	MATERIALS DESCRIPTION
①	LEAN CLAY with SAND (CL) - brownish red, dry, medium plasticity, subangular fine to medium sand, trace fine gravel, rootlets (RESIDUAL SOIL)
②	METAVOLCANIC ROCK - bluish gray and olive, dry, highly weathered, medium strong, highly fractured, well defined foliation, similar to CLAYEY SAND with Gravel and Cobble (SC); fine to coarse sand
③	METAVOLCANIC ROCK - bluish gray, moderately weathered, strong, moderately fractured, refusal at 3.5 depth Latitude: 38.659029 Longitude: -121.057009

LOGGED BY: Jordan Annand

DATE: 8/19/19

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PROJECT NO. 20193141
 ENTRY BY: D. Ross
 CHECKED BY: J. Annand
 DATE: 08/28/2019

TEST PIT LOG
 TP-26
 CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

A-32



KLEINFELDER

Bright People. Right Solutions.

APPENDIX B LABORATORY TESTING

GENERAL

Laboratory tests were performed on selected samples as an aid in classifying the soils and to evaluate physical properties of the soils that may affect foundation design and construction procedures. The tests were performed in general conformance with the current ASTM or Caltrans standards. A description of the laboratory-testing program is presented below.

MOISTURE CONTENT

Moisture content testing was performed on a selected sample recovered from our borings. Moisture contents were determined in general accordance with ASTM Test Method D2216. Results of the testing are presented on the boring logs in Appendix A and as an attachment in this appendix.

ATTERBERG LIMITS

Atterberg limits testing was performed on selected soil samples to assist in classification. Testing was performed in general accordance with ASTM D4318. Results are presented attached to this appendix.

R-VALUE

Resistance value (R-value) tests were performed on selected bulk soil samples obtained to evaluate pavement support characteristics of the near-surface onsite soils. R-value tests were performed in accordance with Caltrans Standard Test Method 301. The test results are attached in this appendix.

ROCK STRENGTH (UNCONFINED COMPRESSIVE STRENGTH)

Unconfined compressive strength tests were performed on select samples of intact rock from our rock core samples. These tests were performed in accordance with ASTM D7012 and are included in this appendix.

PRELIMINARY SOIL CORROSIVITY

A series of chemical tests were performed on a selected sample of the near-surface soils to estimate pH, resistivity and sulfate and chloride contents. The sample was tested in general accordance with California Test Methods 643, 422, and 417 for pH and minimum resistivity,

soluble chlorides, and soluble sulfates, respectively. Test results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to construction materials. The tests were performed by AP Engineering and Laboratory, Inc. of Pomona, California. The results of the tests are presented in Table 4 of Section 4.10 of the report and attached to this appendix.

TOPSOIL ANALYTICAL TESTS

Topsoil analytical testing was performed on one representative sample of the near-surface soils by Waypoint Analytical of Anaheim, California. The topsoil was tested for percentages of organic matter, percentages of deleterious material, pH, mineral content, micro and macro nutrient content, and herbicide presence in the soil. The test results are presented in the Waypoint Analytical report attached to this appendix.

Exploration ID	Depth (ft.)	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
					Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
TP-(1)	0.0 - 2.0	SANDY LEAN CLAY (CL)									Corrosion Test R-Value= 63
TP-(2)	0.0 - 2.0	SANDY LEAN CLAY (CL)	6.6					31	22	9	
TP-(10)	0.0 - 1.5	SANDY, SILTY CLAY (CL-ML)	7.4					29	21	8	Corrosion Test
TP-(14)	0.0 - 2.0	SANDY SILT (ML)									Corrosion Test R-Value= 54
TP-(21)	0.0 - 1.5	SANDY, SILTY CLAY (CL-ML)	5.5					25	19	6	Corrosion Test
TP-(26)	0.0 - 1.5	LEAN CLAY WITH SAND (CL)									R-Value= 63

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = NonPlastic



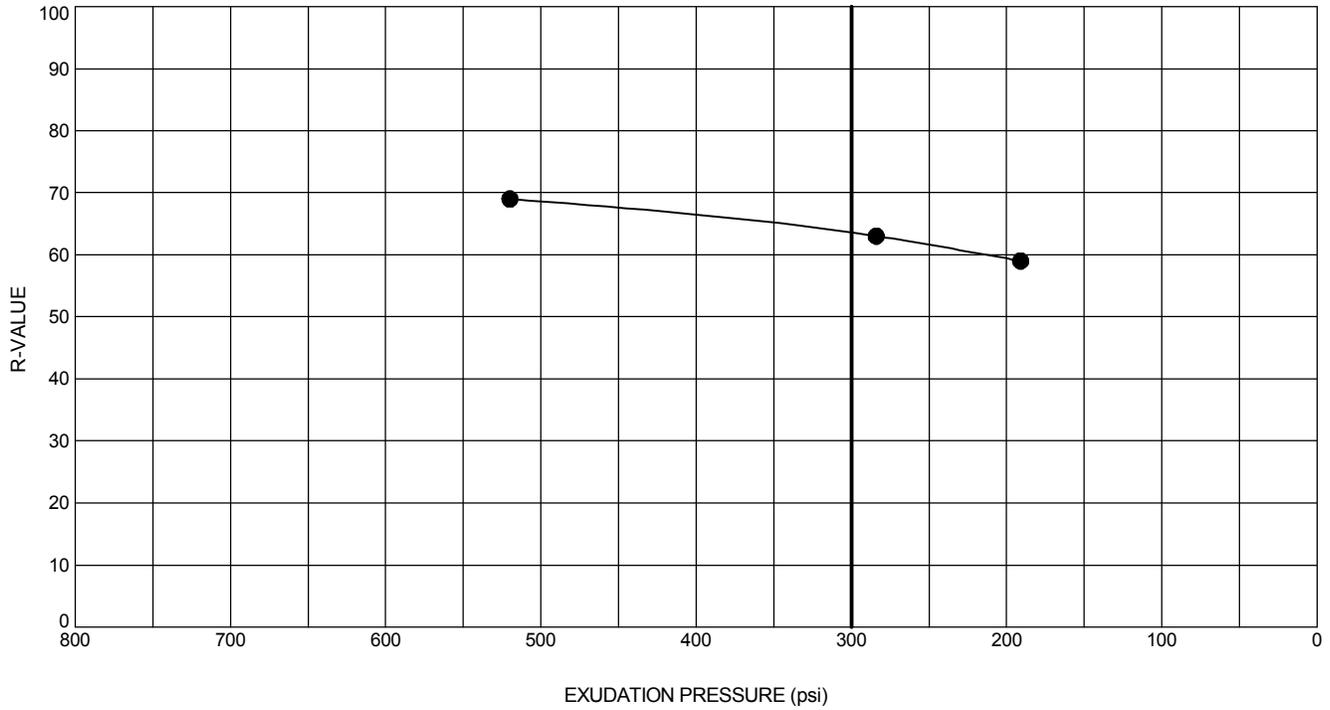
PROJECT NO.: 20193141
DRAWN BY: JDS
CHECKED BY: DD
DATE: 9/11/2019
REVISED: 10/4/2019

**LABORATORY TEST
RESULT SUMMARY**

CSM COSTCO EL DORADO HILLS
SILVA VALLEY PARKWAY
EL DORADO HILLS, CALIFORNIA

FIGURE

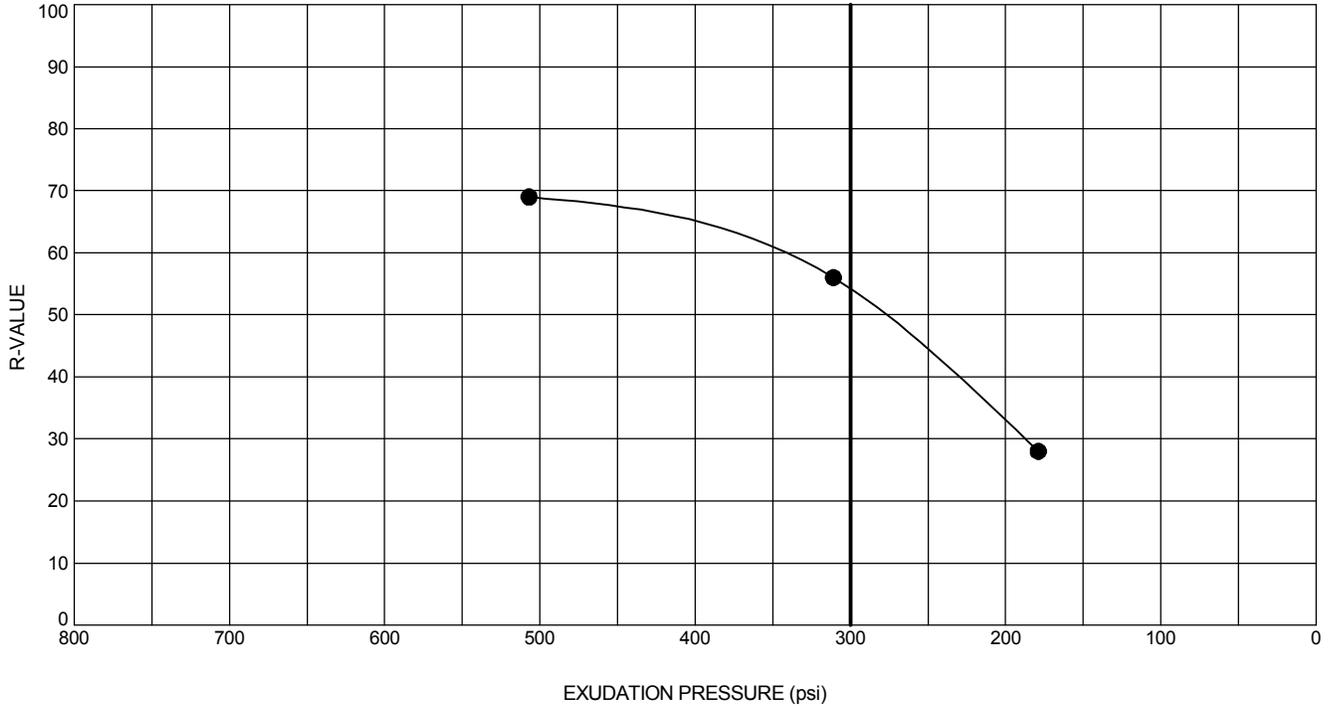
B-1



Exploration ID	Depth (ft.)	Sample Description	R-Value @ 300 psi Exudation Pressure		
TP-(1)	0 - 2	SANDY LEAN CLAY (CL)	63		
Specimen No.	Moisture at Time of Test (%)	Dry Unit Weight (pcf)	Expansion Pressure (psi)	Exudation Pressure (psi)	Corrected Resistance Value
1	16.3	108.1	286	284	63
2	15.4	110.1	450	520	69
3	17.1	108.4	268	191	59

Testing performed in general accordance with ASTM D2844.

