Appendix G-1

Geotechnical Exploration

GEOTECHNICAL EXPLORATION

PROPOSED MERIDIAN WEST CAMPUS UPPER PLATEAU

EAST OF LA CROSSE STREET AND SOUTH OF CAMINO DEL SOL

RIVERSIDE, CALIFORNIA

Prepared For **LEWIS LAND DEVELOPERS, LLC**
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Project Number 13226.001

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Project No. 13226.001

Lewis Land Developers, LLC
1156 North Mountain Avenue
Upland, California 91786

Attention: Mr. Adam Collier

Subject: Geotechnical Exploration
Proposed Meridian West Campus - Upper Plateau
East of La Crosse Street and South of Camino Del Sol
March JPA, Riverside County, California

In accordance with your request, we are pleased to provide this report for the subject project summarizing our geotechnical findings, conclusions and recommendations regarding the design and construction of the proposed development. Based on the results of our findings and conclusions, it is our opinion that the site is suitable for the intended use provided the recommendations included in herein are implemented during design and construction phases of development. However, it should be noted that additional geotechnical evaluations and/or reviews will be required based on final site development and/or grading plans.

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

Respectfully submitted,
LEIGHTON CONSULTING, INC.

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1.0 INTRODUCTION

1.1 Purpose and Scope

This geotechnical exploration is for the proposed Meridian Upper Plateau commercial development, located generally south of Camino Del Sol and east of La Crosse Way, County of Riverside, California (see Figure 1). Our scope of services for this exploration included the following:

- A site reconnaissance, excavation of 44 exploratory excavator test pits and 6 small-diameter hollow stem auger borings. Approximate locations of these test pits and borings are depicted on the *Geotechnical Map*. The logs are presented in Appendix A-1.
- Geotechnical laboratory testing of selected soil samples collected during this exploration. Test results are presented in Appendix B.
- A geophysical study to further evaluate rippability and depth of onsite bedrock with 18 seismic refraction lines. Approximate locations of the seismic lines are depicted on the *Geotechnical Map*. The geophysical report is included as Appendix A-2.
- Geotechnical engineering analyses performed or as directed by a California registered Geotechnical Engineer (GE) and reviewed by a California Certified Engineering Geologist (CEG).
- Preparation of this report which presents our geotechnical conclusions and recommendations regarding the proposed structures.

This report is not intended to be used as an environmental assessment (Phase I or other), or foundation plan review.

1.2 Project and Site Description

The project site is approximately 312 acres of mostly vacant land located generally south of East Alessandro Boulevard and west of Meridian Parkway in the March JPA General Plan area of Riverside Country, California (*see* Figure 1, *Site Location Map*). Topographically, the property contains rolling hills with the highest elevation of approximately 1,765 feet MSL in the central portion of the site and the lowest elevation of approximately 1,645 feet MSL is located in the northeastern portion of the site. Drainage is generally from the elevated central portion of the site to the perimeters through natural drainage features incised in to the rolling hills.

The majority of the site is currently occupied by the former March Air Force Base ordnance area. This ordnance area is surrounded by approximately 10-foot high barbed-wire-topped chain link fencing, and makes up approximately 70% of the overall

Site. The remainder of the Site is vacant and undeveloped land. The ordnance area contains 14 single-story, concrete ordnance storage bunkers (circa 1940's and 1950's), and seven other associated single-story buildings (circa late 1950's to mid 1960's) in various states of abandonment. Numerous asphalt paved roads, as well as some dirt roads, exist within the ordnance area, and connect these various structures/bunkers. The facilities on-site are no longer in use by the military. A tenant is currently using the bunkers as storage for pyrotechnics. Existing nearby improvements include Industrial buildings to the east of the site, residential to the north, west and south, and a church to the southwest. It is our understanding that a buffer of undisturbed land will remain between the surrounding existing developments and the proposed new development.

Based on provided site plan (RGA, 2020) the proposed site development includes large industrial buildings ranging in size from approximately 200,000 to 1,000,000 square-feet (SF) and various future lots ranging in size from approximately 7 to 67 acres to host these industrial buildings and associated park sites and access roads. Access to the development will be through the extension of Cactus from the east, Brown Road from the north and Barton Road traversing the western portion of the site.

Based on the review of the provided preliminary grading plans, site grading is expected to have cuts of up to approximately 50 feet deep and fills of up to approximately 55 feet thick, plus remedial grading, where applicable. Although no structural loads or foundations plans are developed yet, we anticipate the structural loads to range up to 200 kips for isolated columns/pads and 10 kips/lineal-foot for continuous wall footings. If site development significantly differs from the assumptions made herein, the recommendations included in this report should be subject to further evaluation.

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 Field Exploration

Our field exploration for this report consisted of the excavation of forty-four (44) excavator test pits located generally within areas of planned building footprints to provide basis for foundation and pavement design. Test pits were excavated utilizing a Cat 349F, with an operating weight of 105,000 pounds to further evaluate rock hardness in the field. In addition, six (6) small-diameter borings were advanced within the areas of planned building footprints. During exploration, relatively undisturbed and disturbed/bulk samples were collected for further laboratory testing and evaluation. Approximate locations of these explorations are depicted on the *Geotechnical Map* (see Plate 1). Sampling was conducted by a staff geologist from our firm. After logging and sampling, the excavations were loosely backfilled with spoils generated during excavation. The exploration logs are included in Appendix A.

A seismic refraction survey was performed by Atlas Geophysics to further evaluate rock rippability at depth. The full report is attached as Appendix A-2.

2.2 Laboratory Testing

Laboratory tests were performed on representative bulk samples to provide a basis for development of remedial earthwork and geotechnical design parameters. The laboratory testing program included expansion index, maximum density/optimum moisture content relationships, R-value, sieve analysis, and corrosion suites. The results of our laboratory testing from this exploration and previous investigations are presented in Appendix B.

3.0 GEOTECHNICAL AND GEOLOGIC FINDINGS

3.1 Regional Geology

The site is located within a prominent geomorphic province in southwestern California known as the Peninsular Ranges. This province is characterized by steep, elongated ranges and valleys that trend northwestward. More specifically, the proposed site is located within the relatively stable Perris Block of the Peninsular Ranges.

The Perris Block, approximately 20 miles by 50 miles in extent, is bounded by the San Jacinto Fault Zone to the northeast, and the Elsinore Fault Zone to the southwest. The Perris Block has had a complex tectonic history, undergoing relative vertical land-movements of several thousand feet in response to movement on the Elsinore and San Jacinto Fault Zones. Within the general site vicinity, thin residual sedimentary and volcanic materials mantle crystalline bedrock, consisting of the Val Verde Tonalite (Kvt) and lesser amounts of Cretaceous granitic dikes (Kg).

3.2 Site Specific Geology

3.2.1 Earth Materials

Our field exploration, observations, and review of the pertinent literature indicate that materials on the site include the following units; top soil/residual soil, and granitic Val Verde Tonalite (Kvt). For the engineering purposes of this report, we have grouped the upper near surface soil materials into one unit, Topsoil/Residual Soil. These units are discussed in the following sections in order of increasing age. A more detailed description of each unit is provided on the logs of borings in Appendix A.

- **Undocumented Artificial Fill (not a mapped unit):** Although not encountered in our subsurface exploration, undocumented fill should be expected as roadway embankments, previous utility trench backfill and fill associated with the various onsite structures. Fill soils are expected to have been generated from site excavations.
- **Residual soil/Topsoil (not a mapped unit):** Residual soil materials are expected to mantle the majority of the site. The residual soil generally consists of a thin surface layer up to 5 feet in depth in some areas. Encountered materials appear to be generally porous and relatively loose and have a low expansion potential. These materials are generally comprised of light to grayish brown silty sand (SM) and clayey sand (SC).
- **Colluvium (Qcol):** Colluvium was encountered in the gently sloping central portion of the site and generally extends to approximate depths of 3 to 9 feet BGS. Encountered materials generally consist of silty to clayey sand (SM/SC) and

appear to be relatively porous and expected to have very low to low expansion potential (EI<51)

- **Alluvium (Qal):** Recent alluvial deposits are expected to exist within drainages or low-laying areas of the site. Where encountered, the alluvium generally extends to a depth of 6 feet BGS. Encountered materials generally consist of clayey sand to sandy clay(SC/CL) and appear to be relatively porous and expected to have very low to low expansion potential (EI<51)
- **Val Verde Tonalite (Kvt):** The Val Verde Tonalite (Cretaceous granite) was encountered near the surface across the majority of the site with the exception of TP-44. In TP-44, the Tonalite was encountered at an approximate depth of 9 feet BGS. As observed during the field exploration, the condition of the near-surface bedrock varies from that of completely disintegrated rock that has become a dense soil-like deposit to that of moderately to highly weathered rock. Where encountered, the bedrock is generally massive and can be expected to range from readily rippable to non-rippable depending on the degree of weathering. The less weathered granitic rock is anticipated to generate sand, gravel, cobbles, and possibly oversize boulders. The more weathered bedrock produced fine to coarse sand with silt and gravel size rock fragments. The weathered bedrock is expected to be generally suitable for re-use as compacted fill. It should be anticipated that deep cuts will generate boulders or core stones (greater than 12 inches) that will require special placement described later in Section 5.2 of this report.

3.3 Groundwater and Surface Water

Groundwater was only encountered in one boring (B-6) during this exploration at an approximate depth of 48 feet below the existing ground surface. Groundwater was also encountered during previous grading of the western terminus of Cactus Avenues for Meridian Park West. The groundwater encountered within the Tonalite bedrock is associated with a joint/fracture system If encountered during grading and/or utility installation; this condition would likely be associated with localized seepages along existing joints and fractures. Groundwater may be encountered during grading and canyon subdrains are recommended in the canyon fill areas to mitigate water accumulation at the transition between native bedrock and engineered fill. In addition, groundwater seepage may appear in cut slopes exposing joints and fractures or earth materials of contrasting permeabilities. Mitigation of possible seepage within building pads or cut-slope areas can be provided on an individual basis after evaluation by the geotechnical consultant during grading operations. Surface water was not observed onsite during our field reconnaissance.

3.4 Landslides/Debris Flow and Rockfalls

No evidence of on-site landslides/debris flow or rock fall was observed during our field investigation. Thick deposits of surficial soils typically associated with landsliding or debris flows are not present and, therefore, landslide hazard at the sight is considered low. Based on the current proposed buildings, no prominent rock outcrop will remain onsite, therefore the rock fall hazard is considered very low. The potential for rock fall due to either erosion or seismic ground shaking is considered nil. Other soils susceptible to slumping (i.e. such as thick residual soil/colluvium) will be removed and compacted during the course of grading.

