APPENDIX E

Geotechnical Investigation for Proposed Madison Flats Multi-Family Residential Development Southwest of Madison Street and Railroad Avenue, Riverside, California (Geotechnical Investigation) (Leighton and Associates, Inc., December 2022)

GEOTECHNICAL INVESTIGATION

PROPOSED MADISON FLATS
MULTI-FAMILY RESIDENTIAL DEVELOPMENT
SOUTHWEST OF MADISON STREET
AND RAILROAD AVENUE
RIVERSIDE, CALIFORNIA

Prepared For

GILBANE DEVELOPMENT COMPANY
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Prepared By

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Project No. 13693.001

December 5, 2022

Leighton

Leighton and Associates, Inc.
A Leighton Group Company

December 5, 2022

Project No. 13693.001

Gilbane Development Company
1100 North Glebe Road, Suite 1000
Arlington, Virginia 22201

Attention: Mr. Blaise Rastello
Development Director/Affordable Housing

Subject: Geotechnical Investigation
Proposed Madison Flats Multi-Family Residential Development
Southwest of Madison Street and Railroad Avenue
Riverside, California

In response to your request, Leighton and Associates, Inc. (Leighton) has conducted this geotechnical investigation for the proposed Madison Flats multi-family residential development located southwest of Madison Street and Railroad Avenue in the City of Riverside, California. The purpose of this exploration has been to evaluate the general geotechnical conditions at the site with respect to the proposed development and to provide preliminary geotechnical recommendations for design and construction of the project.

Based on this geotechnical investigation, construction of the proposed multi-family residential development is feasible from a geotechnical standpoint. The most significant geotechnical issues with respect to the project are those related to the potential for strong seismic shaking and potentially compressible soil. Good planning and design of the project can limit the impact of these constraints. This report presents our preliminary findings, conclusions, and geotechnical recommendations for the project.

We appreciate the opportunity to work with you on this project. If you have any questions regarding this report, please call us at your convenience.

Respectfully submitted,

LEIGHTON AND ASSOCIATES, INC.

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1.0 INTRODUCTION

1.1 Site Location and Description

The approximately 4.15-acre site is located southwest of Madison Street and Railroad Avenue within the City of Riverside, California (see Figure 1, *Site Location Map*). The site is bounded to the northwest and southwest by Railroad Avenue, to the northeast by Madison Street, and to the southeast by the BNSF Railroad Tracks. Residential homes lie to the northwest beyond Railroad Avenue and to the southeast beyond the existing railroad tracks.

The property is elongated and roughly rectangular in shape and currently undeveloped. The property is comprised of Assessor's Parcel Numbers (APNs) 230-233-013-03, 230-245-015-2, 230-245-013-0, and 230-253-010-2. The site contains gravel on the surface, a few palm trees, small sheds on the northeast end, and trace scattered construction debris that appear to be associated with the railroad.

Based on a review of historical aerial photographs, the site has been undeveloped since at least 1948. Two dirt roads appear to have crossed the southern portion of the site prior to the construction of Railroad Avenue sometime between 1967 and 1985 (NETR, 2022). The site is relatively flat with elevations from 857 and 863 feet above mean sea level (msl) draining gently towards the northwest.

1.2 Proposed Development

Based on correspondence with Psomas and the provided *Madison Flats City Submission* packet prepared by Studio One Eleven, dated October 14, 2021, we understand that the proposed project will include the construction of 27, two- to three-story multi-family buildings. The proposed buildings are generally closely spaced together with parking areas and courtyards separating groups of buildings. Building footprints range from approximately 1,100 square feet (SF) to 1,500 SF in plan area. Approximately 2.61 acres are slated for senior residential housing consisting of 75 one- and two-bedroom units. Approximately 1.54 acres are slated for multi-family residential housing consisting of 45 one to three-bedroom units. Also planned, are nine courtyard areas, two surface parking lots with approximately 76 designated parking spaces, associated landscaping, amenity spaces, associated dry and wet utilities, and three drywell locations for water quality infiltration.

A conceptual grading plan was not available at the time of this study but based on current surface elevations and no underground parking planned for design, we anticipate relatively shallow cuts and fills to achieve design grade (generally on the order of 5 feet or shallower for the proposed building).

1.3 Purpose

The purpose of this study has been to evaluate the general geotechnical conditions at the site with respect to the proposed development and provide preliminary geotechnical recommendations for design and construction of the proposed project.

1.4 Scope of Work

Our geotechnical investigation included exploration with hollow-stem auger borings, infiltration testing, laboratory testing, and geotechnical analysis to evaluate existing site conditions and to develop the recommendations contained in this report. Our scope of work has included the following tasks:

- Background Review: We reviewed available geotechnical reports, literature, geotechnical/geologic maps, and historical aerial photographs relevant to the planned improvements and available from our in-house library.

- Utility Coordination: We contacted DigAlert (811) at least 48 hours prior to drilling borings to locate major utilities, underground services, and easements.

- Field Exploration: A total of seven (7) hollow-stem auger borings (LB-1 through LB-7) were drilled, logged, and sampled at locations throughout the site to evaluate subsurface conditions. These hollow-stem auger borings were drilled to depths ranging from 21½ to 51½ feet below the existing ground surface (bgs) by a subcontracted truck-mounted drill rig. During drilling of our borings, California-Modified split-spoon ring or Standard Penetration Test (SPT) samplers were used to collected soil from each sampling interval for geotechnical laboratory testing and analyses. Bulk samples of representative soil types were also collected for geotechnical laboratory testing. Each boring was logged by a member of our technical staff under supervision of a licensed Civil Engineer.

Drilled borings were backfilled with soil cuttings. Logs of the drilled borings are provided in Appendix B. Boring locations are shown on the accompanying Figure 2, *Boring Location Map*.

- Infiltration Testing: Well permeameter tests were performed within three additional borings drilled at the site (IT-1 through IT-3) to estimate soil infiltration characteristics onsite. These tests were located based on the KMZ file provided by the project Civil Engineer, Psomas, which indicated three proposed drywell locations. Depths of these drywells were not provided at the time of our investigation, and the depths were selected based on the soil types encountered during drilling. Test zones for each well permeameter reached maximum depths ranging from approximately 15 feet to 48½ feet bgs. In-situ infiltration testing was performed in general accordance with Riverside County guidelines. The results of the infiltration testing are presented in Appendix B. Discussion of the test results and infiltration rate are presented in Section 2.4.

- Geotechnical Laboratory Testing: Geotechnical laboratory tests were conducted on relatively undisturbed and bulk soil samples obtained during our field investigation. This laboratory testing program was designed to evaluate engineering characteristics of site soils. Laboratory tests conducted during this investigation include:

    - In situ moisture content
    - Sieve analysis for grain-size distribution
    - Atterberg Limits
    - Expansion Index
    - Collapse potential
    - Consolidation
    - Modified proctor compaction test
    - R-Value
    - Water-soluble sulfate concentration
    - Resistivity, chloride content and pH

The laboratory test results are presented in Appendix C.

- Engineering Analysis: Data obtained from our background review, field exploration, and geotechnical laboratory testing was evaluated and analyzed to develop geotechnical conclusions and provide preliminary recommendations presented in this report by a Professional Engineer and Certified Engineering Geologist in accordance with the standard of care provided by our industry in this area for this type of project.

- Report Preparation: Results of our preliminary geotechnical investigation have been summarized in this report, presenting our findings, conclusions and preliminary geotechnical recommendations for earthwork and remedial grading, fill placement, foundation design parameters, retaining wall, pavement design, and cement type.

2.0 FINDINGS

2.1 Regional Geologic Setting

The site is located in the northern Peninsular Ranges geomorphic province of southern California along the southern margin of the Chino Basin. Cretaceous igneous rocks of the southern California Batholith underlie and crop out in this area of the Peninsular Ranges. Northwest-trending, right-lateral, strike-slip faults dominate the structure of the Peninsular Ranges. Major structural features within this region include: the Whittier-Elsinore fault zone and the Santa Ana Mountains to the southwest, the Chino-Central Avenue fault and Puente Hills to the west, and the San Jacinto fault zone to the northeast. The closest active fault to the site is related to the San Jacinto fault zone located approximately 11.1 miles northeast of the project site.

The site rests on generally flat terrain underlain by late to middle Pleistocene old alluvial fan soils (Morton et al., 2002). These deposits typically consist of sandy sediment. Regional geologic conditions are depicted on Figure 3, *Regional Geology Map*.

2.2 Subsurface Soil Conditions

The site has been mapped as being underlain by Quaternary old alluvial fan deposits (Qof; see Figure 3, *Regional Geology Map*). We encountered artificial fill in the upper 1 to 2½ feet in our borings underlain by native old alluvial fan deposits. Because a geotechnical report of rough grading summarizing grading observations and testing of the previously placed fill was not available at the time of this report, existing onsite fill materials have been considered undocumented. Based on our observation during drilling, undocumented artificial fill encountered consisted of scattered gravel on the surface over very loose to loose silty sands and very stiff sandy silts. Native old alluvial fan deposits observed in our borings to explored depths primarily consisted of silty sands with interbedded layers of clean sands, silts, clayey sands, and clays. Sands in the upper 10 feet were generally described as very loose to medium dense soils and light brown to brown in color. In general, the native old alluvial fan deposits became denser with depth. Deeper native sands encountered were generally described as medium dense to very dense, light brown to orangish brown to explored depths. The interbedded layers of native clays and silts were generally described as stiff to hard with layer thicknesses as much as 10 feet in vertical dimension.

Soils within the upper 10 feet generally had in situ moisture contents ranging from 2 to 15 percent by weight, with in situ dry densities of 111 to 122 pcf.

2.2.1 Compressible and Collapsible Soil

Soil compressibility refers to a soil's potential for settlement when subjected to increased loads as from a fill surcharge. Based on our investigation, the near surface alluvial soil encountered is generally considered slightly to moderately compressible. Partial removal and recompaction of this material under shallow foundations is recommended to reduce the potential for adverse total and differential settlement of the proposed improvements to acceptable levels.

Collapse potential refers to the potential settlement of a soil under existing stresses upon being wetted. A collapse test performed on a near-surface sample resulted in a moderate collapse potential. Based on the relatively dense nature of the underlying soils encountered below 5 feet in our borings, and our recommendations to remove both artificial fill and loose native alluvium to at least 5 feet from the existing surface, the potential for significant soil collapse upon completion of grading is considered low.

2.2.2 Expansive Soil

Expansive soils contain significant amounts of clay particles that swell considerably when wetted and shrink when dried. Foundations constructed on these soils are subject to large uplifting forces caused by the swelling. Without proper measures taken, heaving and cracking of both building foundations and slabs-on-grade could result.

Based on results from representative sample collected at the site during exploration drilling, the onsite soils are anticipated to have a very low expansion potential.

2.2.3 Sulfate Content

Water-soluble sulfates in soil can react adversely with concrete. However, concrete in contact with soil containing sulfate concentrations of less than 0.1 percent by weight is considered to have negligible sulfate exposure based on the American Concrete Institute (ACI) provisions, adopted by the 2019 CBC (CBC, 2019 and ACI, 2014).

A near-surface soil sample was tested during this investigation for soluble sulfate content. The results of this test indicate a sulfate content less than 0.01 percent by weight, indicating negligible sulfate exposure (Exposure Class S0).

2.2.4 Resistivity, Chloride and pH

Soil corrosivity to ferrous metals can be estimated by the soil's electrical resistivity, chloride content, and pH level. In general, soil having a minimum resistivity less than 1,000 ohm-cm is considered severely corrosive, while soil having a minimum resistivity of 1,000 to 2,000 is considered corrosive. Soil with a chloride content of 500 ppm or greater is considered corrosive to ferrous metals.

As a screening for potentially corrosive soil, a representative soil sample was tested during this investigation to estimate minimum resistivity, chloride content, and pH. This test indicated a minimum resistivity 1,100 ohm-cm, chloride content of 40 ppm, and pH of 7.6. Based on these results, the onsite soil is considered corrosive to ferrous metals.

2.3 Groundwater

Groundwater was not encountered in our borings drilled onsite to a maximum explored depth of 51½ feet bgs. Historical data from groundwater elevation contour maps dating back to 1933 (CDWR, 1970) indicate groundwater levels in the area of the site on the order of approximately 775 above mean sea level, which correlates to a depth of about 82 feet bgs from the lowest elevation at the site. Recent groundwater data from the Western Municipal Water District (CDWR, 2022) indicated the shallowest groundwater historically measured from State Well No. 03S05W09E001S, located approximately 0.5 mile southwest from the site, was 91 feet below ground surface (bgs) in 2012. Based on these, groundwater levels at this project site are expected to be deeper than 50 feet bgs.

2.4 Infiltration

Well permeameter infiltration testing was performed within borings IT-1 through IT-3 to evaluate infiltration characteristics of tested subsurface soils in those test zones. Out test zones were selected to target pockets of more granular layers with lower percent fines. Infiltration testing was conducted in general accordance with County of Riverside guidelines.

A well permeameter infiltration test is useful for field measurements of the infiltration rate of soils and is suited for testing when the design depth of the infiltration device is deeper than current existing grades, especially in areas where excavating a test pit is difficult, or where the depth of a test pit would be considerably deep. At this project site, testing consisted of advancing the borings at the locations indicated in the KMZ file provided by Psomas.

The three tests conducted at the subject site consisted of excavating a boring to the test depths of approximately 15, 20, and 48½ feet bgs. A layer of clean sand/gravel was placed in each boring bottom to support temporary perforated well casing pipe. In addition, No. 3 Monterey sand was poured around the outside of the well casing within each test zone to prevent the boring from caving/collapsing or eroding when water was added. A water hydrant with hose attached added water to the boring as water infiltrated into the soil. These tests were performed either by measuring the volume of water needed to maintain a constant water head in the boring or measuring the water level in the boring as it fell and the time that the water level took to decrease. The volume of water percolated during timed intervals was converted into an incremental infiltration rate, in inches per hour (in./hr.). These tests were conducted based on the USBR 7300-89 test method.

Results of the infiltration testing are summarized below and are provided in Appendix A. The infiltration rates presented below are raw and a Factor of Safety has not been applied. Infiltration recommendations are included in Section 3.10 of this report.

Table 1 – Minimum (Unfactored) Infiltration Rate

Boring	Soil Type	Approx. Test Zone (ft.), bgs	Percent Fines	Unfactored Infiltration Rate (in./hr.)
IT-1	SM & ML	17 to 20	28 to 80	0.6
IT-2	SM	10 to 13	30	1.6
IT-3	SC,ML,SM	43 to 48	15 to 70	0.2

2.5 Faulting and Seismicity

Our review of available in-house literature indicates that there are no known active faults traversing or trending towards the site. The closest known active or potentially active fault is related to the San Jacinto fault zone, located approximately 11.1 miles northeast of the site (see Figure 4, *Regional Fault and Historical Seismicity Map*).

The principal seismic hazard that could affect the site is ground shaking resulting from an earthquake occurring along several major active or potentially active faults in southern California. Known regional faults that could produce the most significant ground shaking at the site include those associated with the San Jacinto and San Andreas fault zones as well as the Elsinore fault zone.

Site seismic parameters are included in Section 3.4 of this report.

2.6 Secondary Seismic Hazards

In general, secondary seismic hazards for sites in the region could include soil liquefaction, earthquake-induced settlement, lateral displacement, landslides, and earthquake-induced flooding. The potential for secondary seismic hazards at the site is discussed below.

2.6.1 Liquefaction Potential

Liquefaction is the loss of soil strength or stiffness due to a buildup of pore-water pressure during severe ground shaking. Liquefaction is associated primarily with loose (low density), saturated, fine-to-medium grained, cohesionless soils. As the shaking action of an earthquake progresses, the soil grains are rearranged, and the soil densifies within a short period of time. Rapid densification of the soil results in a buildup of pore-water pressure. When the pore-water pressure approaches the total overburden pressure, the soil reduces greatly in strength and temporarily behaves similarly to a fluid. Effects of liquefaction can include sand boils, settlement, and bearing capacity failures below structural foundations.

The site is mapped as being in a zone of low liquefaction susceptibility by County of Riverside's Map My County database (RCIT, 2022). Due to the historical groundwater level at the site being deeper than 50 feet and the relatively dense nature of the underlying soils, liquefaction is not a concern for this site.

2.6.2 Seismically Induced Settlement

During a strong seismic event, seismically induced settlement can occur within loose to moderately dense, dry or saturated granular soil. Settlement caused by ground shaking is often nonuniformly distributed, which can result in differential settlement.

We have performed analyses to estimate the potential for seismically induced settlement using the method of Tokimatsu and Seed (1987), and based on Martin and Lew (1999), considering the maximum considered earthquake (MCE) peak ground acceleration (PGA_M). Design/historic high groundwater levels of 82 feet below ground surface were used in the analysis. Based on our analysis, a potential for approximately 1.1 inches of seismic settlement is estimated at the site. Based on the implementation of our overexcavation recommendations presented later in this report, the estimated potential seismic settlement is reduced to approximately 0.9 inch. Results of our seismic settlement analysis is presented in Appendix D.

If the potential differential settlement is estimated as half of the total seismic settlement over a horizontal distance of 30 feet, this would result in a maximum 0.5 inch differential settlement in 30 feet, or angular distortion of 0.0012L. This would be within the differential settlement threshold of 0.010L for "other multistory structures" of Risk Category II, as listed in Table 12.13-3 of ASCE 7-16. "Other" buildings are those not constructed with concrete or masonry wall systems (i.e. wood- or steel-framed). The structural engineer should determine Structure Type and

Risk Category and evaluate whether the differential settlement estimates described above are tolerable. A copy of ASCE 7-16 Table 12.13-3 is provided as follows for reference.

Table 12.13-3 Differential Settlement Threshold

Structure Type	Risk Category		
	I or II	III	IV
Single-story structures with concrete or masonry wall systems	0.0075L	0.005L	0.002L
Other single-story structures	0.015L	0.010L	0.002L
Multistory structures with concrete or masonry wall systems	0.005L	0.003L	0.002L
Other multistory structures	0.010L	0.006L	0.002L

2.6.3 Slope Stability and Seismically Induced Landslides

The site and its immediate surroundings are generally level without significant slopes. This site is not considered susceptible to static slope instability or seismically induced landslides.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Based on this investigation, construction of the proposed development is feasible from a geotechnical standpoint. No severe geologic or soils related issues were identified that would preclude development of the site for the proposed improvements. The most significant geotechnical issues at the site are those related to the potential for strong seismic shaking and potentially compressible near-surface soils. Good planning and design of the project can limit the impact of these constraints. Remedial recommendations for these and other geotechnical issues are provided in the following sections.

Although not identified during this investigation, seepage pits, or other buried structures, trash pits, buried utilities, or items related to past site are likely present, though not encountered during our exploration. If such items are encountered during grading, they would require further evaluation and special consideration based on actual conditions encountered.

3.1 General Earthwork and Grading

All grading should be performed in accordance with the General Earthwork and Grading Specifications presented in Appendix E, unless specifically revised or amended below or by future recommendations based on final development plans.

3.1.1 Site Preparation

Prior to construction, the site should be cleared of vegetation, trash and debris, which should be disposed of offsite. Any underground obstructions should be removed, as should large trees and their root systems. Resulting cavities should be properly backfilled and compacted. Efforts should be made to locate existing utility lines. Those lines should be removed or rerouted if they interfere with the proposed construction, and the resulting cavities should be properly backfilled and compacted.

3.1.2 Overexcavation and Recompaction

To reduce the potential for adverse differential settlement of the proposed improvements, the underlying subgrade soil should be prepared in such a manner that a uniform response to the applied loads is achieved.

Prior to overexcavation and recompaction of onsite native soils, any clean undocumented artificial fill should be removed and may be used as compacted fill for the project. Undocumented artificial fill has been estimated, based on observations of our borings, to reach depths of approximately 1 foot to 2½ feet below the current ground surface. Localized areas of deeper undocumented artificial fill may be encountered during grading.

In addition to the complete removals of undocumented artificial fill onsite and for structures with shallow foundations, we recommend that onsite alluvial soils be overexcavated and recompacted to a minimum depth of 3 feet below the bottom of the proposed footings or 5 feet below existing grade, whichever is deeper. Overexcavation and recompaction should extend a minimum horizontal distance of 5 feet from perimeter edges of the proposed footings (including columns connected to the buildings), or a distance equal to the depth of overexcavation below the footings, where feasible.

Local conditions may require that deeper overexcavation be performed; such areas should be evaluated by Leighton during grading.

Areas outside these overexcavation limits planned for asphalt or concrete pavement, flatwork, low retaining walls (3 feet or less; taller walls should be overexcavated per the recommendations for buildings), and site walls, and areas to receive fill should be overexcavated to a minimum depth of 24 inches below the existing ground surface or 12 inches below the proposed subgrade (or bottom of footing), whichever is deeper. In addition, all undocumented artificial fill should be overexcavated.

After completion of the overexcavation, and prior to fill placement, the exposed surfaces should be scarified to a minimum depth of 6 inches, moisture conditioned to or slightly above optimum moisture content, and recompacted to a minimum 90 percent relative compaction, relative to the ASTM D 1557 laboratory maximum density.

3.1.3 Fill Placement and Compaction

Onsite soil to be used for compacted structural fill should also be free of debris, organic material and oversized material (greater than 8 inches in largest dimension). Any soil to be placed as fill, whether onsite or imported material, should be reviewed and possibly tested by Leighton.

All fill soil should be placed in thin, loose lifts, moisture conditioned, as necessary, and compacted to a minimum 90 percent relative compaction. The soils should be placed at or above optimum moisture content. Relative compaction should be determined in accordance with ASTM Test Method D1557. The upper 8 inches of subgrade soils for pavement areas should be compacted to 95 percent relative compaction. Aggregate base for pavement should be compacted to a minimum of 95 percent relative compaction.

3.1.4 Import Fill Soil

Import soil to be placed as fill should be geotechnically accepted by Leighton. Preferably at least 3 working days prior to proposed import to the site, the contractor should provide Leighton pertinent information of the proposed import soil, such as location of the soil, whether stockpiled or native in place, and pertinent geotechnical reports if available. We recommend that a Leighton representative visit the proposed import site to observe the soil conditions and obtain representative soil samples. Potential issues may include soil that is more expansive than onsite soil, soil that is too wet, soil that is too rocky or too dissimilar to onsite soils, oversize material, organics, debris, etc.

3.1.5 Shrinkage and Subsidence

The change in volume of excavated and recompacted soil varies according to soil type and location. This volume change is represented as a percentage increase (bulking) or decrease (shrinkage) in volume of fill after removal and recompaction. Subsidence occurs as in-place soil (e.g., natural ground) is moisture-conditioned and densified to receive fill, such as in processing an overexcavation bottom. Subsidence is in addition to shrinkage due to recompaction of fill soil. Field and laboratory data used in our calculations included laboratory-measured maximum dry densities for soil types encountered at the subject site, the measured in-place densities of soils encountered and our experience. We preliminarily estimate the following earth volume changes will occur during grading:

Shrinkage	Approximately 15 +/- 4 percent
Subsidence (overexcavation bottom processing)	Approximately 0.15 foot

The level of fill compaction, variations in the dry density of the existing soils and other factors influence the amount of volume change. Some adjustments to earthwork volume should be anticipated during grading of the site.

3.1.6 Rippability and Oversized Material

Generally, rock or rock fragments observed during our field investigation were less than 2 inches in dimension and generally located near the surface. Oversized rock (greater than 8 inches) encountered during earthwork activities should be placed in deeper fill areas or in non-structural areas (parking lots).

3.2 Shallow Foundation Recommendations

The proposed two- and three-story multifamily buildings can be supported on conventional spread or strip footing shallow foundation systems. Maximum column loading and wall loading is not available at the time of this report. We have anticipated that the proposed residential buildings will be wood-framed and lightly loaded. We assume a maximum column load of 50 kips and maximum wall load of 2.5 kips per lineal foot are generally applicable for the relatively light residential structural loads. Structural loading information should be provided to us when available for review.

Overexcavation and recompaction of the footing subgrade soil should be performed as detailed in Section 3.1. The following recommendations are based on the onsite soil conditions and soils with a “very low” expansion potential.

3.2.1 Minimum Embedment and Width

Based on our preliminary investigation, footings should have a minimum embedment per code requirements, with a minimum width of 24 inches for isolated and continuous footings.

3.2.2 Allowable Bearing

An allowable bearing pressure of 2,000 pounds-per-square-foot (psf) may be used, based on the minimum embedment depth and width above. This allowable bearing value may be increased by 250 psf per foot increase in depth or width to a maximum allowable bearing pressure of 3,000 psf. If higher bearing pressures are required, this should be reviewed on a case-by-case basis and may include additional overexcavation and/or soil reinforcement. These allowable bearing pressures are for total dead load and sustained live loads. Footing reinforcement should be designed by the structural engineer.

3.2.3 Lateral Load Resistance

Soil resistance available to withstand lateral loads on a shallow foundation is a function of the frictional resistance along the base of the footing and the passive resistance that may develop as the face of the structure tends to move into the soil. The frictional resistance between the base of the foundation and the subgrade soil may be computed using a coefficient of friction of 0.30. The passive resistance may be computed using an allowable equivalent fluid pressure of 240 pounds per cubic foot (pcf), assuming there is constant contact between the footing and undisturbed soil. The coefficient of friction and passive resistance may be combined without further reduction.

3.2.4 Increase in Bearing and Friction - Short Duration Loads

The allowable bearing pressure and coefficient of friction values may be increased by one-third when considering loads of short duration, such as those imposed by wind and seismic forces.