	PROJECT NO.: 20193141	R-VALUE CSM COSTCO EL DORADO HILLS SILVA VALLEY PARKWAY EL DORADO HILLS, CALIFORNIA	FIGURE
	DRAWN BY: DR CHECKED BY: DD DATE: 10/14/2019 REVISED: -		B-3



Exploration ID	Depth (ft.)	Sample Description			R-Value @ 300 psi Exudation Pressure
TP-(14)	0 - 2	SANDY SILT (ML)			54
Specimen No.	Moisture at Time of Test (%)	Dry Unit Weight (pcf)	Expansion Pressure (psi)	Exudation Pressure (psi)	Corrected Resistance Value
1	15.2	113.5	294	311	56
2	13.5	116.0	494	507	69
3	16.9	113.0	178	179	28

Testing performed in general accordance with ASTM D2844.



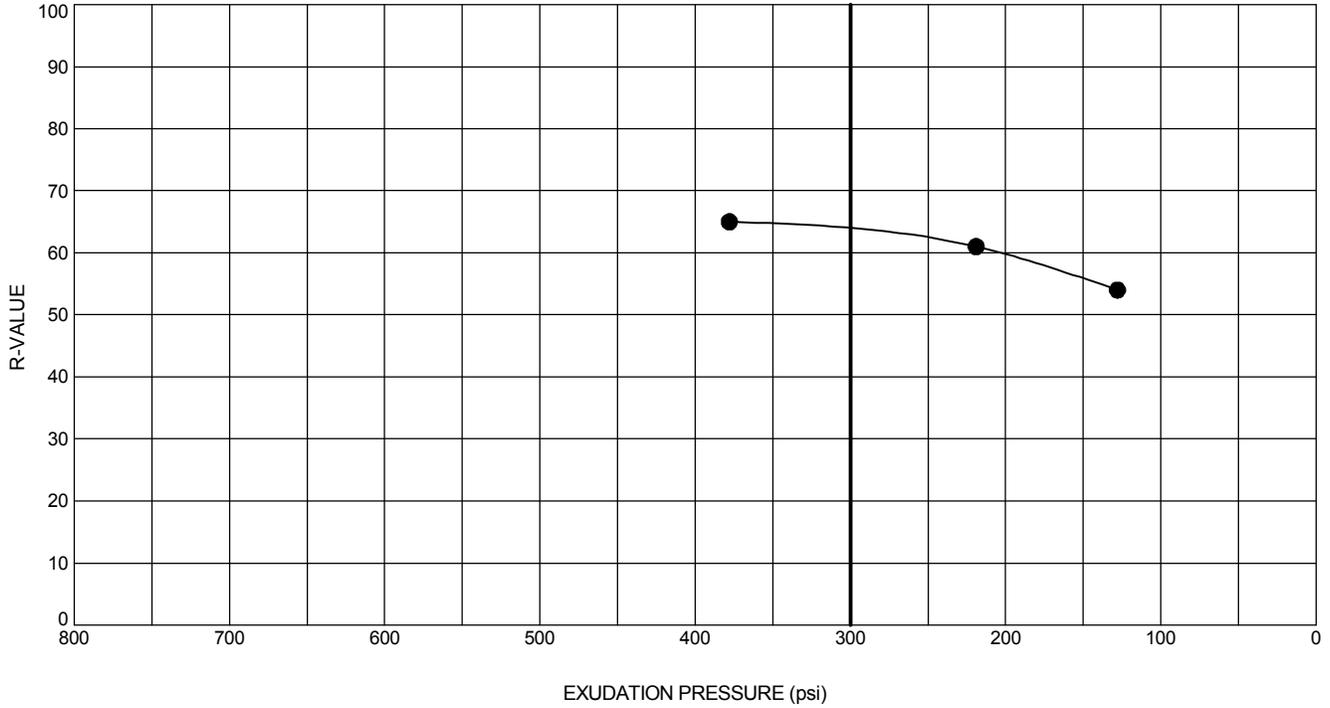
PROJECT NO.: 20193141
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 CHECKED BY: DD
 DATE: 10/14/2019
 REVISED: -

R-VALUE

CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

B-4



Exploration ID	Depth (ft.)	Sample Description			R-Value @ 300 psi Exudation Pressure
TP-(26)	0 - 1.5	LEAN CLAY WITH SAND (CL)			63
Specimen No.	Moisture at Time of Test (%)	Dry Unit Weight (pcf)	Expansion Pressure (psi)	Exudation Pressure (psi)	Corrected Resistance Value
1	13.8	119.1	169	128	54
2	12.9	118.9	208	378	65
3	13.3	119.5	195	219	61

Testing performed in general accordance with ASTM D2844.



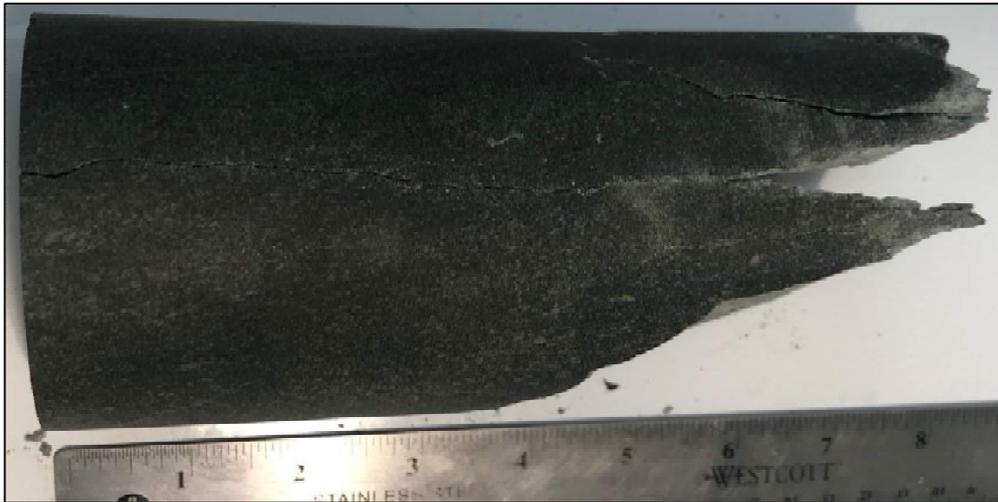
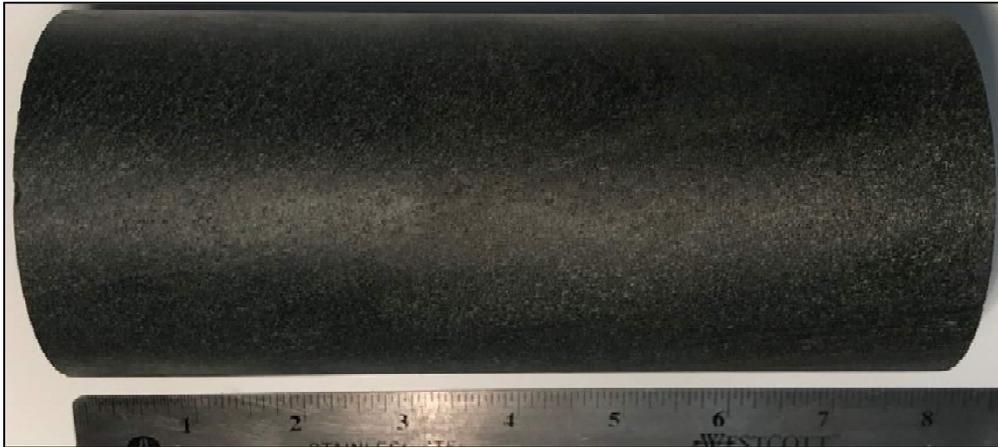
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 CHECKED BY: DD
 DATE: 10/14/2019
 REVISED: -

R-VALUE

CSM COSTCO EL DORADO HILLS
 SILVA VALLEY PARKWAY
 EL DORADO HILLS, CALIFORNIA

FIGURE

B-5



Specimen Preparation in accordance with ASTM D4543	Diameter, in	D _o	3.27
Remarks:	Height, in	H _o	6.79
	Moisture Condition		As Received
	Unit Weight, pcf	ρ _d	183
	Uniaxial Compressive Strength (psi)	σ _u	17,400
	Time to Failure, mm:ss		2:52

Description of Specimen: Metavolcanic		Test Method: ASTM D7012, Method C
Boring:	KB-4	
Run:	4	
Depth, ft:	16.6-17.6	
Test Date:	10/9/2019	

<p>9969 Horn Rd., Sacramento, CA 95827</p>	PROJECT NO.: 20193141 ENTRY BY: S. Rader CHECKED BY: B. Anderson DATE: 10/18/2019	UNIAXIAL COMPRESSION TEST CSM COSTCO EL DORADO HILLS SILVA VALLEY PARKWAY EL DORADO HILLS, CALIFORNIA	FIGURE B-6
			PAGE: 1 of 1



AP Engineering and Testing, Inc.