3.5 Rippability

Based on our geotechnical exploration and the seismic refraction survey conducted by Atlas Geophysics (See, Appendix C), we anticipate the bedrock in most of the site to be rippable to the proposed design grades with conventional heavy earth moving equipment in good operating conditions (Caterpillar D9L or D10 with single shank ripper and rock teeth). Localized marginally rippable to unrippable rock will be encountered, particularity in the areas of excavations deeper than 25 feet. However, unrippable rock or buried core stones (P-wave velocities typically >7,000 feet/second) may exist at depth of 15 to 25 feet BGS in some areas of the site (see SL-9 and SL-14). In addition, due to differential weathering of the bedrock materials, very heavy ripping and/or other specialized excavation techniques may be required to maintain desired excavation rates. For proposed building pads and utility trenches in marginally rippable to non-rippable rock areas, it may be desirable to over-excavate at least 2 feet below the bottom of proposed utilities, storm water storage basins or 3 to 4 feet below pad grade (or lower truck loading ramp areas) to facilitate future trenching operations. Pad over-excavation should be sloped a minimum of 1 percent towards the deeper fills or streets.

3.6 Regional Faulting and Fault Activity

The subject site, like the rest of Southern California, is located within a seismically active region as a result of being located near the active margin between the North American and Pacific tectonic plates. Based on published geologic hazard maps, this site is not located within a currently designated Alquist-Priolo (AP) Earthquake Fault Zone; nor is located within a County Fault Zone. The nearest zoned active faults are the San Bernardino segment of the San Jacinto Fault Zone, located approximately 8.8 miles (14.2 km) northeast of the site and the San Jacinto Valley Segment of the San Jacinto Fault Zone, located approximately 8.9 miles (14.4 km) east of the site (Blake, 2000c).

3.7 Seismic Coefficients per 2019 CBC

As is common for virtually all of Southern California, strong ground shaking can be expected at the site during moderate to severe earthquakes in this general region. Intensity of ground shaking at a given location depends primarily upon earthquake magnitude, site distance from the source, and site response (soil type) characteristics. Based on our explorations and review, the site is underlain by weathered granitic bedrock. As such, the site is classified as a Class C site. In accordance with ASCE 7-16 as the Design Code Reference Document, the 2019 CBC seismic coefficients for the site is listed in table below. The project structural engineer should confirm such assumption or else a site–specific ground motion analysis will be required.

Table 1. 2019 CBC Seismic Coefficients

Site Seismic Coefficients / Coordinates		Design Value (g)
Latitude: 33.9050		Site Class C
Longitude: -117.3067		
Mapped Spectra (OSHPD)	Spectral Response (short), S_S	1.50 g
	Spectral Response (1 sec), S_1	0.60 g
	Site Modified Peak Ground Acceleration, PGA_M	0.60 g
	Max. Considered Earthquake Spectral Response Acceleration (short), S_{MS}	1.80 g
	Max. Considered Earthquake Spectral Response Acceleration – (1 sec), S_{M1}	0.84 g
	5% Damped Design Spectral Response Acceleration (short), S_{DS}	1.20 g
	5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.56 g
	Site-Specific Peak Ground Acceleration, PGA	0.50 g

* g- Gravity acceleration

The results of the analysis also indicate that the adjusted Peak Ground Acceleration (PGA_M) for this site is 0.6g.

3.8 Secondary Seismic Hazards

Ground shaking can induce "secondary" seismic hazards such as liquefaction, dynamic densification, lateral spreading, flooding, seiche/tsunami, collapsible soils, and ground rupture, as discussed in the following subsections:

3.8.1 Dynamic Settlement (Liquefaction and/or Dry Settlement)

Due to the lack of shallow groundwater and relatively dense nature of underlying materials, dynamic settlement (Liquefaction and/or Dry Settlement) is not considered a geologic hazard on this site.

3.8.2 Lateral Spreading

Due to the lack of shallow groundwater and relatively dense nature of underlying materials lateral spreading is not considered a geologic hazard on this site.

3.8.3 Flooding

The site is not within a flood plain and potential for flooding is considered very low for this site.

3.8.4 Seiche and Tsunami

Due to the site location and lack of nearby open bodies of water, the possibility of the affects due to seiches or tsunami is considered non-existent.

3.8.5 Collapsible Soils

Laboratory testing indicates that the onsite soils (residual soils) are expected to possess a slight collapse potential. Based on the remedial grading recommendations to remove and compact the near surface soils (Section 4.2.1) as well as the anticipated deep cuts and fills, this geologic hazard on this site is considered very low.

3.8.6 Expansive Soils

Limited laboratory testing indicated that onsite soils generally possess a very low expansion potential (EI<21). However, localized deposits of residual soils may possess low expansion potential (EI<51). The mitigation for this geologic hazard is presented in Section 4.2.4 of this report.

3.8.7 Ground Rupture

Since this site is not located within a mapped Fault Zone, the possibility of ground surface-fault-rupture is very low at this site.

3.9 Slope Stability

Proposed 2:1 (horizontal to vertical) cut slopes in the weathered bedrock will be grossly stable under static and seismic conditions. Slope faces in highly weathered bedrock are inherently subject to erosion, particularly if exposed to rainfall and irrigation. Landscaping and slope maintenance should be conducted as soon as possible in order to increase long-term surficial stability. If unstable conditions are encountered during grading as identified by the geotechnical consultant, a stabilization fill may be considered as depicted in Appendix D. Proposed 2:1 fill slopes up to heights of 30 feet constructed with onsite soils are considered to be grossly stable. Slopes with greater heights should be reviewed prior to construction.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 General

Based on the results of this exploration, it is our opinion that the site is suitable for the proposed development from a geotechnical viewpoint. Grading of the site should be in accordance with our recommendations included in this report and future recommendations and evaluations made during construction by the geotechnical consultant.

4.2 Earthwork

Earthwork should be performed in accordance with the General Earthwork and Grading Specifications in Appendix D as well as the following recommendations. The recommendations contained in Appendix D, are general grading specifications provided for typical grading projects and some of the recommendations may not be strictly applicable to this project. The specific recommendations contained in the text of this report supersede the general recommendations in Appendix D.

The contract between the developer and earthwork contractor should be worded such that it is the responsibility of the contractor to place fill properly in accordance with the recommendations of this report, the specifications in Appendix D, applicable County Grading Ordinances, notwithstanding the testing and observation of the geotechnical consultant during construction.

4.2.1 Site Preparation and Remedial Grading

Prior to grading, the proposed structural improvement areas (i.e. all-structural fill areas, pavement areas, buildings, etc.) should be cleared of surface and subsurface pipelines and obstructions. Heavy vegetation, roots and debris should be disposed of offsite. Any onsite wells or septic waste system should be removed or abandoned in accordance with the Riverside County Department of Environmental Health. Voids created by removal of buried/unsuitable materials should be backfilled with properly compacted soil in general accordance with the recommendations of this report.

The near surface soils (including residual soils/colluvium and alluvium) are potentially compressible in their present state and may settle under the surcharge of fills or foundation loading. As such, these materials should be removed in all settlement-sensitive areas including building pads, pavement, and slopes. The depth of removal should extend into underlying dense bedrock, but not generally expected to exceed a depth of 3 to 9 feet. Acceptability of all removal bottoms should be reviewed by an engineering geologist or geotechnical engineer and documented in the as-graded geotechnical report. The removal limit should be established by a

1:1 (horizontal:vertical) projection from the edge of fill soils supporting structural fill or settlement-sensitive structures downward and outward to competent material identified by the geotechnical consultant. This may require remedial grading that extends beyond the limits of design grading. Removal will also include benching into competent material as the fills rise. Areas adjacent to existing property limits or protected habitat areas may require special considerations and monitoring. Steeper temporary slopes in these areas may be considered.

After completion of the recommended removal of unsuitable soils and prior to fill placement, the exposed surface should be scarified to a minimum depth of 8-inches, moisture conditioned as necessary to optimum moisture content and compacted using heavy compaction equipment to an unyielding condition. All structural fill should be compacted throughout to 90 percent of the ASTM D 1557 laboratory maximum density, at or slightly above optimum moisture.

The California Building Code and County of Riverside require that no oversize rock (>12-inches) be placed within 10 feet of the surface of a structural fill and/or building pad. The grading plan should be carefully reviewed during grading to verify that oversized rocks are buried below a 10-foot fill cap. Generally, oversize rock will require windrowing, individual burial, or other special placement methods as further described in Appendix D. In addition, an adequate supply of granular fill material will be needed for placement around the rocks. A grading contractor with experience in the handling and placement of oversize rock should be selected for this project.

4.2.2 Cut/Fill Transition and Streets

In order to mitigate the impact of underlying cut/fill transition conditions, we recommend overexcavation of the cut portion underlying building pads during grading to a minimum depth of 3 feet below finish pad elevation or 2 feet below bottom of footings, whichever is deeper. This overexcavation does not include scarification or preprocessing prior to placement of fill. Overexcavation should encompass the entire building limits a horizontal distance equal to the depth of overexcavation or to a minimum distance of 5 feet, whichever is greater. Overexcavation bottoms should be sloped as needed to reduce the accumulation of subsurface water.

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

4.2.3 Structural Fills

The onsite soils are generally suitable for re-use as compacted fill, provided they are free of debris and organic matter. Fills placed within 10 feet of finish pad grades or slope faces should contain no rocks over 12 inches in maximum dimension. In addition, encountered clayey soils layers (EI>21), if any, should be placed at a depth greater than 5 feet below finished grades.

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

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

Fills placed on slopes steeper than 5:1 (horizontal:vertical) should be benched into dense soils (see Appendix C for benching detail). Benching should be of sufficient depth to remove all loose material. A minimum bench height of 2 feet into approved material should be maintained at all times.

4.2.4 Suitability of Site Soils for Fills

Topsoil and vegetation layers, root zones, and similar surface materials should be striped and stockpiled or removed from the site. Existing on-site soils should be considered suitable for re-use as compacted fills provided the recommendations contained herein are followed. Fill materials with expansion index greater than 21 should not be used in upper 3 feet of subgrade soils below building pad. If cobbles and boulders larger than 6-inches in largest diameter are encountered or produced during grading, these oversized cobbles and boulders should be reduced to less than 6 inches or placed in structural fill as outlined in Appendix D.

4.2.5 Import Soils

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

4.2.6 Utility Trenches

Utility trenches should be backfilled with compacted fill in accordance with the *Standard* Specifications *for Public Works Construction,* (“Greenbook”), 2021 Edition. Fill material above the pipe zone should be placed in lifts not exceeding 8 inches in uncompacted thickness and should be compacted to at least 90 percent relative compaction (ASTM D 1557) by mechanical means only. Site soils may generally be suitable as trench backfill provided these soils are screened of rocks over 1½ inches in diameter and organic matter. If imported sand is used as backfill, the upper 3 feet in building and pavement areas should be compacted to 95 percent. The upper 6 inches of backfill in all pavement areas should be compacted to at least 95 percent relative compaction.