3.3 Recommendations for Slabs-On-Grade

Concrete slabs-on-grade should be designed by the structural engineer in accordance with the current CBC for a soil with a very low expansion potential. Where conventional light floor loading conditions exist, the following minimum recommendations should be used. More stringent requirements may be required by local agencies, the structural engineer, the architect, or the CBC. Laboratory testing should be conducted at finish grade to evaluate the expansion index of near-surface subgrade soils. In addition, slabs-on-grade should have the following minimum recommended components:

Subgrade Moisture Conditioning: The subgrade soil should be moisture conditioned to at least 2 percent above optimum moisture content to a minimum depth of 12 inches prior to placing steel or concrete.

Moisture Retarder: A minimum of 10-mil polyethelene moisture retarder (such as Stego Wrap) should be placed below slabs where moisture-sensitive floor coverings or equipment is planned. The structural engineer should specify pertinent concrete design parameters and moisture migration prevention measures, such as whether a sand blotter layer should be placed over the vapor retarder. Gravel or other protruding objects that could puncture the moisture retarder should be removed from the subgrade prior to placing the vapor retarder.

Concrete Thickness: Slabs-on-grade should be at least 4 inches thick. Reinforcing steel should be designed by the structural engineer, but as a minimum should be No. 3 rebar placed at 18 inches on center, each direction, mid-depth in the slab.

Minor cracking of the concrete as it cures, due to drying and shrinkage is normal and should be expected. However, cracking is often aggravated by a high water/cement ratio, high concrete temperature at the time of placement, small nominal aggregate size, and rapid moisture loss due to hot, dry, and/or windy weather conditions during placement and curing. Cracking due to temperature and moisture fluctuations can also be expected. Low slump concrete can reduce the potential for shrinkage cracking. Additionally, our experience indicates that reinforcement in slabs and foundations can generally reduce the potential for concrete cracking. The structural engineer should consider these components in slab design and specifications.

Moisture retarders can reduce, but not eliminate moisture vapor rise from the underlying soils up through the slab. Floor covering manufacturers should be consulted for specific recommendations.

Leighton does not practice in the field of moisture vapor transmission evaluation, since this is not specifically a geotechnical issue. Therefore, we recommend that a qualified person, such as the flooring subcontractor and/or structural engineer, be consulted with to evaluate the general and specific moisture vapor transmission paths and any impact on the proposed construction. That person should provide recommendations for mitigation of potential adverse impact of moisture vapor transmission on various components of the structures as deemed appropriate.

3.4 Seismic Design Parameters

The site will experience strong ground shaking after the proposed project is developed resulting from an earthquake occurring along one or more of the major active or potentially active faults in southern California. Accordingly, the project should be designed in accordance with all applicable current codes and standards utilizing the appropriate seismic design parameters to reduce seismic risk as defined by California Geological Survey (CGS) Chapter 2 of Special Publication 117a (CGS, 2008). Through compliance with these regulatory requirements and the utilization of appropriate seismic design parameters selected by the design professionals, potential effects relating to seismic shaking can be reduced.

The following parameters should be considered for design under the 2019 CBC:

Table 2 – Mapped 2019 CBC Seismic Parameters

2019 CBC Parameters (CBC or ASCE 7-16 reference)	Value 2019 CBC
Site Latitude and Longitude (degrees): 33.9323, -117.4055	
Site Class Definition (1613.2.2, ASCE 7-16 Ch 20)	D **
Mapped Spectral Response Acceleration at 0.2s Period (1613.2.1), S_s	1.500 g
Mapped Spectral Response Acceleration at 1s Period (1613.2.1), S_1	0.572 g
Short Period Site Coefficient at 0.2s Period (T1613.2.3(1)), F_a	1.000 g
Long Period Site Coefficient at 1s Period (T1613.2.3(2)), F_v	1.728 g *
Adjusted Spectral Response Acceleration at 0.2s Period (1613.2.3), S_{MS}	1.500 g
Adjusted Spectral Response Acceleration at 1s Period (1613.2.3), S_{M1}	0.988 g *
Design Spectral Response Acceleration at 0.2s Period (1613.2.4), S_{DS}	1.000 g
Design Spectral Response Acceleration at 1s Period (1613.2.4), S_{D1}	0.659 g *
Mapped MCE_G peak ground acceleration (11.8.3.2, Fig 22-9 to 13), **PGA**	0.500 g
Site Coefficient for Mapped MCE_G *PGA* (11.8.3.2), F_{PGA}	1.100
Site-Modified Peak Ground Acceleration (1803.5.12; 11.8.3.2), PGA_M	0.550 g

* Per Table 11.4-2 of Supplement 1 of ASCE 7-16, this value of F_v may only be used to calculate T_s [that note is not included in Table 1613A.2.3(2)]; note that S_{D1} and S_{M1} are functions of F_v. In addition, per Exception 2 of 11.4.8 of ASCE 7-16, special equations for C_s are required. This is in lieu of a site-specific ground motion hazard analysis per ASCE 7-16 Chapter 21.2.

** Site Class D, and all of the resulting parameters in this table, may only be used for structures without seismic isolation or seismic damping systems.

Based on the 2019 CBC Table 1613.2.3(2) footnote c., F_v should be determined in accordance with Section 11.4.8 of ASCE 7-16, since the mapped spectral response acceleration at 1 second is greater than 0.2g for Site Class D; in accordance with Section 11.4.8 of ASCE 7-16, a site-specific seismic analysis is required. However, the values provided in the table above may be utilized if design is performed in accordance with Exception (2) in Section 11.4.8 of ASCE 7-16, with special requirements for the seismic response coefficient (C_S), and F_v is only used for calculation of T_S. This exception does not apply (and the values in the table above would not be applicable) for proposed structures with seismic isolation or seismic damping systems. The project structural engineer should review the seismic parameters. A site-specific seismic ground motion analysis can be performed upon request.

Based on ASCE 7-16 Equation 11.8-1, the F_{PGA} is 1.1, the PGA is 0.500g and the PGA_M is 0.550g. As an added check, PGA and hazard deaggregation were also estimated using the United States Geological Survey's (USGS) 2008 Interactive Deaggregations utility. The results of this analysis indicate that the predominant modal earthquake has a PGA of 0.75g with a magnitude of approximately 8.1 (MW) at a distance on the order of 17.9 kilometers for the Maximum Considered Earthquake (2% probability of exceedance in 50 years); 2/3 of this value is 0.42g. Deaggregation results are included in Appendix C.

3.5 Retaining Walls

We are not aware that retaining walls will be constructed at the project site. The following retaining wall recommendations are included for design consideration of walls a height less than 6 feet. Taller walls should be reviewed on a case-by-case basis. We recommend that retaining walls be backfilled with low expansive soil and constructed with a back drain in accordance with the recommendations provided on Figure 5 (rear of text). Based on these recommendations, the following parameters may be used for the design of conventional retaining walls:

Static Equivalent Fluid Pressure (pcf)	
Condition	Level Backfill
Active	40 pcf
At-Rest	60 pcf
Passive	240 pcf (allowable) (Maximum of 3,000 psf)

The above values do not contain an appreciable factor of safety unless noted, so the structural engineer should apply the applicable factors of safety and/or load factors during design, as specified by the California Building Code.

Cantilever walls that are designed to yield at least 0.001H, where H is equal to the wall height, may be designed using the active condition. Rigid walls and walls braced at the top should be designed using the at-rest condition.
Passive pressure is used to compute soil resistance to lateral structural

movement. In addition, for sliding resistance, a frictional resistance coefficient of 0.30 may be used at the concrete and soil interface. The lateral passive resistance should be taken into account only if it is ensured that the soil providing passive resistance, embedded against the foundation elements, will remain intact with time.

In addition to the above lateral forces due to retained earth, surcharge due to improvements, such as an adjacent structure or traffic loading, should be considered in the design of the retaining wall. Loads applied within a 1:1 projection from the surcharging structure on the stem of the wall should be considered in the design.

We recommend that the wall designs for walls 6 feet tall or taller be checked seismically using an additive seismic Equivalent Fluid Pressure (EFP) of 20 pcf of level backfill, which is added to the equivalent fluid pressure.

A soil unit weight of 120 pcf may be assumed for calculating the actual weight of the soil over the wall footing.

Retaining wall footings should have a minimum width of 24 inches and a minimum embedment of 18 inches below the lowest adjacent grade. An allowable bearing capacity of 2,000 pcf may be used for retaining wall footing design, based on the minimum footing width and depth.

3.6 Pavement Design

Based on the design procedures outlined in the 2017 Caltrans Highway Design Manual and using a design R-value of 35 based on near surface soils laboratory testing and our experience with nearby sites, flexible pavement sections may consist of the following for the traffic index indicated. Final pavement design should be based on the Traffic Index determined by the project civil engineer and R-value testing provided near the end of grading.

Traffic Index	Asphaltic Concrete (AC) Thickness (inches)	Class 2 Aggregate Base Thickness (inches)
5 or less (auto access)	3.0	4.5
7 (truck access and fire lanes)	4.0	8.5

If asphalt pavement is to be constructed prior to construction, the full pavement thickness should be placed to support heavy construction traffic.

In areas where rigid concrete pavement is planned with auto and light truck access, we recommend 5 inches of Portland Cement Concrete (PCC) over 4 inches of aggregate base placed on prepared subgrade soil. For heavy truck access, we recommend a minimum of 6 inches of PCC over 6 inches of aggregate base. The PCC should have a 28-day compressive strength of 4,000 psi. Reinforcement should be specified by the structural engineer. The PCC pavement sections should be provided with crack-control joints spaced no more than 8 feet on center each way. If sawcuts are used, they should have a minimum depth of ¼ of the slab thickness and made within 24 hours of concrete placement. We recommend that sections be as nearly square as possible.

PCC sidewalks should be at least 4 inches thick over prepared subgrade soil, with construction joints no more than 8 feet on center each way, with sections as nearly square as possible. Use of reinforcing will help reduce severity of cracking.

For concrete trash aprons, ADA stalls and ADA cross-walks, we recommend that a minimum 5 inches of concrete over prepared subgrade soil.

All pavement construction should be performed in accordance with the Standard Specifications for Public Works Construction. Field observations and periodic testing, as needed during placement of the base course materials, should be undertaken to ensure that the requirements of the standard specifications are fulfilled. Prior to placement of aggregate base, the subgrade soil should be processed to a minimum depth of 6 inches, moisture-conditioned, as necessary, and recompacted to a minimum of 95 percent relative compaction. Aggregate base should be moisture conditioned, as necessary, and compacted to a minimum of 95 percent relative compaction.

3.7 Temporary Excavations

All temporary excavations, including utility trenches, retaining wall excavations and other excavations should be performed in accordance with project plans, specifications and all OSHA requirements.

No surcharge loads should be permitted within a horizontal distance equal to the height of cut or 5 feet, whichever is greater from the top of the slope, unless the cut is shored appropriately. Excavations that extend below an imaginary plane inclined at 45 degrees below the edge of any adjacent existing site foundation should be properly shored to maintain support of the adjacent structures.

Cantilever shoring should be designed based on an active equivalent fluid pressure of 40 pcf. If excavations are braced at the top and at specific design intervals, the active pressure may then be approximated by a rectangular soil pressure distribution with the pressure per foot of width equal to 26H, where H is equal to the depth of the excavation being shored.

During construction, the soil conditions should be regularly evaluated to verify that conditions are as anticipated. The contractor should be responsible for providing the "competent person" required by OSHA, standards to evaluate soil conditions. Close coordination between the competent person and the geotechnical engineer should be maintained to facilitate construction while providing safe excavations.

3.8 Trench Backfill

Utility-type trenches onsite can be backfilled with the onsite material, provided it is free of debris, organic and oversized material. Prior to backfilling the trench, pipes should be bedded and shaded in a granular material that has a sand equivalent of 30 or greater and will allow water to readily permeate. Gravel or rock should not be used for trench backfill without written approval by Leighton. If gravel or open-graded rock is approved and used as bedding or shading, it should be wrapped in Mirafi 140N filter fabric, or equivalent, to prevent surrounding soil from washing into the pore spaces in the gap graded rock. Shading should extend at least 12 inches above the top of the pipe. The bedding/shading materials should be densified in-place by mechanical means, or in accordance with Greenbook specifications.

Subsequent to pipe bedding and shading, backfill soils should be placed in loose layers, moisture conditioned, as necessary, and mechanically compacted using a minimum standard of 90 percent relative compaction (ASTMS D1557). The thickness of layers should be based on the compaction equipment used in accordance with the Standard Specifications for Public Works Construction (Greenbook). The upper 6 inches in pavement areas should be compacted to 95 percent compaction.

3.9 Surface Drainage

Inadequate control of runoff water and/or poorly controlled irrigation can cause the onsite soils to expand and/or shrink, producing heaving and/or settlement of foundations, flatwork, walls, and other improvements. Maintaining adequate surface drainage, proper disposal of runoff water, and control of irrigation should help reduce the potential for future soil moisture problems.

Positive surface drainage should be designed to be directed away from foundations and toward approved drainage devices, such as gutters, paved drainage swales, or watertight area drains and collector pipes.

Surface drainage should be provided to prevent ponding of water adjacent to the structures. In general, the area around the buildings should slope away from the building. We recommend that unpaved landscaped areas adjacent to the buildings be avoided. Roof runoff should be carried to suitable drainage outlets by watertight drain pipes or over paved areas.

3.10 Infiltration Recommendations

Although variability was encountered in the soils throughout the site, with soils below 20 feet containing large amounts of variation with clays, silts, and both silty and clayey sands with high amounts of fines (silt and clay), which yielded low infiltration rates during our testing, a mostly continuous silty sand layer with lower percent fines was encountered from approximately 10 to 15 feet bgs at the infiltration test locations. For the underlying alluvial soils that are granular with a low fines content, we recommend an unfactored (small-scale) infiltration rate of 0.7 inch per hour (reduced due to presence of finer-grained soils below), for depths of at least 10 feet below current grade on the southwestern half of the site. Dry well systems may be feasible to infiltrate into the deeper granular layers in some areas of the site. We recommend that infiltration systems extend a minimum of 10 feet below current grades.

Based on our testing, infiltration appears to be feasible in the southern region of the project site, but dependent upon location and depth of infiltration due to the variances in soil composition encountered at the site and the results of percolation testing. Additional testing to confirm the location, depth of invert and type of device should be anticipated if locations differ from areas and depths tested.

We recommend that a correction factor/safety factor be applied to the infiltration rate in conformance with Riverside County guidelines, since monitoring of actual facility performance has shown that actual infiltration rates are lower than measured in small-scale tests. Infiltration basins are subject to siltation, which can result in reduced infiltration rates. *This small-scale infiltration rate should be divided by a design factor of at least 3 for buried chambers and dry wells, and at least 4 for open basins; although the design/safety factor may be higher based on project-specific aspects.* It should be noted that during periods of prolonged precipitation, underlying soils tend to become saturated to greater depths/extent. Therefore, infiltration rates tend to decrease with prolonged rainfall.

Some design considerations are presented in the following paragraphs:

- **Adjacent Structure Impact**: As infiltrating water can seep within soil strata partially horizontally, it is important to consider impact that infiltration facilities can play on nearby subterranean structures, such as basement walls or open excavations, whether onsite or offsite, and whether existing or planned. Any such nearby features should be identified and evaluated as to whether infiltrating water can impact these facilities. Infiltration facilities should not be constructed adjacent to or under buildings. Setbacks should be discussed with Leighton during the planning process, but a building setback of at least 15 feet horizontally is initially suggested.

- **Dry Well Locations and Depths**: Further testing may be required depending on final design of infiltration dry wells. Infiltration rates are anticipated to vary based on location and depth. Infiltration concepts should be discussed with Leighton as infiltration plans are being developed. We should review all infiltration plans, including locations and depths of proposed facilities. Further testing may be required depending on infiltration facilities design details, particularly considering type, depth and location.

- **Siltation and Soil Changes**: These infiltration rates are for a clean, un-silted infiltration surface in native, sandy alluvial soil. These values may be reduced over time as silting of the basin or chamber occurs. Furthermore, if the basin or chamber bottom is allowed to be compacted by heavy equipment, this value is expected to be reduced. Infiltration of water through soil is highly dependent on such factors as grain size distribution of soil particles, gradation (uniform versus well graded), particle shape, fines content and density. Small changes in soil conditions, including density, can cause large differences in observed infiltration rates. Infiltration is not suitable in compacted fill. For open basins and swales, vegetation within the basin bottoms and sides is expected to help reduce erosion and help maintain infiltration rates.

- **De-silting Weir/Facilities**: Periodic flow of water carrying sediments into the basin or chamber, plus deposition of fine wind-blown sediments and sediments from erosion of basin side walls, will eventually cause the basin bottom or chamber to accumulate a layer of silt, which has the potential to significantly reducing the overall infiltration rate of the basin or chamber. Therefore, we recommend that significant amounts of silt/sediment not be allowed to flow into the facility within stormwater, especially during construction of the project and prior to achieving a mature landscape onsite. We recommend that an easily maintained, robust silt/sediment removal system be installed to pretreat storm water before it enters the infiltration facility. Infiltration facilities should be constructed with spillways or other appropriate means that would prevent overfilling that could damage the facility or adjacent improvements.

- **Drainage/Infiltration Time Cycle**: In general, the rate of infiltration reduces as the head of water in the infiltration facility reduces, and it also reduces with prolonged periods of infiltration. As such, water typically infiltrates much faster near the beginning of and/or immediately after storm events than at times well after a storm when the water level in the facility has receded, since the infiltration rate is then slower due to both lower head and longer overall duration of infiltration. In open basins with compacted or silty bottoms, this could be problematic, in that even if the basin had already infiltrated significant amounts of storm water, the lower several inches or feet of water could remain in the basin for an extended period of time, creating prolonged open-water safety concern (such as potential for mosquitos and waterborne diseases, algae odor, etc.). In a buried/cover infiltration chamber, these conditions would be of less concern.

- **Maintenance**: Infiltration facilities should be routinely monitored, especially before and during the rainy season, and corrective measures should be implemented if and as needed. Things to check for include removal of trash or dumping, proper infiltration, absence of accumulated silt, and that de-silting filters/features are clean and functioning. Pretreatment desilting features should be cleaned and maintained as recommended by the manufacturer or designer. Even with measures to prevent silt from flowing into the infiltration facility, accumulated silt may need to be removed.

3.11 Sulfate Attack and Corrosion Protection

Based on the results of laboratory testing, concrete structures in contact with the onsite soil will have negligible exposure to water-soluble sulfates in the soil (Exposure Class S0). Type II cement may be used for concrete construction. The concrete should be designed in accordance with Table 4.3.1 of the American Concrete Institute ACI 318-14 provisions (ACI, 2014).

Based on our laboratory testing, the onsite soil is considered corrosive to ferrous metals. Corrosion protection of underground metallic utilities should be provided. Corrosion information presented in this report should be provided to your underground utility contractors.

3.12 Additional Geotechnical Services

The preliminary geotechnical recommendations presented in this report are based on subsurface conditions as interpreted from limited subsurface explorations and limited laboratory testing. Our preliminary geotechnical recommendations provided in this report are based on information available at the time the report was prepared and may change as plans are developed. Additional geotechnical investigation and analysis may be required based on final improvement plans. Leighton should review the site and grading plans when available and comment further on the geotechnical aspects of the project. Geotechnical observation and testing should be conducted during excavation and all phases of grading operations. Our conclusions and preliminary recommendations should be reviewed and verified by Leighton during construction and revised accordingly if geotechnical conditions encountered vary from our preliminary findings and interpretations.

Geotechnical observation and testing should be provided:

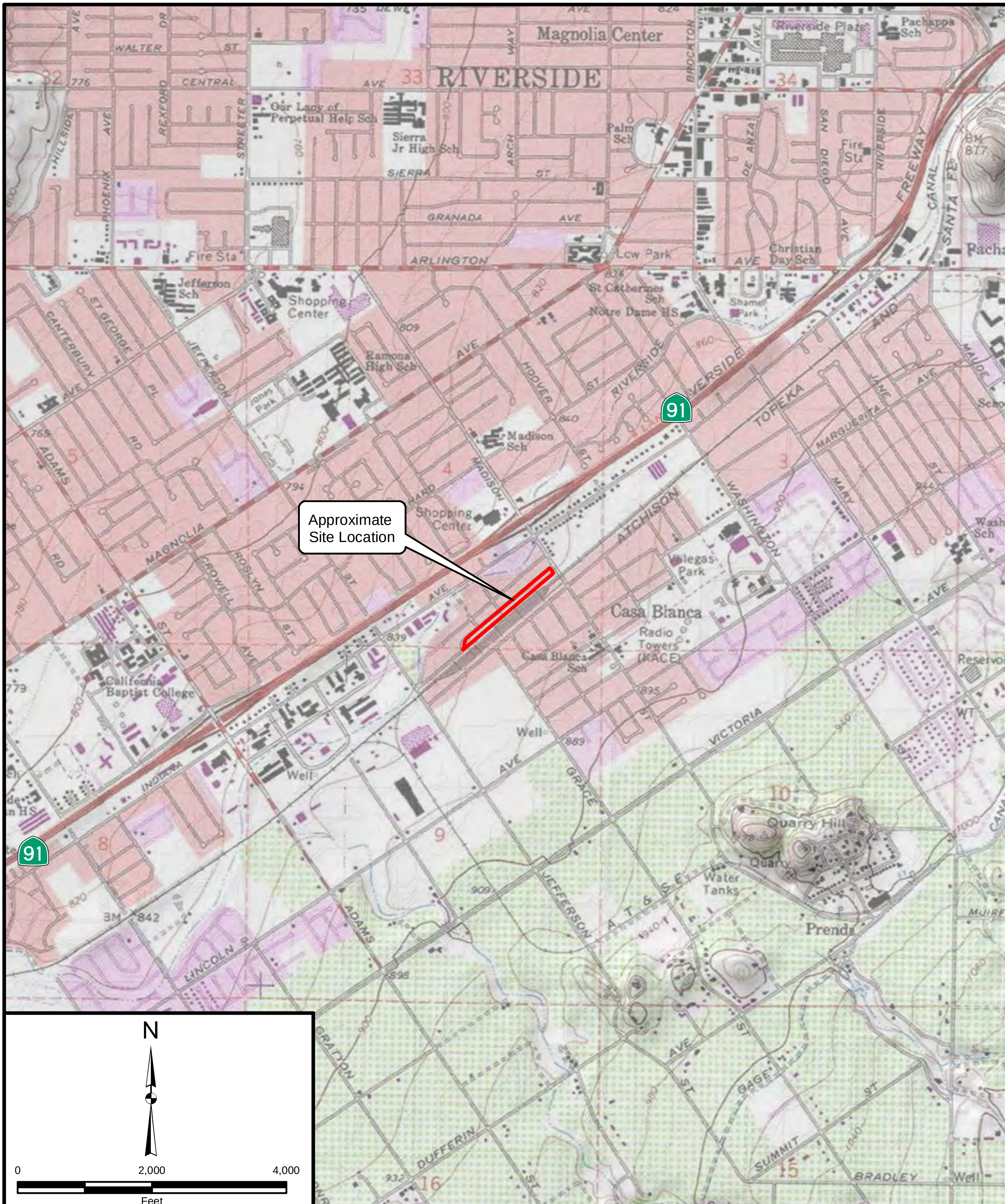
- After completion of site clearing.
- During overexcavation of compressible soil.
- During compaction of all fill materials.
- After excavation of all footings and prior to placement of concrete.
- During utility trench backfilling and compaction.
- During pavement subgrade and base preparation.
- When any unusual conditions are encountered.

4.0 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 Leighton and Associates, Inc. will provide geotechnical observation and testing during construction.

This report was prepared for the sole use of the Gilbane Development Company for application to the design of the proposed residential development in accordance with generally accepted geotechnical engineering practices at this time in California.

See the GBA insert on the following page for important information about this geotechnical engineering report.



