MTC
MATERIALS TESTING & CONSULTING, INC.

June 15, 2022

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Subject: **Report of Geotechnical Investigation and Engineering**
Proposed Tulalip Utilities Building Development
Snohomish County Tax Parcel Numbers 00616500600100 & 00616500601200
3015 Mission Beach Road, Tulalip, Washington

MTC Project No.: **22B116**

Dear Mr. Leslie,

This letter transmits our Geotechnical Investigation and Engineering Report for the above-referenced project. Materials Testing & Consulting, Inc. (MTC) has performed this Geotechnical Investigation in accordance with our Proposal for Geotechnical Services, dated March 4, 2022.

We would be pleased to continue our role as your geotechnical engineering consultants during the project planning and construction. We also have a keen interest in providing materials testing and special inspection during construction of this project. We will be pleased to meet with you at your convenience to discuss these services.

We appreciate the opportunity to provide geotechnical engineering services to you for this project. If you have any questions regarding this report, or if we can provide further assistance with other aspects of the project, please contact MTC at (360) 755-1990.

Respectfully Submitted,
MATERIALS TESTING & CONSULTING, INC.

Kevin Walter

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Attachment: *Geotechnical Investigation and Engineering Report*

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GEOTECHNICAL INVESTIGATION AND ENGINEERING REPORT

Proposed Tulalip Utilities Building Site Development

Snohomish County Tax Parcel Numbers 00616500600100 & 00616500600200
3015 Mission Beach Road, Tulalip, Washington

Prepared for:

Tulalip Utilities Authority
C/O: Mr. Mike Leslie

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June 15, 2022
MTC Project Number: **22B116**

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1.0 INTRODUCTION

1.1 GENERAL

This report presents the findings and recommendations of Materials Testing & Consulting, Inc.'s (MTC) geotechnical engineering study conducted for the design and construction of a new utilities building with associated parking and utilities. The proposed building site consists of an existing building, and the project entails the demolition of the current structure and construction of a new 2-story building in Tulalip, Washington. The location, vicinity and a satellite photo of the project site are shown in Figures 2 and 3 of Appendices A and B, respectively.

1.2 PROJECT DESCRIPTION

It is our understanding that the project consists of constructing one (1) 2-story facility and associated parking. MTC was provided general site layout plans. Design details including foundation loads were not provided yet are assumed to be typical for the style of construction and the anticipated loads associated with two-story building. MTC was provided requirements to be included in the final report from the structural engineer (KPFF). In addition to geotechnical assessment for building design, the client has requested an infiltration evaluation for onsite stormwater facilities. Specifics on type and depth of facilities are not known at this time.

MTC should be allowed to review the final plans and specifications for the project to ensure that the recommendations presented herein are appropriate. Recommendations and conclusions presented by this report will need to be re-evaluated if changes to the proposed construction are made.

1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of our study was to explore subsurface conditions at the site and provide geotechnical engineering recommendations for design and construction of the proposed building improvements. This study has also included a general assessment of site liquefaction potential based on the scope of explorations to date. In addition, the scope of work of this study includes an assessment of site infiltration feasibility and determination of design rates if applicable.

A summary of MTC's findings, interpretations, and recommendations including liquefaction risk and infiltration assessment is provided herein for the client's planning and design of site development. Our scope of services was consistent with that presented in our Proposal for Geotechnical Engineering Services, dated March 04, 2022.

2.0 SITE EXPLORATION AND LABORATORY TESTING

2.1 SITE EXPLORATION

Our site exploration activities were performed on April 27, 2022. Activities involved observing excavation of five (5) excavator-dug test pits (TP) spread among the potential building areas and potential stormwater facility locations per the project proposal. In addition, six (6) supplemental Dynamic Cone Penetrometer (DCP) tests were performed to help characterize in-situ soil strength conditions for liquefaction analysis and correlate soil consistencies with test pit stratigraphic observations. Subsurface exploration locations were selected following discussion with the project design team to provide representative coverage of the area proposed for development. One (1) Kessler Dynamic Cone Penetrometer (KDCP) tests was advanced east of the maintenance building in the proposed parking and driveway areas for evaluation of road subgrade suitability and pavement design parameters including in-situ CBR determination. Test pits were excavated to depths of 5.0 to 6.0 feet below present grade (BPG) at planned excavation depths. DCP tests were advanced to approximately 3.2 to 13.5 feet BPG upon reaching refusal conditions.

Test pit and DCP test locations were field located by an MTC Project Geologist following the sample location plan provided by the client to provide optimal coverage of the proposed development area. Test pits were excavated with a small to medium sized excavator. Test pits TP-1 and TP-2 were advanced along the western boundary of the lot to the north and south, respectively. TP-3 was advanced near the northeastern portion of the lot. TP-4 and TP-5 were advanced in approximately the center of the lot, north and south, respectively. DCP locations are correlated with the test pits, to include DCP-4A, DCP-4B and kDCP-3 being advanced at TP-4 and TP-3 respectively. Test pit explorations were monitored by MTC personnel, who examined and visually classified the materials encountered in accordance with the Unified Soil Classification System (USCS) and ASTM D2487, obtained representative soil samples, and recorded pertinent information including soil stratigraphy, soil engineering and infiltration characteristics, and indications of groundwater occurrences. Upon completion, test pits were backfilled with native soil tailings.

Grab subsurface soil samples were collected from proposed building location and stormwater gallery locations during test pit excavations, as depicted on the attached logs. All samples were placed in plastic bags to limit moisture loss, labeled, and returned to MTC's laboratory for analysis and storage. Samples will be retained for a minimum of 90 days from the date of collection. Additional laboratory analyses can be performed at the request of the client.

Location and vicinity maps are provided as Figure 2, Appendix A. Exploration locations are shown on a preliminary site plan in Appendix B, Figure 3. Additional information on the site exploration is provided with our revised exploration logs in Appendix C of this report, accompanied by a USCS classification chart as Figure 4. Laboratory results are presented in Appendix D. Plots of calculated liquefaction analysis are provided in Appendix E.

2.2 LABORATORY TESTING

Laboratory tests were performed on selected soil samples in accordance with ASTM standards to determine index and engineering properties of the site soils. Tests included supplementary soil classification, grain-size distribution via sieve analysis. Cation Exchange Coefficient and Organic Content tests were subcontracted. Laboratory test results are presented on test reports included in Appendix D.

3.0 EXISTING SITE CONDITIONS

3.1 SURFACE DESCRIPTION

The property is located on Mission Beach Road, on the southeastern corner of Tulalip Bay, Washington. The property is currently occupied by the existing Tulalip Utilities building and associated parking. The area to the west and northeast of the subject property is residential and the area to the east is a cemetery. Located approximately 609 feet (0.12 miles) the northwest is Tulalip Bay and located approximately 260 feet (0.05 miles) to the south is Possession Sound. Development plans include the demolition of the existing structure and construction of a new 2-story building and associated parking. Parking improvements are planned for the areas immediately southwest and southeast of the proposed building, with additional parking and roadways planned just northeast of the proposed building. MTC understands that stormwater feature locations will be dependent on the infiltration analysis results of this report.

Topography onsite is very flat with minor undulations. Based on the elevation of the surrounding area, we anticipate final building grades to be at approximately present grade.

Photo A: Looking south at the northwest corner of the building. DCP-1 in progress

Photo B: Standing on 30th Drive NW, looking northeast at the existing building. DCP-2 in progress.

Photo C: Looking north DCP-3 in progress.