Where granular backfill is used in utility trenches adjacent to moisture sensitive subgrades and foundation soils, we recommend that a cut-off "plug" of impermeable material be placed in these trenches at the perimeter of buildings, and at pavement edges adjacent to irrigated landscaped areas. A "plug" can consist of a 5-foot long section of clayey soils with more than 35-percent passing the No. 200 sieve, or a Controlled Low Strength Material (CLSM) consisting of one sack of Portland-cement plus one sack of bentonite per cubic-yard of sand. CLSM should generally conform to requirements of the "Greenbook". This is intended to reduce the likelihood of water permeating trenches from landscaped areas, then seeping along permeable trench backfill into the building and pavement subgrades, resulting in wetting of moisture sensitive subgrade earth materials under buildings and pavements.

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

4.2.7 Shrinkage

The volume change of excavated onsite soils upon recompaction is expected to vary with materials, density, insitu moisture content, and location and compaction effort. The in-place and compacted densities of soil materials vary and accurate overall determination of shrinkage and bulking cannot be made. Therefore, we recommend site grading include, if possible, a balance area or ability to adjust grades slightly to accommodate some variation. Based on our geotechnical laboratory results, we expect recompaction shrinkage of subsurface soils and bulking of bedrock materials (when recompacted to an average 92 percent of ASTM D1557) and estimate the following earth volume changes will occur during grading:

Geologic Unit	Estimated Shrinkage/Bulking
Residual Soil/Colluvium/Alluvium	10% shrinkage, +/- 5%
Bedrock (Upper 30 ft)	5 to 10% bulking, +/- 3%

4.2.8 Drainage

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

4.3 Foundation Design

Shallow spread or continuous footings bearing on a newly placed properly compacted fill are anticipated for the proposed structures.

4.3.1 Design Parameters – Spread/Continuous Shallow Footings

Footings should be embedded at least 12-inches below lowest adjacent grade for the proposed structure. Footing embedment should be measured from lowest adjacent finished grade, considered as the top of interior slabs-on-grade or the finished exterior grade, excluding landscape topsoil, whichever is lower. Footings located adjacent to utility trenches or vaults should be embedded below an imaginary 1:1 (horizontal:vertical) plane projected upward and outward from the bottom edge of the trench or vault, up towards the footing.

- **Bearing Capacity**: For footings on newly placed, properly compacted fill soil, an allowable vertical bearing capacity of 2,500 pounds-per-square-foot (psf) should be used. These footings should have a minimum base width of 18 inches for continuous wall footings and a minimum bearing area of 3 square feet (1.75-ft by 1.75-ft) for pad foundations. The bearing pressure value may be increased by 250 psf for each additional foot of embedment or each additional foot of width to a maximum vertical bearing value of 4,500 psf. Additionally, these bearing values may be increased by one-third when considering short-term seismic or wind loads. A modulus of subgrade reaction, K of 200 PCI may be used to relative dense bedrock or onsite soil compacted to minimum 90% relative compaction.
- **Lateral loads**: Lateral loads may be resisted by friction between the footings and the supporting subgrade. A maximum allowable frictional resistance of 0.35 may be used for design. In addition, lateral resistance may be provided by passive pressures acting against foundations poured neat against properly compacted granular fill. We recommend that an allowable passive pressure based on an equivalent fluid pressure of 350 pounds-per-cubic-foot (pcf) be used in design. These friction and passive values have already been reduced by a factor-of-safety of 1.5.

4.3.2 Settlement Estimates

For settlement estimates, we assumed that column loads will be no larger than 200 kips, with bearing wall loads not exceeding 10 kips per foot of wall. If greater column or wall loads are required, we should re-evaluate our foundation recommendation, and re-calculate settlement estimates.

Buildings located on compacted fill soils as required per Section 4.2.1 above should be designed in anticipation of 1 inch of total static settlement and 0.5-inch of static differential settlement within a 40 foot horizontal run.

4.4 Vapor Retarder

It has been a standard of care to install a moisture-vapor retarder underneath all slabs where moisture condensation is undesirable. Moisture vapor retarders may retard but not totally eliminate moisture vapor movement from the underlying soils up through the slabs. Moisture vapor transmission may be additionally reduced by use of concrete additives. Leighton Consulting, Inc. does not practice in the field of moisture vapor transmission evaluation/mitigation. Therefore, we recommend that a qualified person/firm be engaged/consulted with to evaluate the general and specific moisture vapor transmission paths and any impact on the proposed construction. This person/firm should provide recommendations for mitigation of potential adverse impact of moisture vapor transmission on various components of the structure as deemed appropriate.

However, based on our experience, the standard of practice in Southern California has evolved over the last 15 to 20 years into a construction of a vapor retarder system that generally consisted of a membrane (such as 15-mil thick), underlain by a capillary break consisting of 4 inches of clean ½-inch-minimum gravel or 2-inch sand layer (SE>30). The structural engineer/architect or concrete contractor often require a sand layer be placed over the membrane (typically 2-inch thick layer) to help in curing and reduction of curling of concrete. If such sand layer is placed on top of the membrane, the contractor should not allow the sand to become wet prior to concrete placement (e.g., sand should not be placed if rain is expected).

In conclusion, the construction of the vapor barrier/retarder system is dependent on several variables which cannot be all geotechnically evaluated and/or tested. As such, the design of this system should be a design team/owner decision taking into consideration finish flooring materials and manufacture's installation requirements of proposed membrane. Moreover, we recommend that the design team also follow ACI Committee 302 publication for "Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials" (ACI 302.2R-06) which includes a flow chart that assists in determining if a vapor barrier/retarder is required and where it is to be placed.

4.5 Retaining Walls

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

Table 2. Retaining Wall Design Earth Pressures (Static, Drained)

Loading Conditions	Equivalent Fluid Density (pcf)	
	Level Backfill	2:1 Backfill
Active	36	55
At-Rest	55	90
Passive*	350	150 (2:1, sloping down)

* This assumes level condition in front of the wall will remain for the duration of the project, not to exceed 3,500 psf at depth.

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

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

4.6 Sulfate Attack

Based on past experience in this area, the onsite soils are expected to possess negligible sulfate content. Type II soils or equivalent may be used. Further testing should be performed at the completion of site grading to confirm such conditions.

4.7 Preliminary Pavement Design

Our preliminary HMA pavement design is based on an R-value of 57 and the Caltrans Highway Design Manual. For planning and estimating purposes, the pavement sections are calculated based on Traffic Indexes (TI) as indicated in Table below:

Table 3. Asphalt Pavement Sections

General Traffic Condition	Traffic Index (TI)	Asphalt Concrete (inches)	Aggregate Base* (inches)
Automobile Parking Lanes	4.5	3.0	4.0
	5.0	3.0	4.0
Truck Access & Driveways	6.0	3.0	4.0
	6.5	3.5	4.0
Roadways (Barton, Brown)	7.0	4.0	4.0
Roadways (Cactus)	9.0	5.0	5.0

Appropriate Traffic Index (TI) should be selected or verified by the project civil engineer and actual R-value of the subgrade soils will need to be verified after completion of site grading to finalize the pavement design. Pavement design and construction should also conform to applicable local, county and industry standards. The Caltrans pavement section design calculations were based on a pavement life of approximately 20 years with periodic flexible pavement maintenance.

Where PCC pavement is planned, the following table provides sections based on the design standards presented in the ACI "Guide for the Design and construction of Concrete Parking Lots" (ACI 330R-14), R-value test results, and the provided Average Daily Truck Traffic Indices (ADTT). The ADTT index is provided by Client/civil engineer.

Table 4. Pavement Sections

Street	ADTT	R-Value	PCC (Inches)
Heavy Truck Traffic	>700	>40	8.0
Moderate Truck Traffic/Parking	≤ 300		7.0
Parking/Light Traffic	≤ 50		6.5

- **Traffic Categories ACI 330, Table 3.3*

The above recommended concrete sections are based on properly compacted fill soils with a very low expansion potential (EI<21) and R-Value greater than 40. All utility trenches should be compacted to 90 percent relative compaction and pavement subgrade (upper 12-inches) uniformly compacted (non-yielding) to 95 percent of the laboratory maximum dry density (ASTM D1557) and at/or slightly above optimum moisture content. Compaction should extend a minimum of 12-inches beyond formlines. Slab edges and construction joint details provided by ACI should be followed. Slab edges that will be subject to through going traffic should be tapered from the heaviest traffic load into the lessor traffic load area a minimum of 3 feet. The PCC pavement should have a minimum of 28-day compressive strength of 3250 psi (or MOR of 550 psi). Construction and crack control joints should be designed per structural engineer's requirements and/or ACI or ACPA guidelines.

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

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

5.0 GEOTECHNICAL CONSTRUCTION SERVICES

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

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

- After completion of site demolition and clearing,
- During over-excavation of compressible soil,
- During compaction of all fill materials,
- After excavation of all footings and prior to placement of concrete,
- During utility trench backfilling and compaction, and
- When any unusual conditions are encountered.

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

6.0 LIMITATIONS

This report was based in part on data obtained from a limited number of observations, site visits, soil excavations, samples and tests. Such information is, by necessity, incomplete. The nature of many sites is such that differing soil or geologic conditions can be present within small distances and under varying climatic conditions. Changes in subsurface conditions can and do occur over time. Therefore, our findings, conclusions and recommendations presented in this report are based on the assumption that we (Leighton Consulting, Inc.) will provide geotechnical observation and testing during construction as the Geotechnical Engineer of Record for this project. Please refer to Appendix D, GBA's *Important Information About This Geotechnical-Engineering Report*, prepared by the Geoprofessional Business Association (GBA) presenting additional information and limitations regarding geotechnical engineering studies and reports.

This report was prepared for the sole use of Client and their design team, for application to design of the proposed maintenance building, in accordance with generally accepted geotechnical engineering practices at this time in California. Any unauthorized use of or reliance on this report constitutes an agreement to defend and indemnify Leighton Consulting, Inc. from and against any liability, which may arise as a result of such use or reliance, regardless of any fault, negligence, or strict liability of Leighton Consulting, Inc.