Project: 13693.001	Eng/Geol: JDH/SGO
Scale: 1 " = 2,000 '	Date: November 2022

Reference: Copyright:© 2013 National Geographic Society, i-cubed

SITE LOCATION MAP

Proposed Multi-Family Residential Development
Southwest of Madison Street and Railroad Avenue
Riverside, California

FIGURE 1

Leighton

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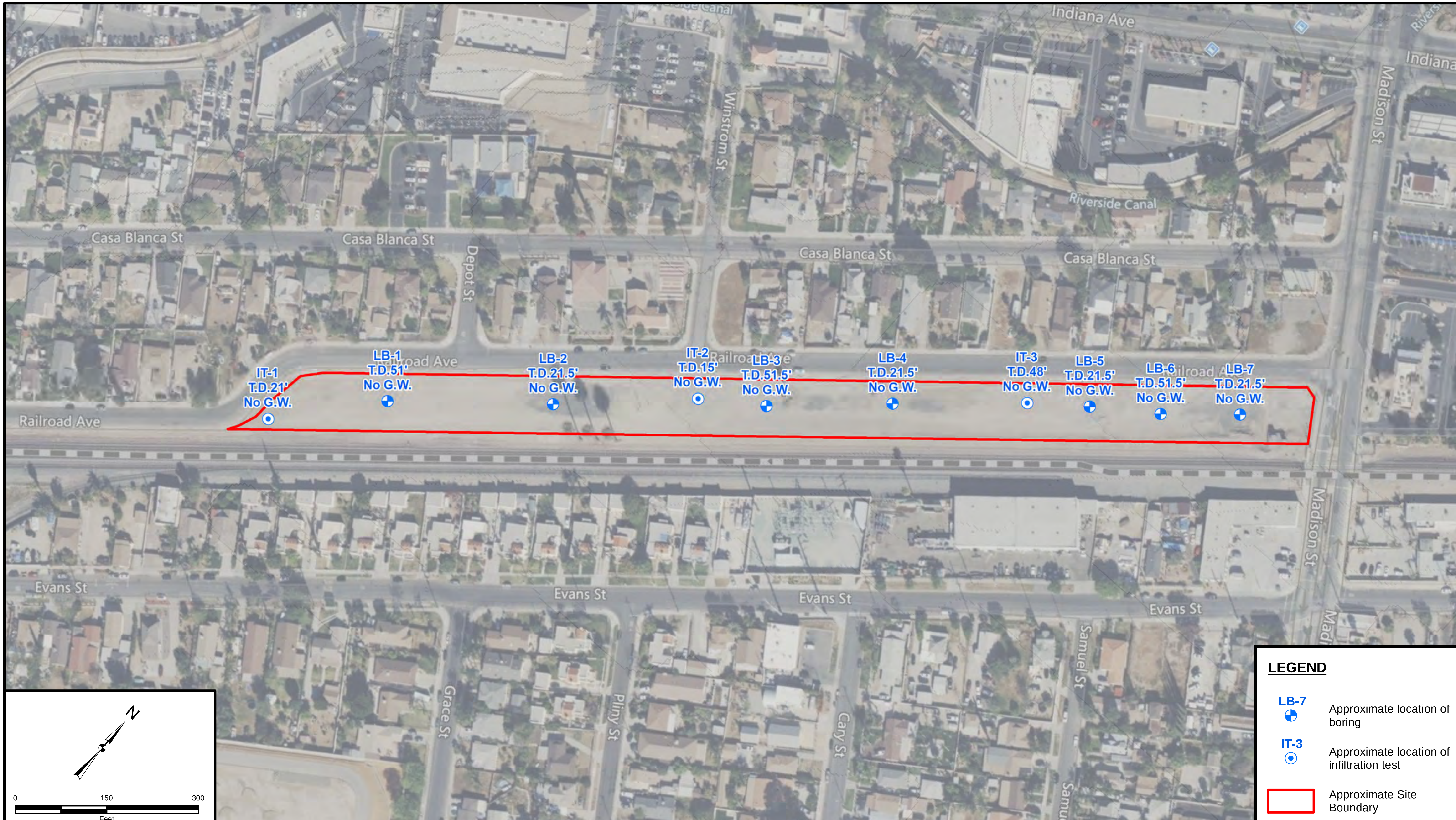

LEGEND

LB-7	Approximate location of boring
IT-3	Approximate location of infiltration test
	Approximate Site Boundary

Project: 13693.001	Eng/Geol: JDH/SGO
Scale: 1 " = 150 '	Date: November 2022

Reference: © 2022 Microsoft Corporation © 2022 Maxar ©CNES (2022) Distribution Airbus DS © 2022 TomTom

BORING LOCATION MAP

Proposed Multi-Family Residential Development
Southwest of Madison Street and Railroad Avenue
Riverside, California

FIGURE 2

Leighton

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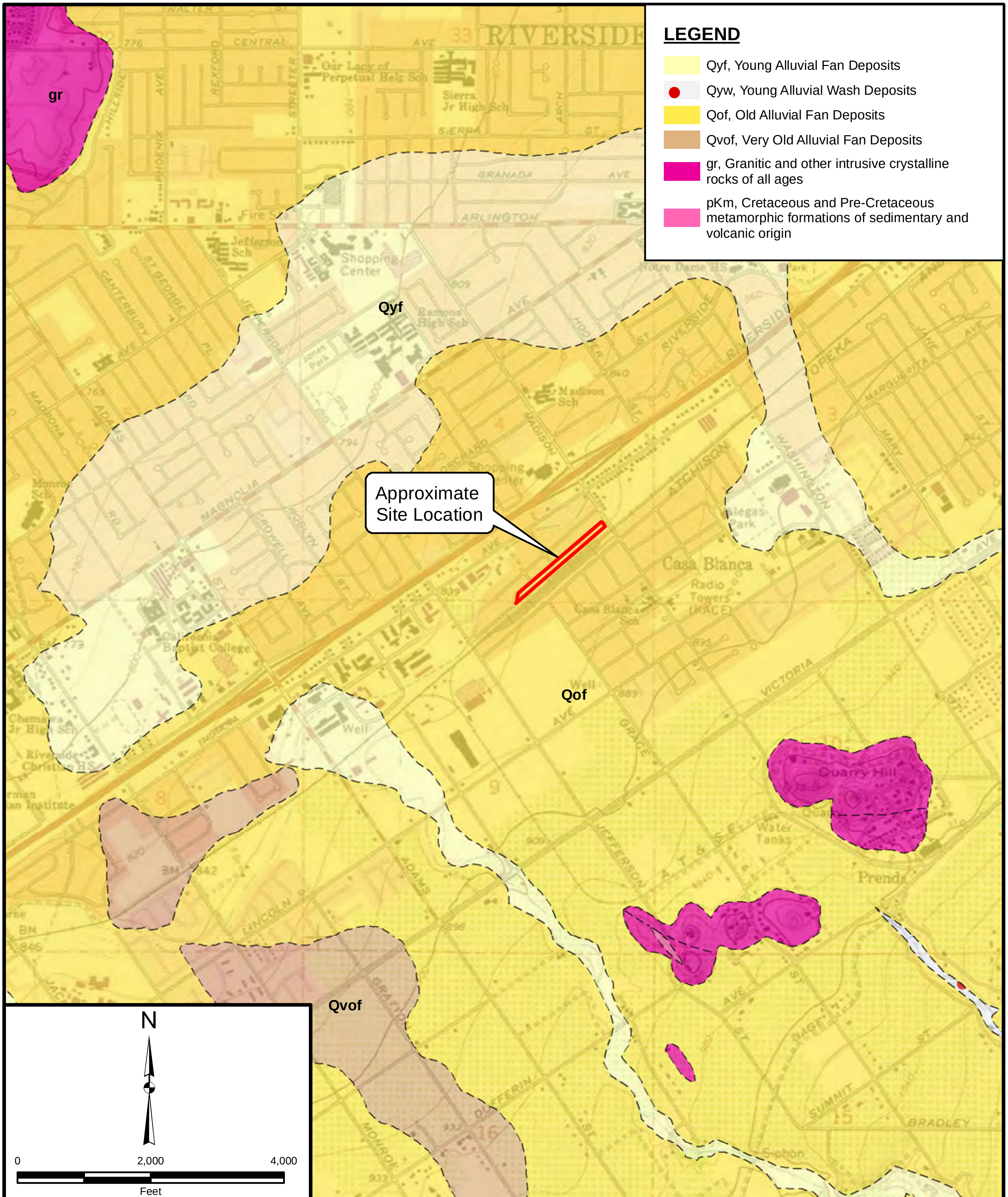


Project: 13693.001	Eng/Geol: JDH/SGO
Scale: 1 " = 2,000 '	Date: November 2022

Reference: Southern California USGS Geology in GIS Format served by California Geological Survey, 2018.

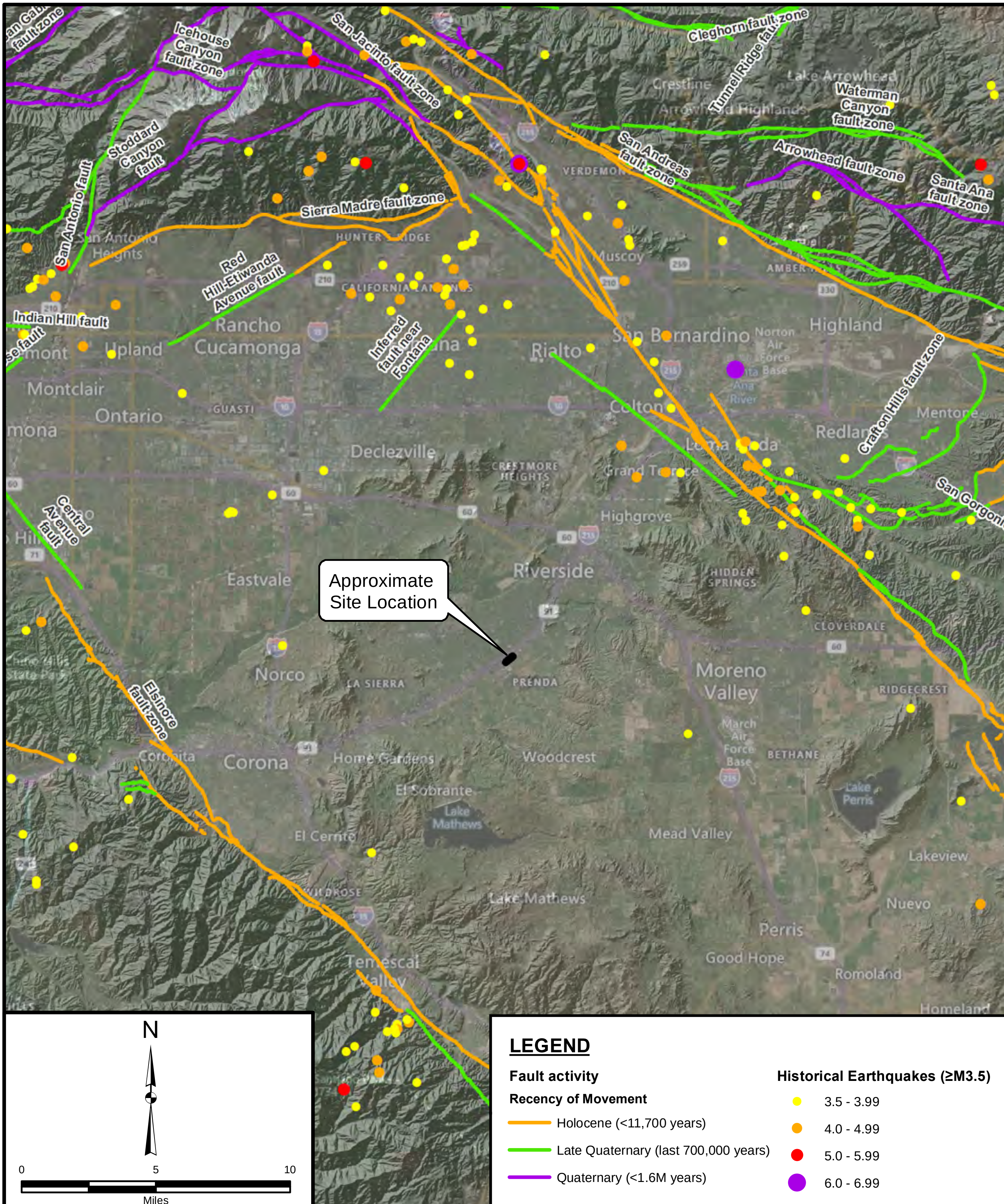
REGIONAL GEOLOGY MAP

Proposed Multi-Family Residential Development
Southwest of Madison Street and Railroad Avenue
Riverside, California

FIGURE 3

Leighton

Map Saved as J:\Drafting\13693\001\Maps\13693.001_F03_RGM_2022-11-09.mxd on 11/9/2022 1:29:08 PM Author: KVM (btran)



LEGEND

Fault activity

Recency of Movement

- Holocene (<11,700 years)
- Late Quaternary (last 700,000 years)
- Quaternary (<1.6M years)

Historical Earthquakes (≥M3.5)

- 3.5 - 3.99
- 4.0 - 4.99
- 5.0 - 5.99
- 6.0 - 6.99

Project: 13693.001	Eng/Geol: JDH/SGO
Scale: 1 " = 5 miles	Date: November 2022

Basemap Reference: © 2022 Microsoft Corporation
Earthstar Geographics SIO © 2022 TomTom
Seismicity Data Reference: maps.conservation.ca.gov

REGIONAL FAULTS AND HISTORICAL SEISMICITY MAP

Proposed Multi-Family Residential Development
Southwest of Madison Street and Railroad Avenue
Riverside, California

FIGURE 4

Leighton

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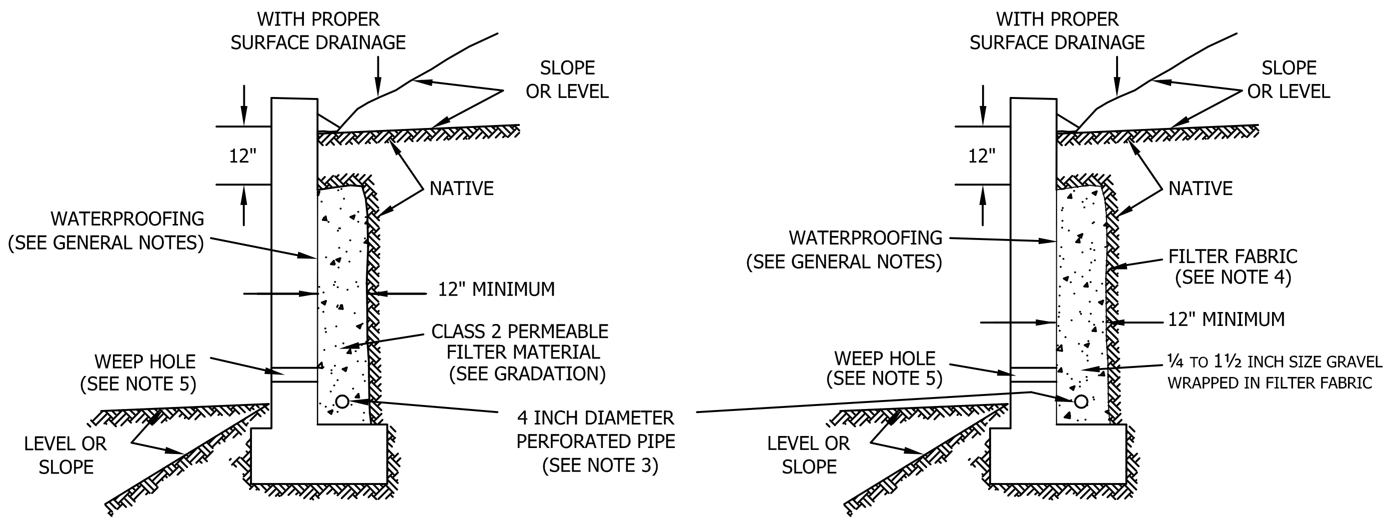
SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

OPTION 1: PIPE SURROUNDED WITH CLASS 2 PERMEABLE MATERIAL

OPTION 2: GRAVEL WRAPPED IN FILTER FABRIC



Class 2 Filter Permeable Material Gradation
Per Caltrans Specifications

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

GENERAL NOTES:

* Waterproofing should be provided where moisture nuisance problem through the wall is undesirable.
* Water proofing of the walls is not under purview of the geotechnical engineer
* All drains should have a gradient of 1 percent minimum

*Outlet portion of the subdrain should have a 4-inch diameter solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding)

*Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

Notes:

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

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

WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

Leighton

Figure 5

P:Drafting\templates\details\retain-wall-backfill-and subdrain.dwg (7/00)

APPENDIX A

REFERENCES

APPENDIX A

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APPENDIX B

GEOTECHNICAL EXPLORATION LOGS

GEOTECHNICAL BORING LOG LB-1

Project No.	13693.001	**Date Drilled**	11-3-22
Project	Gilbane Development - Madison Flats	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - Autohammer	**Ground Elevation**	861'
Location	See Figure 2 - Boring Location Map	**Sampled By**	AA

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.	
860	0			B-1				SM	**Artificial Fill (Afu):** @Surface: SILTY SAND WITH GRAVEL (SM), brown, dry, fine to coarse sand, 20% fines, 10% gravel (field estimate)	
				R-1	7 6 6	115	5	SM	**Old Alluvial Fan Deposits (Qof):** @2.5': SILTY SAND (SM), loose, brown, dry, fine to medium sand, 45% fines (field estimate)	
855	5			R-2	4 6 7	114	6	SM	@5': SILTY SAND (SM), loose, brown, dry, fine to medium sand, 35% fines (field estimate)	
				R-3	7 10 11	117	7	SM	@7.5': SILTY SAND (SM), medium dense, brown, dry, fine to coarse sand, 35% fines (field estimate)	
850	10			R-4	7 8 13	115	10	SM	@10': SILTY SAND (SM), medium dense, brown, dry, fine to coarse sand, 35% fines (field estimate)	
845	15			S-1	4 5 6			SP	@15': POORLY GRADED SAND (SP), medium dense, light brown, slightly moist, fine to coarse sand, 5% fines (lab)	-200
840	20			R-5	12 18 24	127	8	CL	@20': SANDY LEAN CLAY (CL), very stiff, brown, slightly moist, 70% medium plasticity fines (field estimate)	
								SM	@21.25': SILTY SAND (SM), medium dense, brown, slightly moist, medium to coarse sand, 15% fines (field estimate)	
835	25			S-2	4 3 4			ML	@25': SANDY SILT (ML), medium stiff, brown, slightly moist, fine to medium sand, 70% low plasticity fines (field estimate)	
	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 LB-1

Project No.	13693.001	**Date Drilled**	11-3-22
Project	Gilbane Development - Madison Flats	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - Autohammer	**Ground Elevation**	861'
Location	See Figure 2 - Boring Location Map	**Sampled By**	AA

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			R-6	11 16 22			CL	@30': LEAN CLAY WITH SAND (CL), very stiff, brown, slightly moist, 80% medium plasticity fines (field estimate) -Soil stuck on auger, difficult to drill	
830										
	35			S-3				CL	@35': LEAN CLAY WITH SAND (CL), brown, slightly moist, slow dilatency, 80% medium plasticity fines (field estimate)	
825										
	40			R-7	8 12 17			ML	@40': SANDY SILT (ML), very stiff, brown, slightly moist, fine to medium sand, 70% low plasticity fines (field estimate)	
820										
	45			S-4	28 50/5"			SC	@45': CLAYEY SAND (SC), very dense, orangish brown, slightly moist, medium to coarse sand, 40% fines (field estimate)	
815										
	50			R-8	27 50/6"			SC	@50': CLAYEY SAND (SC), very dense, orangish brown, slightly moist, medium to coarse sand, 20% fines (field estimate)	
810										
									TOTAL DEPTH = 51 FEET **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	55									
805										
	60									

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

TYPE OF TESTS:

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

Leighton

GEOTECHNICAL BORING LOG LB-2

Project No.	13693.001	**Date Drilled**	11-3-22
Project	Gilbane Development - Madison Flats	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - Autohammer	**Ground Elevation**	862'
Location	See Figure 2 - Boring Location Map	**Sampled By**	AA

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			B-1				SM	**Artificial Fill (Afu):** @Surface: SILTY SAND WITH GRAVEL (SM), brown, dry, fine to coarse sand, 20% fines, 10% gravel (field estimate)	
860									**Old Alluvial Fan Deposits (Qof):**	
				R-1	4 7 10			SM	@2.5': SILTY SAND (SM), medium dense, brown, slihgtly moist, fine to medium sand, 45% fines (field estimate)	
	5			R-2	4 6 7	113	5	SC	@5': CLAYEY SAND (SC), loose, brown, slightly moist, low toughness, 41% fines (lab)	
855										
				R-3	5 7 9	116	8	SC	@7.5': CLAYEY SAND (SC), medium dense, brown, slightly moist, low toughness, 45% low plasticity fines (field estimate)	AL, -200
	10			R-4	7 11 15			SM	@10': SILTY SAND (SM), medium dense, brown, slightly moist, fine sand, 45% fines (field estimate)	
850										
	15			S-1	3 6 5			SM	@15': SILTY SAND (SM), medium dense, brown, slightly moist, fine sand, 40% fines (field estimate)	
845										
	20			R-5	5 9 17			SM	@20': SILTY SAND (SM), medium dense, brown, slightly moist, fine sand, 30% fines (field estimate)	
840									**TOTAL DEPTH = 21.5 FEET** **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	25									
835										
	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

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GEOTECHNICAL BORING LOG LB-3

Project No.	13693.001	**Date Drilled**	11-3-22
Project	Gilbane Development - Madison Flats	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - Autohammer	**Ground Elevation**	861'
Location	See Figure 2 - Boring Location Map	**Sampled By**	AA

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			B-1				SM	**Artificial Fill (Afu):** @Surface: SILTY SAND WITH GRAVEL (SM), brown, slightly moist, fine to coarse sand, 20% fines, 30% gravel (field estimate)	MD, SA, CR
860										
				R-1	6 7 8	117	3	SM	**Old Alluvial Fan Deposits (Qof):** @2.5': SILTY SAND (SM), loose, brown, dry, fine to coarse sand, 40% fines (field estimate)	
	5			R-2	3 5 10	111	10	ML	@5': LEAN CLAY WITH SAND (CL), stiff, brown, slightly moist, 85% medium plasticity fines (field estimate)	CO
855										
				R-3	5 9 10	122	6	SC	@7.5': CLAYEY SAND (SC), medium dense, brown, slightly moist, 42% fines (lab)	-200, AL
	10			R-4	4 9 12	115	13	ML	@10': SANDY SILT (ML), stiff, brown, slightly moist, 75% medium plasticity fines (field estimate)	
850										
	15			S-1	3 7 6			SP	@15': POORLY GRADED SAND (SP), medium dense, brown, slightly moist, fine to coarse sand, 5% fines (lab)	-200
845										
	20			R-5	8 14 18	116	7	SC	@20': CLAYEY SAND (SC), medium dense, brown, slightly moist, 45% medium plasticity fines (field estimate)	
840										
	25			S-2	5 9 10			CL	@25': LEAN CLAY (CL), very stiff, brown, slightly moist, 90% medium plasticity fines (field estimate)	
835										
	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

GEOTECHNICAL BORING LOG LB-3

Project No.	13693.001	**Date Drilled**	11-3-22
Project	Gilbane Development - Madison Flats	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - Autohammer	**Ground Elevation**	861'
Location	See Figure 2 - Boring Location Map	**Sampled By**	AA

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
830	30			R-6	8 13 23			CL	@30': LEAN CLAY (CL), very stiff, brown, slightly moist, 90% medium plasticity fines (field estimate)	
825	35			S-3	8 9 13			ML	@35': SILT WITH SAND (ML), very stiff, brown, slightly moist, 80% low plasticity fines (field estimate)	
820	40			R-7	26 50/5"			SC	@40': CLAYEY SAND (SC), very dense, brown and white, slightly moist, fine to coarse sand, cemented, 30% fines (field estimate)	
815	45			S-4	10 12 17			SM	@45': SILTY SAND (SM), medium dense, brown, slightly moist, fine to medium sand, 35% fines (field estimate)	
810	50			R-8	13 28 32			ML	@50': SANDY SILT (ML), hard, brown, slightly moist, fine to medium sand, 60% low plasticity fines (field estimate)	
805	55								**TOTAL DEPTH = 51.5 FEET** **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	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

Leighton

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GEOTECHNICAL BORING LOG LB-4

Project No.	13693.001	**Date Drilled**	11-3-22
Project	Gilbane Development - Madison Flats	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - Autohammer	**Ground Elevation**	857'
Location	See Figure 2 - Boring Location Map	**Sampled By**	AA

SOIL DESCRIPTION

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

Elevation Feet	Depth Feet	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0							**Artificial Fill (Afu):** @Surface: SILTY SAND WITH GRAVEL (SM), brown, slightly moist, fine to coarse sand, 15% fines, 10% gravel (field estimate)	
855			R-1	5 4 5			ML	**Old Alluvial Fan Deposits (Qof):** @2.5': SANDY SILT (ML), medium stiff, brown, slightly moist, fine sand, 65% low plasticity fines (field estimate)	
	5		R-2	6 8 9	120	9	SM	@5': SILTY SAND (SM), medium dense, brown, slightly moist, medium to coarse sand, 30% fines (field estimate)	
850			R-3	12 15 17			SM	@7.5': SILTY SAND (SM), medium dense, brown, slightly moist, medium to coarse sand, 30-45% fines (field estimate)	
	10		R-4	9 8 11	118	9	SM	@10': SILTY SAND (SM), medium dense, brown, slightly moist, fine sand, 30% fines (field estimate)	
845									
	15		S-1	6 7 9			CL	@15': CLAY with SAND (CL), stiff, brown, slightly moist, 80% medium plasticity fines (field estimate)	
840									
	20		R-5	13 15 19			SC	@20': CLAYEY SAND (SC), medium dense, brown, slightly moist, fine to coarse sand, 45% medium plasticity fines (field estimate)	
835								**TOTAL DEPTH = 21.5 FEET** **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	25								
830									
	30								

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

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

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GEOTECHNICAL BORING LOG LB-5

Project No.	13693.001	**Date Drilled**	11-3-22
Project	Gilbane Development - Madison Flats	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - Autohammer	**Ground Elevation**	857'
Location	See Figure 2 - Boring Location Map	**Sampled By**	AA

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.