Photo D: Looking north at the southeast corner of the building. DCP-5 in progress.

3.2 AREA GEOLOGY

The *Geologic Map of the Tulalip Quadrangle, Island and Snohomish County, Washington* and published by U.S. Geologic Survey (Minard, et al.) indicates the project site is mapped regionally as Quaternary Marine Glacial Drift, member *(Qmg)* at a 1:24,000 scale. Qmg is described as a sparsely pebbly, medium-dark-gray diamicton consisting chiefly of sand, silt, and clay.

Shallow subsurface conditions are mapped by the USDA NRCS Web Soil Survey as *Kitsap silt loam* (0 to 8 percent slopes) for the entirety of the site. *Kitsap silt loam* is formed in terraces with a parent material of lacustrine deposits. A typical profile consists of ashy silt loam to 6 inches, silt loam 6 to 33 inches, and stratified silt to silty clay loam 33 to 60+ inches below present grade (BPG). The soil is somewhat moderately well drained, has a depth to a restrictive feature of more than 80 inches, and is assigned Hydrologic Soil Group C with a moderately low to moderately high capacity to transmit water. Per the NRCS description, the depth to groundwater is about 18 to 30 inches BPG.

3.3 SOIL CONDITIONS

A general characterization of on-site soil units encountered during our exploration is presented below. The exploration logs in Appendix C present details of soils encountered at each exploration location.

The on-site soils are generally characterized as follows in stratigraphic order to depth:

- **Organic-Rich Silty Sand (SM):**
  Organic-rich topsoil was encountered at TP-3. Thicknesses was from 0.0 to 0.5 feet before encountering native shallow soils. Surface topsoil consisted of dark brown, moist organic-rich silty sand with prevalent organics forming a layer of sod.

- **Gravel (GP-GM):**
  A gravel unit was observed at all test pit locations surrounding the main building TP-1, TP-2, TP-4, and TP-5. This matrix was poorly graded containing some sand and trace silt. Thickness ranged from 0.0 to 1.0 feet before subsurface soils were encountered.

- **Sandy Silt to Silt with Sand (ML):**
  Within the northernmost test pit locations (TP-1, TP-3, and TP-4), native fine grain glacial drift deposits were observed beneath the gravel at depths ranging from 0.4 to 5.5 feet BPG. This unit ranged from gray to dark brown and contained occasional gravel. It was observed to be moist to wet throughout with mottling in some and no free water or seepage noted.

- **Sand with Silt to Sand with Gravel (SM-SP):**
  Within the southernmost test pit locations (TP-2 and TP-5), native sand glacial drift deposits were observed beneath the gravel, and overlying the silt units, at depths ranging from 0.4 to 4.5 feet BPG. This unit ranged from gray to dark brown and contained occasional gravel. It was observed to be moist to wet throughout with mottling in some and no free water or seepage noted.

DCP test results confirmed consistencies of the soils observed via test pits and were used to assess soil densities at depths beyond test pit termination. At all DCP test locations, except DCP-2, surface soils in the upper 2.7 feet ranged from very loose or loose to medium dense. The soil conditions below 3.1 feet BPG become consistently medium dense to dense. DCP tests were terminated due to refusal between 8.8 to 13.5 feet BPG in dense soils.

The Kessler DCP test location at kDCP-3 noted bearing capacity ranging between 2000 psi to 3500 psi between 0.0 to 4.3 feet BPG, then steadily increasing up to 9500 psi at the final depth of 5.6 feet BPG.

3.4 SURFACE WATER AND GROUNDWATER CONDITIONS

No surface water features were observed within the project site. The nearest major surface water features to the subject site are Tulalip Bay located approximately 609 feet (0.12 miles) the northwest and Possession Sound approximately 260 feet (0.05 miles) to the south.

No pervasive groundwater table was observed at the time of the field investigation in any of the test pit excavations. Oxidation staining of the subsoil was indicated by the light brown to orange coloration and is interpreted to be caused by the percolation of meteoric water downward through the soils.

Based on the time of field work during the winter season, observed conditions are expected to represent elevated seasonal conditions though may not be representative of “peak” winter season or heightened spring season groundwater conditions. Maximum seasonal high groundwater level was not fully determined during this scope of investigation. A geotechnical report by Rittenhouse-Zeman and Associates, Inc., 1986 reports that ground water in the vicinity of proposed improvements is at about 2 to 7 feet BPG. This should be explored throughout the wet season for accurate determination of seasonal groundwater table.

MTC’s scope of investigation did not include observation and determination or monitoring of seasonal groundwater variations, conclusive measurement of groundwater elevations at the time of exploration, or characterization of water table conditions past the limits of exploration for this scope of work. At the request of the client, MTC can perform additional services for verifying groundwater elevations throughout the wet season or deeper explorations to confirm water table elevation, if required.

4.0 KEY GEOTECHNICAL CONSIDERATIONS

This section discusses significant geotechnical issues that must be addressed in project planning and design and forms the basis for the geotechnical engineering design recommendations presented in Section 5.0 and construction recommendations presented in Section 6.0.

4.1 GENERAL SITE SOIL CONDITIONS

The results of MTC's investigation indicate organic-rich topsoil, and loose or soft subsoil beneath the proposed location of building area extends typically to about 0.0 to 3.1 feet BPG. Below organic-rich topsoil and subsoil deposits to be stripped, variably medium dense to dense native glacial marine deposits extend to about 6.0 to 9.0 feet BPG. Below these depths, medium dense to dense conditions generally persist until termination depths of 8.8 to 13.1 feet BPG from practical refusal.

4.2 SCOPE OF SITE GRADING

A grading plan was not set at the time of this report. Based on discussions with the project team, we understand that final grade will be similar to present to match the existing roadway. Stripping of any topsoil, organic-rich soils, and uncontrolled fill is recommended for the building footprint and its margins related to new construction. Imported fills are anticipated to be required for foundations and slab-on-grade areas depending on final building design.

4.3 TEMPORARY EXCAVATION CUT SLOPES, SHORING, AND DEWATERING

Plans for excavation including temporary cuts and proposed shoring, if required, were not available to MTC at the time of this report. Based on our project understanding, excavations are anticipated to be relatively shallow. If deep excavations are left open and require worker entry, repealed cut slopes and/or shoring will likely be needed due to the loose nature of site soils and shallow water presence. Section 6.3 of this report provides general recommendations for treatment of temporary excavations. MTC can provide further consultation, design, and evaluation services for cut slopes if desired. If shoring is required beyond typical OSHA standards, MTC can provide geotechnical engineering for shoring upon request.

Dewatering may be necessary for excavations during the wet, winter months. General recommendations for site preparation and wet weather construction are addressed in section 6.1.3 of this report. However, it should be noted that this study did not include a hydrogeologic evaluation necessary for accurate appraisal of site flow conditions or volume estimates and is only generally suitable for planning and design of dewatering methods.

4.4 SEISMIC DESIGN PARAMETERS AND LIQUEFACTION POTENTIAL

According to the *Liquefaction Susceptibility Map of Snohomish County, Washington,* and the accompanying *Seismic Site Class Map* (Palmer et al., 2004), the site vicinity is identified as having a *low to moderate* liquefaction susceptibility. Liquefaction is a phenomenon typically associated with a subsurface profile of relatively loose, cohesionless soils saturated by groundwater. Under seismic shaking the pore pressure can exceed the soil's shear resistance and the soil 'liquefies', which may result in excessive differential settlements that are damaging to structures and disruptive to exterior improvements. The accompanying *Seismic Site Class Map* (Palmer et al., 2004) classifies the project regional vicinity as *Site Class D*. These seismic map designations appear directly related to the geologic mapping of the project vicinity.