REFERENCES

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Project: 13226.001	Eng/Geol: SIS/BAA
Scale: 1 " = 2,500 '	Date: September 2021

Base Map: ESRI ArcGIS Online 2021

SITE LOCATION MAP

Proposed Meridian Upper Plateau
Vista Grande Drive, Riverside, California

FIGURE 1

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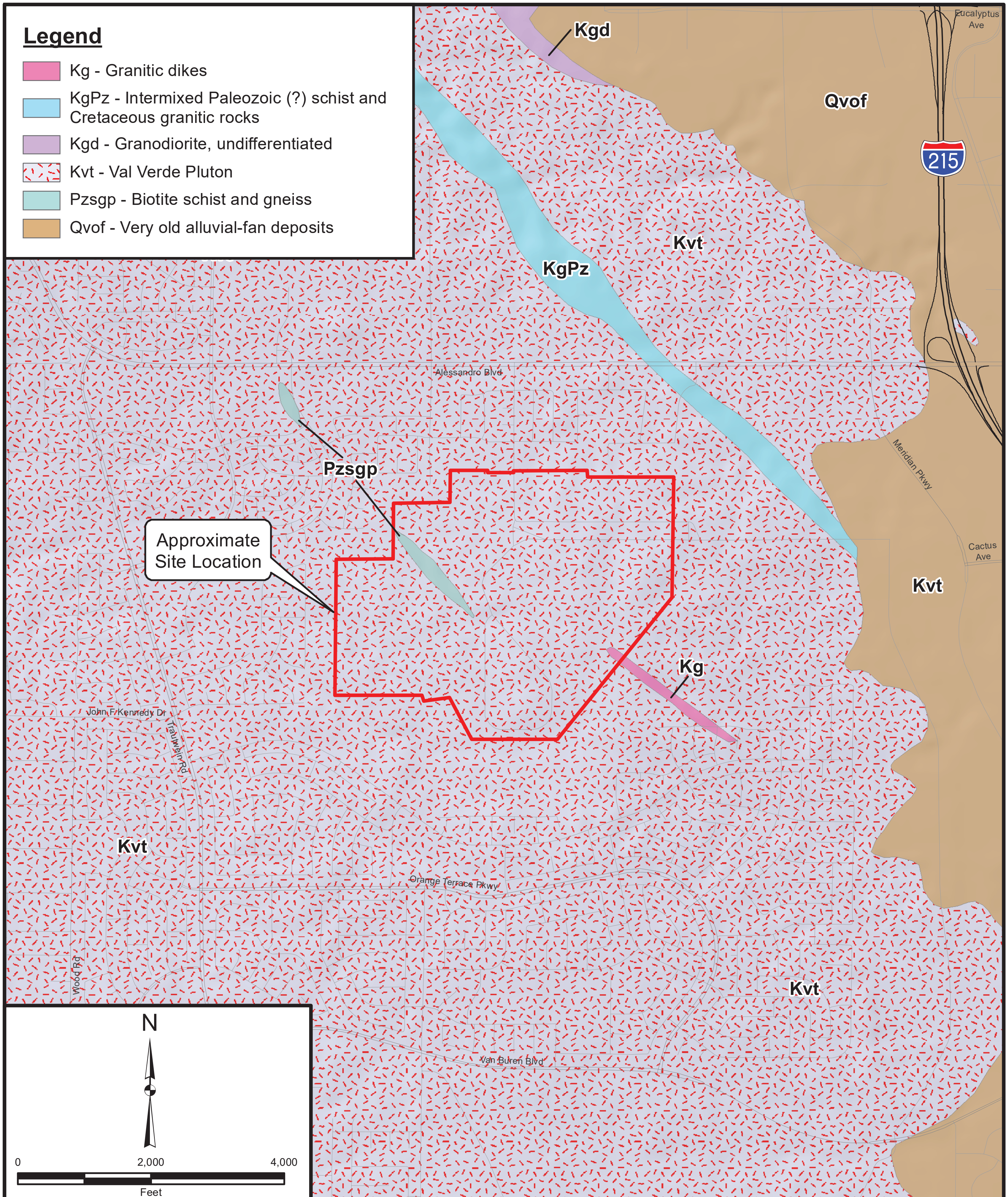
Map Saved as V:\Drafting\13226\001\Maps\13226.001_F01_SLM_2021-08-17.mxd on 9/23/2021 4:27:26 PM Author: Leighton Geomatics (mmurphy)



Project: 13226.001

Eng/Geol: SIS/BAA

Scale: 1 " = 2,000 '

Date: September 2021

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

Author: Leighton Geomatics (mmurphy)

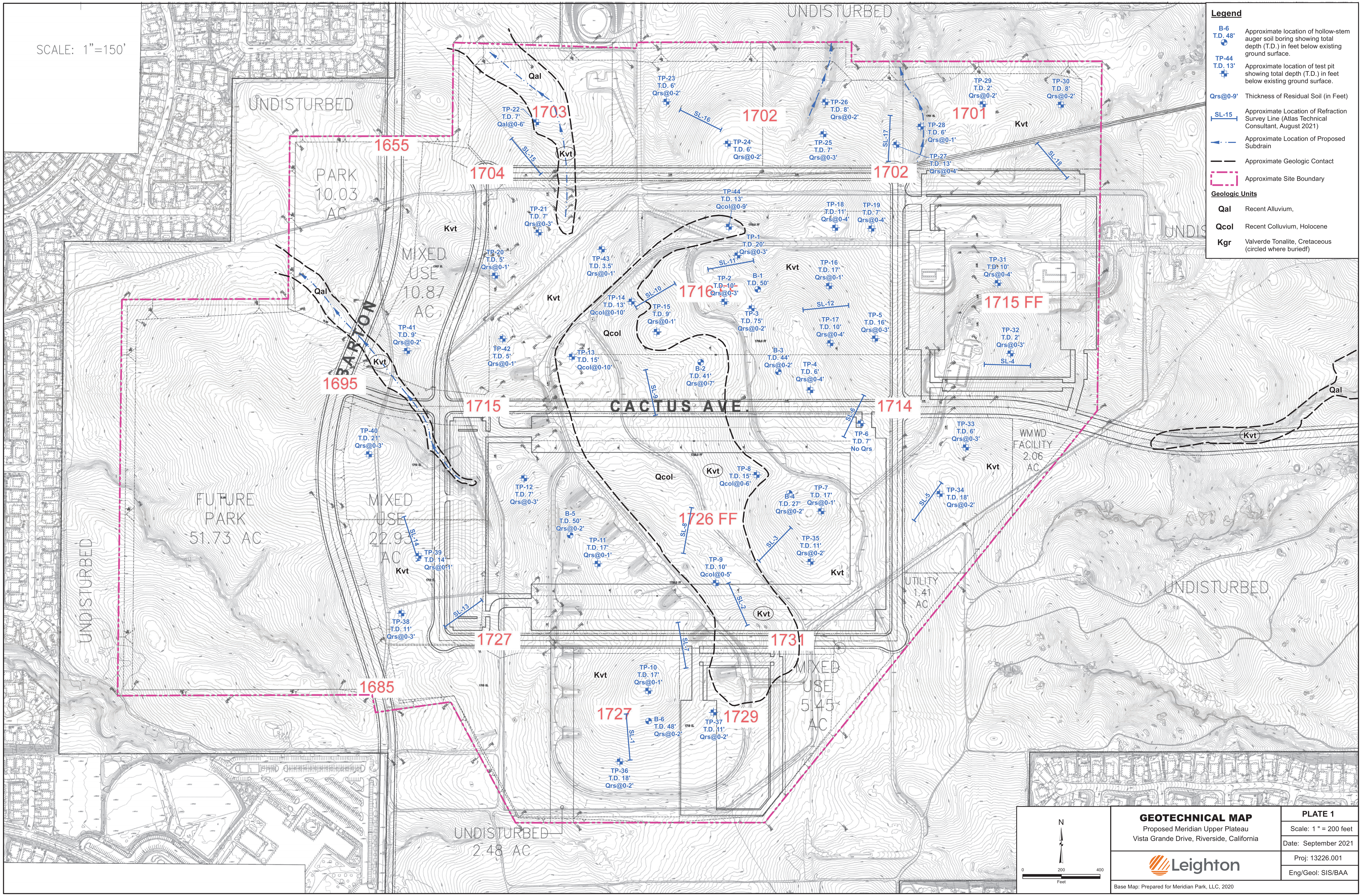
REGIONAL GEOLOGY MAP

Proposed Meridian Upper Plateau
Vista Grande Drive, Riverside, California

FIGURE 2

Leighton

Map Saved as V:\Drafting\13226\001\Maps\13226-001_F02_RGM_2021-09-23.mxd on 9/23/2021 4:50:00 PM



SCALE: 1"=150'
UNDISTURBED
PARK
10.03
AC
MIXED
USE
10.87
AC
FUTURE
PARK
51.73 AC
MIXED
USE
22.93
AC
UNDISTURBED
2.48 AC
MIXED
USE
5.45
AC
UTILITY
1.41
AC
WMWD
FACILITY
2.06
AC
CACTUS AVE.
BARTON
1655
1695
1685
1703
1704
1702
1701
1715
1714
1716
1715 FF
1726 FF
1727
1731
1729
Qal
Qcol
Kvt
Legend
B-6 T.D. 48' — Approximate location of hollow-stem auger soil boring showing total depth (T.D.) in feet below existing ground surface.
TP-44 T.D. 13' — Approximate location of test pit showing total depth (T.D.) in feet below existing ground surface.
Qrs@0-9' — Thickness of Residual Soil (in Feet)
SL-15 — Approximate Location of Refraction Survey Line (Atlas Technical Consultant, August 2021)
Approximate Location of Proposed Subdrain
Approximate Geologic Contact
Approximate Site Boundary
Geologic Units
Qal — Recent Alluvium,
Qcol — Recent Colluvium, Holocene
Kgr — Valverde Tonalite, Cretaceous (circled where buriedf)
GEOTECHNICAL MAP
Proposed Meridian Upper Plateau
Vista Grande Drive, Riverside, California
PLATE 1
Scale: 1 " = 200 feet
Date: September 2021
Proj: 13226.001
Eng/Geol: SIS/BAA
Leighton
Base Map: Prepared for Meridian Park, LLC, 2020
N
0
200
400
Feet

APPENDIX A

GEOTECHNICAL FIELD EXPLORATIONS

GEOTECHNICAL BORING LOG B-1

Project No.	13226.001	**Date Drilled**	8-2-21
Project	Meridian Upper Plateau	**Logged By**	BAA
Drilling Co.	MARTINI DRILLING	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1742'
Location	See Geotechnical Map	**Sampled By**	BAA

SOIL DESCRIPTION

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

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0			B1				SM	**Residual Soil** SILTY SAND, dense, reddish brown, slightly moist, medium sand	
1740				R1	50/6"	122	7			
									Granitic Bedrock recovered as Poorly graded SAND with silt, very dense, pale brown to grayish brown, slightly moist	
	5			R2	50/5"	116	5			
1735				R3	50/4"		3.2			
	10			S1	50/6"					
1730										
	15			S2	50/5"					
1725										
	20			S3	50/5"					
1720										
	25			S4	50/3"					
1715										
	30									

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

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

Leighton

GEOTECHNICAL BORING LOG B-1

Project No.	13226.001	**Date Drilled**	8-2-21
Project	Meridian Upper Plateau	**Logged By**	BAA
Drilling Co.	MARTINI DRILLING	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1742'
Location	See Geotechnical Map	**Sampled By**	BAA

SOIL DESCRIPTION

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

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30									
1710										
	35									
1705										
	40								@ 40'; becomes harder to drill	
1700										
	45									
1695										
	50			S5	50/2.5"					
									Total Depth 50' No Groundwater Encountered Backfilled 8/2/2021	
1690										
	55									
1685										
	60									

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

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

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

GEOTECHNICAL BORING LOG B-2

Project No.	13226.001	**Date Drilled**	8-2-21
Project	Meridian Upper Plateau	**Logged By**	BAA
Drilling Co.	MARTINI DRILLING	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1730'
Location	See Geotechnical Map	**Sampled By**	BAA