DBE | MBE | SBE

2607 Pomona Boulevard | Pomona, CA 91768

t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

CORROSION TEST RESULTS

Client Name: Kleinfelder

AP Job No.: 19-0901

Project Name: Costco El Dorado Hills New Warehouse

Date: 09/04/19

Project No.: 20193141.001A

Boring No.	Sample No.	Depth (feet)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
TP-1	Bulk 6	0-2	CL-ML	3848	5.2	36	35
TP-10	Bulk 3	0-2	CL-ML	5324	6.1	38	39
TP-14	Bulk 4	0-2	CL-ML	6453	6.0	34	34
TP-21	Bulk 7	0-1.5	CL-ML	5012	5.7	41	55

NOTES: Resistivity Test and pH: California Test Method 643
Sulfate Content : California Test Method 417
Chloride Content : California Test Method 422
ND = Not Detectable
NA = Not Sufficient Sample
NR = Not Requested



Anaheim Office
September 25, 2019
Report 19-253-0006

Kleinfelder, Inc.
380 North First Street
Suite A
San Jose CA 95112

Attn: Dan Dockendorf

RE: Costco El Dorado Hills, Updated New Warehouse

Background

One composite sample was processed on September 10, 2019 identified as soil from areas where new landscaping is scheduled for installation. Fertilizer and amendment recommendations were requested. The sample was analyzed for horticultural suitability, fertility, and physical characteristics. The results of the analyses are attached. Organic matter testing was run separately on individual subsamples and these results are also attached.

Analytical Results and Comments

The reaction of the sample is moderately acidic at a pH of 6.0. This is within the range preferred for most plants. Salinity (ECe), sodium, chloride and boron are safely low. The sodium adsorption ratio (SAR) indicates that sodium is adequately balanced by soluble calcium and magnesium; this balance is important for soil structure quality, which relates to the rate at which water infiltrates the soil.

According to the USDA Soil Classification system, the texture of the less than 2mm fraction of the soil is classified as loam. Organic matter content is low at 2.3% dry weight. Based on this information the estimated infiltration rate is moderate at 0.25 inch per hour. Infiltration rates may vary due to differences in compaction across the site. The over 50% silt plus clay present indicates that this soil will have some potential for issues with slow drainage and high water holding capacity and irrigation timing should take this into account. Additional subdrainage may be beneficial for larger specimens being installed in flat areas in this soil.

In terms of soil fertility, nitrogen, phosphorus and sulfate are low and calcium is fair. All of the other major nutrients are sufficient for proper plant nutrition at this time. Of the micronutrients; copper and manganese are abundant while zinc and iron are sufficient.

Boron is safely low for general ornamental plants and may be below optimum levels for plant nutritional purposes. Irrigation water often supplies sufficient boron to meet plant nutritional requirements. However, if boron is low in the irrigation water and/or plants show symptoms of boron deficiency after they are well established, you may consider an application of a product containing boron at the manufacturer's label rate. Boron deficiency symptoms often include stunted or deformed younger growth and tight internodes. Tissue testing can be performed to identify a boron deficiency if it is suspected. Incorporation of a composted greenwaste amendment may be sufficient to negate this deficiency, product depending.

Anaheim Office
Report 19-253-0006

Recommendations

Nitrogen, phosphorus and calcium fertilizers are recommended at the time of planting. Incorporation of a nitrogen stabilized organic amendment or composted greenwaste product is recommended in order to improve soil nutrient holding capacity and porosity. If a composted greenwaste amendment is chosen, that would provide additional phosphorus and potassium as well as supplemental micronutrients, product depending.

To Prepare for Mass Planting:

Drainage of the root zone should be improved by first loosening the top 10 inches of any undisturbed or compacted soil. The following materials should then be evenly spread and thoroughly blended with the top 6 inches of soil to form a homogenous layer:

<u>Amount per 1000 Square Feet</u>	
5 cubic yards	Nitrogen Stabilized Organic Amendment*
8 pounds	Ammonium Phosphate (16-20-0)*
25 pounds	Gypsum (Calcium Sulfate)

*The rate may change based on the analysis of the chosen organic amendment. This rate is based on 270 lbs. of dry weight of organic matter per cubic yard of amendment. If a composted greenwaste amendment is chosen that provides a substantial amount of phosphorus, the ammonium phosphate should be replaced with ammonium sulfate (21-0-0) at a 7 pound rate.

To Prepare Backfill For Trees and Shrubs:

- Excavate planting pits at least twice as wide as the diameter of the rootball.
- Soil immediately below the root ball should be left undisturbed to provide support but the sides and the bottom around the side should be cultivated to improve porosity.
- The top of the rootball should be at or slightly above final grade.
- The top 12 inches of backfill around the sides of the rootball of trees and shrubs may consist of the above amended soil or may be prepared as follows:

3 parts	Site Soil
1 part	Nitrogen Stabilized Organic Amendment*

Uniformly blended with:

<u>Amount / Cubic Yard of Backfill</u>	
1/2 pound	Ammonium Phosphate (16-20-0)*
1 1/3 pounds	Gypsum (Calcium Sulfate)

- Backfill below 12 inches required for 24 inch box or larger material should not contain the organic amendment or ammonium phosphate, but should still contain the gypsum at the recommended rate. In order to improve phosphorus levels below 12 inches in depth, triple superphosphate should be incorporated at a 1/4 pound rate.
- Ideally a weed and turf free zone should be maintained just beyond the diameter of the planting hole. A 2-4 inch deep layer of coarse mulch can be placed around the tree or shrub. Mulch should be kept a minimum 4 inches from the trunk.
- Irrigation of new plantings should take into consideration the differing texture of the rootball substrate and surrounding soil matrix to maintain adequate moisture during this critical period of establishment.



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Report 19-253-0006

Maintenance

Maintenance fertilization should rely primarily on a nitrogen only program supplemented with a complete fertilizer in the fall and spring. Beginning 45-60 days after planting, ammonium sulfate (21-0-0) should be applied at a rate of 5 pounds per 1000 square feet with reapplication every 45-60 days. Alternatively, slow release Sulfur Coated Urea (43-0-0) may be applied at 6 pounds per 1000 square feet every 90 days. Once plants are performing satisfactorily, the frequency of fertilization may be decreased depending on color and rate of growth desired. In the winter for a quick greening effect, calcium nitrate (15.5-0-0) may be applied at a 6 pound rate if applicable. Early fall and spring, substitute a complete fertilizer such as 15-15-15 to help insure continuing adequate phosphorus and potassium.

Alternatively, Blood Meal (12-0-0) provides available nitrogen fairly rapidly while materials such as Feather Meal (12-0-0), Soybean or Cotton Seed Meal (7-1-1) are slower to provide available nitrogen, but they extend the length of time they make this contribution. In order to provide a good supply of nitrogen for a 3-4 month time frame a good combination would be 6 pounds Blood Meal and 14 pounds Feather Meal per 1000 square feet. In the fall and spring, substitute a complete organic fertilizer such as 5-5-5 applied at the manufacturer's label rate. Or, nutrient rich composted greenwaste may be spread in a 1 to 2 inch layer, which generally carries enough nutrition to boost complete nutrition though a source of nitrogen might also be added at a half rate to assure adequate nitrogen availability.

If we can be of any further assistance, please feel free to contact us.

A handwritten signature in black ink that reads "Annmarie Lucchesi".

Annmarie Lucchesi
alucchesi@waypointanalytical.com

Emailed 9 Pages: ddockendorf@kleinfelder.com

Report Number
19-253-0006
Account Number
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Page: 1 of 5

Project: Costco-El Dorado Hills
Updated New Warehouse

Purchase Order: 20193141.001A
Report Date: 09/25/2019
Date Received: 09/10/2019

REPORT OF ANALYSIS

Lab Number: 08136
Sample ID: S-1

Date Sampled:

Analysis	Result	Quantitation Limit	Method	Date and Time Test Started	Analyst
Organic Matter (Titration) , %	2.92		WALK-BLACK	09/25/2019 14:30	VVP

Method Reference:

Methods of Soil Analysis, Part 3 - Chemical Methods, 2nd Ed. Rev. Soil Science Society of America, Black, C.A et al. 1982, pages 995-996.

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Date Received: 09/10/2019

REPORT OF ANALYSIS

Lab Number: 08137
Sample ID: S-2

Date Sampled:

Analysis	Result	Quantitation Limit	Method	Date and Time Test Started	Analyst
Organic Matter (Titration) , %	1.47		WALK-BLACK	09/25/2019 14:30	VVP

Method Reference:

Methods of Soil Analysis, Part 3 - Chemical Methods, 2nd Ed. Rev. Soil Science Society of America, Black, C.A et al. 1982, pages 995-996.