The SEAOC Seismic Design Map Tool was used to determine site-specific seismic design coefficients and spectral response accelerations for the project site conservatively assuming design Site Class D. Parameters in Table 1 were calculated using ASCE 7-16 and 2018 International Building Code standards.

Table 1. Seismic Design Parameters – Site Class D

Mapped Acceleration Parameters (MCE horizontal)	S_S	1.218 g
	S_1	0.434 g
Site Coefficient Values	F_a	1.013
	F_v	1.85
Calculated Peak SRA	S_{MS}	1.234 g
	S_{M1}	0.803 g
Design Peak SRA (*2/3 of peak*)	S_{DS}	0.822 g
	S_{D1}	0.535 g
MCE Peak Ground Acceleration Maximum (PGA_M)		0.574 g
Seismic Design Category – Short Period (0.2 Second) Acceleration		D
Seismic Design Category – 1-Second Period Acceleration		D

Based on the findings of this study, the site is generally considered to have a moderate risk of liquefaction-induced settlement due to relatively loose shallow soils. The site-specific hazard is lessened by deposits exhibiting increasing density with depth. Liquefaction analysis was completed to further assess the need for additional mitigations to facilitate the proposed construction.

4.5 LIQUEFACTION HAZARD ANALYSIS

MTC performed a generalized site-specific analysis of liquefaction susceptibility and resulting ground subsidence from available site exploration data collected via DCP explorations corresponding to the upper approximately 7 to 11 feet of the subsurface profile, terminating on dense conditions. Deeper soil data was obtained and extrapolated from a previous geotechnical study (Rittenhouse-Zeman and Associates, Inc., 1986). Data from DCP locations were considered for construction of a "typical" blow count profile.

Soil strength data was averaged over a one-foot scale, which is considered suitable and representative for this analysis given the relative consistency of the DCP data on the foot-scale. Blow count intervals were then correlated to soil stratigraphy as observed shallowly in test pits and interpreted from provided boring logs, mapped geology and residue on extracted rods for soils at greater depth.

Analysis was completed using LiquefyPro, Version 5.8h, published by CivilTech Software©. LiquefyPro performs liquefaction settlement analysis in accordance with the latest National Center for Earthquake Engineering Research (NCEER) Workshop recommended procedures and provides several options for the treatment of data inputs. Settlement estimates were obtained utilizing methods of Tokimatsu & Seed (1987) and Ishihara & Yoshimine (1990). A 7.0 magnitude earthquake event was applied. Calculations were completed for maximum considered earthquake peak ground acceleration (0.574g) as provided by the ASCE 7-16 guidelines. To reflect liquefaction risk of existing conditions most accurately, no factor of safety or external surface load was applied. For purposes of assessing a conservative scenario of liquefaction potential, the predominantly fine-grained members of the stratigraphy were not prohibited from liquefication. Table 2 summarizes the results of MTC's liquefaction analysis represented graphically in Appendix E.

If construction is planned for locations other than what is proposed in Figure 3 of this report, additional liquefaction analysis and subsequent mitigation will be necessary.

Table 2. Summary of Liquefaction-Induced Settlement Estimates and Inputs

ANALYSIS SCENARIO	**DCP-1 Total Settlement Potential** (inches)	**DCP-5 Total Settlement Potential** (inches)
Tokimatsu & Seed (1987)	0.60	0.78
Ishihara & Yoshimine (1990)	0.73	1.05
AVERAGE OF RESULTS	**0.67**	**0.92**
Seasonal Groundwater Depth	10 feet BPG	
Earthquake Magnitude	7.0	
MCE Peak Ground Acceleration	PGA-max = 0.574 g	
Factor of Safety	FS = 1.0	

Liquefaction analysis predicts a maximum potential seismic-induced ground settlement ranging from 0.60 to 1.05 inches, representing existing conditions with no ground improvements or surcharge loading from building pad preparations and under maximum considered earthquake peak ground acceleration and seasonally elevated groundwater tables. This analysis is based on liquefaction-induced settlement in the upper 13 feet of the profile where DCP tests terminated in dense conditions. Actual total accumulated settlements may be higher when fully considering the upper 50 feet of the subsurface profile. However, in our opinion the generally suitable conditions at end depths do not warrant further investigation and analysis given the nature and scale of the project.

In our opinion, this magnitude of potential seismic-induced settlement represents a low to moderate site response to liquefaction which does not exceed settlement tolerances commonly applied to construction of structures such as the proposed building, which are typically assumed to be on the order of around 1.0 inch maximum. Given the calculated settlement values average up to 0.92 inches for the general site, approximately 0.80 inches can be assumed for differential settlement across the building site. Due to the variability of expected settlement across the site, some construction mitigations are considered necessary from a geotechnical standpoint to facilitate this project, particularly additional protection to help safeguard against localized excess settlement of individual foundation elements. We understand that the current design of the proposed building implements spread and continuous, strip footing elements and a slab-on-grade floor. The below recommendations are provided for foundation design and construction which apply conservative design criteria toward building support and protection in a seismically sensitive area for a high-risk category building.

5.0 DESIGN RECOMMENDATIONS

5.1 FOUNDATION FEASIBILITY

Two requirements must be fulfilled in foundation design. First, load must be less than the ultimate bearing capacity of foundation soils to maintain stability; and secondly, differential settlement must not exceed an amount that will produce adverse behavior of the structure. Allowable settlement is usually exceeded before bearing capacity considerations become important; thus, the allowable bearing pressure is normally controlled by settlement considerations including differential settlement. Excess settlement due to adverse soil conditions may be a result of shallow or deep soils, or a combination of both.

Soil conditions encountered at the site are representative of recessional outwash deposits. Excluding topsoil, upper sandy soils are variably very loose to medium dense. Material becomes consistently medium dense and dense shortly after an increase in gravel is observed terminating at about 7 to 10.5 feet BPG.

The variable strength of native soils in the upper 1.0 to 3.5 feet BPG are of potential concern for bearing of building loads and differential settlement susceptibility. It is MTC's opinion that a shallow foundation consisting of spread and continuous perimeter footings supporting a moderate sized public safety facility with an interior slab-on grade as proposed is suitable for use assuming the recommendations provided below are followed for foundation construction and site preparations. MTC recommends that we be contacted to review applicable plans if revised to ensure they are consistent with the content and intent of recommendations provided herein.

5.2 FOUNDATION RECOMMENDATIONS

Assuming site preparation and foundation design is completed as described above, we recommend the following:

- **Allowable Soil Bearing Capacity:**
  A maximum allowable bearing capacity of 2,000 pounds per square foot (psf) for spread and strip perimeter foundations is recommended. This applies to footings placed on medium dense native soils or compacted structural fill placed on medium dense native soils in accordance with recommendations given in Section 6.0 of this report. Soils must be verified as suitably firm for the prescribed construction and organic-free at subgrade level prior to commencing pad installation.

  The allowable bearing capacity may be increased by 1/3 for transient loading due to wind and seismic events.

- **Minimum Footing Depth:**
  For a shallow perimeter footing system, all exterior footings shall be embedded a minimum of 18 inches and all interior footings shall be embedded a minimum of 12 inches below the lowest adjacent finished grade, but not less than the depth required by design. However, all footings must be founded on the prescribed bearing stratum cited above, and no footing should be founded in or above organic-rich or unsuitably loose/soft soils or non-verified fills.