SOIL DESCRIPTION

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

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
1730	0							SM/SC	**Colluvium** SILTY CLAYEY SAND, strong brown to reddish brown, slightly moist, fine to medium sand, trace fine gravel	
				R1	4 2 6	102	6			
1725	5			R2	7 11 4	116	7			
				R3	7 15 23				**Granitic Bedrock** Poorly graded SAND with silt, dense, slightly moist, medium to coarse sand	
1720	10			S1	9 15 18					
1715	15			S2	10 30 50/5"		8.1			
1710	20			S3	35 50/2"					
1705	25			S4	26 50/4"					
1700	30									

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

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

Leighton

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

GEOTECHNICAL BORING LOG B-2

Project No.	13226.001	**Date Drilled**	8-2-21
Project	Meridian Upper Plateau	**Logged By**	BAA
Drilling Co.	MARTINI DRILLING	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1730'
Location	See Geotechnical Map	**Sampled By**	BAA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
1700	30								@ 30'; becomes harder to drill	
1695	35									
1690	40									
									Refusal @ 41' No Groundwater Encountered Backfilled 8/2/2021	
1685	45									
1680	50									
1675	55									
1670	60									

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

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

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GEOTECHNICAL BORING LOG B-3

Project No.	13226.001	**Date Drilled**	8-2-21
Project	Meridian Upper Plateau	**Logged By**	BAA
Drilling Co.	MARTINI DRILLING	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1756'
Location	See Geotechnical Map	**Sampled By**	BAA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0							SM	**Residual Soil** SILTY SAND, medium dense, pale brown, slightly moist, medium sand	
1755										
				R1	50/3"	107	2		**Granitic Bedrock** recovered as SAND with silt, dense, grayish brown, slightly moist, medium to coarse sand	
	5			S1	50/5"					
1750										
									@ 7'; becomes harder to drill	
	10			S2	50/3.5"					
1745										
	15									
1740										
	20									
1735										
	25									
1730										
	30									

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

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

Leighton

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

GEOTECHNICAL BORING LOG B-3

Project No.	13226.001	**Date Drilled**	8-2-21
Project	Meridian Upper Plateau	**Logged By**	BAA
Drilling Co.	MARTINI DRILLING	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1756'
Location	See Geotechnical Map	**Sampled By**	BAA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30									
1725										
	35									
1720										
	40									
1715										
	45								Refusal @ 44' No Groundwater Encountered Backfill 8/2/2021	
1710										
	50									
1705										
	55									
1700										
	60									

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

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

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

Leighton

GEOTECHNICAL BORING LOG B-4

Project No.	13226.001	**Date Drilled**	8-2-21
Project	Meridian Upper Plateau	**Logged By**	BAA
Drilling Co.	MARTINI DRILLING	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1755'
Location	See Geotechnical Map	**Sampled By**	BAA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1755	0			B1				SC-SM	**Residual Soil** SILTY, CLAYEY SAND, medium dense, reddish brown, slightly moist, fine to medium sand	
				R1	16 50/4.5"	111	8		**Granitic Bedrock** recovered as Poorly graded SAND with silt, dense to very dense, slightly moist, medium to coarse sand	
1750	5			R2	50/6"					
1745	10			S1	50/5.5"					
1740	15								@ 15'; becomes harder to drill	
1735	20									
1730	25									
									Refusal @ 27' No Groundwater Encountered Backfilled 8/2/2021	
1725	30									

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

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

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

Leighton

GEOTECHNICAL BORING LOG B-5

Project No.	13226.001	**Date Drilled**	8-2-21
Project	Meridian Upper Plateau	**Logged By**	BAA
Drilling Co.	MARTINI DRILLING	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1739'
Location	See Geotechnical Map	**Sampled By**	BAA

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0			B1				SM	**Topsoil** SILTY SAND, medium dense, pale brown, slightly moist, fine to medium sand	
				R1	50/6"	126	3		**Granitic Bedrock** recovered as Poorly graded SAND with silt, very dense, grayish brown, slightly moist, coarse sand	
1735	5			S1	34 50/5"					
1730	10			S2	34 50/5.5"					
1725	15			S3	50/5.5"					
1720	20									
1715	25									
1710	30									

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

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

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

Leighton

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

GEOTECHNICAL BORING LOG B-5

Project No.	13226.001	**Date Drilled**	8-2-21
Project	Meridian Upper Plateau	**Logged By**	BAA
Drilling Co.	MARTINI DRILLING	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1739'
Location	See Geotechnical Map	**Sampled By**	BAA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30									
1705	35								@ 35'; becomes harder to drill	
1700	40									
1695	45									
1690	50			S4	50/2"					
									Total Depth 50' No Groundwater Encountered Backfill 8/2/2021	
1685	55									
1680	60									

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

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

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

Leighton

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

GEOTECHNICAL BORING LOG B-6

Project No.	13226.001	**Date Drilled**	8-2-21
Project	Meridian Upper Plateau	**Logged By**	BAA
Drilling Co.	MARTINI DRILLING	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	1750'
Location	See Geotechnical Map	**Sampled By**	BAA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
1750	0							SM	**Residual Soil** SILTY SAND, medium dense, pale brown, slightly moist, fine to coarse sand	
				R1	37 50/4"	122	4		**Granitic Bedrock** recovered as Poorly graded SAND with silt, very dense, grayish brown, slightly moist, coarse sand	
1745	5			S1	50/6"					
1740	10			S2	27 50/3"					
1735	15								@ 15' becomes harder to drill	
1730	20									
1725	25									
1720	30									

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

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

GEOTECHNICAL BORING LOG B-6

Project No. 13226.001
Project Meridian Upper Plateau
Drilling Co. MARTINI DRILLING
Drilling Method Hollow Stem Auger - 140lb - Autohammer - 30" Drop
Location See Geotechnical Map

Date Drilled 8-2-21
Logged By BAA
Hole Diameter 8"
Ground Elevation 1750'
Sampled By BAA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1720	30									
1715	35									
1710	40									
1705	45									
1700	50			S3	50/4"				Total Depth 50' Groundwater Encountered @ 47.75' Backfilled 8/2/2021	
1695	55									
1690	60									

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

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

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

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

APPENDIX A-1

LOGS OF EXPLORATORY BORINGS/TEST PITS

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LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

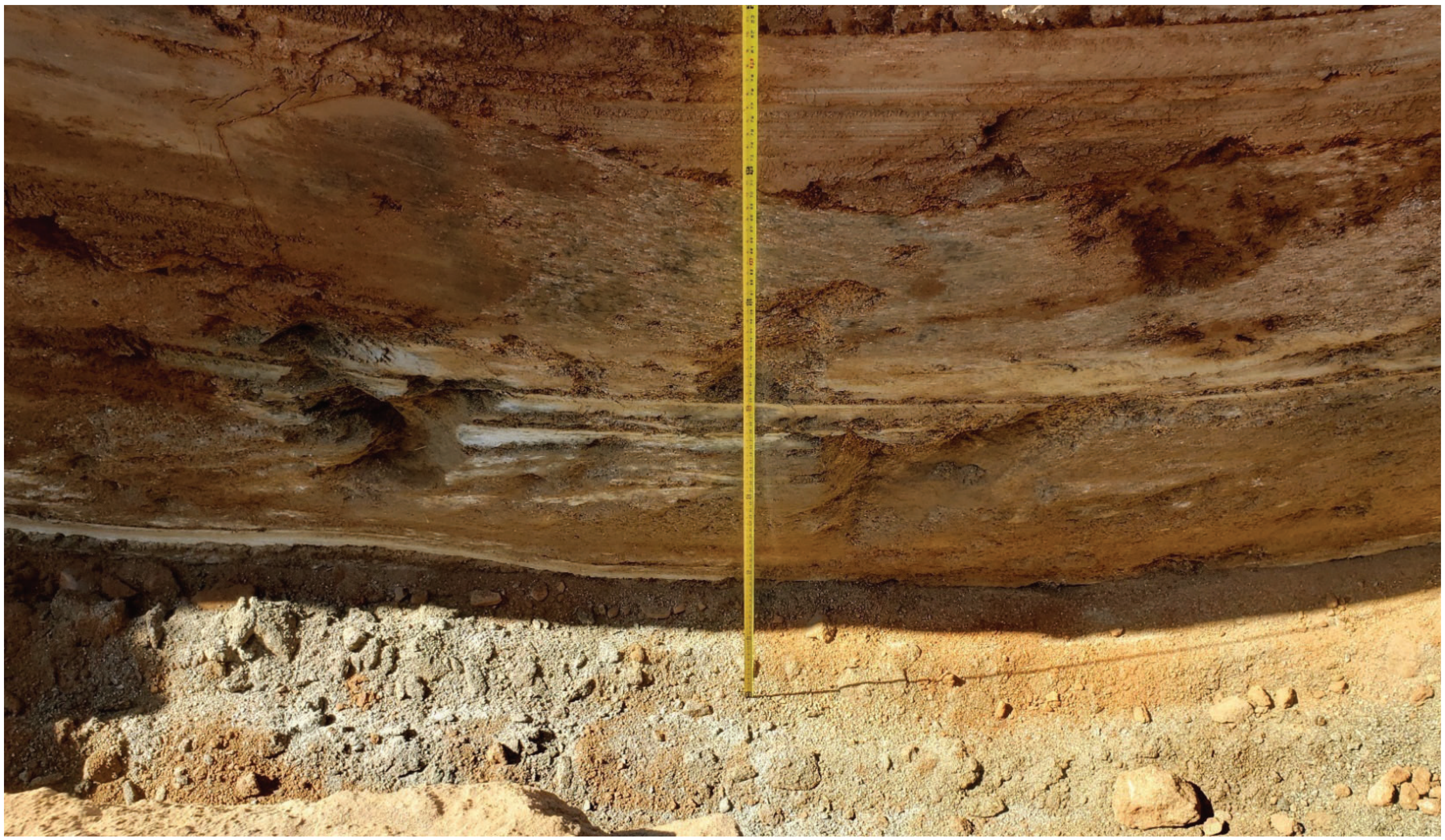
TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-1	B-1 B-2		SM	**Residual Soil (Qrs)**; 0' 3.0' – SILTY SAND, reddish brown, moist medium dense, trace gravel. **Bedrock (Kvt)**; 3.0'-19.0' – Granitic BEDROCK, gray to yellowish brown, completely weathered, moist, heavily fractured, soft. Total Depth 19.0', no groundwater, backfilled with spoils.

LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-2			SM/ SC-SM	**Residual Soil (Qrs)**; 0'-3.0' – SILTY SAND to SILTY CLAYEY SAND, reddish brown, moist medium dense, medium to coarse sand **Granitic Bedrock (Kvt)**; 3.0-12.0' – Granitic Bedrock, grayish brown, soft, completely weathered to moderately weathered, heavily fractured. Total Depth 12.0', no groundwater, backfilled with spoils.