Graphic Log: N S

Elevation Feet	Depth Feet	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
857	0							**Artificial Fill (Afu):** @Surface: SILTY SAND WITH GRAVEL (SM), brown, slightly moist, fine to coarse sand, 15% fines, 10% gravel (field estimate)	
855			R-1	5 9 10			CL	**Old Alluvial Fan Deposits (Qof):** @2.5': LEAN CLAY WITH SAND (CL), stiff, brown, slightly moist, 85% medium plasticity fines (field estimate)	
	5		R-2	10 13 12			SM	@5': SILTY SAND (SM), medium dense, brown, slightly moist, fine to medium sand, 30% fines (field estimate)	CO
850			R-3	6 10 12			SM	@7.5': SILTY SAND (SM), medium dense, brown, slightly moist, fine to coarse sand, 15% fines (field estimate)	
	10		R-4	6 7 13	113	5	SM	@10': SANDY SILT (ML), stiff, brown, slightly moist, fine to coarse sand, 70% low to medium plasticity fines (field estimate)	
845									
	15		S-1	5 5 6			ML	@15': SILT WITH SAND (ML), stiff, brown, slightly moist, fine sand, 85% low plasticity fines (field estimate)	
840									
	20		R-5	8 14 19			ML	@20': SILT WITH SAND (ML), very stiff, brown, slightly moist, fine sand, 85% low plasticity fines (field estimate)	
835								**TOTAL DEPTH = 21.5 FEET** **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	25								
830									
	30								

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

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

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GEOTECHNICAL BORING LOG LB-6

Project No.	13693.001	**Date Drilled**	11-3-22
Project	Gilbane Development - Madison Flats	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - Autohammer	**Ground Elevation**	858'
Location	See Figure 2 - Boring Location Map	**Sampled By**	AA

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			B-1				SM	**Artificial Fill (Afu):** @Surface: SILTY SAND WITH GRAVEL (SM), brown, slightly moist, fine to coarse sand, 15% fines, 10% gravel (field estimate)	EI, RV
855				R-1	7 10 20	119	6	ML	**Old Alluvial Fan Deposits (Qof):** @2.5': SILT (ML), very stiff, brown, slightly moist, 90% low plasticity fines (field estimate)	
	5			R-2	10 10 17	122	2	SM	@5': SILTY SAND (SM), medium dense, brown, slightly moist, fine to coarse sand, 30% fines (field estimate)	
850				R-3	7 10 11	117	2	SM	@7.5': SILTY SAND (SM), medium dense, brown, slightly moist, fine to medium sand, 40% low plasticity fines (field estimate)	
	10			R-4	7 23 26	119	5	SM	@10': SILTY SAND (SM), medium dense, brown, slightly moist, fine to medium sand, 45% low plasticity fines (lab)	-200, AL
845										
	15			S-1	5 8 10			ML	@15': SANDY SILT (ML), very stiff, brown, slightly moist, fine to medium sand, 75% low plasticity fines (field estimate)	
840										
	20			R-5	9 13 25			ML	@20': SILT (ML), very stiff, brown, slightly moist, medium toughness, 90% low plasticity fines (field estimate)	
835										
	25			S-2	4 8 9			SM	@25': SILTY SAND (SM), medium dense, brown, slightly moist, fine to coarse sand, 40% fines (field estimate)	
830										
	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

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GEOTECHNICAL BORING LOG LB-6

Project No.	13693.001	**Date Drilled**	11-3-22
Project	Gilbane Development - Madison Flats	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - Autohammer	**Ground Elevation**	858'
Location	See Figure 2 - Boring Location Map	**Sampled By**	AA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	30			R-6	13 27 27			SP ML	@30': POORLY GRADED SAND (SP), medium dense, light brown, slightly moist, medium to coarse sand, 5% fines (field estimate) @30.5': SILT WITH SAND (ML), hard, brown, slightly moist, 80% low plasticity fines, (field estimate)	AL
825										
	35			S-3	6 10 17			SM	@35': SILTY SAND (SM), medium dense, brown, slightly moist, fine to coarse sand, 20% fines (field estimate)	
820										
	40			R-7	14 26 40			SM	@40': SILTY SAND (SM), dense, brown, slightly moist, medium to coarse sand, 15% fines (field estimate)	
815										
	45			S-4	6 18 22			SM	@45': SILTY SAND (SM)), dense, light brown, slightly moist, medium to coarse sand, 15% fines (field estimate)	
810										
	50			R-8	24 38 46			SP-SM	@50': POORLY GRADED SAND with SILT (SP), very dense, light brown, slightly moist, medium to coarse sand, 10% fines (field estimate)	
805									**TOTAL DEPTH = 51.5 FEET** **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	55									
800										
	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

Leighton

GEOTECHNICAL BORING LOG LB-7

Project No.	13693.001	**Date Drilled**	11-3-22
Project	Gilbane Development - Madison Flats	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - Autohammer	**Ground Elevation**	858'
Location	See Figure 2 - Boring Location Map	**Sampled By**	AA

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								**Artificial Fill (Afu):** @Surface: SILTY SAND WITH GRAVEL (SM), brown, slightly moist, fine to coarse sand, 15% fines 10% gravel (field estimate)	
855				R-1	10 13 14	118	5	ML	**Old Alluvial Fan Deposits (Qof):** @2.5': SANDY SILT (ML), very stiff, brown, slightly moist, fine to coarse sand, 60% low plasticity fines (field estimate)	
	5			R-2	6 4 2			SM	@5': SILTY SAND (SM), very loose, brown, slightly moist, medium to coarse sand, 18% fines (lab)	-200
850				R-3	6 8 11	117	3	SP ML	@7.5': POORLY GRADED SAND (SP), loose, light brown, slightly moist, fine to coarse sand, 5% fines (field estimate) @8': SANDY SILT (ML), medium stiff, brown, slightly moist, fine sand, 70% low plasticity fines (field estimate)	
	10			R-4	11 23 28			ML	@10': SILT WITH SAND (ML), very stiff, brown, slightly moist, 85% low plasticity fines (field estimate)	
845										
	15			S-1	4 7 7			SM	@15': SILTY SAND (SM), medium dense, brown, slightly moist, fine to coarse sand, 30% fines (field estimate)	
840										
	20			S-2	6 8 9			SP	@20': POORLY GRADED SAND (SP), loose, light brown, slightly moist, fine to coarse sand, 5% fines (field estimate)	
835									**TOTAL DEPTH = 21.5 FEET** **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	25									
830										
	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

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GEOTECHNICAL BORING LOG IT-1

Project No.	13693.001	**Date Drilled**	11-4-22
Project	Gilbane Development - Madison Flats	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - Autohammer	**Ground Elevation**	860'
Location	See Figure 2 - Boring Location Map	**Sampled By**	AA

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
860	0							SM	**Artificial Fill (Afu):** @Surface: SILTY SAND WITH GRAVEL (SM), brown, slightly moist, fine to coarse sand, 15% fines, 10% gravel (field estimate)	
									Old Alluvial Fan Deposits (Qof):	
855	5							SM	@5': SILTY SAND (SM), brown, dry, fine to medium sand, 40% fines (field estimate)	
850	10							SM	@10': SILTY SAND (SM), brown, dry, fine to coarse sand, 40% fines (field estimate)	
845	15			S-1	4 5 7			ML	@15': SANDY SILT (ML), stiff, brown, slightly moist, fine to coarse sand, 70% low plasticity fines (field estimate)	
				S-2	4 6 7			SM	@17': SILTY SAND (SM), medium dense, brown, slightly moist, fine sand, 28% fines (lab)	-200
								SP-SM	@18.25': POORLY GRADED SAND WITH SILT (SP-SM), medium dense, brown, slightly moist, fine sand, 10% fines (field estimate)	
840	20			S-3	2 3 3			SM	@20': SILTY SAND (SM), loose, brown, slightly moist, fine sand, 38% fines (lab)	-200
								ML	@21': SANDY SILT (ML), medium stiff, brown, slightly moist, fine sand, 80% low plasticity fines (field estimate)	
835	25									
830	30									

TOTAL DEPTH = 21.5 FEET
NO GROUNDWATER ENCOUNTERED
INFILTRATION TEST PERFORMED FROM 16 TO 21 FEET

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 IT-2

Project No.	13693.001	**Date Drilled**	11-4-22
Project	Gilbane Development - Madison Flats	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - Autohammer	**Ground Elevation**	862'
Location	See Figure 2 - Boring Location Map	**Sampled By**	AA

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
862	0							SM	**Artificial Fill (Afu):** @Surface: SILTY SAND WITH GRAVEL (SM), brown, slightly moist, fine to coarse sand, 15% fines, 10% gravel (field estimate)	
860									**Old Alluvial Fan Deposits (Qof):**	
	5							SC	@5': CLAYEY SAND (SC), brown, slightly moist, 35% fines (field estimate)	
855										
	10			S-1	2 2 4			SM	@10': SILTY SAND (SM), loose, brown, slightly moist, fine sand, 30% fines (field estimate) 4-inch lense of SP @10.25'	
850										
				S-2	3 3 4			ML	@13.5': SILTY SAND (SM), loose, brown, slightly moist, fine sand, 55% fines (lab)	-200
	15									
845									**TOTAL DEPTH = 15 FEET** **NO GROUNDWATER ENCOUNTERED** **INFILTRATION TEST PERFORMED FROM 10 TO 15 FEET**	
	20									
840										
	25									
835										
	30									

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

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

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GEOTECHNICAL BORING LOG IT-3

Project No.	13693.001	**Date Drilled**	11-4-22
Project	Gilbane Development - Madison Flats	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - Autohammer	**Ground Elevation**	857'
Location	See Figure 2 - Boring Location Map	**Sampled By**	AA

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.	
	0							SM	**Artificial Fill (Afu):** @Surface: SILTY SAND WITH GRAVEL (SM), brown, slightly moist, fine to coarse sand, 15% fines, 30% gravel (field estimate)	
855									**Old Alluvial Fan Deposits (Qof):**	
	5							SM	@5': SILTY SAND (SM), brown, slightly moist, fine to medium sand	
850										
	10							SM	@5': SILTY SAND (SM), brown, slightly moist, fine to coarse sand	
845										
	15							ML	@15': SANDY SILT (ML), brown, dry to moist, fine sand, 60% fines (field estimate)	
840										
	20									
835										
	25							SM	@25': SILTY SAND (SM), brown, slightly moist, fine to medium sand, 40% fines (field estimate)	
830										
	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

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GEOTECHNICAL BORING LOG IT-3

Project No.	13693.001	**Date Drilled**	11-4-22
Project	Gilbane Development - Madison Flats	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - Autohammer	**Ground Elevation**	857'
Location	See Figure 2 - Boring Location Map	**Sampled By**	AA

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							SM	@30': SILTY SAND (SM), brown, slightly moist, fine to medium sand, 40% fines (field estimate)	
825										
	35									
820										
	40							SM	@40': SILTY SAND (SM), brown, slightly moist, fine to coarse sand, 40% fines (field estimate)	
815										
				S-1	13 19 32			SC	@43': SILTY CLAYEY SAND (SC-SM), very dense, brown, slightly moist, fine to coarse sand, 45% fines (field estimate)	
	45			S-2	10 19 21			ML	@45': SANDY SILT (ML), hard, brown, slightly moist, fine to coarse sand, 70% low plasticity fines (field estimate) -Small lenses of SP	
810				S-3	5 10 11			SP	@47': SILTY SAND (SM), medium dense, brown, slightly moist, medium to coarse sand, 15% fines (lab)	-200
	50								**TOTAL DEPTH = 48.5 FEET** **NO GROUNDWATER ENCOUNTERED** **INFILTRATION TEST PERFORMED FROM 43 TO 48 FEET**	
805										
	55									
800										
	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
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Results of Falling Head Infiltration Test

Leighton 60th Anniversary

Project: 13693.001

Exploration #/Location:	*IT-1*
Depth Boring drilled, bgs (ft):	21
Tested by:	AA
USCS Soil Type in test zone:	SM/ML
Weather (start to finish):	Sunny
Water Source/pH:	H2O Hydrant
Measured boring diameter:	8 in. — 4 in. Well Radius
Depth to GW or aquitard, bgs:	100 ft
Well Prep:	Drilled to 21 feet bgs ,pipe set at 20.14 ft bgs, bottom 10 foot screened and #3 sand placed around anulus to 10 ft bgs

Initial estimated Depth to Water Surface (in.):	210
Average depth of water in well, "h" (in.):	29
approx. h/r:	7.2
Tu (Fig. 8) (ft):	82.5
Tu>3h?:	yes, OK

Cross-sectional area for flow calcs based on Δh

Well pack sand porosity	0.3
Casing outer diameter, in.	2.3
Casing inner diameter, in.	2.1
Cross-sectional area, in.^2	17.3

	ft	in.	Total (in.)
Depth to bottom of well measured from top of c	20. ft	0. in.	240
Casing stickup measured above top of auger (or ground		1. in.	1
Depth to top of sand from top of casing	10. ft		

Depth of well bottom below top of casing (in): 241

Use of Barrels:	No
Use of Flow Meter:	No
Test Type:	Falling Head

Field Data | **Calculations**

Date	Time	Depth to WL in Boring (measured from top of casing)		Water Temp (deg F)	Refilled? (or Comments)	Δt (min)	Total Elapsed Time (min)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3)			Flow (in^3/ min)	q, Flow (in^3/ hr)	Average Infiltration Surface Area, (in^2)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date	Start time:											from supply	from Δh	Total						
11/7/2022	12:00	ft	in.																	
11/7/22	12:10	17.0					10	203.1	36.9											
11/7/22	12:12	17.2				2	12	204.8	35.2	-1.68	36	0	29	29	15	872		0.9	0.21	0.84
11/7/22	12:15	17.3				3	15	206.6	33.4	-1.8	34	0	31	31	10	623		0.9	0.16	0.63
11/7/22	12:20	17.56				5	20	209.7	30.3	-3.12	32	0	54	54	11	648		0.9	0.20	0.70
11/7/22	12:25	17.75				5	25	212.0	28.0	-2.28	29	0	39	39	8	473		0.9	0.16	0.56
11/7/22	12:35	18.13				10	35	216.6	23.4	-4.56	26	0	79	79	8	473		0.9	0.22	0.63
11/7/22	12:45	18.5				10	45	221.0	19.0	-4.44	21	0	77	77	8	461		0.9	0.29	0.73
11/7/22	12:55	19.24				10	55	229.9	10.1	-8.88	15	0	154	154	15	922		0.9	1.64	2.04
11/7/22	13:00	19.37				5	60	231.4	8.6	-1.56	9	0	27	27	5	324		0.9	0.60	1.05
					Refilled															
11/7/22	13:01	16.35					61	195.2	44.8											
11/7/22	13:03	16.60				2	63	198.2	41.8	-3	43	0	52	52	26	1557		0.9	0.28	1.26
11/7/22	13:05	16.69				2	65	199.3	40.7	-1.08	41	0	19	19	9	560		0.9	0.11	0.48
11/7/22	13:10	16.93				5	70	202.2	37.8	-2.88	39	0	50	50	10	598		0.9	0.13	0.53
11/7/22	13:20	17.32				10	80	206.8	33.2	-4.68	36	0	81	81	8	486		0.9	0.13	0.48
11/7/22	13:30	17.63				10	90	210.6	29.4	-3.72	31	0	64	64	6	386		0.9	0.12	0.43
11/7/22	13:40	17.89				10	100	213.7	26.3	-3.12	28	0	54	54	5	324		0.9	0.12	0.40
11/7/22	13:50	18.18				10	110	217.2	22.8	-3.48	25	0	60	60	6	361		0.9	0.17	0.50
11/7/22	14:00	18.48				10	120	220.8	19.2	-3.6	21	0	62	62	6	374		0.9	0.23	0.59
11/7/22	14:10	19.09				10	130	228.1	11.9	-7.32	16	0	127	127	13	760		0.9	1.01	1.59
11/7/22	14:15	19.3				5	135	230.6	9.4	-2.52	11	0	44	44	9	523		0.9	0.88	1.52
					Refilled															
11/7/22	14:17	16.37					137	195.4	44.6											
11/7/22	14:20	16.56				3	140	197.7	42.3	-2.28	43	0	39	39	13	789		0.9	0.14	0.64
11/7/22	14:25	16.78				5	145	200.4	39.6	-2.64	41	0	46	46	9	548		0.9	0.11	0.47
11/7/22	14:35	17.15				10	155	204.8	35.2	-4.44	37	0	77	77	8	461		0.9	0.11	0.43
11/7/22	14:40	17.52				5	160	209.2	30.8	-4.44	33	0	77	77	15	922		0.9	0.27	0.97
11/7/22	15:00	17.88				20	180	213.6	26.4	-4.32	29	0	75	75	4	224		0.9	0.08	0.27
11/7/22	15:10	18.08				10	190	216.0	24.0	-2.4	25	0	42	42	4	249		0.9	0.11	0.34
11/7/22	15:20	18.32				10	200	218.8	21.2	-2.88	23	0	50	50	5	299		0.9	0.16	0.45
					Refilled															
11/7/22	15:23	17.1					203	204.2	35.8											
11/7/22	15:25	17.21				2	205	205.5	34.5	-1.32	35	0	23	23	11	685		0.9	0.17	0.68
11/7/22	15:37	17.61				12	217	210.3	29.7	-4.8	32	0	83	83	7	415		0.9	0.13	0.45
11/7/22	15:45	17.82				8	225	212.8	27.2	-2.52	28	0	44	44	5	327		0.9	0.12	0.39
11/7/22	15:55	18.05				10	235	215.6	24.4	-2.76	26	0	48	48	5	286		0.9	0.12	0.38
11/7/22	16:05	18.3				10	245	218.6	21.4	-3	23	0	52	52	5	311		0.9	0.16	0.46
11/7/22	16:10	18.4				5	250	219.8	20.2	-1.2	21	0	21	21	4	249		0.9	0.14	0.40
																			Minimum Rate:	0.27
																			Raw Rate for design, prior to application of adjustment factors:	**0.58**

Results of Well Permeameter, from USBR 7300-89 Method

Project: 13693.001

Exploration #/Location: IT-2
Depth Boring drilled, bgs (ft): 15
Tested by: AA
USCS Soil Type in test zone: SM
Weather (start to finish): Rain
Water Source/pH: H2O
Measured boring diameter: 8 in. — 4 in. Well Radius
Depth to GW or aquitard, bgs: 100 ft
Well Prep: Drilled to 15 feet bgs ,pipe set at 15.15ft bgs, bottom 10 foot screened and #3 sand placed around anulus to 5 ft bgs

Initial estimated Depth to Water Surface (in.): 117
Average depth of water in well, "h" (in.): 63
approx. h/r: 15.8
Tu (Fig. 8) (ft): 90.2
Tu>3h?: yes, OK

Cross-sectional area for flow calcs based on Δh
Well pack sand porosity: 0.3
Casing outer diameter, in.: 2.3
Casing inner diameter, in.: 2.1
Cross-sectional area, in.^2: 17.3

	ft	in.	Total (in.)
Depth to bottom of well measured from top of auger (or ground surface)	15.1 ft	0. in.	181
Casing stickup measured above top of auger (or ground surface) (+ is up)	0. ft	1. in.	1
Depth to top of sand from top of casing	5. ft	0. in.	

Depth of well bottom below top of casing (in): 182

Use of Barrels: No
Use of Flow Meter: Yes
Test Type: Constant Head

Flow Meter ID: 2497 Meter Units: Gallons 0.05 gallons/pulse Data logger ID:

Field Data / **Calculations**

Date	Time	Water Level in Supply Barrel (in.)	Data from Flow Meter: Reading (gallons)	Interval Pulse Count	Depth to WL in Boring (measured from top of casing) ft	in.	Water Temp (deg F)	Refilled? (or Comments)	Δt (min)	Total Elapsed Time (min)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3) from supply	from Δh	Total	Flow (in^3/min)	q, Flow (in^3/hr)	Average Infiltration Surface Area, (in^2)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date 11/7/2022	Start time: 7:30		Gallons																				
11/7/22	7:49		1786.97		10.3					19	122.6	58.6											
11/7/22	7:51		1787.82		10.19				2	21	121.3	59.9	1.32	59	196	-23	174	87	5206		0.9	0.52	3.12
11/7/22								Adjusted Flow															
11/7/22	7:54		1788.66		10.06					24	119.7	61.5											
11/7/22	7:56		1789.41		9.96				2	26	118.5	62.7	1.2	62	173	-21	152	76	4575		0.9	0.43	2.62
11/7/22	7:58		1790.07		9.93				2	28	118.2	63.0	0.36	63	152	-6	146	73	4387		0.9	0.41	2.48
11/7/22	8:00		1790.66		9.88				2	30	117.6	63.6	0.6	63	136	-10	126	63	3777		0.9	0.34	2.12
11/7/22								Adjusted Flow															
11/7/22	8:05		1791.44		10.33					35	123.0	58.2											
11/7/22	8:08		1792.11		10.51				3	38	125.1	56.1	-2.16	57	155	37	192	64	3843		0.9	0.43	2.38
11/7/22	8:10		1792.73		10.18				2	40	121.2	60.0	3.96	58	143	-68	75	37	2242		0.9	0.22	1.37
11/7/22	8:15		1793.74		10.23				5	45	121.8	59.4	-0.6	60	233	10	244	49	2924		0.9	0.30	1.74
11/7/22	8:20		1794.18		10.22				5	50	121.6	59.6	0.12	60	102	-2	100	20	1195		0.9	0.12	0.71
11/7/22	8:30		1796.32		10.14				10	60	120.7	60.5	0.96	60	494	-17	478	48	2866		0.9	0.28	1.69
11/7/22	8:40		1798.37		10.07				10	70	119.8	61.4	0.84	61	474	-15	459	46	2754		0.9	0.27	1.61
11/7/22	8:50		1800.54		10.01				10	80	119.1	62.1	0.72	62	501	-12	489	49	2933		0.9	0.28	1.69
11/7/22	9:00		1802.68		9.97				10	90	118.6	62.6	0.48	62	494	-8	486	49	2916		0.9	0.27	1.66
11/7/22	9:10		1804.8		9.91				10	100	117.9	63.3	0.72	63	490	-12	477	48	2864		0.9	0.26	1.62
11/7/22	9:20		1806.95		9.89				10	110	117.7	63.5	0.24	63	497	-4	492	49	2955		0.9	0.27	1.66
11/7/22	9:30		1809.09		9.87				10	120	117.4	63.8	0.24	64	494	-4	490	49	2941		0.9	0.27	1.64
11/7/22	9:40		1811.23		9.83				10	130	117.0	64.2	0.48	64	494	-8	486	49	2916		0.9	0.26	1.62
11/7/22	9:50		1813.38		9.82				10	140	116.8	64.4	0.12	64	497	-2	495	49	2967		0.9	0.27	1.64
11/7/22	10:00		1815.53		9.79				10	150	116.5	64.7	0.36	65	497	-6	490	49	2943		0.9	0.26	1.62
11/7/22	10:11		1817.89		9.76				11	161	116.1	65.1	0.36	65	545	-6	539	49	2940		0.9	0.26	1.61
11/7/22	10:20		1819.81		9.75				9	170	116.0	65.2	0.12	65	444	-2	441	49	2943		0.9	0.26	1.61
11/7/22	10:30		1821.9		9.74				10	180	115.9	65.3	0.12	65	483	-2	481	48	2884		0.9	0.25	1.57
11/7/22	10:40		1824.03		9.72				10	190	115.6	65.6	0.24	65	492	-4	488	49	2927		0.9	0.25	1.59
11/7/22	10:50		1826.17		9.69				10	200	115.3	65.9	0.36	66	494	-6	488	49	2929		0.9	0.25	1.59
11/7/22	11:00		1828.31		9.68				10	210	115.2	66.0	0.12	66	494	-2	492	49	2954		0.9	0.25	1.59
11/7/22	11:10		1830.46		9.67				10	220	115.0	66.2	0.12	66	497	-2	495	49	2967		0.9	0.25	1.60
11/7/22	11:20		1832.57		9.64				10	230	114.7	66.5	0.36	66	487	-6	481	48	2887		0.9	0.25	1.55
11/7/22	11:30		1834.7		9.63				10	240	114.6	66.6	0.12	67	492	-2	490	49	2940		0.9	0.25	1.57
																					Minimum Rate:		0.71
																					Raw Rate for design, prior to application of adjustment factors:		**1.57**

Results of Falling Head Infiltration Test

Project: 13693.001

Exploration #/Location: IT-3
Depth Boring drilled, bgs (ft): 48
Tested by: AA
USCS Soil Type in test zone: SP/ML
Weather (start to finish): Sunny
Water Source/pH: H2O Hydrant
Measured boring diameter: 8 in. 4 in. Well Radius
Depth to GW or aquitard, bgs: 100 ft
Well Prep: Drilled to 48 feet bgs ,pipe set at 48.3 ft bgs, bottom 10 foot screened and #3 sand placed around anulus to 38 ft bgs

Initial estimated Depth to Water Surface (in.): 514
Average depth of water in well, "h" (in.): 39
approx. h/r: 9.7
Tu (Fig. 8) (ft): 57.2
Tu>3h?: yes, OK

Cross-sectional area for flow calcs based on Δh
Well pack sand porosity: 0.3
Casing outer diameter, in.: 2.3
Casing inner diameter, in.: 2.1
Cross-sectional area, in.^2: 17.3

Use of Barrels: No
Use of Flow Meter: No
Test Type: Falling Head

	ft	in.	Total (in.)
Depth to bottom of well measured from top of a[uger]	48.3 ft	0. in.	580
Casing stickup measured above top of auger (	2. ft	3. in.	27
Depth to top of sand from top of casing	38. ft		

Depth of well bottom below top of casing (in): 607

Flow Meter ID: 0.05 gallons/pulse
Data logger ID:

Field Data / **Calculations**

Date	Time	Depth to WL in Boring (measured from top of casing) ft	in.	Water Temp (deg F)	Refilled? (or Comments)	Δt (min)	Total Elapsed Time (min)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3) from supply	from Δh	Total	Flow (in^3/ min)	q, Flow (in^3/ hr)	Average Infiltration Surface Area, (in^2)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date 11/4/2022	Start time: 11:00																			
11/4/22	11:33	45.67					33	521.0	58.6											
11/4/22	11:35	45.9				2	35	523.7	55.9	-2.64	57	0	46	46	23	1370		0.9	0.16	0.85
11/4/22	11:37	46.08				2	37	526.0	53.6	-2.28	55	0	39	39	20	1183		0.9	0.14	0.76
11/4/22	11:40	46.34				3	40	529.1	50.5	-3.12	52	0	54	54	18	1079		0.9	0.14	0.73
11/4/22	11:42	46.46				2	42	530.5	49.1	-1.44	50	0	25	25	12	747		0.9	0.10	0.53
11/4/22	11:45	46.68				3	45	533.2	46.4	-2.64	48	0	46	46	15	913		0.9	0.14	0.67
11/4/22	11:48	46.86				3	48	535.3	44.3	-2.16	45	0	37	37	12	747		0.9	0.12	0.58
11/4/22	11:51	47.07				3	51	537.8	41.8	-2.52	43	0	44	44	15	872		0.9	0.16	0.71
11/4/22	11:55	47.30				4	55	540.6	39.0	-2.76	40	0	48	48	12	716		0.9	0.15	0.62
11/4/22	12:00	47.59				5	60	544.1	35.5	-3.48	37	0	60	60	12	722		0.9	0.17	0.67
11/4/22	12:05	47.92				5	65	548.0	31.6	-3.96	34	0	68	68	14	822		0.9	0.23	0.85
11/4/22	12:09	48.31				4	69	552.7	26.9	-4.68	29	0	81	81	20	1214		0.9	0.45	1.43
11/4/22	12:15	49.15				6	75	562.8	16.8	-10.08	22	0	174	174	29	1744		0.9	1.42	2.68
11/4/22	12:20	49.75				5	80	570.0	9.6	-7.2	13	0	125	125	25	1494		0.9	2.78	3.61
					Refilled															
11/4/22	12:25	44.77					85	510.2	69.4											
11/4/22	12:30	45.55				5	90	519.6	60.0	-9.36	65	0	162	162	32	1943		0.9	0.20	1.07
11/4/22	12:37	45.7				7	97	521.4	58.2	-1.8	59	0	31	31	4	267		0.9	0.03	0.16
11/4/22	12:40	45.75				3	100	522.0	57.6	-0.6	58	0	10	10	3	208		0.9	0.02	0.13
11/4/22	12:45	45.88				5	105	523.6	56.0	-1.56	57	0	27	27	5	324		0.9	0.04	0.20
11/4/22	12:49	45.97				4	109	524.6	55.0	-1.08	55	0	19	19	5	280		0.9	0.03	0.18
11/4/22	12:55	46.12				6	115	526.4	53.2	-1.8	54	0	31	31	5	311		0.9	0.04	0.20
11/4/22	13:05	46.3				10	125	528.6	51.0	-2.16	52	0	37	37	4	224		0.9	0.03	0.15
11/4/22	13:15	46.46				10	135	530.5	49.1	-1.92	50	0	33	33	3	199		0.9	0.03	0.14
11/4/22	13:25	46.64				10	145	532.7	46.9	-2.16	48	0	37	37	4	224		0.9	0.03	0.16
11/4/22	13:35	46.78				10	155	534.4	45.2	-1.68	46	0	29	29	3	174		0.9	0.03	0.13
11/4/22	13:45	46.89				10	165	535.7	43.9	-1.32	45	0	23	23	2	137		0.9	0.02	0.11
11/4/22	13:58	47.05				13	178	537.6	42.0	-1.92	43	0	33	33	3	153		0.9	0.03	0.13
11/4/22	14:08	47.17				10	188	539.0	40.6	-1.44	41	0	25	25	2	149		0.9	0.03	0.13
11/4/22	14:15	47.24				7	195	539.9	39.7	-0.84	40	0	15	15	2	125		0.9	0.02	0.11
11/4/22	14:25	47.35				10	205	541.2	38.4	-1.32	39	0	23	23	2	137		0.9	0.03	0.12
11/4/22	14:40	47.5				15	220	543.0	36.6	-1.8	37	0	31	31	2	125		0.9	0.03	0.12
11/4/22	14:50	47.59				10	230	544.1	35.5	-1.08	36	0	19	19	2	112		0.9	0.03	0.11
11/4/22	15:00	47.7				10	240	545.4	34.2	-1.32	35	0	23	23	2	137		0.9	0.03	0.14
11/4/22	15:10	47.77				10	250	546.2	33.4	-0.84	34	0	15	15	1	87		0.9	0.02	0.09
11/4/22	15:20	47.87				10	260	547.4	32.2	-1.2	33	0	21	21	2	125		0.9	0.03	0.13
11/4/22	15:30	47.97				10	270	548.6	31.0	-1.2	32	0	21	21	2	125		0.9	0.04	0.14
11/4/22	15:40	48.07				10	280	549.8	29.8	-1.2	30	0	21	21	2	125		0.9	0.04	0.14
11/4/22	15:50	48.15				10	290	550.8	28.8	-0.96	29	0	17	17	2	100		0.9	0.03	0.12
11/4/22	16:00	48.25				10	300	552.0	27.6	-1.2	28	0	21	21	2	125		0.9	0.04	0.15
11/4/22	16:10	48.36				10	310	553.3	26.3	-1.32	27	0	23	23	2	137		0.9	0.05	0.17
11/4/22	16:20	48.51				10	320	555.1	24.5	-1.8	25	0	31	31	3	187		0.9	0.08	0.25
11/4/22	16:30	48.77				10	330	558.2	21.4	-3.12	23	0	54	54	5	324		0.9	0.17	0.48
11/4/22	16:40	49				10	340	561.0	18.6	-2.76	20	0	48	48	5	286		0.9	0.18	0.48
11/4/22	16:50	49.18				10	350	563.2	16.4	-2.16	18	0	37	37	4	224		0.9	0.17	0.42
11/4/22	17:00	49.35				10	360	565.2	14.4	-2.04	15	0	35	35	4	212		0.9	0.19	0.45
11/4/22	17:10	49.54				10	370	567.5	12.1	-2.28	13	0	39	39	4	237		0.9	0.28	0.57
																			Minimum Rate:	0.09
																			Raw Rate for design, prior to application of adjustment factors:	**0.20**

APPENDIX C

LABORATORY TEST RESULTS

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Madison Flats/Geo	Tested By:	F. Mina	Date:	11/16/22
Project No.:	13693.001	Input By:	M. Vinet	Date:	11/17/22
Boring No.:	LB-3	Depth (ft.):	0 - 5.0		
Sample No.:	B-1				
Soil Identification:	Silty Sand (SM), Yellowish Brown.				

Preparation Method: [X] Moist [ ] Dry — [X] Mechanical Ram [ ] Manual Ram

Mold Volume (ft³) 0.03340

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

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	5590	5700	5745	5652		
Weight of Mold (g)	3528	3528	3528	3528		
Net Weight of Soil (g)	2062	2172	2217	2124		
Wet Weight of Soil + Cont. (g)	1518.4	1427.4	1485.8	1395.4		
Dry Weight of Soil + Cont. (g)	1463.8	1355.8	1390.0	1288.4		
Weight of Container (g)	279.9	277.6	278.9	276.5		
Moisture Content (%)	4.6	6.6	8.6	10.6		
Wet Density (pcf)	136.1	143.4	146.3	140.2		
Dry Density (pcf)	130.1	134.4	134.7	126.8		

Maximum Dry Density (pcf) 135.3 **Optimum Moisture Content (%)** 7.8

PROCEDURE USED

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

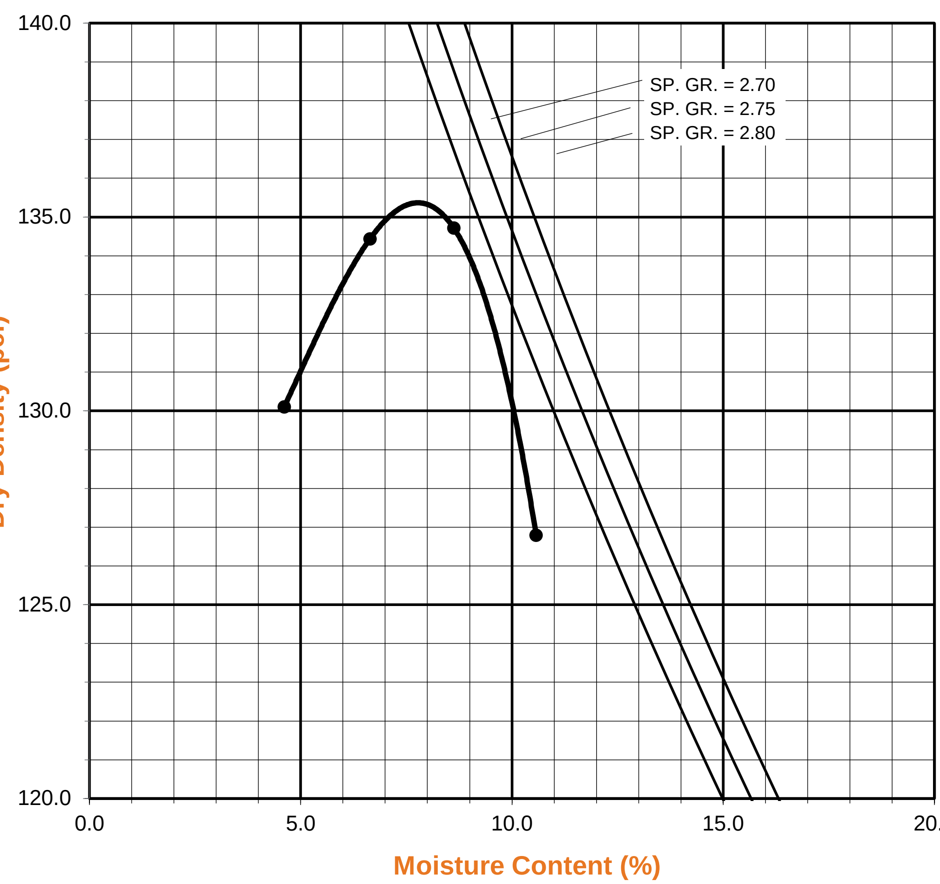
[X] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

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

Particle-Size Distribution:
7:52:41
GR:SA:FI

Atterberg Limits:

LL,PL,PI



Leighton

PARTICLE-SIZE DISTRIBUTION (GRADATION) of SOILS USING SIEVE ANALYSIS

ASTM D 6913

Project Name:	Madison Flats/Geo	Tested By:	MRV	Date:	11/16/22
Project No.:	13693.001	Checked By:	MRV	Date:	11/17/22
Boring No.:	LB-3	Depth (feet):	0 - 5.0		
Sample No.:	B-1				
Soil Identification:	Silty Sand (SM), Yellowish Brown.				

Calculation of Dry Weights	Whole Sample	Sample Passing #4	Moisture Contents	Whole Sample	Sample passing #4
Container No.:	BA	BA	Wt. of Air-Dry Soil + Cont.(g)	1382.5	589.7
Wt. Air-Dried Soil + Cont.(g)	1382.5	589.7	Wt. of Dry Soil + Cont. (g)	1334.3	589.7
Wt. of Container (g)	278.7	278.7	Wt. of Container No.______(g)	278.7	278.7
Dry Wt. of Soil (g)	1055.3	311.0	Moisture Content (%)	4.6	0.0

Passing #4 Material After Wet Sieve	Container No.	BA
	Wt. of Dry Soil + Container (g)	467.1
	Wt. of Container (g)	278.7
	Dry Wt. of Soil Retained on # 200 Sieve (g)	188.4

U. S. Sieve Size		Cumulative Weight of Dry Soil Retained (g)		Percent Passing (%)
	(mm.)	Whole Sample	Sample Passing #4	
1 1/2"	37.500			100.0
1"	25.000			100.0
3/4"	19.000	0.0		100.0
1/2"	12.500	22.9		97.8
3/8"	9.500	36.3		96.6
#4	4.750	71.0		93.3
#8	2.360		18.2	87.8
#16	1.180		52.0	77.7
#30	0.600		80.6	69.1
#50	0.300		111.4	59.9
#100	0.150		142.1	50.7
#200	0.075		175.0	40.8
PAN				

GRAVEL: **7 %**

SAND: **52 %**

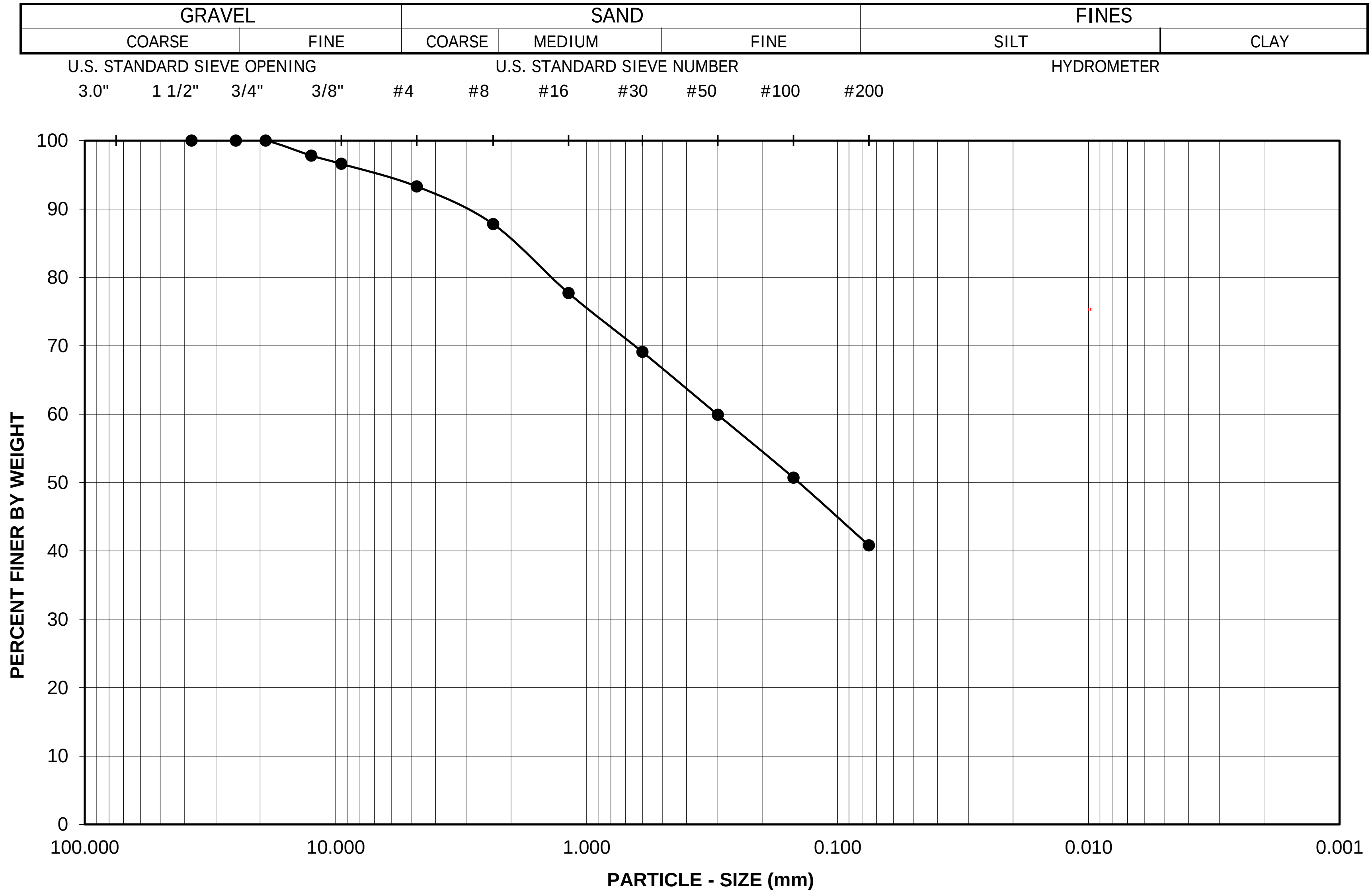
FINES: **41 %**

GROUP SYMBOL: **SM**

Cu = D60/D10 = N/A

Cc = $(D30)^2/(D60*D10)$ = N/A

Remarks:



Project Name: Madison Flats/Geo

Project No.: 13693.001

Boring No.: LB-3

Sample No.: B-1

Depth (feet): 0 - 5.0

Soil Type : SM

Soil Identification: Silty Sand (SM), Yellowish Brown.

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 6913

GR:SA:FI : (%) 7 : 52 : 41

Nov-22

Sieve; LB-3, B-1 (11-03-22)

Boring No.	LB-1	LB-2	LB-3	LB-3	LB-6	LB-7	IT-1	IT-1
Sample No.	S-1	R-2	R-3	S-1	R-4	R-2	S-2	S-3
Depth (ft.)	15.0	5.0	7.5	15.0	10.0	5.0	17.0	20.0
Sample Type	SPT	RING	RING	SPT	RING	RING	SPT	SPT
Soil Classification	SP	SC	SC	SP	SM	SM	SM	SM
Soak Time (min)	10	10	10	10	10	10	10	10
Moisture Correction								
Wet Weight of Soil + Container (gm.)	634.1	609.5	606.9	629.7	622.2	616.0	609.4	550.0
Dry Weight of Soil + Container (gm.)	628.6	595.0	587.1	624.6	605.0	607.0	593.6	528.7
Weight of Container (gm)	279.5	280.5	276.4	280.2	278.0	278.2	278.1	278.1
Moisture Content (%)	1.6	4.6	6.4	1.5	5.3	2.7	5.0	8.5
Container No.:	PO	WO	R2	M	MA	86	K2	BA
Sample Dry Weight Determination								
Weight of Sample + Container (gm.)	628.6	595.0	587.1	624.6	605.0	607.0	593.6	528.7
Weight of Container (gm.)	279.5	280.5	276.4	280.2	278.0	278.2	278.1	278.1
Weight of Dry Sample (gm.)	349.1	314.5	310.7	344.4	327.0	328.8	315.5	250.6
Container No.:	PO	WO	R2	M	MA	86	K2	BA
After Wash								
Dry Weight of Sample + Container (gm)	609.8	467.6	456.7	607.1	458.1	549.2	521.6	432.4
Weight of Container (gm)	279.5	280.5	276.4	280.2	278.0	278.2	278.1	278.1
Dry Weight of Sample (gm)	330.3	187.1	180.3	326.9	180.1	271.0	243.5	154.3
% Passing No. 200 Sieve	**5**	**41**	**42**	**5**	**45**	**18**	**23**	**38**
% Retained No. 200 Sieve	95	59	58	95	55	82	77	62

Leighton

PERCENT PASSING
No. 200 SIEVE
ASTM D 1140

Project Name: Madison Flats/Geo
Project No.: 13693.001
Client Name: Gilbane Development Company
Tested By: M. Vinet Date: 11/15/22

Boring No.	IT-2	IT-3						
Sample No.	S-2	S-3						
Depth (ft.)	13.5	47.0						
Sample Type	SPT	SPT						
Soil Classification	s(ML)	SM						
Soak Time (min)	10	10						
Moisture Correction								
Wet Weight of Soil + Container (gm.)	615.1	606.2						
Dry Weight of Soil + Container (gm.)	581.7	593.6						
Weight of Container (gm)	278.1	278.2						
Moisture Content (%)	11.0	4.0						
Container No.:	BL	AB						
Sample Dry Weight Determination								
Weight of Sample + Container (gm.)	581.7	593.6						
Weight of Container (gm.)	278.1	278.2						
Weight of Dry Sample (gm.)	303.6	315.4						
Container No.:	BL	AB						
After Wash								
Dry Weight of Sample + Container (gm)	414.0	545.2						
Weight of Container (gm)	278.1	278.2						
Dry Weight of Sample (gm)	135.9	267.0						
% Passing No. 200 Sieve	**55**	**15**						
% Retained No. 200 Sieve	45	85						

Leighton

PERCENT PASSING
No. 200 SIEVE
ASTM D 1140

Project Name: Madison Flats/Geo
Project No.: 13693.001
Client Name: Gilbane Development Company
Tested By: M. Vinet Date: 11/15/22

ATTERBERG LIMITS

ASTM D 4318

Leighton

Project Name:	Madison Flats/Geo	Tested By:	F. Mina	Date:	11/16/22
Project No. :	13693.001	Input By:	M. Vinet	Date:	11/17/22
Boring No.:	LB-2	Checked By:	M. Vinet		
Sample No.:	R-2	Depth (ft.)	5.0		
Soil Identification:	Clayey Sand (SC), Dark Yellowish Brown.				

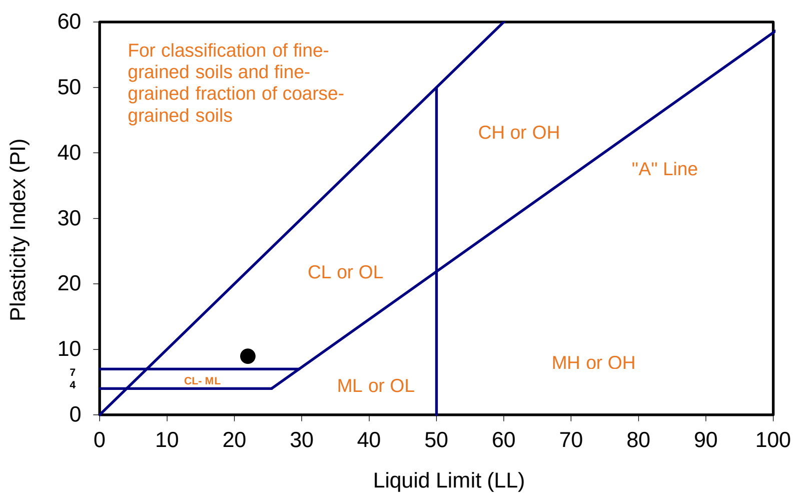
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			15	23	35	
Wet Wt. of Soil + Cont. (g)	23.53	23.59	21.89	23.04	24.99	
Dry Wt. of Soil + Cont. (g)	22.42	22.44	20.30	21.34	23.00	
Wt. of Container (g)	13.74	13.81	13.66	13.80	13.67	
Moisture Content (%) [Wn]	12.79	13.33	23.95	22.55	21.33	

Liquid Limit	**22**
Plastic Limit	**13**
Plasticity Index	**9**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) | 1.46

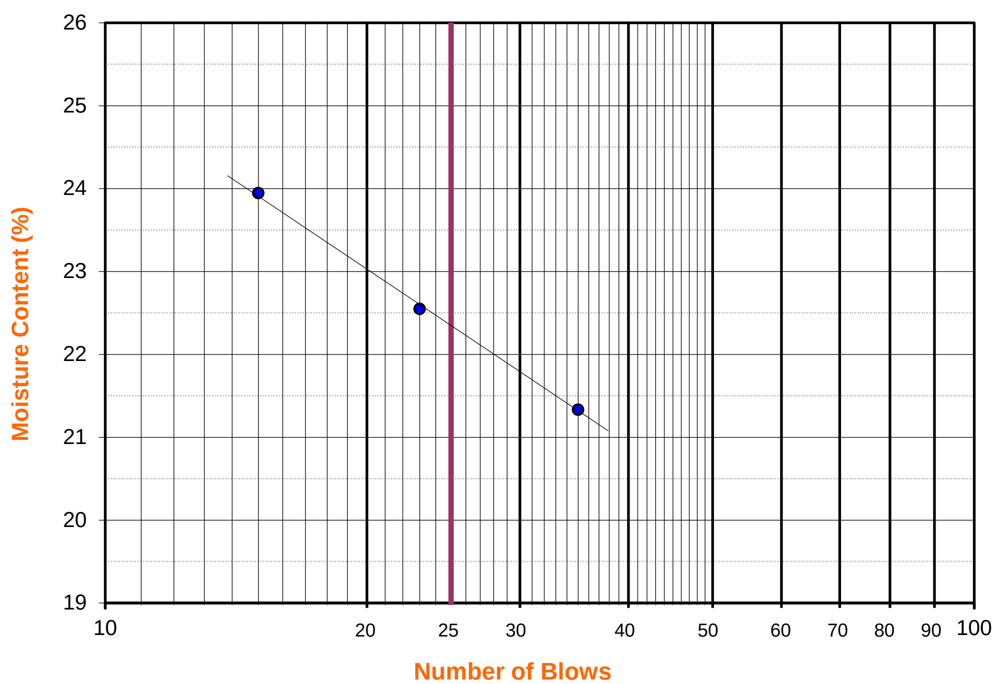
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation — Multipoint - Wet
- [x] Dry Preparation — Multipoint - Dry
- [x] Procedure A — Multipoint Test
- [ ] Procedure B — One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	Madison Flats/Geo	Tested By:	F. Mina	Date:	11/16/22
Project No. :	13693.001	Input By:	M. Vinet	Date:	11/17/22
Boring No.:	LB-3	Checked By:	M. Vinet		
Sample No.:	R-3	Depth (ft.)	7.5		
Soil Identification:	Clayey Sand (SC), Dark Yellowish Brown.				