- **Minimum Footing Width:**
  Footings should be proportioned to meet the stated bearing capacity and/or the IBC 2015 (or current) minimum requirements. For a shallow perimeter and spread footing system, continuous strip footings should be a minimum of 18 inches wide and interior or isolated column footings should be a minimum of 24 inches wide.

- **Estimated Settlements:**
  We estimate that the maximum settlements under static loading will be on the order of 1 inch or less, with a differential settlement of ½ inch, or less, over 50 linear feet. Settlement is anticipated to occur at a high rate when the load is applied during construction.

  Seismic-induced settlement from liquefaction is addressed above. Total settlement potential including seismic influence is estimated to be around 0.85 inches. Placement of a 12-inch thick structural fill pad as described herein will serve to mitigate deleterious effects of differential settlement due to liquefaction.

- **Lateral Bearing Capacity:**
  Lateral loads can be resisted by passive pressure against buried portions of the foundation elements and sliding resistance along its base. We recommend an allowable lateral pressure equal to that generated by a fluid with an equivalent unit weight of 150 pcf EFW, corresponding to structural elements backfilled laterally with structural fill, and for footings placed directly against imported structural fill of a dense consistency. The upper 18 inches of soil should be ignored unless the area is paved or covered with concrete, due to soil softening associated with freeze/thaw, however we understand that the entirety of the building area with be prepared with structural fill after stripping during site preparations. Additional resistance to lateral loads may be calculated by multiplying the vertical dead load on the base of the footing by a factor of 0.35. This assumes footings are placed directly on the prescribed medium dense native soils or structural fill placed on the medium dense native soils and includes a factor of safety of 1.5.

5.3 PAVEMENT DESIGN DISCUSSION

5.3.1 CBR Selection

MTC collected field data in support of pavement design analysis using Kessler DCP equipment, yielding data correlative with CBR values at a location within the proposed parking and driveway improvement areas. Kessler DCP records values by depth at 2-inch increments which are graphically interpreted to CBR values by depth. Results were consistent and concur with test pit observations and Wildcat DCP results in terms of soil characteristics and depth of documented stratigraphy for shallow soils. The Kessler DCP log are attached in Appendix C.

Topsoil and subsoils, observed to about 18 to 30 inches depth, are assumed to be fully stripped and reflected low values. Below stripping depths, native soils recorded CBR values typically averaged 7.9 to 17.3, although greater depths displayed values ranging from 17.3 to 81.5.

Considering the variability of the shallow soils, for the purpose of CBR selection, we assume pavement subgrades will be placed on undisturbed, medium dense native soils. For a conservative design approach and accounting for local variation at shallow depths, a bulk CBR = 7 is assigned. This is assigned assuming finished pavement grades for roads will be similar to existing grade after site leveling occurs, and that stripping depths will at minimum include topsoil and subsoil and unsuitably soft subgrades in all cases (1.5 to 3.5 feet typical thickness depending on location). This value is considered reasonable for the soil type observed (silty sand to sandy silt). Pavement subgrades should also be recompacted to increase in-situ density as possible.

5.3.1 Conventional Pavement Recommendations

1. In all areas to receive pavements, the organic, loose or obviously compressive materials must be removed. Because the exposed subgrade soils will be moisture sensitive and rapidly degrade under construction traffic loads when wet, care should be exercised to protect subgrades until pavements have been placed.

2. The pavement and driveway subgrade shall be proof-rolled to confirm that the subgrade contains no soft or deflecting areas. Areas of excessive yielding should be excavated and backfilled with structural fill. Structural fill shall conform to WSDOT 9-03.14(1) for gravel borrow in accordance with the latest version of the *Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT Standard Specifications)*[1].

3. If structural fill is required, it shall meet the requirements outlined above and shall be compacted to a minimum percent compaction of 95 percent based on its modified Proctor maximum dry density as determined per ASTM D1557. Where reinforcing fabric is used over soft subgrades, an initial lift of 18 inches of structural fill should be placed prior to compacting.

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[1] *Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT Standard Specifications)*; Washington State Department of Transportation; 2014

4. We recommend that fill placed on slopes steeper than 3:1 (H:V) be 'benched' in accordance with hillside terraces entry of section 2-03.3(14) of the latest version of the *Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT Standard Specifications)*.

5. The general parking structural sections should consist of a minimum of 3 inches of ½-inch HMA pavement over a minimum of 7 inches of crushed surfacing base course (CSBC) per WSDOT 9-03.9(3)[3].

5.4 SLAB-ON-GRADE CONSTRUCTION

MTC understands that a slab-on-grade concrete floor is proposed for the building interior. No details on slab loading conditions were provided at the time of this study. We assume the floor is anticipated to be subject to light loading from foot traffic and dead loads from supply storage, small machinery and equipment. The slab thickness is unknown at the time of this report but is assumed to be between 4 to 6 inches, typical of interior slabs. Construction of the slab to counteract the potential for differential settlement and cracking due to point loads and shallow subgrade variability is of concern.

MTC recommends the below activities and parameters for slab-on-grade design and construction:

- **Subgrade Modulus and Base Preparations:**
  We recommend stripping organic-rich soils and uncontrolled fills from slab-on-grade footprints prior to slab base preparation. Anticipated maximum stripping depth based on explorations is approximately 1.0 to 1.3 feet site-wide. Marginally greater depths may be required locally depending on actual conditions encountered.

  Capillary break should be included in addition to the 12-inch minimum section of structural fill. Structural fill base recommendations may be subject to revision based on the final design and level of reinforcement in the concrete slab-on-grade.

  A Subgrade Modulus (k) of 125 pci is allowed for use in design of the slab-on-grade floor constructed over the recommended imported and compacted granular structural fills of at minimum 12 inches thickness placed over suitably firm native subgrade, if applicable.

- **Proof Roll:**
  Prior to slab construction, the prepared building pad shall be proof-rolled to confirm no soft or deflecting areas are present. This is to ensure the existing base is evenly prepared and adequate for support of the slab. MTC recommends that we be contacted for observation of the proof roll and final visual confirmation of prepared base suitability. Areas of excessive rutting, pumping, or yielding shall be excavated and backfilled with new structural fill as described herein.

- **Capillary Break:**
  A capillary break is recommended to maintain a dry slab floor and reduce the potential for floor damage resulting from shallow ground water inundation and increase longevity of the slab. To

provide a capillary moisture break, a 6-inch thick, properly compacted granular mat consisting of open-graded, free-draining angular aggregate is recommended for use. To provide additional slab structural support, and to substitute for a structural fill base as specified, the capillary break should consist of crushed rock all passing the 1-inch sieve and no more than 3 percent (by weight) passing the U.S. No. #4 sieve, compacted in accordance with Section 6.2.2 below.

- **Structural Design Considerations:**
  For any slab areas planned for loading due to heavy storage, large industrialized equipment, or vehicle parking/access, we recommend these slabs be designed for increased rigidity and self-support in order to help counteract the increased potential for differential settlement under loading. MTC suggests at least a minimum reinforced concrete structural section of 8.0 inches be employed for loaded areas, or as specified by the project engineer. Additional reinforcement and thickness of the slab may also be used to aid in reducing the risk of cracking in the case of liquefaction-induced settlement.

  Slab design and specifications related to structural or traffic loading should be assessed or reassessed by the project designer. MTC recommends that we be contacted to review specifications for heavily loaded or traffic areas if present, and to provide additional recommendations appropriate to the type and magnitude of loading including additional site preparation and increased base fill section requirements if needed.