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REPORT OF ANALYSIS

Lab Number: 08138
Sample ID: S-3

Date Sampled:

Analysis	Result	Quantitation Limit	Method	Date and Time Test Started	Analyst
Organic Matter (Titration) , %	1.52		WALK-BLACK	09/25/2019 14:30	VVP

Method Reference:

Methods of Soil Analysis, Part 3 - Chemical Methods, 2nd Ed. Rev. Soil Science Society of America, Black, C.A et al. 1982, pages 995-996.

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Report Date: 09/25/2019
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REPORT OF ANALYSIS

Lab Number: 08139
Sample ID: S-4

Date Sampled:

Analysis	Result	Quantitation Limit	Method	Date and Time Test Started	Analyst
Organic Matter (Titration) , %	1.76		WALK-BLACK	09/25/2019 14:30	VVP

Method Reference:

Methods of Soil Analysis, Part 3 - Chemical Methods, 2nd Ed. Rev. Soil Science Society of America, Black, C.A et al. 1982, pages 995-996.

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REPORT OF ANALYSIS

Lab Number: 08140
Sample ID: S-5

Date Sampled:

Analysis	Result	Quantitation Limit	Method	Date and Time Test Started	Analyst
Organic Matter (Titration) , %	1.50		WALK-BLACK	09/25/2019 14:30	VVP

Method Reference:

Methods of Soil Analysis, Part 3 - Chemical Methods, 2nd Ed. Rev. Soil Science Society of America, Black, C.A et al. 1982, pages 995-996.

Comments:

Project : Costco-El Dorado Hills
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COMPREHENSIVE SOIL ANALYSIS

Sample Description - Sample ID	Half Sat %	pH	ECe dS/m	NO ₃ -N ppm	NH ₄ -N ppm	PO ₄ -P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
	TEC	Qual Lime		Sufficiency Factors											
Composite	21	6.0	0.2	5	13	4	97	902	337	3.6	2.3	39	53	2.33	08141
	74	None		0.4	0.2	0.8	0.7	2.0	3.7	0.6	4.8	1.5			

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO ₄ meq/L		Coarse 5 - 12	Fine 2 - 5	Very Coarse 1 - 2	Sand Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5	Silt .002-.05	Clay 0-.002		
2.3	1.5	0.6	0.3	0.07	0.6	0.4	4.2	5.2	6.6	7.4	29.2	42.4	14.2	Loam	08141

08141 Chloride (Cl) = 0.000 meq/L
08141 Aluminum = 1.62 meq/L

Sufficiency factor (1.0=sufficient for average crop) below each nutrient value. N factor based on 200 ppm constant feed. SAR = Sodium adsorption ratio. Half Saturation %=approx field moisture capacity. Nitrogen(N), Potassium(K), Calcium(Ca) and Magnesium(Mg) by sodium chloride extraction. Phosphorus(P) by sodium bicarbonate extraction. Copper(Cu), Zinc(Zn), Manganese(Mn) & Iron(Fe) by DTPA extraction. Sat. ext. method for salinity (ECe as dS/m), Boron (B), Sulfate(SO₄), Sodium(Na). Gravel fraction expressed as percent by weight of oven-dried sample passing a 12mm(1/2 inch) sieve. Particle sizes in millimeters. Organic percentage determined by Walkley-Black or Loss on Ignition.

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Lab Number: 08136
Sample ID: S-1

Date Sampled:

Analysis	Result	Quantitation Limit	Method	Date and Time Test Started	Analyst
Organic Matter (Titration) , %	2.92		WALK-BLACK	09/25/2019 14:30	VVP

Method Reference:

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Lab Number: 08137
Sample ID: S-2

Date Sampled:

Analysis	Result	Quantitation Limit	Method	Date and Time Test Started	Analyst
Organic Matter (Titration) , %	1.47		WALK-BLACK	09/25/2019 14:30	VVP

Method Reference:

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REPORT OF ANALYSIS

Lab Number: 08138
Sample ID: S-3

Date Sampled:

Analysis	Result	Quantitation Limit	Method	Date and Time Test Started	Analyst
Organic Matter (Titration) , %	1.52		WALK-BLACK	09/25/2019 14:30	VVP

Method Reference:

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Lab Number: 08139
Sample ID: S-4

Date Sampled:

Analysis	Result	Quantitation Limit	Method	Date and Time Test Started	Analyst
Organic Matter (Titration) , %	1.76		WALK-BLACK	09/25/2019 14:30	VVP

Method Reference:

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REPORT OF ANALYSIS

Lab Number: 08140
Sample ID: S-5

Date Sampled:

Analysis	Result	Quantitation Limit	Method	Date and Time Test Started	Analyst
Organic Matter (Titration) , %	1.50		WALK-BLACK	09/25/2019 14:30	VVP

Method Reference:

Methods of Soil Analysis, Part 3 - Chemical Methods, 2nd Ed. Rev. Soil Science Society of America, Black, C.A et al. 1982, pages 995-996.

Comments:

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COMPREHENSIVE SOIL ANALYSIS

Sample Description - Sample ID	Half Sat %	pH	ECe dS/m	NO ₃ -N ppm	NH ₄ -N ppm	PO ₄ -P ppm	K ppm	Ca ppm	Mg ppm	Cu ppm	Zn ppm	Mn ppm	Fe ppm	Organic % dry wt.	Lab No.
	TEC	Qual Lime		Sufficiency Factors											
Composite	21	6.0	0.2	5	13	4	97	902	337	3.6	2.3	39	53	2.33	08141
	74	None		0.4	0.2	0.8	0.7	2.0	3.7	0.6	4.8	1.5			

Saturation Extract Values						SAR	Gravel %		Percent of Sample Passing 2 mm Screen					USDA Soil Classification	Lab No.
Ca meq/L	Mg meq/L	Na meq/L	K meq/L	B ppm	SO ₄ meq/L		Coarse 5 - 12	Fine 2 - 5	Sand		Silt .002-.05	Clay 0-.002			
								Very Coarse 1 - 2	Coarse 0.5 - 1	Med. to Very Fine 0.05 - 0.5					
2.3	1.5	0.6	0.3	0.07	0.6	0.4	4.2	5.2	6.6	7.4	29.2	42.4	14.2	Loam	08141

08141 Chloride (Cl) = 0.000 meq/L

08141 Aluminum = 1.62 meq/L

Sample Summary Table

Report Number: 19-253-0005
Client Project Description: Costco-El Dorado Hills
Updated New Warehouse

Lab No	Client Sample ID	Matrix	Date Collected	Date Received	Method	Lab ID
75362	Composite	Solids		09/10/2019	SW-7471A	
75362	Composite	Solids		09/10/2019	6010D	

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Project Costco-El Dorado Hills
Information : Updated New Warehouse

Report Number : **19-253-0005**

REPORT OF ANALYSIS

Report Date : 09/17/2019

Received : 09/10/2019

Lab No : **75362**
Sample ID : **Composite**

Matrix: **Solids**
Sampled:

Analytical Method: 6010D **Prep Batch(es):** L453530 09/11/19 17:10
Prep Method: 3050B

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Batch
Total Silver	<0.250	mg/Kg	0.250	1	09/13/19 02:05	JTR	L453803
Total Arsenic	2.04	mg/Kg	0.500	1	09/13/19 02:05	JTR	L453803
Total Barium	46.4	mg/Kg	0.500	1	09/13/19 02:05	BKN	L453803
Total Beryllium	0.283	mg/Kg	0.0500	1	09/13/19 02:05	JTR	L453803
Total Cadmium	0.758	mg/Kg	0.100	1	09/13/19 17:25	JTR	L454188
Total Cobalt	23.2	mg/Kg	0.500	1	09/13/19 02:05	JTR	L453803
Total Chromium	34.3	mg/Kg	0.250	1	09/13/19 02:05	JTR	L453803
Total Copper	65.4	mg/Kg	0.250	1	09/13/19 02:05	JTR	L453803
Total Molybdenum	<0.250	mg/Kg	0.250	1	09/13/19 02:05	JTR	L453803
Total Nickel	14.5	mg/Kg	0.250	1	09/13/19 17:25	JTR	L454188
Total Lead	5.47	mg/Kg	0.300	1	09/13/19 02:05	JTR	L453803
Total Antimony	<0.500	mg/Kg	0.500	1	09/13/19 02:05	JTR	L453803
Total Selenium	<0.500	mg/Kg	0.500	1	09/13/19 17:25	JTR	L454188
Total Thallium	<1.00	mg/Kg	1.00	1	09/13/19 02:05	JTR	L453803
Total Vanadium	138	mg/Kg	0.500	1	09/13/19 02:05	JTR	L453803
Total Zinc	65.3	mg/Kg	1.25	1	09/13/19 02:05	JTR	L453803

Qualifiers/ DF Dilution Factor MQL Method Quantitation Limit
Definitions

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Project Costco-El Dorado Hills
Information : Updated New Warehouse

Report Number : **19-253-0005**

REPORT OF ANALYSIS

Report Date : 09/17/2019

Received : 09/10/2019

Lab No : **75362**
Sample ID : **Composite**

Matrix: **Solids**
Sampled:

Analytical Method: SW-7471A **Prep Batch(es):** **L453537** 09/12/19 08:00
Prep Method: SW-7471A (PREP)

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Batch
Mercury (Total)	0.0218	mg/Kg	0.0153	1	09/12/19 11:10	TJS	L453732