LOG OF TEST PITS

PROJECT NO.: 13226.001 | **LOGGED BY: BAA**
PROJECT NAME: Meridian Upper Plateau | **DATE: 7/27-30/2021**

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-3			SM/ SC-SM	**Residual Soil (Qrs)**; 0'-2.0' – SILTY SAND to SILT CLAYEY SAND, reddish brown, moist, loose to medium dense, medium to coarse sand. **Granitic Bedrock (Kvt)**; 2.0'-25' – grayish brown, soft to moderately hard, completely to moderately weathered, heavily fractured. Total Depth 25.0', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-4			SM/ SC-SM	**Residual Soil (Qrs)**; 0-4.0' – SILTY SAND to SILTY CLAYEY SAND reddish brown, moist, medium dense, fine to medium sand. **Granitic Bedrock (Kvt)**; 4.0'-6.0' – grayish brown, moderately weathered, soft to moderately hard, moderately fractured. Total Depth 6.0', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-5			SM	**Residual Soil (Qrs)**; 0-3.0' – SILTY SAND, reddish brown, medium dense, slightly moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 3.0-16.0' – grayish brown, soft to moderately hard, completely to moderately weathered, heavily fractured. Total Depth 16.0', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-6				**Granitic Bedrock (Kvt)**; 0-7.0' – grayish brown, soft to moderately hard, moderately weathered, heavily fractured. Total Depth 7.0', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-7			SM/ SC-SM	**Residual Soil (Qrs)**; 0-1.0' – SILTY SAND to SILTY CLAYEY SAND, medium dense, slightly moist, medium to coarse sand. **Granitic Bedrock (Kvt)**; 1.0-17.0' – grayish brown, moderately hard, completely to moderately weathered, heavily fractured. Total Depth 17.0', no groundwater, backfilled with spoils.

LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-8	B-1		SM SC	**Colluvium (Qcol)**; 0-3.0' – SILTY SAND, reddish brown, medium dense, moist, fine to medium sand. **Colluvium (Qcol)**; 3.0-6.0' – CLAYEY SAND, olive brown, medium dense, moist , medium to coarse sand, trace angular crystalline cobbles. **Granitic Bedrock (Kvt)**; 6.0-15.0' – dark gray to grayish brown, moderately hard, moderately weathered, heavily fractured. Total Depth 15.0', no groundwater, backfilled with spoils.

LOG OF TEST PITS

PROJECT NO.: 13226.001 | **LOGGED BY: BAA**
PROJECT NAME: Meridian Upper Plateau | **DATE: 7/27-30/2021**

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-9			SC	**Colluvium (Qcol)**; 0-5.0' – CLAYEY SAND, pale brown to reddish brown, medium dense, moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 5.0-10.0' – grayish brown, soft to moderately hard, moderately weathered, heavily fractured. Total Depth 10.0', no groundwater, backfilled with spoils.

Leighton

LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-10			SM	**Residual Soil (Qrs)**; 0-1.0' – SILTY SAND, reddish brown, medium dense, slightly moist, medium to coarse sand (weathered in place). **Granitic Bedrock (Kvt)**; 1.0-17.0' –grayish brown, soft to moderately hard, slightly moist, completely to moderately weathered, heavily fractured. Total Depth 17.0', no groundwater, backfilled with spoils.

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TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-11			SM	**Residual Soil (Qrs)**; 0-1.0' – SILTY SAND, reddish brown, medium dense, slightly moist, medium to coarse sand (weathered in place). **Granitic Bedrock (Kvt)**; 1.0-10.0' – grayish brown, soft to moderately hard, slightly moist, moderately weathered, heavily fractured. Total Depth 10.0', no groundwater, backfilled with spoils.

LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-12			SC	**Residual Soil (Qrs)**; 0-3.0' – CLAYEY SAND, reddish brown, loose to medium dense, dry to slightly moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 3.0-7.0' – gray to grayish brown, moderately hard, slightly moist, moderately weathered, heavily fractured. Total Depth 7.0', no groundwater, backfilled with spoils.

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-13	B-1		SM	**Colluvium (Qcol)**; 0-10.0' – SILTY SAND, strong brown, medium dense to stiff, moist, fine to medium sand, wire fragments and concrete block encountered. **Granitic Bedrock (Kvt)**; 10.0-15.0' – pale brown to grayish brown, soft to moderately hard, slightly moist, completely to moderately weathered, heavily fractured. Total Depth 15.0', no groundwater, backfilled with spoils.

<u>**LOG OF TEST PITS**</u>

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-14			SC	**Colluvium (Qcol)**; 0-4.0' – CLAYEY SAND, reddish brown, medium dense, slightly moist. **Colluvium (Qcol)**; 4.0-10.0' – SANDY CLAY (Hard Pan), olive brown, moderately indurated, moist, trace angular gravel. **Granitic Bedrock (Kvt)**; 10.0-13.0' – gray brown, moderately hard, moderately weathered, heavily fractured. Total Depth 13.0', no groundwater, backfilled with spoils.

Leighton

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

test PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-15			SC-SM	**Residual Soil (Qrs)**; 0-1.0' – SILTY CLAYEY SAND, reddish brown, moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 1.0-9.0' – reddish brown (1-4'), grayish brown (4-9'), moderately hard, slightly moist, moderately weathered, heavily fractured. Total Depth 9.0', no groundwater, backfilled with spoils.

Leighton

LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-16			SC	**Residual Soil (Qrs)**; 0-1.0' – CLAYEY SAND, reddish brown, medium dense, slightly moist, medium to coarse sand. **Granitic Bedrock (Kvt)**; 1.0-12.0' – grayish brown, soft to moderately hard, moderately weathered, heavily fractured. Igneous Intrusion; 2.0-4.0' – olive brown to reddish brown, hard, fresh, moderately fractured, crystalline Total Depth 12.0', no groundwater, backfilled with spoils.

Leighton

LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-17			SM	**Residual Soil (Qrs)**; 0-4.0' – SILTY CLAYEY SAND, reddish brown, medium dense, slightly moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 4.0-10.0' – grayish brown, soft to moderately hard, slightly moist, completely to moderately weathered, heavily fractured. Total Depth 10.0', no groundwater, backfilled with spoils.

Leighton

LOG OF TEST PITS

PROJECT NO.: 13226.001 | **LOGGED BY: BAA**
PROJECT NAME: Meridian Upper Plateau | **DATE: 7/27-30/2021**

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-18			SC-SM	**Residual Soil (Qrs)**; 0-4.0' – SILTY CLAYEY SAND, reddish brown, slightly moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 4.0-11.0' – grayish brown, moderately hard, slightly moist, moderately weathered, heavily fractured. Total Depth 11.0', no groundwater, backfilled with spoils.

Leighton

LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-19			SC	**Residual Soil (Qrs)**; 0-2.0' – SANDY CLAY to CLAYEY SAND, reddish brown, loose to medium dense, slightly moist. **Residual Soil (Qrs)**; 2.0-4.0' – SANDY CLAY to CLAYEY SAND (Hard Pan), reddish brown, slightly moist, moderately to strongly cemented **Granitic Bedrock (Kvt)**; 4.0-7.0' – grayish brown, soft to moderately hard, slightly moist, moderately weathered, heavily fractured. Total Depth 7.0', no groundwater, backfilled with spoils.

Leighton

LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-20			SC	**Residual Soil (Qrs)**; 0-1.0' – CLAYEY SAND, reddish brown, medium dense, slightly moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 1.0-5.0' – grayish brown, soft to moderately hard, slightly moist, moderately weathered, heavily fractured. Total Depth 5.0', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-21			SC-SM	**Residual Soil (Qrs)**; 0-3.0' – CLAYEY SAND, reddish brown, medium dense, moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 3.0-7.0' – grayish brown, soft to moderately hard, slightly moist, moderately weathered, heavily fractured. Total Depth 7.0', no groundwater, backfilled with spoils.

Leighton

LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-22			SC	**Alluvium (Qal)**; 0-3.0' – CLAYEY SAND, reddish brown, medium dense, slightly moist, fine to medium sand.
			SC/CL	**Alluvium (Qal)**; 3.0-6.0' – CLAYEY SAND to SANDY CLAY (Hard Pan), reddish brown to strong brown, slightly moist, medium sand, moderately to strongly cemented
				Granitic Bedrock (Kvt); 6.0-7.0' – grayish brown, moderately hard, slightly moist, moderately weathered, heavily fractured.
				Total Depth 7.0', no groundwater, backfilled with spoils.

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

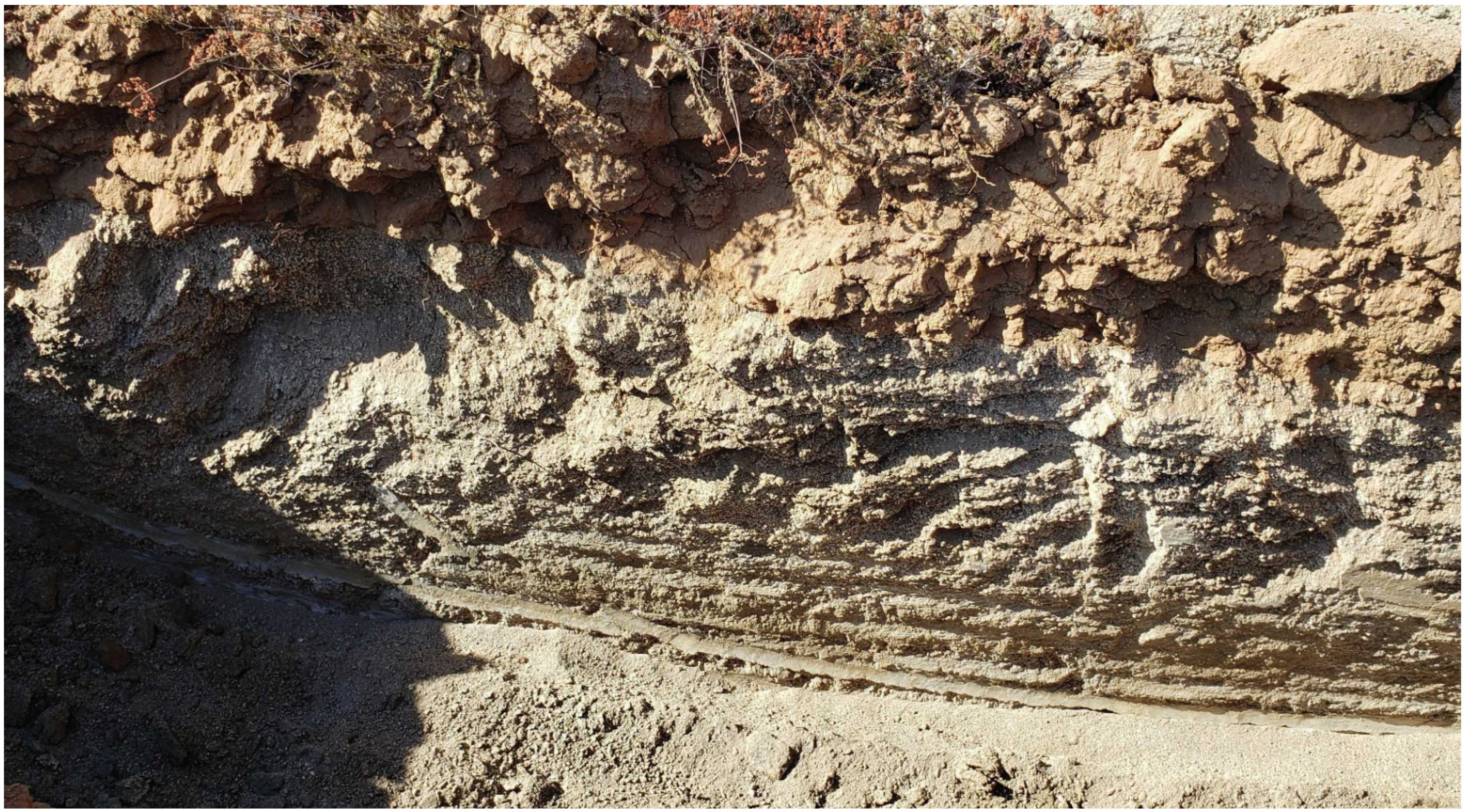
TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-23			SC	**Residual Soil (Qrs)**; 0-2.0' – CLAYEY SAND, reddish brown, medium dense, moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 2.0-6.0' – grayish brown, moderately hard, moderately weathered, heavily fractured, becomes darker when it becomes fresher/harder. Total Depth 6.0', no groundwater, backfilled with spoils.

LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-24			SC	**Residual Soil (Qrs)**; 0-2.0' –CLAYEY SAND, reddish brown, medium dense, moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 2.0-6.0' – grayish brown, moderately hard, moderately weathered, heavily fractured, becomes dark gray when it becomes fresher/harder. Total Depth 6.0', no groundwater, backfilled with spoils.



LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

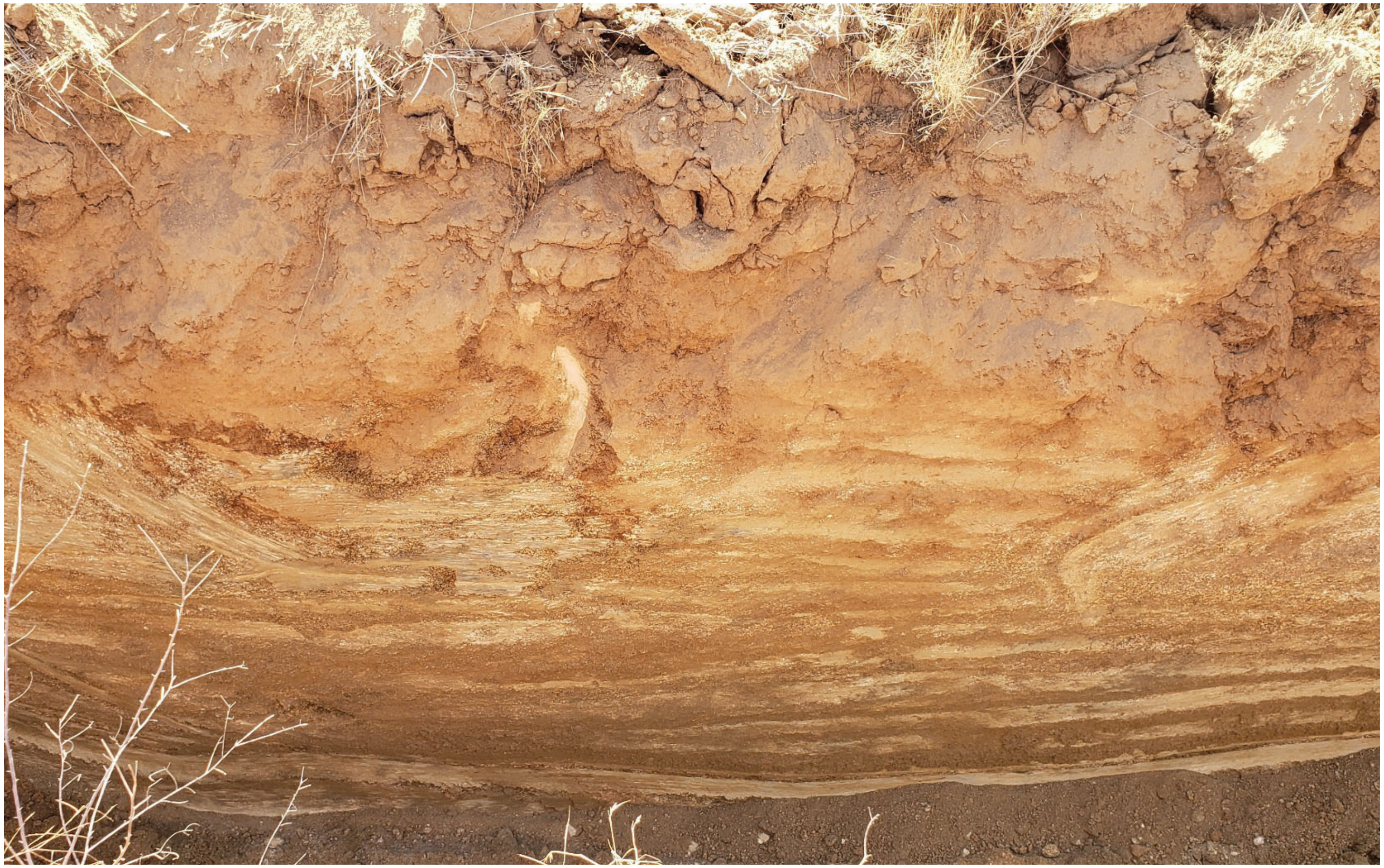
TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-25			SC-SM	**Residual Soil (Qrs)**; 0-3.0' – SILTY CLAYEY SAND, reddish brown, medium dense, slightly moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 3.0-7.0' – grayish brown, moderately hard, slightly moist, moderately weathered, heavily fractured, becomes dark gray as it becomes fresher/harder. Total Depth 7.0', no groundwater, backfilled with spoils.

LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-26			SM	**Residual Soil (Qrs)**; 0-2.0' – SILTY SAND, reddish brown, medium dense, slightly moist, medium sand, trace clay. **Granitic Bedrock (Kvt)**; 2.0-8.0' – grayish brown, moderately hard, slightly moist, moderately weathered, heavily fractured. Total Depth 8.0', no groundwater, backfilled with spoils.



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LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-27			SC-SM	**Residual Soil (Qrs)**; 0-4.0' – SILTY CLAYEY SAND, reddish brown, medium dense, slightly moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 4.0-13.0' – grayish brown, moderately hard, slightly moist, completely to moderately weathered, heavily fractured, becomes dark gray as it becomes fresher/harder. Total Depth 13.0', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

PROJECT NO.: 13226.001 **LOGGED BY: BAA**
PROJECT NAME: Meridian Upper Plateau **DATE: 7/27-30/2021**

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-28			SC-SM	**Residual Soil (Qrs)**; 0-1.0' – SILTY CLAYEY SAND, light brown to reddish brown, medium dense, moist, fine sand. **Granitic Bedrock (Kvt)**; 1.0-6.0' – grayish brown to yellowish brown, moderately hard to hard, slightly moist, moderately weathered, heavily fractured. Total Depth 6.0', no groundwater, backfilled with spoils.

LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-29a			SC	**Residual Soil (Qrs)**; 0-2.0' – CLAYEY SAND, reddish brown, medium dense, slightly moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 2.0-3.0' – grayish brown, moderately hard, slightly moist, moderately weathered, heavily fractured. **Igneous Intrusion (T_{IG})**; gray to white with iron staining, very hard, slightly weathered to fresh, slightly fractured. Total Depth 3.0', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-29b			SC	**Residual Soil (Qrs)**; 0-2.0' – CLAYEY SAND, reddish brown, medium dense, slightly moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 2.0-3.0' – grayish brown, moderately hard, slightly moist, moderately weathered, heavily fractured. **Igneous Intrusion (T_{IG})**; gray to white with iron staining, very hard, slightly weathered to fresh, slightly fractured. Total Depth 3.0', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-30			SM	**Residual Soil (Qrs)**; 0-2.0' – SILTY SAND, reddish brown, medium dense, moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 2.0-8.0' – grayish brown, moderately hard, moderately weathered, heavily fractured, grades to dark gray with fresher rock. Total Depth 8.0', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-31	B-1		SM	**Residual Soil (Qrs)**; 0-4.0' – SILTY SAND, reddish brown, medium dense, slightly moist, medium to coarse sand, trace clay. **Granitic Bedrock (Kvt)**; 4.0-10.0' – grayish brown, moderately hard, slightly moist, moderately weathered, heavily fractured, becomes dark gray as it become fresher Total Depth 10.0', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

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TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-32			SM	**Residual Soil (Qrs)**; 0-3.0' – SILTY SAND, reddish brown, medium dense, slightly moist, medium sand. **Granitic Bedrock (Kvt)**; 3.0-12.0' – grayish brown, soft to moderately hard, slightly moist, completely to moderately weathered, heavily fractured. Total Depth 12.0', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

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PROJECT NAME: Meridian Upper Plateau

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DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-33			SC-SM	**Residual Soil (Qrs)**; 0-3.0' – SILTY CLAYEY SAND, reddish brown, medium dense, slightly moist, medium sand. **Granitic Bedrock (Kvt)**; 3.0-6.0' – grayish brown, soft to moderately hard, slightly moist, completely to moderately weathered, heavily fractured. Total Depth 6.0', no groundwater, backfilled with spoils.

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TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-34			SC-SM	**Residual Soil (Qrs)**; 0-2.0' – SILTY CLAYEY SAND, reddish brown, medium dense, slightly moist, medium to coarse sand. **Granitic Bedrock (Kvt)**; 2.0-18.0' – grayish brown, soft to moderately hard, slightly moist, completely to moderately weathered, heavily fractured. Total Depth 18.0', no groundwater, backfilled with spoils.

LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-35	B-1		SM	**Residual Soil (Qrs)**; 0-2.0' – SILTY SAND, reddish brown, medium dense, slightly moist, medium to coarse sand. **Granitic Bedrock (Kvt)**; 2.0-11.0' – grayish brown, soft to moderately hard, slightly moist, completely to moderately weathered, heavily fractured. Total Depth 11.0', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

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PROJECT NAME: Meridian Upper Plateau

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DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-36			SM	**Residual Soil (Qrs)**; 0-2.0' – SILTY SAND, reddish brown, medium dense, slightly moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 2.0-18.0' – grayish brown, soft to moderately hard, slightly moist, moderately weathered, heavily fractured. Total Depth 18.0', no groundwater, backfilled with spoils.