5.5 INFILTRATION RATE DETERMINATION

Gradation Analysis Method & Results

During site explorations, MTC collected representative samples of soil horizons at depths among potential infiltration strata located above the observed restrictive conditions during field explorations. We understand that facilities are in initial planning stages and are dependent the results of this study. Laboratory gradation analyses were completed including sieve and hydrometer tests for stormwater design characterization and rate determination to supplement field observations. Results of laboratory testing in terms of rate calculation are summarized below.

Laboratory results were interpreted to recommended hydraulic conductivity (Ksat) values in accordance with methods of the Washington State Department of Ecology *Stormwater Management Manual for Western Washington* (SMMWW), *2019 edition*. Standard correction factors were applied as noted in the reference documents. Data and Ksat values are summarized in Table 3 below.

Gradation results were applied to the Massmann (2003) Equation (1) to calculate Ksat representing the initial saturated hydraulic conductivity, as described in the 2019 DOE SMMWW Volume V-5.4.

$$\text{(1)} \qquad \log10(Ksat) = -1.57 + 1.90*D10 + 0.015*D60 - 0.013*D90 - 2.08*ff$$

Table 3 reports for each sample the input laboratory values and calculated Ksat. Corrected Ksat values presented below are a product of the initial Ksat and correction factor CFT. For a generalized design situation, we have applied a site variability factor of CFv = 0.5 along with typical values of CFt = 0.4 (for the Grain Size Method) and CFm = 0.9 (assuming standard influent control).

$$CFT = CFv \times CFt \times CFm = 0.5 \times 0.4 \times 0.9 = 0.18 \quad (2)$$

Table 3. Results of Massmann Analysis on Shallow Soils

TP #	**Depth** *(BPG)*	**USCS**	**D10**	**D60**	**D90**	**Ff (%)**	**Ksat** *(inches/hour)*	**Corrected Ksat** *(inches/hour)*
2	**2.9**	SM	0.022	0.325	2.290	33.9	7.821	**1.41**
3	**2.5**	ML	0.012	0.071	1.503	63.8	1.814	**0.33**
5	**2.7**	ML	0.006	0.111	2.420	58.4	2.230	**0.72**

5.5.1 Infiltration Design and Rates Discussion

MTC understands the stormwater system is undergoing design at this time and pending the results of this assessment to confirm general site feasibility and assist in determining suitable depths, locations, and sizing of infiltration features if feasible. Facility types may include a variety of shallow or infiltration trenches.

Grain Size analysis methods based on DoE 2019 Massmann (2003) Equation (1) calculation criteria have yielded Corrected Ksat values ranging from 0.72 to 1.41 inches per hour corresponding to samples of shallow and lower drift deposits collected from test pit locations TP-2, TP-3, and TP-5, in the vicinity of potential stormwater facilities. Upper subsoils were observed to have fines content ranging from 33.9% to 63.8%. No restrictive unit or groundwater indications were observed. Site conditions are infeasible for traditional infiltration drywells and other centralized features requiring 5 feet of separation, given the mapped sand units in all test pits ranged from 1.0 to 3.4 feet in depth. Shallow on-site infiltration is considered, such as for pervious pavement, bio-retention gardens or smaller LID features such as raingardens or bioswales (requiring 3 feet of separation to restrictive conditions) may be feasible depending on location and field verification. For general site-wide infiltration, ***we recommend applying a maximum design Ksat value of 0.3 inches/hour***. This value represents the low end of calculated Ksat values for native conditions at shallow depths throughout the site.

The derived rate is meant to provide a general characterization of subsurface transmission potential for the designer's consideration but is not necessarily intended to be applied as a final infiltration rate for facilities of an undetermined location and depth or for facilities of a larger size/volume. The inherent site limitations and depth to pervasive groundwater table from final grades must be considered in design. The facility designer should also review assumed correction factors per reference literature to ensure applicability with the proposed development, level of anticipated controls, and long-term maintenance plan. The designer may make reasonable adjustments to correction factors and the resulting design values based on these criteria to ensure design and operational intent is met.

Treatment Potential (CEC)

To confirm treatment quality of shallow native soils at potential infiltration areas and depths, MTC subcontracted Cation Exchange Capacity (CEC) testing for two representative samples of the native soils corresponding to those used for rate calculation in Table 3. CEC tests were conducted on samples from test pits TP-3 (2.5 feet BPG) and TP-5 (2.7 feet BPG) on the southcentral and eastern portions of the site. Testing yielded CEC values ranging from 10.4 to 9.2 meq/100g, respectively. Results are attached in Appendix D.

The Department of Ecology 2019 SMMWW addresses minimum requirements for treatment soils. According to *Site Suitability Criteria (SSC)-6*, soils meeting a minimum CEC target of 5 meq/100g may be accounted as treatment media without modification. The minimum thickness for infiltration treatment soils is 18 inches or greater. Finally, treatment soils are expected to contain at least 1.0 percent organic content. The results of the samples tested returned values of 1.1 percent organic matter in TP-3 at 2.5 feet BPG and 1.2 percent organic matter in TP-5 at 2.7 feet BPG which suggest that, on average, the upper soil profile is at minimum CEC standards. Additionally, the upper subsoil unit is below the required thickness. If stormwater treatment is required, it may be necessary to either amend the shallow soils to be conducive to treatment or apply bio-filtration media prior to infiltrating to increase the thickness of the treatment soils.

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 EARTHWORK

6.1.1 Excavation

Excavations can generally be performed with conventional earthmoving equipment such as bulldozers, scrapers, and excavators.

Where possible, excavations made within about one foot of finished subgrade level should be performed with smooth edged buckets to minimize subgrade disturbance and the potential for softening to the greatest extent practical.

6.1.2 Subgrade Evaluation and Preparation

After excavations have been completed to the planned subgrade elevations, but before placing fill or structural elements, the exposed subgrade soils should be evaluated under the full-time observation and guidance of an MTC representative. Where appropriate, the subgrade should be proof-rolled with a minimum of two passes with a fully loaded dump truck, water truck or scraper. In circumstances where this seems unfeasible, an MTC representative may use alternative methods for subgrade evaluation.

Any loose soil should be compacted to a firm and unyielding condition and at least to 95 percent of the modified Proctor maximum dry density per ASTM D1557. Any areas that are identified as being soft or yielding during subgrade evaluation should be over-excavated to a firm and unyielding condition or to the depth determined by the geotechnical engineer. Where over-excavation is performed below a structure, the over-excavation area should extend beyond the outside of the footing a distance equal to the depth of the over-excavation below the footing. The over-excavated areas should be backfilled with properly compacted structural fill.

6.1.3 Site Preparation, Erosion Control and Wet Weather Construction

The existing native silty subgrade will be moisture sensitive and could become loose or soft and difficult to compact or traverse with construction equipment when wet. During wet weather, the contractor should take measures to protect the exposed building pad and subgrades and limit construction traffic during earthwork activities.

Once the geotechnical engineer has approved a subgrade, further measures should be implemented to prevent degradation or disturbance of the subgrade. These measures could include, but are not limited to, placing a layer of crushed rock or lean concrete on the exposed subgrade, or covering the exposed subgrade with a plastic tarp and keeping construction traffic off the subgrade. Once subgrade has been approved, any disturbance because the subgrade was not protected should be repaired by the contractor at no cost to the owner.

During wet weather, earthen berms or other methods should be used to prevent runoff from draining into excavations. All runoff should be collected and disposed of properly. Measures may also be required to reduce the moisture content of on-site soils in the event of wet weather. These measures can include, but are not limited to, air drying and soil amendment, etc.