**Qualifiers/
Definitions**

DF

Dilution Factor

MQL

Method Quantitation Limit



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August 20, 2019

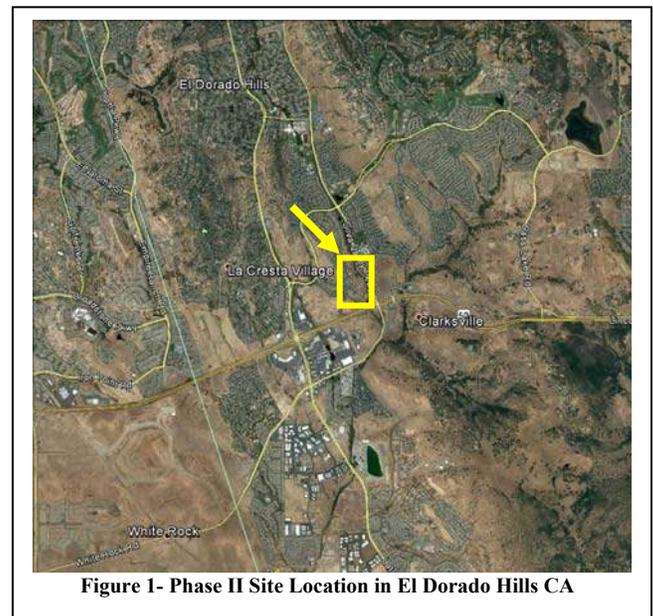
Dan Dockendorf
Kleinfelder, Inc.
40 Clark St # J
Salinas, California 93901

Subject: Report
Phase II Seismic Refraction Survey
Silva Valley Parkway Development
El Dorado Hills, California

Dear Mr. Dockendorf:

1.0 INTRODUCTION

This letter presents the results of Advanced Geological Services, Inc. (AGS) seismic refraction survey in support of grading work at a 16-acre site north of Tong Road and west of Silva Valley Parkway in El Dorado Hills, California (Figure 1). The survey objective was to assess the depth and excavation characteristics (rippability) of bedrock. The survey was performed on August 7 and 8, 2019 by AGS senior geophysicist Roark W. Smith and his assistant. Field oversight was provided by Mr. Jordan Annand of Kleinfelder, who showed AGS the seismic line locations, which were marked in the field with wood stakes labeled with the seismic line number. The survey comprised seven seismic lines of varying lengths and orientations distributed across the site (Figure 2).



2.0 SUMMARY OF FINDINGS

- Three velocity layers were detected— Layer V_1 is the uppermost approximately 1- to 7-foot thick low-velocity layer representing surficial soil. Layer V_2 is a medium-velocity (from about 3,985 to 6,000 fps) layer representing deeply-weathered bedrock. Layer V_3 is a high-velocity layer (12,200 to over 18,500 fps) representing little-weathered, "hard" bedrock.
- On the basis of the Caterpillar Performance Handbook "rip chart", the Layer V_3 "hard" bedrock at this site is classified as non-rippable. This non-rippable "hard" bedrock mostly occurs at depths ranging from 7 to 15 feet, but was found as shallow as one (1)

foot bgs along SL-4 in the western-central portion of the site and as deep as 42 feet along SL-6 in the eastern portion of the site. The refraction survey showed V_3 velocities ranging between 12,200 to over 18,500 fps, and the “rip chart” classifies metamorphic rock exhibiting P-wave velocities greater than 9,200 fps and “non-rippable” with a D9R tractor.

3.0 SITE DESCRIPTION

The survey consisted of seven seismic lines ranging from 230 to 600 feet in length; the lines were distributed across a 16-acre triangular-shaped area of gently rolling, grass-covered hills (Figure 2). It is worth noting that the site was seismically “noisy” at times due to vehicle traffic along the nearby Parkway.

4.0 SEISMIC REFRACTION METHOD OVERVIEW

The seismic refraction method uses compressional (P-) wave energy to delineate seismic velocity layers within the subsurface. Interpretation entails correlating the velocity layers to geologic features such as soil and various types of bedrock. To perform a refraction survey, an elastic wave (compressional, or P-wave) is generated at certain locations (shotpoints) along a survey line. The P-wave energy is usually produced by striking the ground with a sledgehammer. As the P-wave propagates through the ground it is refracted along boundaries between geologic layers with different seismic velocities.

Part of the refracted P-wave energy returns to the ground surface where it is detected by vibration-sensitive devices called geophones, which are placed in a co-linear array along the seismic survey line. The geophone data are fed to a seismograph, where they are recorded, and then to a computer, where they are analyzed to determine the depth and velocities of subsurface seismic layers. Key data for refraction analysis are the positions of the geophones and shotpoints along a seismic line, and the amount of time it takes for the refracted wave to travel from the shotpoint to each geophone location. Because the P-wave is the fastest traveling of all types of seismic waves, it can be readily identified as the first deflection (“first break”) on a seismic trace.

Additional discussion of the refraction method, its limitations, and the relationship between seismic velocity and geologic materials is presented in Appendix A.

5.0 FIELD PROCEDURES

Due to the lack of vehicle access, AGS hand-carried the seismic gear to each line location. For each seismic line, AGS laid out a fiberglass tape measure and placed an array of 24 geophones on the ground at 10-foot to 20-foot intervals to form a seismic “spread” that measured from 230 to 300 feet long. For seismic lines longer than 300 feet (e.g., SL-7), AGS laid out a second spread to achieve the required line length. The geophones were coupled to the ground by means of 3-inch metal spikes attached to the geophone base. Three shotpoints were used along each spread, with shotpoints located five feet beyond each end of the geophone array and at the array midpoint. AGS produced P-waves through multiple impacts with a 16-lb sledge hammer against a metal plate placed on the ground surface at each shotpoint location. In general, 10 hammer blows were used (“stacked”) at the end shotpoints and 5 blows were used at the center shotpoint.

The P-waves produced by the hammer impacts were detected using Mark Products 14-Hz geophones. The detected seismic signals were recorded using a DAQLink II seismic system connected to a laptop computer.

After the seismic data were obtained along each line, AGS performed a hand-level survey to measure the relative elevation changes along the line so that the ground surface topography could be incorporated into the data analysis. After the seismic survey was completed AGS used a Trimble Pro-XR Global Positioning System (GPS) to record the seismic line locations.

6.0 DATA PROCESSING AND ANALYSIS

In general, the refraction data quality is “good”; however, due to traffic noise from the nearby roadway the quality of some of the refraction data is only “fair”. Regardless, for the most part the “first breaks” could be readily identified and picked on the seismic records. Data quality was enhanced by “stacking,” which entailed using multiple hammer blows at each shotpoint location to improve the signal-to-noise ratio. The additive affect of stacking of multiple hammer blows at the same location enhances or increases the amplitude of the signal (i.e., the P-wave arrival) while amplitude of the background noise, which, being random in nature, tends to cancel itself on successive hammer blows and remains largely unchanged.

Seismic data were transferred from the seismograph to a desktop computer where they were processed using the *SeisImager* software package by Geometrics, Inc. Briefly, *SeisImager* is a computer inversion program that generates an initial velocity layer model, produces synthetic data from the model, and then adjusts the model so that the synthetic data better matches the observed field data. The agreement between the synthetic and observed data provides an indication of how well the model represents the true subsurface conditions.

First, AGS used the *SeisImager* module *PickWin* to interpret (“pick”) the P-wave arrivals (“first breaks”) for each of the shotpoint data sets (“shot gathers”) per line. *PickWin* was also used to check (against the geophysicist’s field log) that the proper locations were assigned to the geophones and shotpoints. Next, the first break files were fed to the *SeisImager* module *PlotRefra*, which was used review time-distance (TD) plots for the seismic lines and assign a seismic layer to each arrival time. For the refraction analysis, each P-wave arrival is considered to have refracted from a distinct seismic layer. The number of layers resolved by the seismic survey, and their thickness and average velocity, is indicated by straight line segments on the TD plot; because these straight-line segments represent a constant velocity condition within the subsurface, they tend to represent a distinct geologic layer. The topographic elevation files were incorporated into the analysis at this point. Next, a time-term inversion was performed to produce layered velocity models presented on Figures 3 through 7. Time-term inversion is a linear least-squares technique that uses the layer assignments and the distances and travel times between the shotpoints and the geophones to develop a velocity layer model that best fits the observed data.

7.0 RESULTS

The results of the seismic refraction survey are summarized on Table 1, below, and presented on Figures 2 through 7, which show the seismic line locations and the subsurface velocity layer

models that were calculated from the refraction data.

Overall, three velocity layers were detected— Layer V₁ is the uppermost approximately 1- to 7-foot thick low-velocity layer representing surficial soil. Layer V₂ is a medium-velocity (from about 3,985 to 6,000 fps) layer representing deeply-weathered bedrock. Layer V₃ is a high-velocity layer (12,200 to over 18,500 fps) representing little-weathered, "hard" bedrock. Layer V₃ generally occurs at depths ranging between 7 to 15 feet bgs, but it is found as shallow as one (1) foot bgs to as deep as 42 feet bgs in places. The shallowest bedrock was detected in the northern portion of the site, along SL-1 and SL-2; the deepest along SL-6 in the eastern portion of the site.

On the basis of the Caterpillar Performance Handbook "rip chart", the Layer V₃ "hard" bedrock at this site is non-rippable. This non-rippable "hard" bedrock mostly occurs at depths ranging from 7 to 15 feet, but was found as shallow as one (1) foot bgs in the western-central portion of the site along SL-4 and as deep as 42 feet in the eastern portion of the site along SL-6. The refraction survey showed V₃ velocities ranging between 12,200 to over 18,500 fps, and the "rip chart" classifies metamorphic rock exhibiting P-wave velocities greater than 9,200 fps and "non-rippable" with a D9R tractor.

Velocity information from the seismic survey is summarized in Table 1; rippability information is summarized in Table 2.