LOG OF TEST PITS

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TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-37			SM	**Residual Soil (Qrs)**; 0-2.0' – SILTY SAND, pale brown to reddish brown, medium dense, slightly moist, medium sand, trace clay. **Granitic Bedrock (Kvt)**; 2.0-11.0' – gray brown, moderately hard, slightly moist, moderately weathered, heavily fractured. Total Depth 11.0', no groundwater, backfilled with spoils.

LOG OF TEST PITS

PROJECT NO.: 13226.001
PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-38			SM	**Residual Soil (Qrs)**; 0-3.0' – SILTY SAND, reddish brown, medium dense, slightly moist, medium to coarse sand, trace clay. **Granitic Bedrock (Kvt)**; 3.0-11.0' – pale brown to grayish brown, moderately hard, slightly moist, moderately weathered, heavily fractured, becomes dark gray as it becomes fresher, some white intrusions. Total Depth 11.0', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

PROJECT NO.: 13226.001
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DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-39			SM	**Residual Soil (Qrs)**; 0-1.0' – SILTY SAND, pale brown to reddish brown, medium dense, slightly moist, fine to medium sand. **Granitic Bedrock (Kvt)**; 1.0-14.0' – grayish brown, moderately hard, slightly moist, moderately weathered, heavily fractured, massive. Total Depth 14.0', no groundwater, backfilled with spoils.

LOG OF TEST PITS

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TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-40	B-1		SM	**Residual Soil (Qrs)**; 0-3.0' – SILTY SAND, reddish brown, medium dense, slightly moist, medium to coarse sand. **Granitic Bedrock (Kvt)**; 3.0-21.0' – grayish brown, moderately hard, slightly moist, moderately weathered, heavily fractured. Total Depth 21.0', no groundwater, backfilled with spoils.

LOG OF TEST PITS

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TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-41			SM	**Residual Soil (Qrs)**; 0-2.0' – SILTY SAND, pale brown, loose, dry, fine to medium sand. **Granitic Bedrock (Kvt)**; 2.0-9.0' – grayish brown, moderately hard, slightly moist, moderately weathered. Total Depth 9.0', no groundwater, backfilled with spoils.

LOG OF TEST PITS

PROJECT NO.: 13226.001
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DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-42			SM	**Residual Soil (Qrs)**; 0-1.0' – SILTY SAND, pale brown to reddish brown, loose, dry, fine to medium sand. **Granitic Bedrock (Kvt)**; 1.0-5.0' – grayish brown to dark gray, hard to very hard, moderately to slightly weathered, moderately fractured. Total Depth 5.0', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

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PROJECT NAME: Meridian Upper Plateau

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DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-43			SM	**Residual Soil (Qrs)**; 0-1.0' – SILTY SAND, pale brown, loose, dry, fine to medium sand. **Granitic Bedrock (Kvt)**; 1.0-3.5' – grayish brown, hard to very hard, slightly moist, moderately to slightly weathered, moderately to heavily fractured. Total Depth 3.5', no groundwater, backfilled with spoils.

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LOG OF TEST PITS

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PROJECT NAME: Meridian Upper Plateau

LOGGED BY: BAA
DATE: 7/27-30/2021

TEST PIT#	SAMPLE TYPE & DEPTH	LAB TEST	USCS	DESCRIPTION
TP-44	B-1		SM	**Colluvium (Qcol)**; 0-9.0' – SILTY SAND, strong brown, loose, moist, fine to coarse sand, trace silt. **Granitic Bedrock (Kvt)**; 9.0-14.0' – grayish brown, moderately hard to hard, slightly moist, moderately weathered, heavily fractured. Total Depth 14.0', no groundwater, backfilled with spoils.

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APPENDIX A-2

SEISMIC REFRACTION SURVEY

SEISMIC REFRACTION STUDY

MERIDIAN UPPER PLATEAU

Riverside, California

PREPARED FOR:

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September 16, 2021

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September 16, 2021

Atlas No. 121300SWG
Report No. 1

MR. BRENT ADAM, P.G.
LEIGHTON CONSULTING, INC.
41715 ENTERPRISE CIRCLE NORTH, SUITE 103
TEMECULA, CA 92590

Subject: Seismic Refraction Study
Meridian Upper Plateau
Riverside, California

Dear Mr. Adam:

In accordance with your authorization, Atlas Technical Consultants has performed a seismic refraction study pertaining to the Meridian Upper Plateau project located in Riverside, California. Specifically, our evaluation consisted of performing 18 seismic P-wave refraction traverses at the site. The purpose of our study was to develop subsurface velocity profiles of the areas studied and to assess the depth to bedrock and apparent rippability of the subsurface materials. Our field services were conducted on August 2nd through 4th, 2021. This data report presents our methodology, equipment used, analysis, and results.

If you have any questions, please call us at (619) 280-4321.

Respectfully submitted,
Atlas Technical Consultants LLC

REGISTERED PROFESSIONAL GEOPHYSICIST
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1. INTRODUCTION

In accordance with your authorization, Atlas Technical Consultants has performed a seismic refraction study pertaining to the Meridian Upper Plateau project located in Riverside, California (Figure 1). Specifically, our evaluation consisted of performing 18 seismic P-wave refraction traverses at the site. The purpose of our study was to develop subsurface velocity profiles of the areas studied and to assess the depth to bedrock and apparent rippability of the subsurface materials. Our field services were conducted on August 2nd through 4th, 2021. This data report presents our methodology, equipment used, analysis, and results.

2. SCOPE OF SERVICES

Our scope of services included:

- Performance of 18 seismic P-wave refraction traverses at the project site.
- Compilation and analysis of the data collected.
- Preparation of this data report presenting our results and conclusions.

3. SITE AND PROJECT DESCRIPTION

The project site is a vacant lot on a rolling hill. The entrance to the project site is generally located at the south end of Vista Grande Drive in Riverside, California. The site was formerly owned by March Air Force Base and utilized as a munition storage. Several bunkers exist at the site and access to the bunkers is by dirt roads. Currently, some of these bunkers are abandoned and/or utilize as public storage. The seismic traverses were performed at various locations throughout the site over slightly sloping ground. Vegetation consisted of seasonal grass and a few granite outcrops with varying degrees of weathering were observed at the site. Figures 2 and 3a through 3c depict the general site conditions in the areas of the seismic traverses.

Based on our discussions with you, it is our understanding that your office requested this study in advance of proposed construction activities at the site. We also understand that the results of our study may be used in the formulation of design and construction parameters for the project.

4. STUDY METHODOLOGY

A seismic P-wave (compression wave) refraction study was conducted at the project site to develop subsurface velocity profiles, and to assess the depth to bedrock and apparent rippability of the subsurface materials. The seismic refraction method uses first-arrival times of refracted seismic waves to estimate the thicknesses and seismic velocities of subsurface layers. Seismic P-waves generated at the surface, using a hammer and plate, are refracted at boundaries separating materials of contrasting velocities. These refracted seismic waves are then detected by a series of surface vertical component 14-Hz geophones and recorded with a 24-channel Geometrics Geode seismograph. The travel times of the seismic P-waves are used in conjunction with the shot-to-geophone distances to obtain thickness and velocity information on the subsurface materials.

Eighteen (18) seismic traverses labeled as SL-1 through SL-18, respectively, were conducted at the site. The general location and length of the line were determined by surface conditions, site access, and depth of investigation, as determined by you. Shot points (signal generation locations) were conducted along the lines at the ends, midpoint, and intermediate points between the ends and the midpoint.

The seismic refraction theory requires that subsurface velocities increase with depth. A layer having a velocity lower than that of the layer above will not generally be detectable by the seismic refraction method and, therefore, could lead to errors in the depth calculations of subsequent layers. In addition, lateral variations in velocity, such as those caused by core stones, intrusions, or boulders can also result in the misinterpretation of the subsurface conditions. In general, the effective depth of evaluation for a seismic refraction traverse is approximately one-third to one-fifth of the length of the spread.

In general, the seismic P-wave velocity of a material can be correlated to rippability (see Table 1 below), or to some degree "hardness." Table 1 is based on published information from the Caterpillar Performance Handbook (Caterpillar, 2018), as well as our experience with similar materials, and assumes that a Caterpillar D-9 dozer ripping with a single shank is used. We emphasize that the cutoffs in this classification scheme are approximate and that rock characteristic, such as fracture spacing and orientation, play a significant role in determining rock quality or rippability. The rippability of a mass is also dependent on the excavation equipment used and the skill and experience of the equipment operator.

For trenching operations, the rippability values should be scaled downward. For example, velocities as low as 3,500 feet/second may indicate difficult ripping during trenching operations. In addition, the presence of boulders, which can be troublesome in narrow trenching operations, should be anticipated.

Table 1 – Rippability Classification

Seismic P-wave Velocity	Rippability
0 to 2,000 feet/second	Easy
2,000 to 4,000 feet/second	Moderate
4,000 to 5,500 feet/second	Difficult, Possible Blasting
5,500 to 7,000 feet/second	Very Difficult, Probable Blasting
Greater than 7,000 feet/second	Blasting Generally Required

It should be noted that the rippability cutoffs presented in Table 1 are slightly more conservative than those published in the Caterpillar Performance Handbook. Accordingly, the above classification scheme should be used with discretion, and contractors should not be relieved of making their own independent evaluation of the rippability of the on-site materials prior to submitting their bids.

5. DATA ANALYSIS

The collected data were processed using SIPwin (Rimrock Geophysics, 2003), a seismic interpretation program, and analyzed using SeisOpt Pro (Optim, 2008). SeisOpt Pro uses first arrival picks and elevation data to produce subsurface velocity models through a nonlinear optimization technique called adaptive simulated annealing. The resulting velocity model provides a tomography image of the estimated geologic conditions. Both vertical and lateral velocity information is contained in the tomography model. Changes in layer velocity are revealed as gradients rather than discrete contacts, which typically are more representative of actual conditions.

6. RESULTS AND CONCLUSIONS

As previously indicated, seismic traverses were performed at 18 preselected areas as part of our study. Figures 4a through 4r present the velocity models generated from our analysis with shot point locations at each seismic line represented by red triangles. The results from our seismic study revealed distinct layers/zones in the near-surface that likely represent soil overlying bedrock with varying degrees of weathering. Distinct vertical and lateral velocity variations are evident in the models. These inhomogeneities are likely related to the possible presence of intrusions, and/or differential weathering of the bedrock materials. It is also evident in the tomography models that the depth to bedrock, while varied in degrees of weathering, was fairly shallow in some of the study areas.

Based on the refraction results, variability in the excavatability (including depth of rippability) of the subsurface materials may be expected across the project area. Furthermore, blasting may be required depending on the excavation, depth, location, equipment used, and desired rate of production. In addition, oversized materials should be expected. A contractor with excavation experience in similarly difficult conditions should be consulted for expert advice on excavation methodology, equipment, and production rate.

7. LIMITATIONS

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

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

8. SELECTED REFERENCES

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