Since soils may be difficult to work with during periods of wet weather due to elevated soil moisture content, and frozen soil is not suitable for use as structural fill, we recommend that earthwork activities generally take place in late spring, summer or early fall.

Dewatering efforts may be required locally depending on total excavation depth, season of construction, and weather conditions during earthwork. MTC recommends major earthwork activities take place during the dry season if possible, to minimize the potential for encountering groundwater or seepage near proposed excavation depth.

6.2 STRUCTURAL FILL MATERIALS AND COMPACTION

6.2.1 Materials

All material placed below structure areas should be considered structural fill. Structural fill material shall be free of deleterious material, have a maximum particle size of 6 inches, and be compactable to the required density level.

Excavated native soils consisting of silty sand and sandy silt are not suitable for re-use as structural fill due to low or absent gravel content. Native sands may be used as utility trench backfill outside of structural areas, depending on project specifications.

Imported material can be used as structural fill. Imported structural fill material should conform to Section 9-03.14(1), Gravel Borrow, of the most recent edition (at the time of construction) of the State of Washington Department of Transportation *Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT Standard Specifications)*.

Controlled-density fill (CDF) or lean mix concrete can be used as an alternative to structural fill materials, except in areas where free-draining materials are required or specified.

Angular ballast rock of two to four-inch diameter sizing and composed of competent rock may be used below structural fill areas at footing locations to provide support under columns and where mitigations with groundwater are required.

Frozen soil is not suitable for use as structural fill. Fill material may not be placed on frozen soil.

The contractor should submit samples of each of the required earthwork materials to the geotechnical engineer for evaluation and approval prior to delivery to the site. The samples should be submitted at least 5 days prior to their delivery and sufficiently in advance of the work to allow the contractor to identify alternative sources if the material proves unsatisfactory.

6.2.2 Placement and Compaction

Prior to placement and compaction, structural fill should be moisture conditioned to within 3 percent of its optimum moisture content. Loose lifts of structural fill shall not exceed 8 inches in thickness; thinner lifts will be required for walk-behind or hand operated equipment.

All structural fill shall be compacted to a firm and unyielding condition and to a minimum percent compaction based on its modified Proctor maximum dry density as determined per ASTM D1557. Structural fill placed beneath each of the following shall be compacted to the indicated percent compaction:

Foundation and Floor Slab Subgrades:	95 Percent
Pavement Subgrades (upper 2 feet):	95 Percent
Pavement Subgrades (below 2 feet):	90 Percent
Utility Trenches (upper 4 feet):	95 Percent
Utility Trenches (below 4 feet):	90 Percent

We recommend that fill placed on slopes steeper than 3:1 (H:V) be ‘benched’ in accordance with hillside terraces entry of section 2-03.3(14) of the WSDOT Standard Specifications.

We recommend structural fill placement and compaction be observed on a full-time basis by an MTC representative. A sufficient number of tests shall be performed to verify compaction of each lift. The number of tests required will vary depending on the fill material, its moisture condition and the equipment being used. Initially, more frequent tests will be required while the contractor establishes the means and methods required to achieve proper compaction.

6.3 TEMPORARY EXCAVATIONS AND SLOPES

All excavations and slopes must comply with applicable local, state, and federal safety regulations. Construction site safety is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing soil type information solely as a service to our client for planning purposes. Under no circumstances should the information be interpreted to mean that MTC is assuming responsibility for construction site safety or the Contractor’s activities; such responsibility is not being implied and should not be inferred.

Temporary excavations in the native silty soils should be inclined no steeper than 2H:1V, although locally steeper grades may be approvable depending on actual conditions encountered, season of construction, and the depth of excavation. Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed near the top of any excavation. Where the stability of adjoining walls or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning may be required to provide structural stability and to protect personnel working within the excavation. Earth retention, bracing, or underpinning required for the project (if any) should be designed by a professional engineer registered in the State of Washington.

Temporary excavations and slopes should be protected from the elements by covering with plastic sheeting or some other similar impermeable material. Sheeting sections should overlap by at least 12 inches and be tightly secured with sandbags, tires, staking, or other means to prevent wind from exposing the soils under the sheeting.

6.4 PERMANENT SLOPES

MTC recommends that new areas of permanent slopes including fill embankments be inclined no greater than 3H:1V. Permanent slopes should be planted with a deep-rooted, rapid-growth vegetative cover as soon as possible after completion of slope construction. Alternatively, the slope should be covered with plastic, straw, etc. until it can be landscaped.

6.5 UTILITY TRENCHES AND EXCAVATIONS

The contractor shall be responsible for the safety of personnel working in utility trenches. Given that steep excavations in native soils may be prone to caving, we recommend all utility trenches, but particularly those greater than 4 feet in depth, be supported in accordance with state and federal safety regulations.

Pipe bedding material should conform to the manufacturer’s recommendations and be worked around the pipe to provide uniform support. Cobbles exposed in the bottom of utility excavations should be covered with pipe bedding or removed to avoid inducing concentrated stresses on the pipe.

Trench backfill should be placed and compacted as structural fill as recommended in Section 6.2. Particular care should be taken to ensure bedding or fill material is properly compacted to provide adequate support to the pipe. Jetting or flooding is not a substitute for mechanical compaction and should not be allowed.

7.0 ADDITIONAL RECOMMENDED SERVICES

The recommendations made in this report are based on the assumption that an adequate program of tests and observations will be made during construction to verify compliance with these recommendations. Testing and observations performed during construction should include, but not necessarily be limited to, the following:

- Geotechnical plan review and engineering consultation as needed prior to construction phase,
- Observations and testing of site preparation, earthwork, structural fill placement and compaction,
- Consultation on temporary excavation cutslopes and shoring if needed,
- Testing and inspection of any concrete or masonry included in the final construction plans, and
- Additional consultation and recommendations as may be required during construction.

We strongly recommend that MTC be retained for the construction of this project to provide these and other services. Our knowledge of the project site and the design recommendations contained herein will be of benefit if difficulties arise and either modifications or additional geotechnical engineering recommendations are required or desired. We can also, in a timely fashion observe the actual soil conditions encountered during construction, evaluate the applicability of the recommendations presented in this report to the soil conditions encountered, and recommend appropriate changes in design or construction procedures if conditions differ from those described herein.

We further recommend that project plans and specifications be reviewed by us to verify compatibility with our conclusions and recommendations.

Also, MTC retains fully accredited, WABO-certified laboratory and inspection personnel, and is available for this project’s testing, observation and inspection needs. Information concerning the scope and cost for these services can be obtained from our office.

8.0 LIMITATIONS

Recommendations contained in this report are based on our understanding of the proposed development and construction activities, our field observations and explorations, and our laboratory test results. It is possible that soil and groundwater conditions could vary and differ between or beyond the points explored. If soil or groundwater conditions are encountered during construction that vary or differ from those described herein, we should be notified immediately in order to review and provide supplemental recommendations. If the scope of the proposed construction, including the proposed loads or structural locations, changes from that described in this report, we should be notified to review and provide supplemental recommendations.

We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the site area at the time of our study. No warranty, expressed or implied, is made. The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be conducted by MTC during the construction phase in order to evaluate compliance with our recommendations.

This report may be used only by the Client and their design consultants and only for the purposes stated within a reasonable time from its issuance, but in no event later than 18 months from the date of the report. It is the Client's responsibility to ensure that the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. Note that if another firm assumes Geotechnical Engineer of Record responsibilities, they need to review this report and either concur with the findings, conclusions, and recommendations or provide alternate findings, conclusions and recommendation under the guidance of a professional engineer registered in the State of Washington.