Table 1 Velocity Summary (feet per second) from Layer Models

Seismic Line	Line Length (ft)	Layer V ₁ (topsoil)	Layer V ₂ (weathered bedrock)	Layer V ₃ (little-weathered bedrock)	Approx depth to V ₃ (feet)
SL-1	230	1,310	3,985	13,680	6 – 12
SL-2	230	1,305	6,030	13,820	8 – 15
SL-3	390	1,250	4,970	14,960	3 – 16
SL-4	250	1,100	4,210	16,225	1 – 5
SL-5	300	1,270	5,380	16,260	5 – 15
SL-6	600	1,790	5,995	12,210	17 – 42
SL-7	400	1,390	5,350	18,530	7 – 17

8.0 EXCAVATION CHARACTERISTICS (RIPPABILITY)

Seismic velocity charts relating seismic velocity and excavation characteristics have been developed from field tests by others. These charts list the seismic velocity of various types of bedrock materials and their relative ease of excavation using different types of rippers. Caterpillar Tractor Company publishes a performance manual that lists ripper performance charts for various size tractors and types of rippers.

The range of rippability obtained from the ripper performance chart from the Caterpillar Performance Handbook, 12th Edition (2000) is as follows (in feet per second):

Table 2 Rip Chart for Metamorphic Rock (from The Caterpillar Performance Handbook)

Ripper	Rippable	Marginally Rippable	Non-Rippable
D9R	less than 7,200	7,200 to 9,200	greater than 9,200

This information should only be used as a general guide, however, as many other factors should also be considered. These factors include the rock jointing and fracture patterns, the experience of the equipment operator, and the equipment and excavation methods selected. Based on the observed velocities, it appears that the subsurface bedrock beneath the seismic refraction lines is rippable for a D9R to the top of Layer V₃; however, this information should be combined with a complete and thorough analysis of geotechnical boring data, as well as local ripping experience (if available) to make a final assessment.

9.0 CLOSING

All geophysical data and field notes collected as a part of this investigation will be archived at the AGS office. The data collection and interpretation methods used in this investigation are consistent with standard practices applied to similar geophysical investigations. The correlation of geophysical responses with probable subsurface features is based on the past results of similar surveys although it is possible that some variation could exist at this site. Due to the nature of geophysical data, no guarantees can be made or implied regarding the targets identified or the presence or absence of additional objects or targets.

AGS appreciates working for you. We enjoyed this project and we look forward to working with you again.

Sincerely,



Roark W. Smith
Senior Geophysicist
Advanced Geological Services, Inc.

Figures: Figure 1 Seismic Refraction Survey Area (imbedded in Report text, above)
 Figure 2 Seismic Refraction Line Locations
 Figure 3 P-wave Velocity Layer Models, SL-1 & SL-2
 Figure 4 P-wave Velocity Layer Models, SL-3 & SL-4
 Figure 5 P-wave Velocity Layer Model, SL-5
 Figure 6 P-wave Velocity Layer Model, SL-6
 Figure 7 P-wave Velocity Layer Model, SL-7

Attachments: Appendix A: Seismic Velocity and Limitations of the Refraction Method



SHALLOW "HARD" BEDROCK
 AREA-- LAYER V3 LESS
 THAN 6 FEET BGS ALONG SL-3 AND SL-4



1605 School Street
 Suite 4
 Moraga, CA 94556
 (925) 808-8965

Phase II Seismic Line Locations
 Silva Valley Parkway
 El Dorado Hills

LOCATION: El Dorado Hills, California

CLIENT: Kleinfelder, Inc.

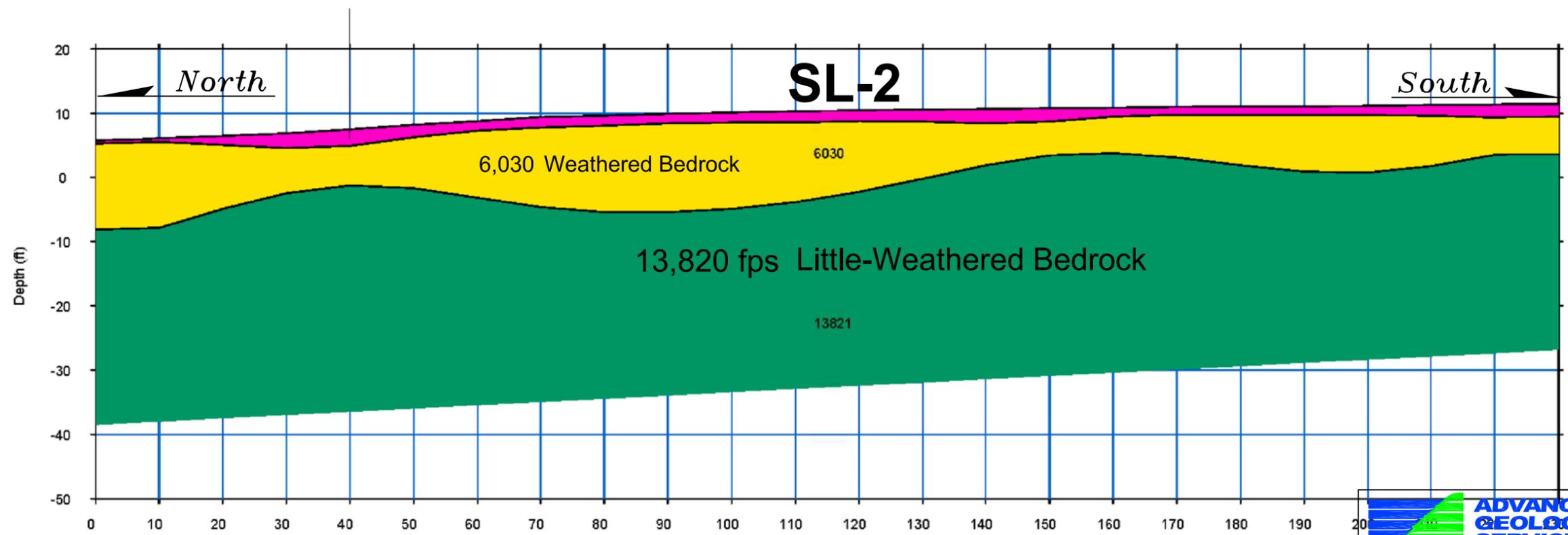
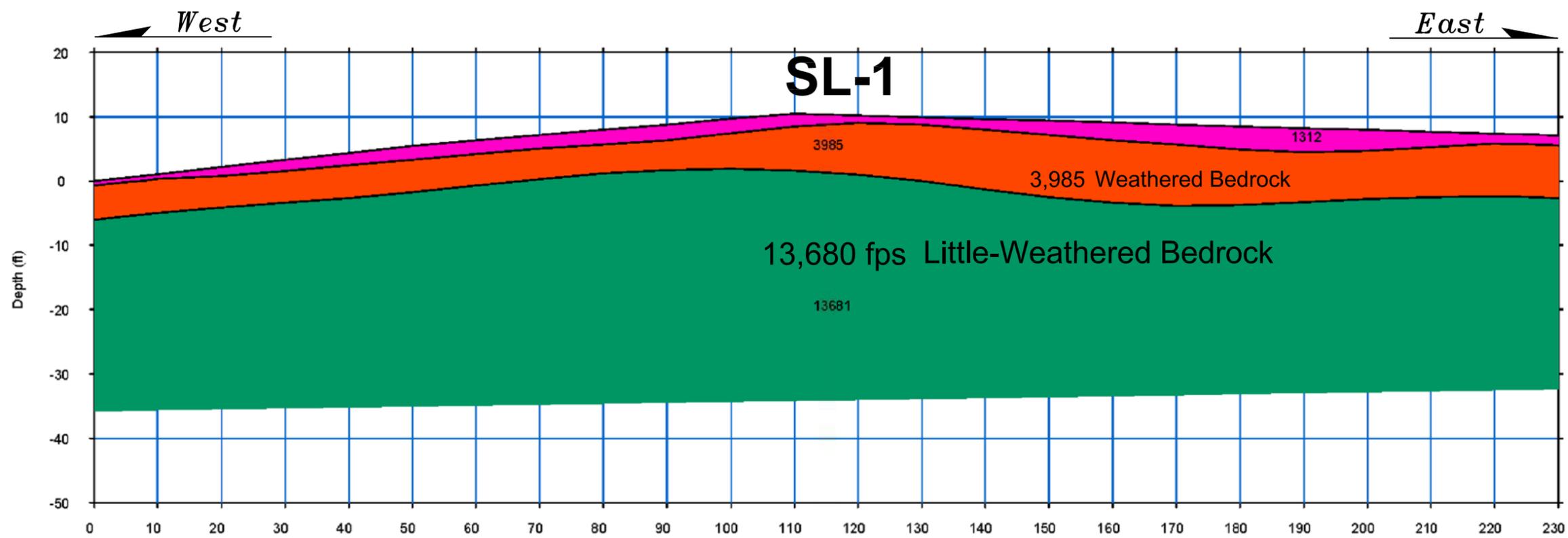
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FIGURE

2



SL-1, SL-2 SEISMIC LINE LOCATIONS



1605 School Street
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SL-1 & SL-2 P-Wave Velocity Layer Models
Silva Valley Parkway, Phase II
Seismic Refraction Investigation

LOCATION: El Dorado Hills, California

CLIENT: Kleinfelder, Inc.