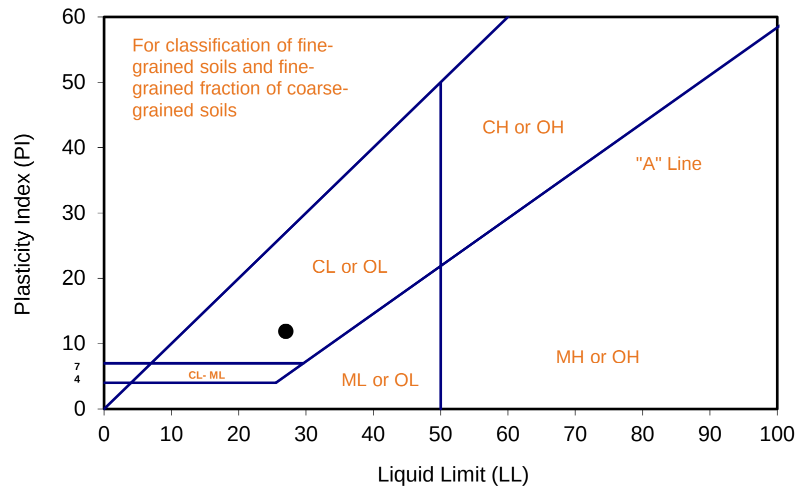
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			15	25	35	
Wet Wt. of Soil + Cont. (g)	23.40	24.81	21.51	22.21	24.26	
Dry Wt. of Soil + Cont. (g)	22.16	23.31	19.78	20.38	22.11	
Wt. of Container (g)	13.69	13.69	13.69	13.60	13.78	
Moisture Content (%) [Wn]	14.64	15.59	28.41	26.99	25.81	

Liquid Limit	**27**
Plastic Limit	**15**
Plasticity Index	**12**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 5.11

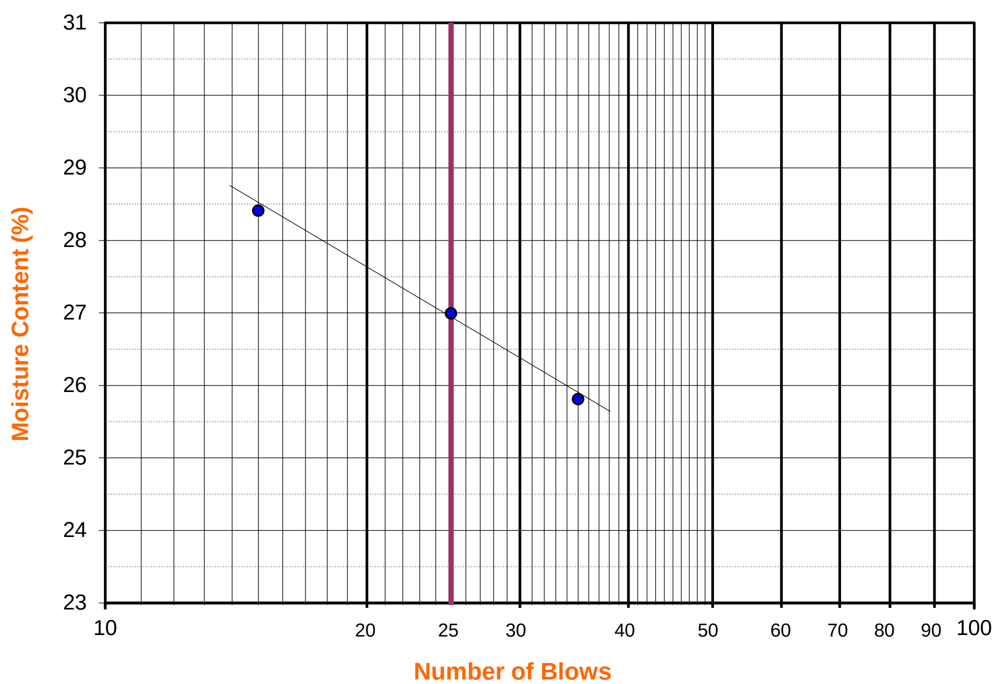
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation Multipoint - Wet
- [X] Dry Preparation Multipoint - Dry
- [X] Procedure A Multipoint Test
- [ ] Procedure B One-point Test



ATTERBERG LIMITS

ASTM D 4318

Leighton

Project Name:	Madison Flats/Geo	Tested By:	F. Mina	Date:	11/16/22
Project No. :	13693.001	Input By:	M. Vinet	Date:	11/17/22
Boring No.:	LB-6	Checked By:	M. Vinet		
Sample No.:	R-4	Depth (ft.)	10.0		
Soil Identification:	Silty Sand (SM), Dark Yellowish Brown.				

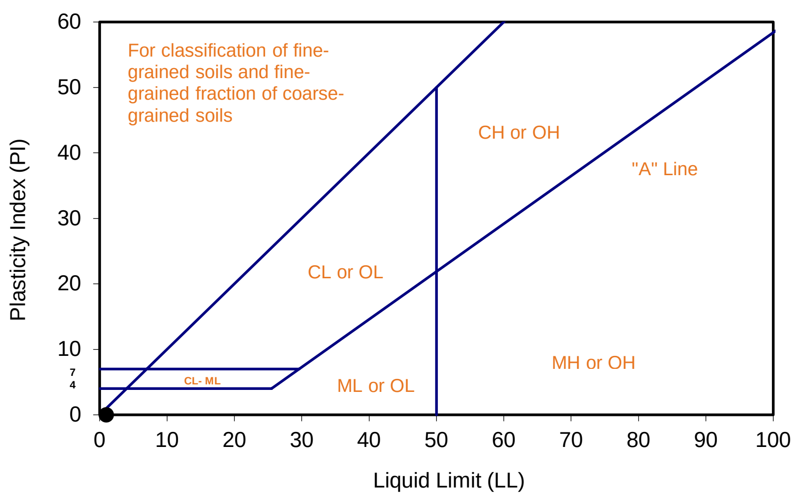
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]						
Wet Wt. of Soil + Cont. (g)	Non-Plastic (NP)		Non-Plastic (NP)			
Dry Wt. of Soil + Cont. (g)						
Wt. of Container (g)						
Moisture Content (%) [Wn]						

Liquid Limit	**NP**
Plastic Limit	**NP**
Plasticity Index	**NP**
Classification	**SM**

PI at "A" - Line = 0.73(LL-20) | #VALUE!

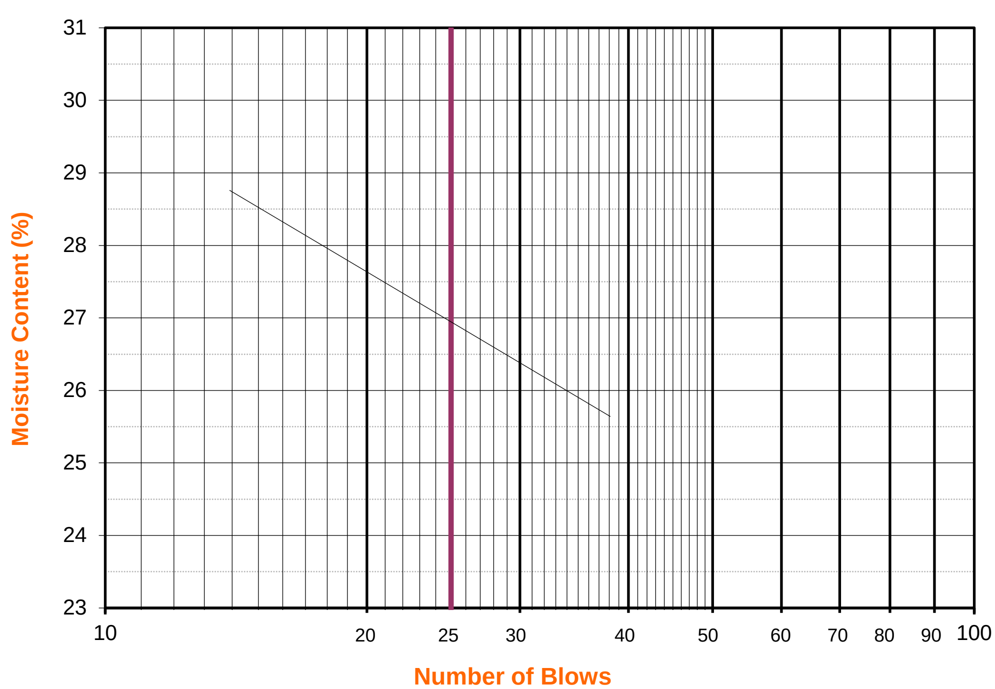
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation — Multipoint - Wet
- [X] Dry Preparation — Multipoint - Dry
- [X] Procedure A — Multipoint Test
- [ ] Procedure B — One-point Test



One-Dimensional Swell or Settlement Potential of Cohesive Soils

(ASTM D 4546) -- Method 'B'

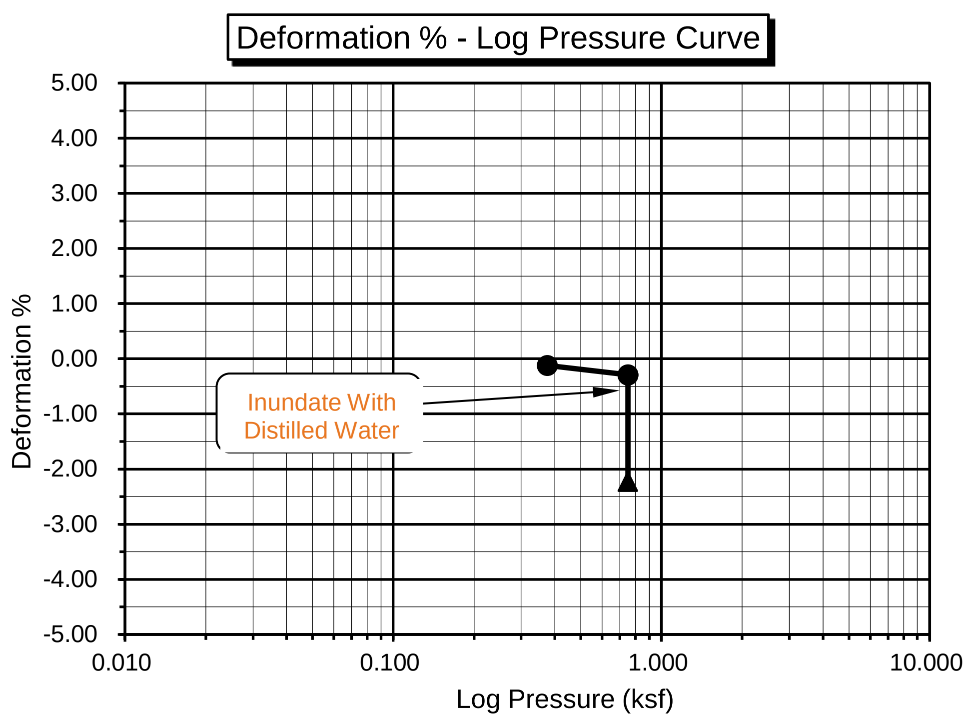
Project Name: Madison Flats/Geo
Project No.: 13693.001
Boring No.: LB-5
Sample No.: R-2
Tested By: M. Vinet Date: 11/15/22
Checked By: M. Vinet Date: 11/17/22
Sample Type: IN SITU
Depth (ft.) 5.0
Sample Description: Silty Sand (SM), Dark Yellowish Brown.
Source and Type of Water Used for Inundation: Arrowhead (Distilled)
** Note: Loading After Wetting (Inundation) not Performed Using this Test Method.

Initial Dry Density (pcf):	110.9
Initial Moisture (%):	6.1
Initial Height (in.):	1.0000
Initial Dial Reading (in):	0.0000
Inside Diameter of Ring (in):	2.416

Final Dry Density (pcf):	113.5
Final Moisture (%) :	14.5
Initial Void ratio:	0.5194
Specific Gravity (assumed):	2.70
Initial Degree of Saturation (%):	31.5

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.375	0.0012	0.9988	0.00	-0.12	0.5176	-0.12
0.750	0.0029	0.9971	0.00	-0.29	0.5150	-0.29
H2O	0.0223	0.9777	0.00	-2.23	0.4855	-2.23

Percent Swell / Settlement After Inundation = -1.95



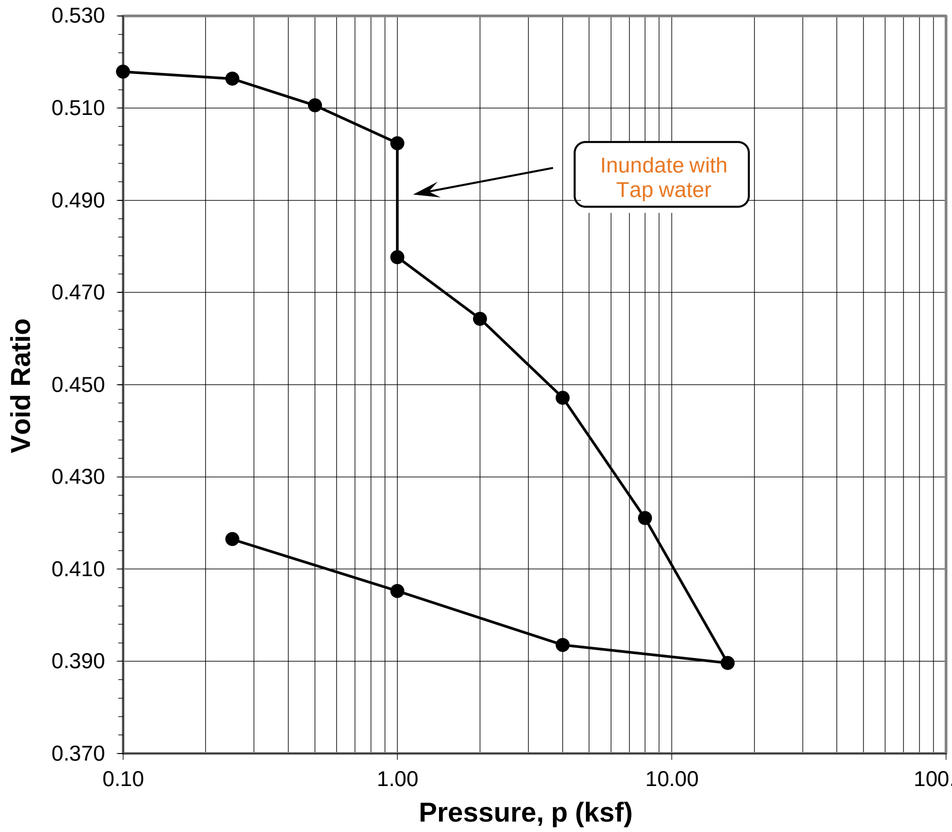
Rev. 01-10

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project Name:	Madison Flats/Geo	Tested By:	M. Vinet	Date:	11/14/22
Project No.:	13693.001	Checked By:	M. Vinet	Date:	11/23/22
Boring No.:	LB-3	Depth (ft.):	5.0		
Sample No.:	R-2	Sample Type:	Ring		
Soil Identification:	Sandy Silt s(ML), Brown.				

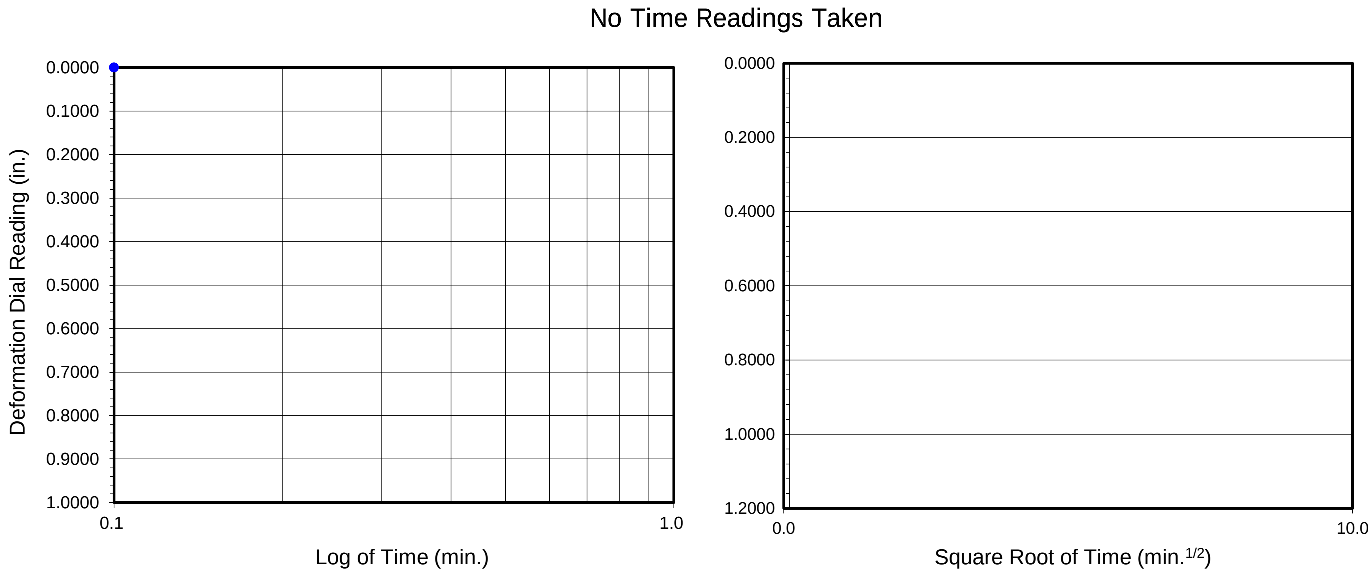
Sample Diameter (in.):	2.415
Sample Thickness (in.):	1.000
Weight of Sample + ring (g):	189.40
Weight of Ring (g):	42.46
Height after consol. (in.):	0.9332
Before Test	
Wt. of Wet Sample+Cont. (g):	347.58
Wt. of Dry Sample+Cont. (g):	321.41
Weight of Container (g):	49.88
Initial Moisture Content (%)	9.6
Initial Dry Density (pcf)	111.5
Initial Saturation (%):	50
Initial Vertical Reading (in.)	0.0000
After Test	
Wt. of Wet Sample+Cont. (g):	247.00
Wt. of Dry Sample+Cont. (g):	226.26
Weight of Container (g):	50.44
Final Moisture Content (%)	15.55
Final Dry Density (pcf):	118.8
Final Saturation (%):	100
Final Vertical Reading (in.)	0.0668
Specific Gravity (assumed):	2.71
Water Density (pcf):	62.43

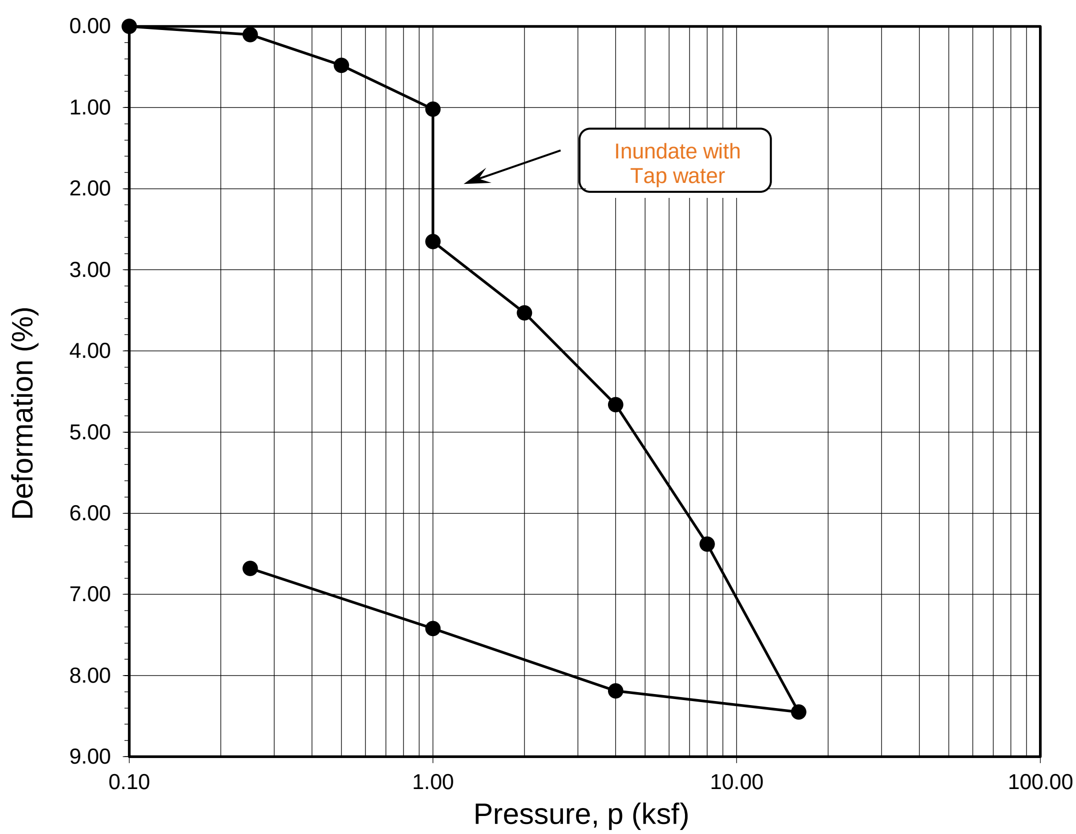


Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.0000	1.0000	0.00	0.00	0.518	0.00
0.25	0.0010	0.9990	0.00	0.10	0.516	0.10
0.50	0.0048	0.9952	0.00	0.48	0.511	0.48
1.00	0.0102	0.9898	0.00	1.02	0.502	1.02
1.00	0.0265	0.9735	0.00	2.65	0.478	2.65
2.00	0.0353	0.9647	0.00	3.53	0.464	3.53
4.00	0.0466	0.9534	0.00	4.66	0.447	4.66
8.00	0.0638	0.9362	0.00	6.38	0.421	6.38
16.00	0.0845	0.9155	0.00	8.45	0.390	8.45
4.00	0.0819	0.9181	0.00	8.19	0.394	8.19
1.00	0.0742	0.9258	0.00	7.42	0.405	7.42
0.25	0.0668	0.9332	0.00	6.68	0.416	6.68

No Time Readings Taken

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)





Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-3	**R-2**	**5**	**9.6**	**15.6**	**111.5**	**118.8**	**0.518**	**0.416**	**50**	**100**

Soil Identification: Sandy Silt s(ML), Brown.

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 13693.001

Madison Flats/Geo

11-22

Leighton

EXPANSION INDEX of SOILS

ASTM D 4829

Project Name:	Madison Flats/Geo	Tested By:	M. Vinet	Date:	11/16/22
Project No. :	13693.001	Checked By:	M. Vinet	Date:	11/17/22
Boring No.:	LB-6	Depth:	0 - 5.0		
Sample No. :	B-1	Location:	N/A		
Sample Description:	Sandy Silt s(ML), Dark Reddish Brown.				

Dry Wt. of Soil + Cont. (gm.)	3522.2
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	3522.2
Weight Soil Retained on #4 Sieve	80.2
Percent Passing # 4	97.7

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0082
Wt. Comp. Soil + Mold (gm.)	597.4	619.6
Wt. of Mold (gm.)	177.7	177.7
Specific Gravity (Assumed)	2.70	2.70
Container No.	7	7
Wet Wt. of Soil + Cont. (gm.)	629.3	619.6
Dry Wt. of Soil + Cont. (gm.)	605.8	386.8
Wt. of Container (gm.)	329.3	177.7
Moisture Content (%)	8.5	14.2
Wet Density (pcf)	126.6	132.2
Dry Density (pcf)	116.7	115.7
Void Ratio	0.445	0.457
Total Porosity	0.308	0.313
Pore Volume (cc)	63.7	65.4
Degree of Saturation (%) [S meas]	**51.6**	**84.2**

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

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
11/16/22	10:15	1.0	0	0.5000
11/16/22	10:25	1.0	10	0.5000
	Add Distilled Water to the Specimen			
11/17/22	8:00	1.0	1295	0.5082
11/17/22	9:00	1.0	1355	0.5082

Expansion Index (EI meas) =	((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	8.2
Expansion Index (Report) =	Nearest Whole Number or Zero (0) if Initial Height is > than Final Heigh	**8**

Rev. 03-08

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TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: Madison Flats/Geo   Tested By : M. Vinet   Date: 11/17/22

Project No. : 13693.001   Data Input By: M. Vinet   Date: 11/17/22

Boring No.	LB-3			
Sample No.	B-1			
Sample Depth (ft)	0 - 5.0			
Soil Identification:	Silty Sand (SM)			
Wet Weight of Soil + Container (g)	100.0			
Dry Weight of Soil + Container (g)	100.0			
Weight of Container (g)	0.0			
Moisture Content (%)	0.0			
Weight of Soaked Soil (g)	100.0			

SULFATE CONTENT, Hach Kit Method

Dilution : 1	3			
Water Fraction (ml)	25			
Tube Reading	60			
PPM Sulfate	**180**			
% Sulfate	0.0180			

CHLORIDE CONTENT, DOT California Test 422

ml of Extract For Titration (B)	30			
ml of AgNO3 Soln. Used in Titration (C)	0.6			
PPM of Chloride (C -0.2) * 100 * 30 / B	40			
PPM of Chloride, Dry Wt. Basis	**40**			

pH TEST, DOT California Test 643

pH Value	**7.60**			
Temperature °C	21.0			

SOIL RESISTIVITY TEST
DOT CA TEST 643

Project Name:	Madison Flats/Geo	Tested By :	M. Vinet	Date:	11/17/22
Project No. :	13693.001	Data Input By:	M. Vinet	Date:	11/17/22
Boring No.:	LB-3	Depth (ft.) :	0 - 5.0		
Sample No. :	B-1				