Land or facility use, on- and off-site conditions, regulations, or other factors may change over time, and additional work may be required. Based on the intended use of the report, MTC may recommend that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the Client or anyone else will release MTC from any liability resulting from the use of this report. The Client, the design consultants, and any unauthorized party, agree to defend, indemnify, and hold harmless MTC from any claim or liability associated with such unauthorized use or non-compliance. We recommend that MTC be given the opportunity to review the final project plans and specifications to evaluate if our recommendations have been properly interpreted. We assume no responsibility for misinterpretation of our recommendations.

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

Appendix A. SITE LOCATION AND VICINITY

Regional Vicinity

Map Source: Google Maps, 2022

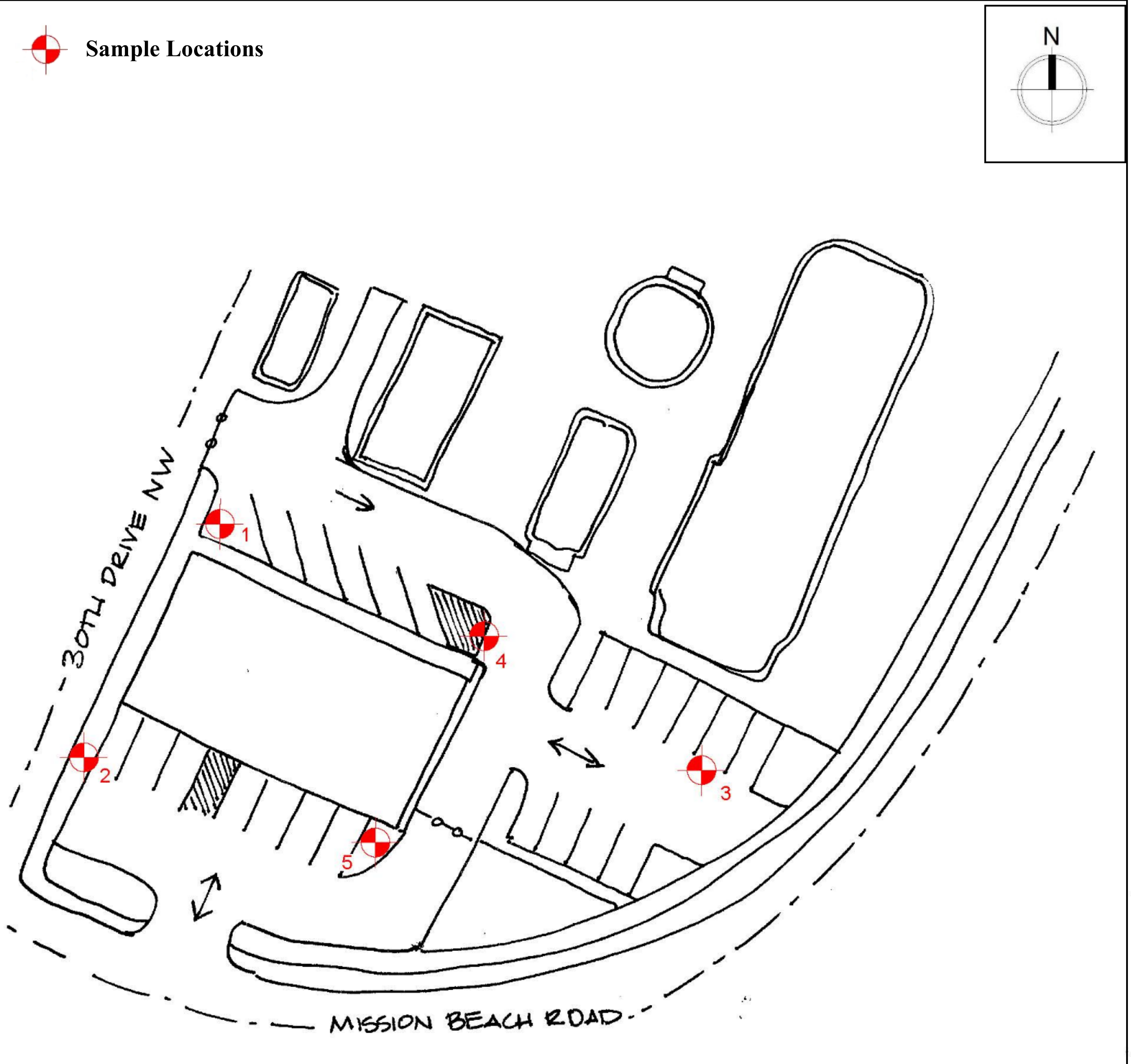
Site Vicinity

Project Location

Map Source:
Snohomish County Assessor, 2022

Materials Testing & Consulting, Inc. 777 Chrysler Drive Burlington, WA 98226	**Regional and Site Vicinity Maps** Tulalip Utilities Building 3015 Mission Beach Rd. Tulalip, WA	**FIGURE** **2**

Appendix B. PRELIMINARY SITE PLANS AND EXPLORATION LOCATIONS



CLIENT PROVIDED SITE PLAN - NOT INTENDED FOR CONSTRUCTION (**NOT TO SCALE)**

Materials Testing & Consulting, Inc.
777 Chrysler Drive
Burlington, WA 98233

Site Map and Exploration Locations
Tulalip Utilities Building
3015 Mission Beach Rd
Tulalip, WA

FIGURE
3

Appendix C. EXPLORATION LOGS

Grab soil samples were collected from each exploration location by our field geologist during test pit excavation. Soil samples collected during the field exploration were classified in accordance with ASTM D2487. All samples were placed in plastic bags to limit moisture loss, labeled, and returned to our laboratory for further examination and testing.

Exploration logs are shown in full in Appendix C. The explorations were monitored by our field geologist who examined and classified the materials encountered in accordance with the Unified Soil Classification System (USCS), obtained representative soil samples, and recorded pertinent information including soil sample depths, stratigraphy, soil engineering characteristics, and groundwater occurrence. Upon completion test pits were backfilled with existing native soils tailings.

The stratification lines shown on the individual logs represent the approximate boundaries between soil types; actual transitions may be either more gradual or more severe. The conditions depicted are for the date and location indicated only, and it should not necessarily be expected that they are representative of conditions at other locations and times.

Penetrometer results from DCP testing are shown in Appendix C. During penetrometer advancement, blow counts were recorded in 10-centimeter increments as a thirty-five-pound weight was dropped a distance of 15 inches. Blow counts were then converted to resistance (kg/cm^2), standard penetration blow counts (N-values), and corresponding soil consistency, as displayed on the logs.

Kessler Dynamic Cone Penetrometer (DCP) tests were conducted using KSE K-100 MD model Kessler DCP equipment to provide general soil strength data and CBR correlation for use in pavement design analysis. The KDCP is designed to generate a profile of correlative California Bearing Ratio versus depth and is operated by recording the number of blows required to advance a 0.8-inch diameter round tip probe for each successive 2-inch increment under the force of a free-falling hammer weighing 17.6 pounds and dropping 22.6 inches. The results of each KDCP test are presented in this Appendix. Accompanying blow count results is a graph of corresponding CBR values displayed by depth.