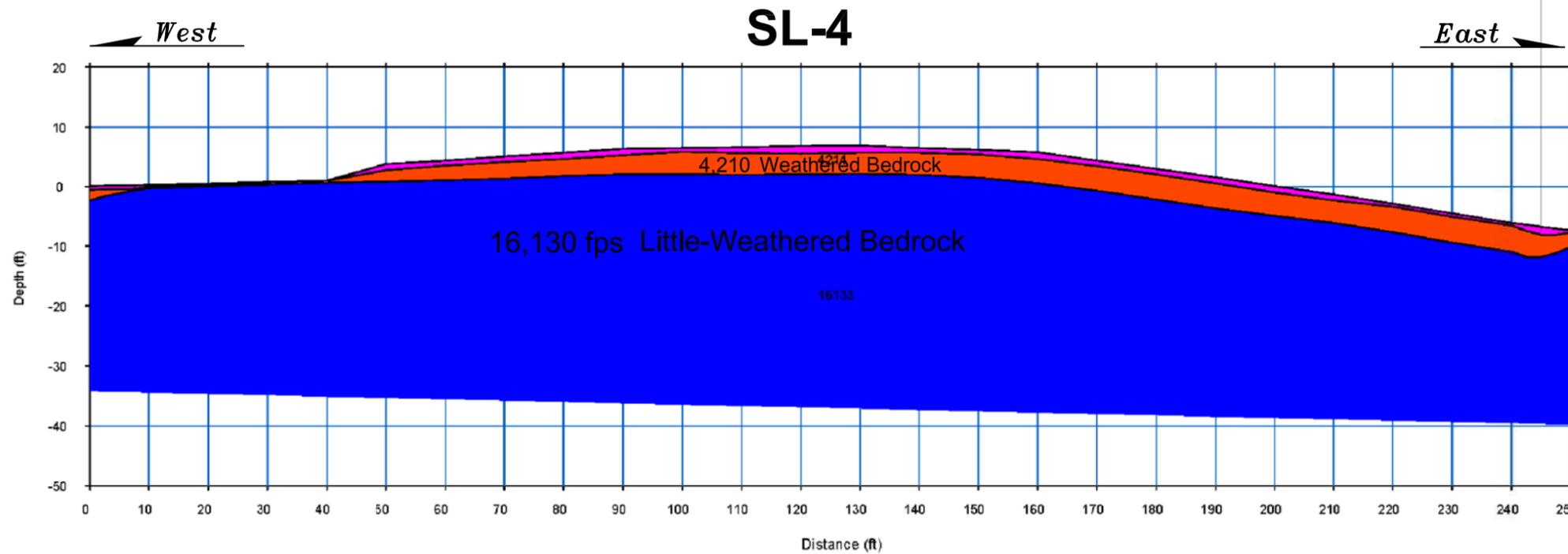
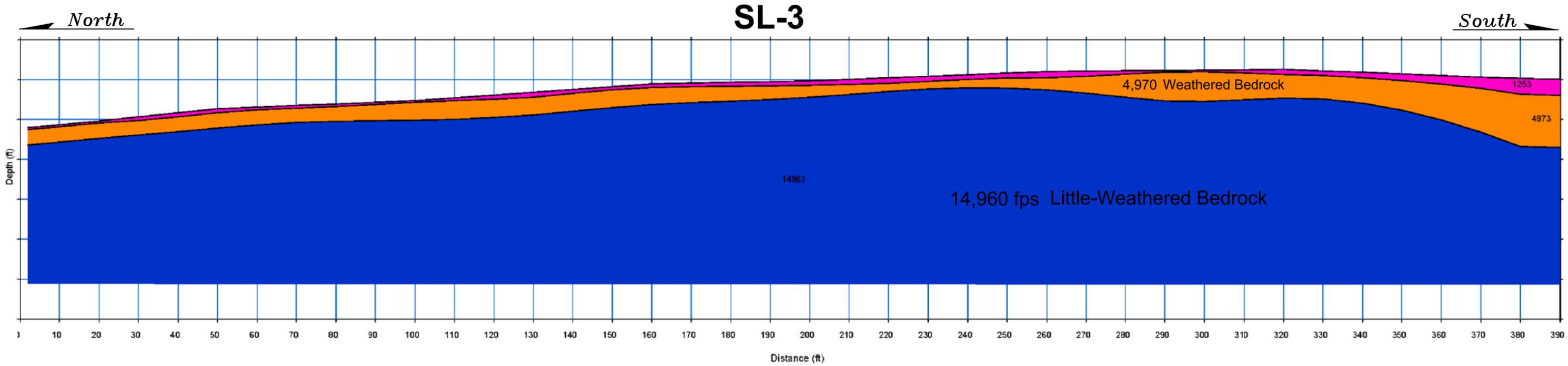
PROJECT #: 19-093-1CA

DATE: Aug 19, 2019

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FIGURE

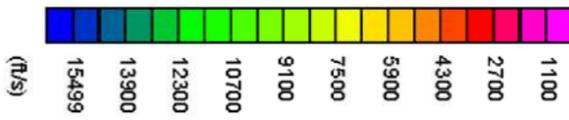
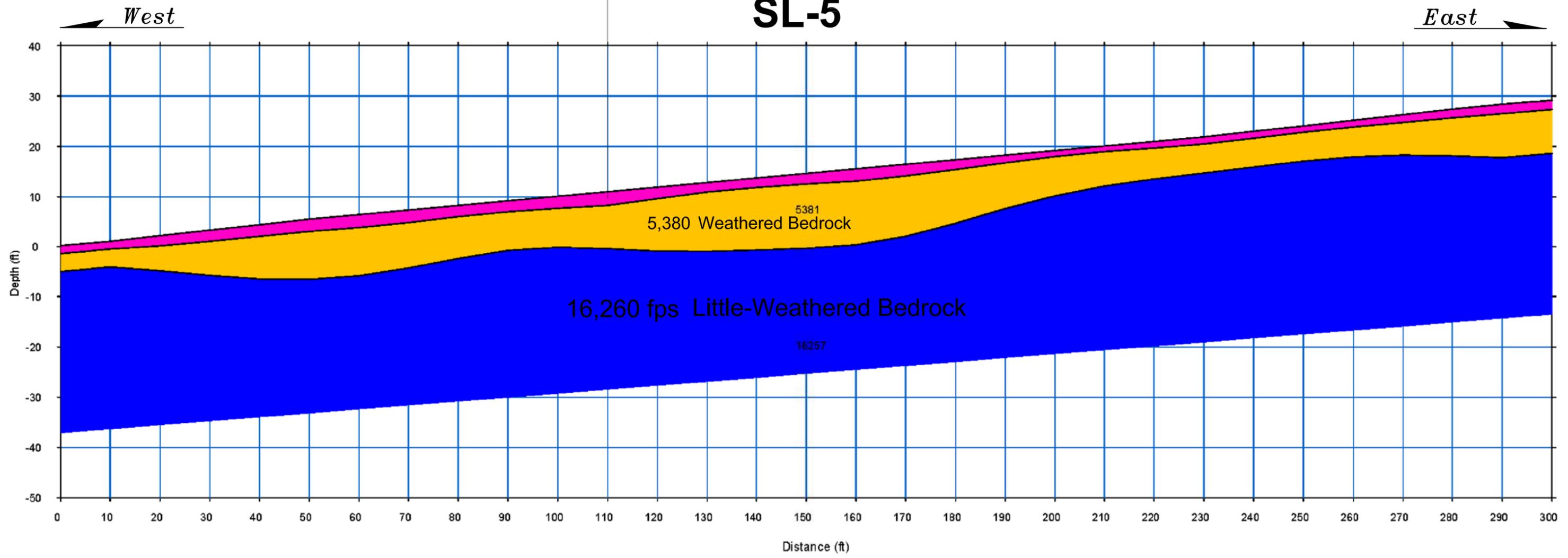
3