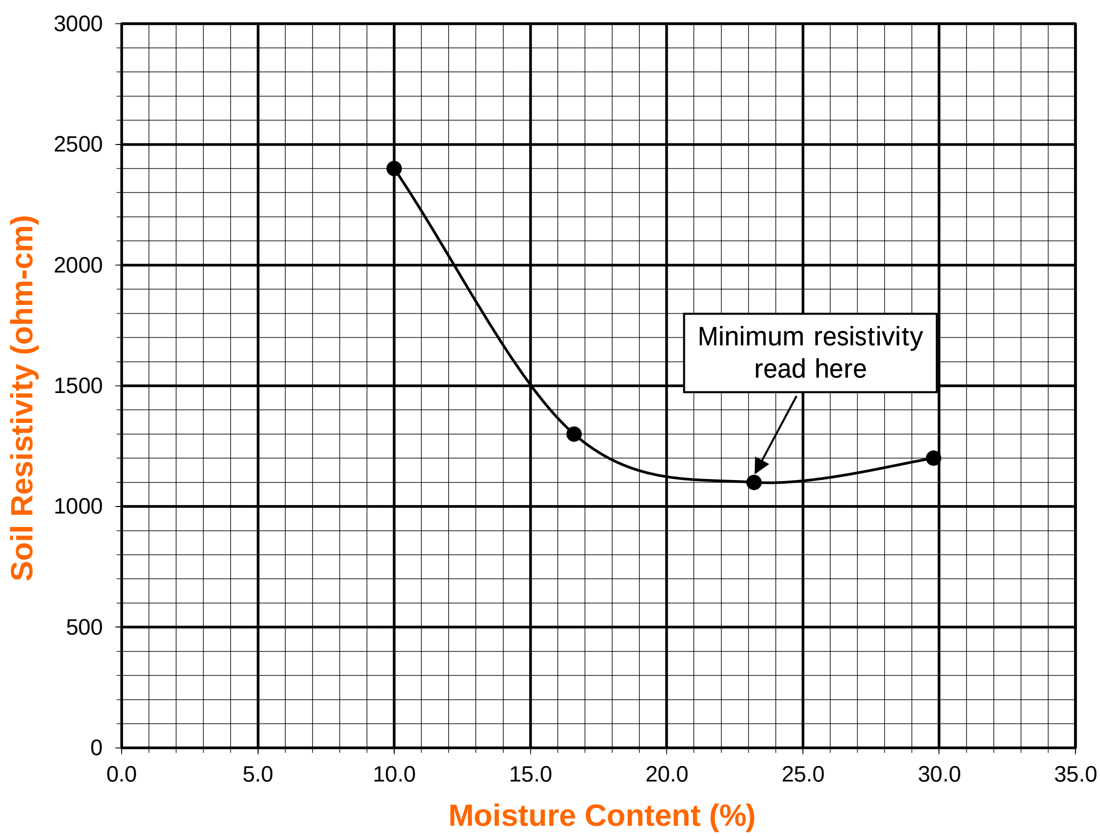
Soil Identification:* Silty Sand (SM)

*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	50	10.00	2400	2400
2	83	16.60	1300	1300
3	116	23.20	1100	1100
4	149	29.80	1200	1200
5				

Moisture Content (%) (MCi)	0.00
Wet Wt. of Soil + Cont. (g)	100.00
Dry Wt. of Soil + Cont. (g)	100.00
Wt. of Container (g)	0.00
Container No.	A
Initial Soil Wt. (g) (Wt)	500.00
Box Constant	1.000
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		Hach Kit	DOT CA Test 422	DOT CA Test 643	
1100	**23.2**	**180**	**40**	**7.60**	**21.0**



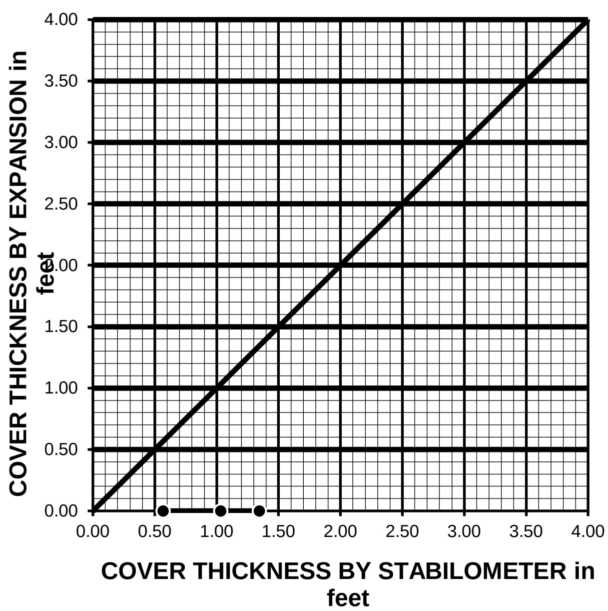
R-VALUE TEST RESULTS
ASTM D 2844

Project Name:	Madison Flats/Geo	Date:	6/15/22
Project Number:	13693.001	Technician:	F. Mina
Boring Number:	LB-6	Depth (ft.):	0 - 5.0
Sample Number:	B-1		
Sample Description:	Sandy Silt s(ML), Dark Reddish Brown.	Sample Location:	N/A

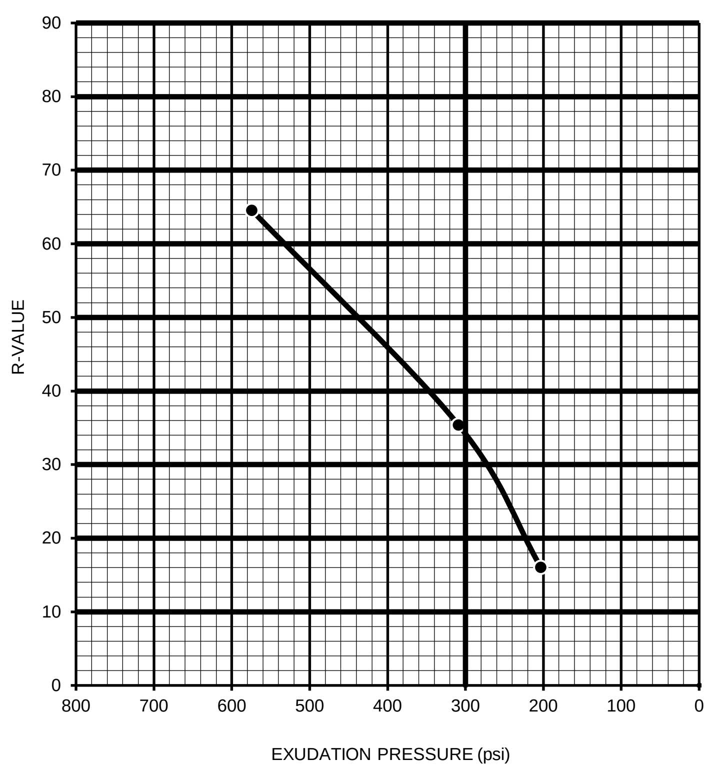
TEST SPECIMEN	A	B	C
MOISTURE AT COMPACTION %	8.7	10.3	11.4
HEIGHT OF SAMPLE, Inches	2.54	2.55	2.50
DRY DENSITY, pcf	118.7	117.8	114.1
COMPACTOR AIR PRESSURE, psi	200	175	150
EXUDATION PRESSURE, psi	574	309	203
EXPANSION, Inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	35	71	110
TURNS DISPLACEMENT	4.90	5.72	5.95
R-VALUE UNCORRECTED	65	35	16
R-VALUE CORRECTED	65	35	16

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.57	1.03	1.34
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION:	N/A
R-VALUE BY EXUDATION:	35
EQUILIBRIUM R-VALUE:	35

APPENDIX D

SUMMARY OF SEISMIC ANALYSIS

Leighton

Latitude, Longitude: 33.932279, -117.405463

Date	11/7/2022, 10:16:24 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.5	MCE_R ground motion. (for 0.2 second period)
S_1	0.572	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.5	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.5	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.55	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.565	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.656	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.572	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.622	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.648	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.945	Mapped value of the risk coefficient at short periods
C_{R1}	0.92	Mapped value of the risk coefficient at a period of 1 s
C_V	1.4	Vertical coefficient

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Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (u…

Latitude

Decimal degrees

33.932279

Longitude

Decimal degrees, negative values for western longitudes

-117.405463

Site Class

259 m/s (Site class D)

Spectral Period

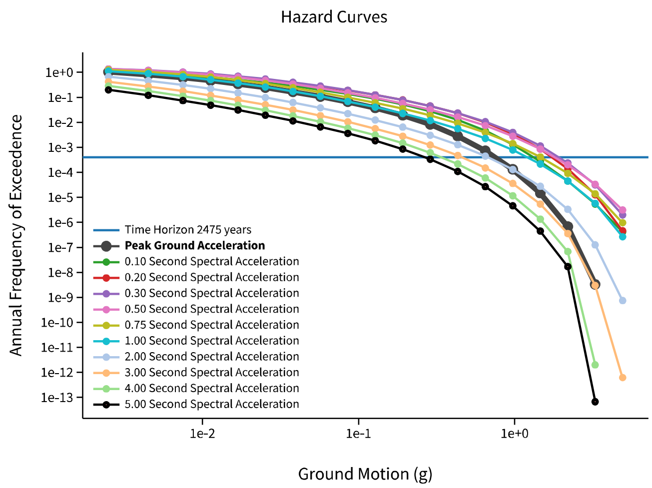
Peak Ground Acceleration

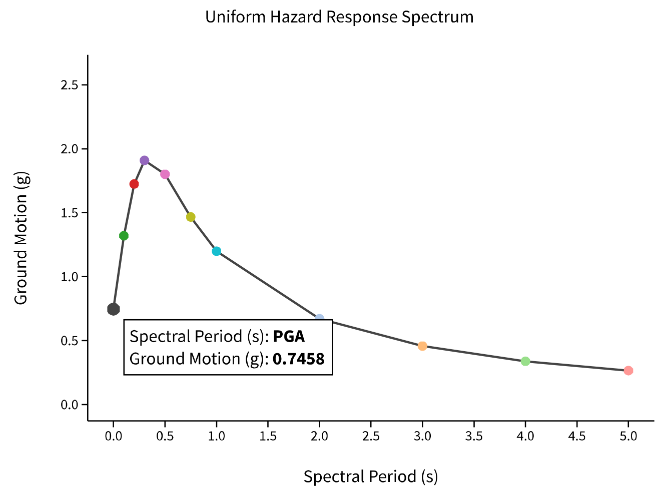
Time Horizon

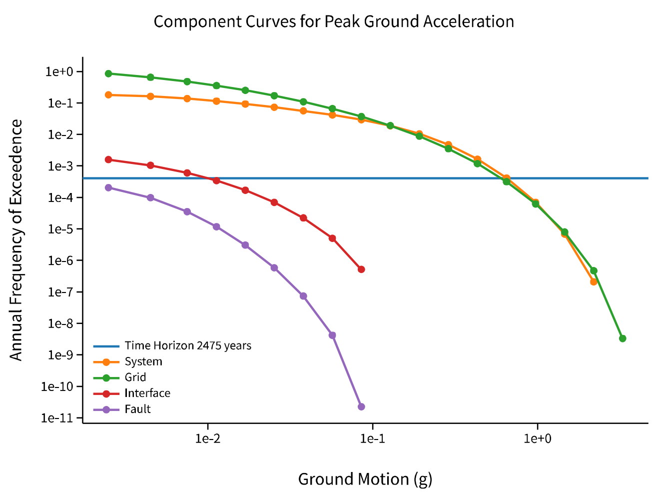
Return period in years

2475

Hazard Curve





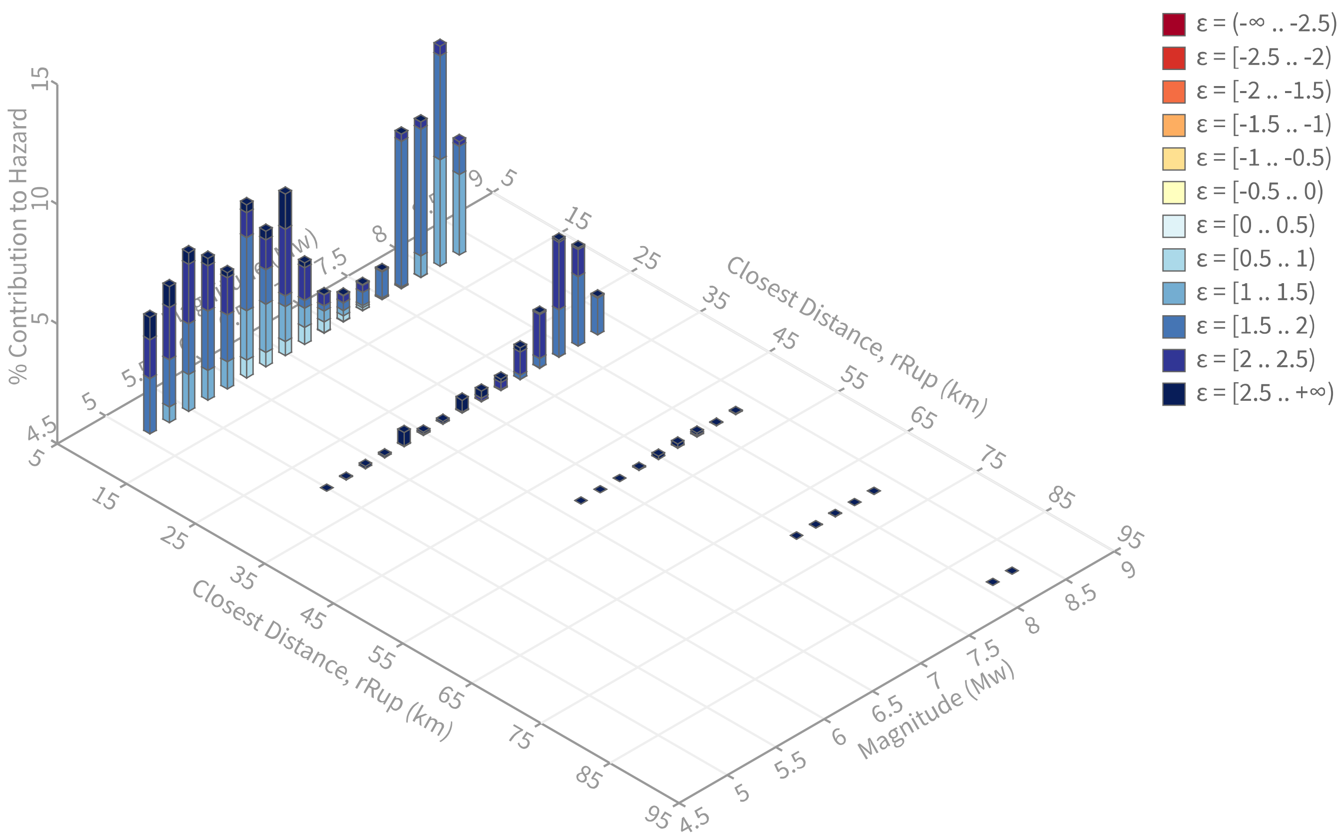


View Raw Data

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.74579695 g

Recovered targets

Return period: 3109.7791 yrs
Exceedance rate: 0.00032156625 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.05 %

Mean (over all sources)

m: 6.84
r: 15.71 km
ε_0: 1.82 σ

Mode (largest m-r bin)

m: 8.1
r: 17.92 km
ε_0: 1.54 σ
Contribution: 9.18 %

Mode (largest m-r-ε_0 bin)

m: 7.71
r: 18.4 km
ε_0: 1.7 σ
Contribution: 6.09 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM32	System							26.56
San Jacinto (San Bernardino) [4]		17.92	8.04	1.57	117.257°W	34.036°N	49.94	11.13
Elsinore (Glen Ivy) rev [0]		18.74	7.08	2.10	117.545°W	33.811°N	223.73	5.66
San Andreas (San Bernardino N) [5]		29.33	7.95	2.04	117.260°W	34.167°N	27.23	4.35
San Andreas (North Branch Mill Creek) [0]		28.48	8.03	1.88	117.252°W	34.163°N	28.88	1.13
UC33brAvg_FM31	System							26.46
San Jacinto (San Bernardino) [4]		17.92	8.05	1.57	117.257°W	34.036°N	49.94	11.21
Elsinore (Glen Ivy) rev [0]		18.74	7.05	2.11	117.545°W	33.811°N	223.73	5.55
San Andreas (San Bernardino N) [5]		29.33	7.95	2.04	117.260°W	34.167°N	27.23	4.30
San Andreas (North Branch Mill Creek) [0]		28.48	8.03	1.88	117.252°W	34.163°N	28.88	1.08
UC33brAvg_FM31 (opt)	Grid							23.56
PointSourceFinite: -117.405, 33.964		6.00	5.77	1.39	117.405°W	33.964°N	0.00	4.36
PointSourceFinite: -117.405, 33.964		6.00	5.77	1.39	117.405°W	33.964°N	0.00	4.36
PointSourceFinite: -117.405, 34.000		8.54	5.80	1.76	117.405°W	34.000°N	0.00	2.83
PointSourceFinite: -117.405, 34.000		8.54	5.80	1.76	117.405°W	34.000°N	0.00	2.83
PointSourceFinite: -117.405, 34.027		10.46	5.95	1.94	117.405°W	34.027°N	0.00	1.16
PointSourceFinite: -117.405, 34.027		10.46	5.95	1.94	117.405°W	34.027°N	0.00	1.16
PointSourceFinite: -117.405, 34.045		12.42	5.87	2.17	117.405°W	34.045°N	0.00	1.14
PointSourceFinite: -117.405, 34.045		12.42	5.87	2.17	117.405°W	34.045°N	0.00	1.14
UC33brAvg_FM32 (opt)	Grid							23.43
PointSourceFinite: -117.405, 33.964		6.00	5.77	1.39	117.405°W	33.964°N	0.00	4.35
PointSourceFinite: -117.405, 33.964		6.00	5.77	1.39	117.405°W	33.964°N	0.00	4.35
PointSourceFinite: -117.405, 34.000		8.54	5.80	1.76	117.405°W	34.000°N	0.00	2.83
PointSourceFinite: -117.405, 34.000		8.54	5.80	1.76	117.405°W	34.000°N	0.00	2.83
PointSourceFinite: -117.405, 34.027		10.46	5.95	1.94	117.405°W	34.027°N	0.00	1.16
PointSourceFinite: -117.405, 34.027		10.46	5.95	1.94	117.405°W	34.027°N	0.00	1.16
PointSourceFinite: -117.405, 34.045		12.42	5.87	2.17	117.405°W	34.045°N	0.00	1.14
PointSourceFinite: -117.405, 34.045		12.42	5.87	2.17	117.405°W	34.045°N	0.00	1.14

Liquefaction Susceptibility Analysis: SPT Method

Leighton

Youd and Idriss (2001), Martin and Lew (1999)

Description: Madison Flats - Riverside ; Case 1; PGAm 0.55; design GW 82; No overex 0
Project No.: 13693.001
Nov 2022

General Boring Information:

Boring No.	Existing GW Depth (ft)	Design GW Depth (ft)	Design Fill Height (ft)	Overex. depth bgs (ft)	Ground Surface Elev (ft)	design gw elve
LB-1	91	82		0	861	779
LB-2	91	82		0	862	780
LB-3	91	82		0	861	779
LB-4	91	82		0	857	775
LB-5	91	82		0	857	775
LB-6	91	82		0	858	776
LB-7	91	82		0	858	776
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0

Boring Location Coordinates X (ft)	Y (ft)
163.77	209.61
370.95	384.13
634.46	612.69
783.36	756.48
1031.9	962.3
1117.5	1042.1
1231.4	1108.7

General Parameters:

a_{max} = 0.55g
M_W = 8.1
MSF eq: 1
MSF = 0.82
Hammer Efficiency = 84
C_E = 1.40
C_B = 1
C_S for SPT? TRUE
Unlined, but room for liner
Rod Stickup (feet) = 3
Ring sample correction = 0.65

Summary of Liquefaction Susceptibility Analysis: SPT Method

Leighton

Liquefaction Method: Youd and Idriss (2001). Seismic Settlement Method: Tokimatsu and Seed (1987) and Martin and Lew (1999).

Project: Madison Flats - Riverside ; Case 1; PGAm 0.55; design GW 82; No overex 0

Project No.: 13693.001

Boring No.	Approx. Layer Depth (ft)	SPT Depth (ft)	Approx Layer Thick-ness (ft)	Plasticity ("n"=non susc. to liq.)	Estimated Fines Cont (%)	γ_t (pcf)	N_m or B (blows/ft)	Sampler Type (enter 2 if mod CA Ring)	Cs	N_m (corrected for Cs and ring->SPT) (blows/ft)	Exist σ_{vo}' (psf)	$(N_1)_{60}$	$(N_1)_{60CS}$	**$CRR_{7.5}$**	Design σ_{vo}' (psf)	$CSR_{7.5}$	CSR_M	**Liquefaction Factor of Safety**	$(N_1)_{60CS}$ (for Settle-ment) (blows/ft)	Dry Sand Strain (%) (Tok/ Seed 87) (%)	Sat Sand Strain (%) (Tok/ Seed 87) (%)	Seismic Sett. of Layer (in.)	**Cummulative Seismic Settlement** (in.)
LB-1	0 to 3.8	2.5	3.8		45	120	12	2	1	7.8	300	13.9	21.7	0.238	300	0.36	0.43	**NonLiq**	21.7	0.06		0.03	0.8
LB-1	3.8 to 6.3	5	2.5		35	120	13	2	1	8.5	600	15.1	23.1	0.259	600	0.35	0.43	**NonLiq**	23.1	0.18		0.05	0.8
LB-1	6.3 to 8.8	7.5	2.5		35	120	21	2	1	13.7	900	23.3	32.9	>Range	900	0.35	0.43	**NonLiq**	32.9	0.05		0.01	0.7
LB-1	8.8 to 12.5	10	3.8		30	120	21	2	1	13.7	1200	21.4	29.4	0.433	1200	0.35	0.43	**NonLiq**	29.4	0.15		0.07	0.7
LB-1	12.5 to 17.5	15	5.0		**5**	120	11	1	1.16	12.8	1800	16.4	16.4	0.175	1800	0.34	0.42	**NonLiq**	16.4	0.32		0.19	0.6
LB-1	17.5 to 22.5	20	5.0		15	120	42	2	1	27.3	2400	33.9	38.0	>Range	2400	0.34	0.42	**NonLiq**	38.0	0.08		0.05	0.5
LB-1	22.5 to 27.5	25	5.0		70	120	25	1	1.3	32.5	3000	36.1	48.3	>Range	3000	0.34	0.41	**NonLiq**	48.3	0.03		0.02	0.4
LB-1	27.5 to 32.5	30	5.0		80	120	38	2	1	24.7	3600	26.3	36.6	>Range	3600	0.33	0.41	**NonLiq**	36.6	0.07		0.04	0.4
LB-1	32.5 to 37.5	35	5.0		80	120	11	1	1.12	12.3	4200	12.2	19.6	0.211	4200	0.32	0.39	**NonLiq**	19.6	0.36		0.22	0.3
LB-1	37.5 to 42.5	40	5.0		70	120	29	2	1	18.9	4800	17.4	25.9	0.311	4800	0.30	0.37	**NonLiq**	25.9	0.19		0.11	0.1
LB-1	42.5 to 47.5	45	5.0		40	120	100	1	1.3	130.0	5400	113.2	140.8	>Range	5400	0.29	0.35	**NonLiq**	140.8	0.01		0.01	0.0
LB-1	47.5 to 52.0	50	4.5		20	120	100	2	1	65.0	6000	53.7	61.6	>Range	6000	0.27	0.33	**NonLiq**	61.6	0.02		0.01	0.0
LB-2	0 to 3.8	2.5	3.8		45	120	17	2	1	11.1	300	19.7	28.7	0.395	300	0.36	0.43	**NonLiq**	28.7	0.05		0.02	0.3
LB-2	3.8 to 6.3	5	2.5		**41**	120	13	2	1	8.5	600	15.1	23.1	0.259	600	0.35	0.43	**NonLiq**	23.1	0.18		0.05	0.3
LB-2	6.3 to 8.8	7.5	2.5		45	120	16	2	1	10.4	900	17.7	26.3	0.320	900	0.35	0.43	**NonLiq**	26.3	0.10		0.03	0.2
LB-2	8.8 to 12.5	10	3.8		45	120	26	2	1	16.9	1200	26.5	36.8	>Range	1200	0.35	0.43	**NonLiq**	36.8	0.06		0.03	0.2
LB-2	12.5 to 17.5	15	5.0		40	120	11	1	1.16	12.8	1800	16.4	24.7	0.286	1800	0.34	0.42	**NonLiq**	24.7	0.14		0.08	0.2
LB-2	17.5 to 22.0	20	4.5		30	120	26	2	1	16.9	2400	21.0	28.9	0.406	2400	0.34	0.42	**NonLiq**	28.9	0.17		0.09	0.1
LB-3	0 to 3.8	2.5	3.8		40	120	15	2	1	9.8	300	17.4	25.9	0.310	300	0.36	0.43	**NonLiq**	25.9	0.05		0.02	0.5
LB-3	3.8 to 6.3	5	2.5		85	120	15	2	1	9.8	600	17.4	25.9	0.310	600	0.35	0.43	**NonLiq**	25.9	0.16		0.05	0.5
LB-3	6.3 to 8.8	7.5	2.5		**42**	120	19	2	1	12.4	900	21.1	30.3	>Range	900	0.35	0.43	**NonLiq**	30.3	0.05		0.02	0.5
LB-3	8.8 to 12.5	10	3.8		75	120	21	2	1	13.7	1200	21.4	30.7	>Range	1200	0.35	0.43	**NonLiq**	30.7	0.08		0.04	0.4
LB-3	12.5 to 17.5	15	5.0		**5**	120	13	1	1.2	15.6	1800	20.0	20.0	0.215	1800	0.34	0.42	**NonLiq**	20.0	0.27		0.16	0.4
LB-3	17.5 to 22.5	20	5.0		45	120	32	2	1	20.8	2400	25.8	36.0	>Range	2400	0.34	0.42	**NonLiq**	36.0	0.08		0.05	0.2
LB-3	22.5 to 27.5	25	5.0		90	120	19	1	1.27	24.1	3000	26.7	37.0	>Range	3000	0.34	0.41	**NonLiq**	37.0	0.10		0.06	0.2
LB-3	27.5 to 32.5	30	5.0		90	120	36	2	1	23.4	3600	24.9	34.9	>Range	3600	0.33	0.41	**NonLiq**	34.9	0.08		0.05	0.1
LB-3	32.5 to 37.5	35	5.0		80	120	22	1	1.28	28.1	4200	27.7	38.3	>Range	4200	0.32	0.39	**NonLiq**	38.3	0.08		0.05	0.1
LB-3	37.5 to 42.5	40	5.0		30	120	100	2	1	65.0	4800	60.0	74.0	>Range	4800	0.30	0.37	**NonLiq**	74.0	0.02		0.01	0.0
LB-3	42.5 to 47.5	45	5.0		35	120	29	1	1.3	37.7	5400	32.8	44.4	>Range	5400	0.29	0.35	**NonLiq**	44.4	0.02		0.01	0.0
LB-3	47.5 to 52.0	50	4.5		60	120	60	2	1	39.0	6000	32.2	43.7	>Range	6000	0.27	0.33	**NonLiq**	43.7	0.03		0.01	0.0
LB-4	0 to 3.8	2.5	3.8		65	120	9	2	1	5.9	300	10.4	17.5	0.187	300	0.36	0.43	**NonLiq**	17.5	0.12		0.05	0.3
LB-4	3.8 to 6.3	5	2.5		30	120	17	2	1	11.1	600	19.7	27.5	0.352	600	0.35	0.43	**NonLiq**	27.5	0.14		0.04	0.2
LB-4	6.3 to 8.8	7.5	2.5		35	120	32	2	1	20.8	900	35.5	47.6	>Range	900	0.35	0.43	**NonLiq**	47.6	0.01		0.00	0.2
LB-4	8.8 to 12.5	10	3.8		30	120	19	2	1	12.4	1200	19.4	27.1	0.341	1200	0.35	0.43	**NonLiq**	27.1	0.16		0.07	0.2