SL-3 & SL-4 SEISMIC LINE LOCATIONS

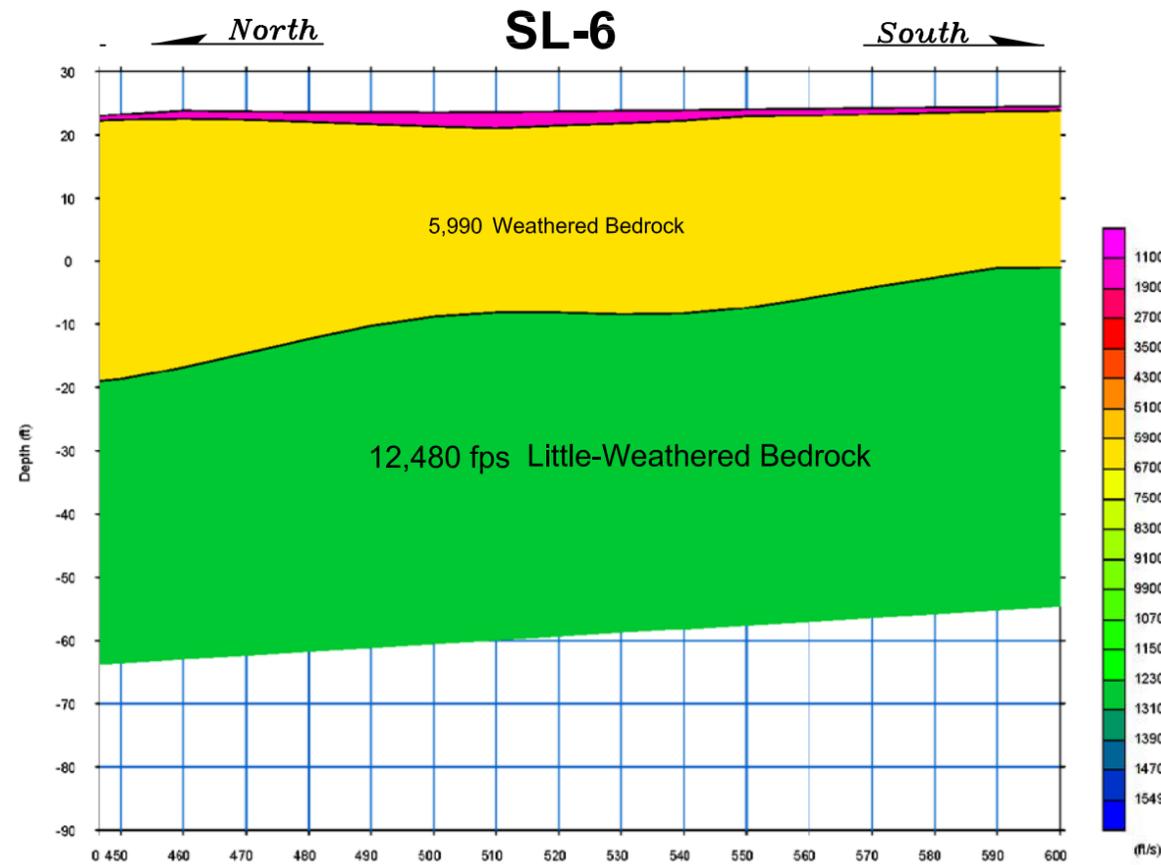
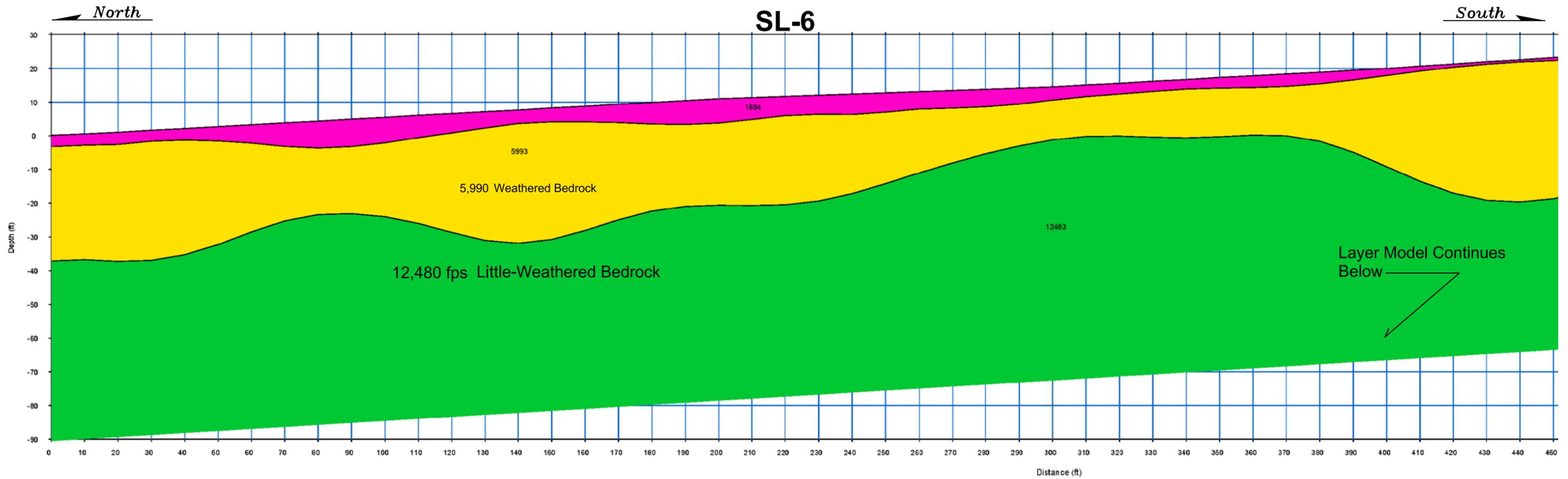
 <p>ADVANCED GEOLOGICAL SERVICES</p>	<p>SL-3 & SL-4 P-Wave Velocity Layer Models Silva Valley Parkway, Phase II Seismic Refraction Investigation</p>	
	<p>1605 School Street Suite 4 Moraga, CA 94556 (925) 808-8965</p>	
<p>LOCATION: El Dorado Hills, California</p>		<p>FIGURE 4</p>
<p>CLIENT: Kleinfelder, Inc.</p>		
<p>PROJECT #: 19-093-1CA</p>		
<p>DATE: Aug 19, 2019</p>	<p>DRAWN BY: R. SMITH</p>	

SL-5



SL-5 SEISMIC LINE LOCATION

 <p>ADVANCED GEOLOGICAL SERVICES</p>	SL-5 P-Wave Velocity Layer Model Silva Valley Parkway, Phase II Seismic Refraction Investigation	
	1605 School Street Suite 4 Moraga, CA 94556 (925) 808-8965	LOCATION: El Dorado Hills, California CLIENT: Kleinfelder, Inc. PROJECT #: 19-093-1CA DATE: Aug 19, 2019 DRAWN BY: R. SMITH



SL-6 SEISMIC LINE LOCATION



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SL-6 P-Wave Velocity Layer Model
Silva Valley Parkway, Phase II
Seismic Refraction Investigation

LOCATION: El Dorado Hills, California

CLIENT: Kleinfelder, Inc.

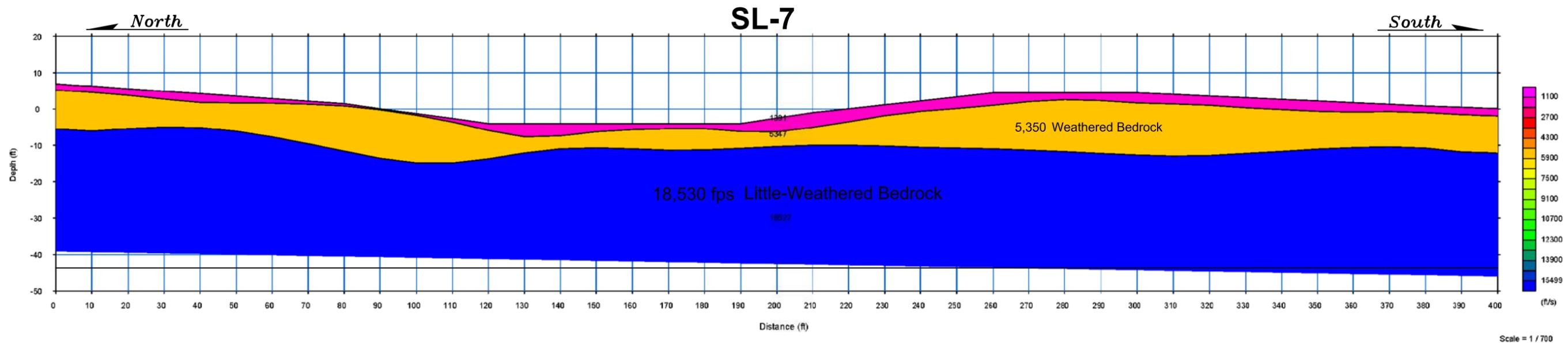
PROJECT #: 19-093-1CA

DATE: Aug 19, 2019

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FIGURE

6



SL-7 SEISMIC LINE LOCATION

 <p>ADVANCED GEOLOGICAL SERVICES</p>	<p>SL-7 P-Wave Velocity Layer Model Silva Valley Parkway, Phase II Seismic Refraction Investigation</p>	
	<p>LOCATION: El Dorado Hills, California</p>	
<p>1605 School Street Suite 4 Moraga, CA 94556 (925) 808-8965</p>	<p>CLIENT: Kleinfelder, Inc.</p>	<p>FIGURE 7</p>
	<p>PROJECT #: 19-093-1CA</p>	
	<p>DATE: Aug 19, 2019</p>	
	<p>DRAWN BY: R. SMITH</p>	

APPENDIX A

SEISMIC VELOCITY AND LIMITATIONS OF THE REFRACTION METHOD

The physical properties of earth materials (fill, sediment, rock) such as compaction, density, hardness, and induration dictate the corresponding seismic velocity of the material. Additionally, other factors such as bedding, fracturing, weathering, and saturation can also affect seismic velocity. In general, low velocities indicate loose soil, poorly compacted fill material, poorly to semi-consolidated sediments, deeply weathered, and highly fractured rock. Conversely, high velocities are indicative of competent rock or dense and highly compacted sediments and fill. The highest velocities are measured in unweathered and little fractured rock.

There are certain limitations associated with the seismic refraction method as applied for this investigation. These limitations are primarily based on assumptions that are made by the data analysis routine. The data analysis routine assumes that the velocities along the length of each spread are uniform. If there are localized zones within each layer where the velocities are higher or lower than indicated, the analysis routine will interpret these zones as changes in the surface topography of the underlying layer. A zone of higher velocity material would be interpreted as a low in the surface of the underlying layer. Zones of lower velocity material would be interpreted as a high in the underlying layer. The data analysis routine also assumes that the velocity of subsurface materials increase with depth. Therefore, if a layer exhibits velocities that are slower than those of the material above it, the slower layer will not be resolved. Also, a velocity layer may simply be too thin to be detected.

The quality of the field data is critical to the construction of an accurate depth and velocity profile. Strong, clear “first-break” information from refracted interfaces will make the data processing, analysis, and interpretation much more accurate and meaningful. Vibrational noise or poor subsurface conditions can decrease the ability to accurately locate and pick seismic waves from the interfaces.

Due to these and other limitations inherent to the seismic refraction method, resultant velocity cross-sections should be considered only as approximations of the subsurface conditions. The actual conditions may vary locally.