Boring No.	Approx. Layer Depth (ft)	SPT Depth (ft)	Approx Layer Thick-ness (ft)	Plasticity ("n"=non susc. to liq.)	Estimated Fines Cont (%)	γ_t (pcf)	N_m or B (blows/ft)	Sampler Type (enter 2 if mod CA Ring)	Cs	N_m (corrected for Cs and ring->SPT) (blows/ft)	Exist σ_{vo}' (psf)	$(N_1)_{60}$	$(N_1)_{60CS}$	**$CRR_{7.5}$**	Design σ_{vo}' (psf)	$CSR_{7.5}$	CSR_M	**Liquefaction Factor of Safety**	$(N_1)_{60CS}$ (for Settle-ment) (blows/ft)	Dry Sand Strain (%) (Tok/ Seed 87) (%)	Sat Sand Strain (%) (Tok/ Seed 87) (%)	Seismic Sett. of Layer (in.)	**Cummulative Seismic Settlement** (in.)
LB-4	12.5 to 17.5	15	5.0		80	120	16	1	1.26	20.1	1800	25.8	35.9	>Range	1800	0.34	0.42	**NonLiq**	35.9	0.06		0.04	0.1
LB-4	17.5 to 22.0	20	4.5		45	120	34	2	1	22.1	2400	27.4	37.9	>Range	2400	0.34	0.42	**NonLiq**	37.9	0.08		0.04	0.0
LB-5	0 to 3.8	2.5	3.8		85	120	19	2	1	12.4	300	22.0	31.5	>Range	300	0.36	0.43	**NonLiq**	31.5	0.02		0.01	0.2
LB-5	3.8 to 6.3	5	2.5		30	120	25	2	1	16.3	600	29.0	38.2	>Range	600	0.35	0.43	**NonLiq**	38.2	0.05		0.02	0.2
LB-5	6.3 to 8.8	7.5	2.5		15	120	22	2	1	14.3	900	24.4	28.1	0.372	900	0.35	0.43	**NonLiq**	28.1	0.10		0.03	0.2
LB-5	8.8 to 12.5	10	3.8		70	120	20	2	1	13.0	1200	20.4	29.5	0.435	1200	0.35	0.43	**NonLiq**	29.5	0.15		0.07	0.2
LB-5	12.5 to 17.5	15	5.0		85	120	11	1	1.16	12.8	1800	16.4	24.7	0.286	1800	0.34	0.42	**NonLiq**	24.7	0.14		0.08	0.1
LB-5	17.5 to 22.0	20	4.5		85	120	33	2	1	21.5	2400	26.6	36.9	>Range	2400	0.34	0.42	**NonLiq**	36.9	0.08		0.04	0.0
LB-6	0 to 3.8	2.5	3.8		90	120	30	2	1	19.5	300	34.8	46.8	>Range	300	0.36	0.43	**NonLiq**	46.8	0.01		0.00	0.2
LB-6	3.8 to 6.3	5	2.5		30	120	27	2	1	17.6	600	31.3	40.9	>Range	600	0.35	0.43	**NonLiq**	40.9	0.02		0.00	0.2
LB-6	6.3 to 8.8	7.5	2.5		40	120	21	2	1	13.7	900	23.3	32.9	>Range	900	0.35	0.43	**NonLiq**	32.9	0.05		0.01	0.2
LB-6	8.8 to 12.5	10	3.8		**45**	120	49	2	1	31.9	1200	50.0	65.0	>Range	1200	0.35	0.43	**NonLiq**	65.0	0.01		0.01	0.2
LB-6	12.5 to 17.5	15	5.0		75	120	18	1	1.3	23.4	1800	30.0	41.0	>Range	1800	0.34	0.42	**NonLiq**	41.0	0.02		0.01	0.2
LB-6	17.5 to 22.5	20	5.0		90	120	38	2	1	24.7	2400	30.6	41.8	>Range	2400	0.34	0.42	**NonLiq**	41.8	0.02		0.01	0.2
LB-6	22.5 to 27.5	25	5.0		40	120	17	1	1.23	20.9	3000	23.2	32.9	>Range	3000	0.34	0.41	**NonLiq**	32.9	0.11		0.07	0.1
LB-6	27.5 to 32.5	30	5.0		80	120	54	2	1	35.1	3600	37.4	49.9	>Range	3600	0.33	0.41	**NonLiq**	49.9	0.02		0.01	0.1
LB-6	32.5 to 37.5	35	5.0		20	120	27	1	1.3	35.1	4200	34.6	41.0	>Range	4200	0.32	0.39	**NonLiq**	41.0	0.02		0.01	0.1
LB-6	37.5 to 42.5	40	5.0		15	120	66	2	1	42.9	4800	39.6	44.0	>Range	4800	0.30	0.37	**NonLiq**	44.0	0.02		0.01	0.0
LB-6	42.5 to 47.5	45	5.0		15	120	40	1	1.3	52.0	5400	45.3	49.9	>Range	5400	0.29	0.35	**NonLiq**	49.9	0.02		0.01	0.0
LB-6	47.5 to 52.0	50	4.5		10	120	84	2	1	54.6	6000	45.1	46.9	>Range	6000	0.27	0.33	**NonLiq**	46.9	0.02		0.01	0.0
LB-7	0 to 3.8	2.5	3.8		60	120	27	2	1	17.6	300	31.3	42.6	>Range	300	0.36	0.43	**NonLiq**	42.6	0.01		0.00	1.1
LB-7	3.8 to 6.3	5	2.5		18	120	6	2	1	3.9	600	7.0	**10.7**	0.119	600	0.35	0.43	**NonLiq**	10.7	1.52		0.46	1.1
LB-7	6.3 to 8.8	7.5	2.5		70	120	19	2	1	12.4	900	21.1	30.3	>Range	900	0.35	0.43	**NonLiq**	30.3	0.05		0.02	0.6
LB-7	8.8 to 12.5	10	3.8		85	120	51	2	1	33.2	1200	52.0	67.4	>Range	1200	0.35	0.43	**NonLiq**	67.4	0.01		0.01	0.6
LB-7	12.5 to 17.5	15	5.0		30	120	14	1	1.22	17.1	1800	21.9	29.9	0.463	1800	0.34	0.42	**NonLiq**	29.9	0.12		0.07	0.6
LB-7	17.5 to 22.0	20	4.5		5	120	17	2	1	11.1	2400	13.7	**13.7**	0.147	2400	0.34	0.42	**NonLiq**	13.7	0.98		0.53	0.5

Liquefaction Susceptibility Analysis: SPT Method

Youd and Idriss (2001), Martin and Lew (1999)

Description: Madison Flats - Riverside ; Case 3; PGAm 0.55; design GW 82; Overex./scarify 5
Project No.: 13693.001
Nov 2022

General Boring Information:

Boring No.	Existing GW Depth (ft)	Design GW Depth (ft)	Design Fill Height (ft)	Overex. depth bgs (ft)	Ground Surface Elev (ft)	design gw elve
LB-1	91	82		5	861	779
LB-2	91	82		5	862	780
LB-3	91	82		5	861	779
LB-4	91	82		5	857	775
LB-5	91	82		5	857	775
LB-6	91	82		5	858	776
LB-7	91	82		5	858	776
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0

Boring Location Coordinates X (ft)	Y (ft)
163.77	209.61
370.95	384.13
634.46	612.69
783.36	756.48
1031.9	962.3
1117.5	1042.1
1231.4	1108.7

General Parameters:

a_{max} = 0.55g
M_W = 8.1
MSF eq: 1
MSF = 0.82
Hammer Efficiency = 84
C_E = 1.40
C_B = 1
C_S for SPT? TRUE
Unlined, but room for liner
Rod Stickup (feet) = 3
Ring sample correction = 0.65

Summary of Liquefaction Susceptibility Analysis: SPT Method

Leighton

Liquefaction Method: Youd and Idriss (2001). Seismic Settlement Method: Tokimatsu and Seed (1987) and Martin and Lew (1999).

Project: Madison Flats - Riverside ; Case 3; PGAm 0.55; design GW 82; Overex./scarify 5

Project No.: 13693.001

Boring No.	Approx. Layer Depth (ft)	SPT Depth (ft)	Approx Layer Thick-ness (ft)	Plasticity ("n"=non susc. to liq.)	Estimated Fines Cont (%)	γ_t (pcf)	N_m or B (blows/ft)	Sampler Type (enter 2 if mod CA Ring)	Cs	N_m (corrected for Cs and ring->SPT) (blows/ft)	Exist σ_{vo}' (psf)	$(N_1)_{60}$	$(N_1)_{60CS}$	**$CRR_{7.5}$**	Design σ_{vo}' (psf)	$CSR_{7.5}$	CSR_M	**Liquefaction Factor of Safety**	$(N_1)_{60CS}$ (for Settle-ment) (blows/ft)	Dry Sand Strain (%) (Tok/ Seed 87) (%)	Sat Sand Strain (%) (Tok/ Seed 87) (%)	Seismic Sett. of Layer (in.)	**Cummulative Seismic Settlement** (in.)
LB-1	0 to 3.8	2.5	3.8	OX	45	120	50	1	1.3	65.0	300	116.0	144.2	>Range	300	0.36	0.43	**NonLiq**	144.2	0.00		0.00	0.8
LB-1	3.8 to 5.0	5	1.3	OX	35	120	50	1	1.3	65.0	600	116.0	144.2	>Range	600	0.35	0.43	**NonLiq**	144.2	0.00		0.00	0.8
LB-1	5.0 to 6.3	5	1.3		35	120	13	2	1	8.5	600	15.1	23.1	0.259	600	0.35	0.43	**NonLiq**	23.1	0.18		0.03	0.8
LB-1	6.3 to 8.8	7.5	2.5		35	120	21	2	1	13.7	900	23.3	32.9	>Range	900	0.35	0.43	**NonLiq**	32.9	0.05		0.01	0.7
LB-1	8.8 to 12.5	10	3.8		30	120	21	2	1	13.7	1200	21.4	29.4	0.433	1200	0.35	0.43	**NonLiq**	29.4	0.15		0.07	0.7
LB-1	12.5 to 17.5	15	5.0		**5**	120	11	1	1.16	12.8	1800	16.4	16.4	0.175	1800	0.34	0.42	**NonLiq**	16.4	0.32		0.19	0.6
LB-1	17.5 to 22.5	20	5.0		15	120	42	2	1	27.3	2400	33.9	38.0	>Range	2400	0.34	0.42	**NonLiq**	38.0	0.08		0.05	0.5
LB-1	22.5 to 27.5	25	5.0		70	120	25	1	1.3	32.5	3000	36.1	48.3	>Range	3000	0.34	0.41	**NonLiq**	48.3	0.03		0.02	0.4
LB-1	27.5 to 32.5	30	5.0		80	120	38	2	1	24.7	3600	26.3	36.6	>Range	3600	0.33	0.41	**NonLiq**	36.6	0.07		0.04	0.4
LB-1	32.5 to 37.5	35	5.0		80	120	11	1	1.12	12.3	4200	12.2	19.6	0.211	4200	0.32	0.39	**NonLiq**	19.6	0.36		0.22	0.3
LB-1	37.5 to 42.5	40	5.0		70	120	29	2	1	18.9	4800	17.4	25.9	0.311	4800	0.30	0.37	**NonLiq**	25.9	0.19		0.11	0.1
LB-1	42.5 to 47.5	45	5.0		40	120	100	1	1.3	130.0	5400	113.2	140.8	>Range	5400	0.29	0.35	**NonLiq**	140.8	0.01		0.01	0.0
LB-1	47.5 to 52.0	50	4.5		20	120	100	2	1	65.0	6000	53.7	61.6	>Range	6000	0.27	0.33	**NonLiq**	61.6	0.02		0.01	0.0
LB-2	0 to 3.8	2.5	3.8	OX	45	120	50	1	1.3	65.0	300	116.0	144.2	>Range	300	0.36	0.43	**NonLiq**	144.2	0.00		0.00	0.3
LB-2	3.8 to 5.0	5	1.3	OX	**41**	120	50	1	1.3	65.0	600	116.0	144.2	>Range	600	0.35	0.43	**NonLiq**	144.2	0.00		0.00	0.3
LB-2	5.0 to 6.3	5	1.3		**41**	120	13	2	1	8.5	600	15.1	23.1	0.259	600	0.35	0.43	**NonLiq**	23.1	0.18		0.03	0.3
LB-2	6.3 to 8.8	7.5	2.5		45	120	16	2	1	10.4	900	17.7	26.3	0.320	900	0.35	0.43	**NonLiq**	26.3	0.10		0.03	0.2
LB-2	8.8 to 12.5	10	3.8		45	120	26	2	1	16.9	1200	26.5	36.8	>Range	1200	0.35	0.43	**NonLiq**	36.8	0.06		0.03	0.2
LB-2	12.5 to 17.5	15	5.0		40	120	11	1	1.16	12.8	1800	16.4	24.7	0.286	1800	0.34	0.42	**NonLiq**	24.7	0.14		0.08	0.2
LB-2	17.5 to 22.0	20	4.5		30	120	26	2	1	16.9	2400	21.0	28.9	0.406	2400	0.34	0.42	**NonLiq**	28.9	0.17		0.09	0.1
LB-3	0 to 3.8	2.5	3.8	OX	40	120	50	1	1.3	65.0	300	116.0	144.2	>Range	300	0.36	0.43	**NonLiq**	144.2	0.00		0.00	0.5
LB-3	3.8 to 5.0	5	1.3	OX	85	120	50	1	1.3	65.0	600	116.0	144.2	>Range	600	0.35	0.43	**NonLiq**	144.2	0.00		0.00	0.5
LB-3	5.0 to 6.3	5	1.3		85	120	15	2	1	9.8	600	17.4	25.9	0.310	600	0.35	0.43	**NonLiq**	25.9	0.16		0.02	0.5
LB-3	6.3 to 8.8	7.5	2.5		**42**	120	19	2	1	12.4	900	21.1	30.3	>Range	900	0.35	0.43	**NonLiq**	30.3	0.05		0.02	0.5
LB-3	8.8 to 12.5	10	3.8		75	120	21	2	1	13.7	1200	21.4	30.7	>Range	1200	0.35	0.43	**NonLiq**	30.7	0.08		0.04	0.4
LB-3	12.5 to 17.5	15	5.0		**5**	120	13	1	1.2	15.6	1800	20.0	20.0	0.215	1800	0.34	0.42	**NonLiq**	20.0	0.27		0.16	0.4
LB-3	17.5 to 22.5	20	5.0		45	120	32	2	1	20.8	2400	25.8	36.0	>Range	2400	0.34	0.42	**NonLiq**	36.0	0.08		0.05	0.2
LB-3	22.5 to 27.5	25	5.0		90	120	19	1	1.27	24.1	3000	26.7	37.0	>Range	3000	0.34	0.41	**NonLiq**	37.0	0.10		0.06	0.2
LB-3	27.5 to 32.5	30	5.0		90	120	36	2	1	23.4	3600	24.9	34.9	>Range	3600	0.33	0.41	**NonLiq**	34.9	0.08		0.05	0.1
LB-3	32.5 to 37.5	35	5.0		80	120	22	1	1.28	28.1	4200	27.7	38.3	>Range	4200	0.32	0.39	**NonLiq**	38.3	0.08		0.05	0.1
LB-3	37.5 to 42.5	40	5.0		30	120	100	2	1	65.0	4800	60.0	74.0	>Range	4800	0.30	0.37	**NonLiq**	74.0	0.02		0.01	0.0
LB-3	42.5 to 47.5	45	5.0		35	120	29	1	1.3	37.7	5400	32.8	44.4	>Range	5400	0.29	0.35	**NonLiq**	44.4	0.02		0.01	0.0
LB-3	47.5 to 52.0	50	4.5		60	120	60	2	1	39.0	6000	32.2	43.7	>Range	6000	0.27	0.33	**NonLiq**	43.7	0.03		0.01	0.0
LB-4	0 to 3.8	2.5	3.8	OX	65	120	50	1	1.3	65.0	300	116.0	144.2	>Range	300	0.36	0.43	**NonLiq**	144.2	0.00		0.00	0.2

Boring No.	Approx. Layer Depth (ft)	SPT Depth (ft)	Approx Layer Thick-ness (ft)	Plasticity ("n"=non susc. to liq.)	Estimated Fines Cont (%)	γ_t (pcf)	N_m or B (blows/ft)	Sampler Type (enter 2 if mod CA Ring)	Cs	N_m (corrected for Cs and ring->SPT) (blows/ft)	Exist σ_{vo}' (psf)	$(N_1)_{60}$	$(N_1)_{60CS}$	**$CRR_{7.5}$**	Design σ_{vo}' (psf)	$CSR_{7.5}$	CSR_M	**Liquefaction Factor of Safety**	$(N_1)_{60CS}$ (for Settle-ment) (blows/ft)	Dry Sand Strain (%) (Tok/ Seed 87) (%)	Sat Sand Strain (%) (Tok/ Seed 87) (%)	Seismic Sett. of Layer (in.)	**Cummulative Seismic Settlement** (in.)
LB-4	3.8 to 5.0	5	1.3	OX	30	120	50	1	1.3	65.0	600	116.0	138.6	>Range	600	0.35	0.43	**NonLiq**	138.6	0.00		0.00	0.2
LB-4	5.0 to 6.3	5	1.3		30	120	17	2	1	11.1	600	19.7	27.5	0.352	600	0.35	0.43	**NonLiq**	27.5	0.14		0.02	0.2
LB-4	6.3 to 8.8	7.5	2.5		35	120	32	2	1	20.8	900	35.5	47.6	>Range	900	0.35	0.43	**NonLiq**	47.6	0.01		0.00	0.2
LB-4	8.8 to 12.5	10	3.8		30	120	19	2	1	12.4	1200	19.4	27.1	0.341	1200	0.35	0.43	**NonLiq**	27.1	0.16		0.07	0.2
LB-4	12.5 to 17.5	15	5.0		80	120	16	1	1.26	20.1	1800	25.8	35.9	>Range	1800	0.34	0.42	**NonLiq**	35.9	0.06		0.04	0.1
LB-4	17.5 to 22.0	20	4.5		45	120	34	2	1	22.1	2400	27.4	37.9	>Range	2400	0.34	0.42	**NonLiq**	37.9	0.08		0.04	0.0
LB-5	0 to 3.8	2.5	3.8	OX	85	120	50	1	1.3	65.0	300	116.0	144.2	>Range	300	0.36	0.43	**NonLiq**	144.2	0.00		0.00	0.2
LB-5	3.8 to 5.0	5	1.3	OX	30	120	50	1	1.3	65.0	600	116.0	138.6	>Range	600	0.35	0.43	**NonLiq**	138.6	0.00		0.00	0.2
LB-5	5.0 to 6.3	5	1.3		30	120	25	2	1	16.3	600	29.0	38.2	>Range	600	0.35	0.43	**NonLiq**	38.2	0.05		0.01	0.2
LB-5	6.3 to 8.8	7.5	2.5		15	120	22	2	1	14.3	900	24.4	28.1	0.372	900	0.35	0.43	**NonLiq**	28.1	0.10		0.03	0.2
LB-5	8.8 to 12.5	10	3.8		70	120	20	2	1	13.0	1200	20.4	29.5	0.435	1200	0.35	0.43	**NonLiq**	29.5	0.15		0.07	0.2
LB-5	12.5 to 17.5	15	5.0		85	120	11	1	1.16	12.8	1800	16.4	24.7	0.286	1800	0.34	0.42	**NonLiq**	24.7	0.14		0.08	0.1
LB-5	17.5 to 22.0	20	4.5		85	120	33	2	1	21.5	2400	26.6	36.9	>Range	2400	0.34	0.42	**NonLiq**	36.9	0.08		0.04	0.0
LB-6	0 to 3.8	2.5	3.8	OX	90	120	50	1	1.3	65.0	300	116.0	144.2	>Range	300	0.36	0.43	**NonLiq**	144.2	0.00		0.00	0.2
LB-6	3.8 to 5.0	5	1.3	OX	30	120	50	1	1.3	65.0	600	116.0	138.6	>Range	600	0.35	0.43	**NonLiq**	138.6	0.00		0.00	0.2
LB-6	5.0 to 6.3	5	1.3		30	120	27	2	1	17.6	600	31.3	40.9	>Range	600	0.35	0.43	**NonLiq**	40.9	0.02		0.00	0.2
LB-6	6.3 to 8.8	7.5	2.5		40	120	21	2	1	13.7	900	23.3	32.9	>Range	900	0.35	0.43	**NonLiq**	32.9	0.05		0.01	0.2
LB-6	8.8 to 12.5	10	3.8		**45**	120	49	2	1	31.9	1200	50.0	65.0	>Range	1200	0.35	0.43	**NonLiq**	65.0	0.01		0.01	0.2
LB-6	12.5 to 17.5	15	5.0		75	120	18	1	1.3	23.4	1800	30.0	41.0	>Range	1800	0.34	0.42	**NonLiq**	41.0	0.02		0.01	0.2
LB-6	17.5 to 22.5	20	5.0		90	120	38	2	1	24.7	2400	30.6	41.8	>Range	2400	0.34	0.42	**NonLiq**	41.8	0.02		0.01	0.2
LB-6	22.5 to 27.5	25	5.0		40	120	17	1	1.23	20.9	3000	23.2	32.9	>Range	3000	0.34	0.41	**NonLiq**	32.9	0.11		0.07	0.1
LB-6	27.5 to 32.5	30	5.0		80	120	54	2	1	35.1	3600	37.4	49.9	>Range	3600	0.33	0.41	**NonLiq**	49.9	0.02		0.01	0.1
LB-6	32.5 to 37.5	35	5.0		20	120	27	1	1.3	35.1	4200	34.6	41.0	>Range	4200	0.32	0.39	**NonLiq**	41.0	0.02		0.01	0.1
LB-6	37.5 to 42.5	40	5.0		15	120	66	2	1	42.9	4800	39.6	44.0	>Range	4800	0.30	0.37	**NonLiq**	44.0	0.02		0.01	0.0
LB-6	42.5 to 47.5	45	5.0		15	120	40	1	1.3	52.0	5400	45.3	49.9	>Range	5400	0.29	0.35	**NonLiq**	49.9	0.02		0.01	0.0
LB-6	47.5 to 52.0	50	4.5		10	120	84	2	1	54.6	6000	45.1	46.9	>Range	6000	0.27	0.33	**NonLiq**	46.9	0.02		0.01	0.0
LB-7	0 to 3.8	2.5	3.8	OX	60	120	50	1	1.3	65.0	300	116.0	144.2	>Range	300	0.36	0.43	**NonLiq**	144.2	0.00		0.00	0.9
LB-7	3.8 to 5.0	5	1.3	OX	18	120	50	1	1.3	65.0	600	116.0	127.0	>Range	600	0.35	0.43	**NonLiq**	127.0	0.00		0.00	0.9
LB-7	5.0 to 6.3	5	1.3		18	120	6	2	1	3.9	600	7.0	**10.7**	0.119	600	0.35	0.43	**NonLiq**	10.7	1.52		0.23	0.9
LB-7	6.3 to 8.8	7.5	2.5		70	120	19	2	1	12.4	900	21.1	30.3	>Range	900	0.35	0.43	**NonLiq**	30.3	0.05		0.02	0.6
LB-7	8.8 to 12.5	10	3.8		85	120	51	2	1	33.2	1200	52.0	67.4	>Range	1200	0.35	0.43	**NonLiq**	67.4	0.01		0.01	0.6
LB-7	12.5 to 17.5	15	5.0		30	120	14	1	1.22	17.1	1800	21.9	29.9	0.463	1800	0.34	0.42	**NonLiq**	29.9	0.12		0.07	0.6
LB-7	17.5 to 22.0	20	4.5		5	120	17	2	1	11.1	2400	13.7	**13.7**	0.147	2400	0.34	0.42	**NonLiq**	13.7	0.98		0.53	0.5

APPENDIX E

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

GENERAL EARTHWORK AND GRADING SPECIFICATIONS FOR ROUGH GRADING

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1.0 General

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

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

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

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

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

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

Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

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

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

2.0 Preparation of Areas to be Filled

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

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

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

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

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

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

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

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

3.0 Fill Material

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

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

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

4.0 Fill Placement and Compaction

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

4.2 Fill Moisture Conditioning: Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557-91).

4.3 Compaction of Fill: After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557-91). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes: In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557-91.

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

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

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

5.0 Subdrain Installation

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

6.0 Excavation

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

7.0 Trench Backfills

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

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

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

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

7.4 Observation and Testing: The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.