Unified Soil Classification System Chart

Major Divisions			Graph	USCS	Typical Description
Coarse Grained Soils More Than 50% Retained On No. 200 Sieve	**Gravel** More Than 50% of Coarse Fraction Retained On No. 4 Sieve	Clean Gravels	▨	GW	Well-graded Gravels, Gravel-Sand Mixtures
			▨	GP	Poorly-Graded Gravels, Gravel-Sand Mixtures
		Gravels With Fines	▨	GM	Silty Gravels, Gravel-Sand-Silt Mixtures
			▨	GC	Clayey Gravels, Gravel-Sand-Clay Mixtures
	Sand More Than 50% of Coarse Fraction Passing No. 4 Sieve	Clean Sands	▨	SW	Well-graded Sands, Gravelly Sands
			▨	SP	Poorly-Graded Sands, Gravelly Sands
		Sands With Fines	▨	SM	Silty Sands, Sand-Silt Mixtures
			▨	SC	Clayey Sands, Clay Mixtures
Fine Grained Soils More Than 50% Passing The No. 200 Sieve	Silts & Clays	Liquid Limit Less Than 50	▨	ML	Inorganic Silts, rock Flour, Clayey Silts With Low Plasticity
			▨	CL	Inorganic Clays of Low To Medium Plasticity
			▨	OL	Organic Silts and Organic Silty Clays of Low Plasticity
	Silts & Clays	Liquid Limit Greater Than 50	▨	MH	Inorganic Silts of Moderate Plasticity
			▨	CH	Inorganic Clays of High Plasticity
			▨	OH	Organic Clays And Silts of Medium to High Plasticity
Highly Organic Soils			▨	PT	Peat, Humus, Soils with Predominantly Organic Content

Sampler Symbol Description

◪	Standard Penetration Test (SPT)
▥	Shelby Tube
⊠	Grab or Bulk
▤	California (3.0" O.D.)
■	Modified California (2.5" O.D.)

Stratigraphic Contact

—	Distinct Stratigraphic Contact Between Soil Strata
╲	Gradual Change Between Soil Strata
- - -	Approximate location of stratagraphic change

▼	Groundwater observed at time of exploration
▽	Measured groundwater level in exploration, well, or piezometer
◆	Perchedwater observed at time of exploration

Modifiers

Description	%
Trace	>5
Some	5-12
With	>12

Soil Consistency

Granular Soils		Fine-grained Soils	
Density	*SPT Blowcount*	*Consistency*	*SPT Blowcount*
Very Loose	0-4	Very Soft	0-2
Loose	4-10	Soft	2-4
Medium Dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very Dense	> 50	Very Stiff	15-30
		Hard	> 30

Grain Size

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		> 12"	> 12"	Larger than a basketball
Cobbles		3 - 12"	3 - 12"	Fist to basketball
Gravel	Coarse	3/4 - 3"	3/4 - 3"	Thumb to fist
	Fine	#4 - 3/4"	0.19 - 0.75"	Pea to thumb
Sand	Coarse	#10 - #4	0.079 - 0.19"	Rock salt to pea
	Medium	#40 - #10	0.017 - 0.079"	Sugar to rock salt
	Fine	#200 - #40	0.0029 - 0.017"	Flour to Sugar
Fines		Passing #200	< 0.0029"	Flour and smaller

Soil Exploration Log Key

ASTM D-2487
Unified Soil Classification System (USCS)

FIGURE
4

MATERIALS TESTING & CONSULTING, INC.

Log of Test Pit Excavation TP-1

Tulalip Utilities Building
Snohomish County TPNs
00616500600100 & 00616500600200
Tulalip, Washington

MTC Job # 22B116

Date Started	: 04/27/2022
Date Completed	: 04/27/2022
Sampling Method	: Grab Samples
Location	: NW of Main Bldg (See Map)
Logged By	: K. Walters

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Water Level	Sample	% Finer than #200	% Moisture
0.0	GP		GRAVEL, crushed				
0.5	GM		GRAVEL, sand, trace silt, crushed, poorly graded, moist to wet, gray				
1.0–2.5	ML		SANDY SILT, wet, brown orange		☒		
3.0–4.5	SM		SILTY SAND, moist to wet, light brown mottling in upper 1 foot		☒ ☒		
5.0–5.5	SP		SAND, moist to wet, brown				
6.0			Bottom at 6.0 feet				

6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0

MATERIALS TESTING & CONSULTING, INC.

Log of Test Pit Excavation TP-2

Tulalip Utilities Building
Snohomish County TPNs
00616500600100 & 00616500600200
Tulalip, Washington

MTC Job # 22B116

Date Started : 04/27/2022
Date Completed : 04/27/2022
Sampling Method : Grab Samples
Location : SW of Main Bldg (See Map)
Logged By : K. Walters

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Water Level	Sample	% Finer than #200	% Moisture
0.0	GP		GRAVEL, sand, some silt **CSTL Gravel**				
0.5	SP		SAND, gravel, moist, gray		☒		
1.0 1.5 2.0 2.5	SP		SAND, gravel, moist, orange to brown		☒ ☒		
	SM		SILTY SAND, moist to dry, gray-brown		☒	33.9	14.1
3.0 3.5 4.0 4.5	ML		SILT, sand, moist, gray mottling in upper 1 foot		☒ ☒ ☒		
5.0			Bottom at 5.0 feet				
5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0							

MATERIALS TESTING & CONSULTING, INC.

Log of Test Pit Excavation TP-3

Tulalip Utilities Building
Snohomish County TPNs
00616500600100 & 00616500600200
Tulalip, Washington

MTC Job # 22B116

Date Started : 04/27/2022
Date Completed : 04/27/2022
Sampling Method : Grab Samples
Location : E of Main Bldg (See Map)
Logged By : K. Walters

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Water Level	Sample	% Finer than #200	% Moisture
0.0	SM		**Sod | Topsoil**				
0.5			SANDY SILT, moist, gray to brown				
1.0			occational gravel				
1.5							
2.0							
2.5	ML				☒	63.8	21.4
3.0							
3.5							
4.0							
4.5							
5.0			SAND, moist to wet, brown		☒		
5.5	SP						
6.0			Bottom at 6.0 feet				
6.5							
7.0							
7.5							
8.0							
8.5							
9.0							
9.5							
10.0							

MATERIALS TESTING & CONSULTING, INC.

Log of Test Pit Excavation TP-4

Tulalip Utilities Building
Snohomish County TPNs
00616500600100 & 00616500600200
Tulalip, Washington

MTC Job # 22B116

Date Started : 04/27/2022
Date Completed : 04/27/2022
Sampling Method : Grab Samples
Location : NE Corner of Main Building (See Map)
Logged By : K. Walters

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Water Level	Sample	% Finer than #200	% Moisture
0.0	GP		**CSTL Gravel**				
0.5 1.0 1.5	ML		SANDY SILT, wet, dark brown abandoned gas line at 1.5 feet				
2.0	ML		SANDY SILT, saturated, brown				
2.5 3.0 3.5 4.0 4.5 5.0	ML		SANDY SILT, moist, gray to brown mottling		☒		
5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0			Bottom at 5.5 feet				

MATERIALS TESTING & CONSULTING, INC.

Log of Test Pit Excavation TP-5

Tulalip Utilities Building
Snohomish County TPNs
00616500600100 & 00616500600200
Tulalip, Washington

MTC Job # 22B116

Date Started : 04/27/2022
Date Completed : 04/27/2022
Sampling Method : Grab Samples
Location : SE Corner of Main Building (See Map)
Logged By : K. Walters

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Water Level	Sample	% Finer than #200	% Moisture
0.0	GP		GRAVEL, sand				
0.5			SAND, silt, moist, dark brown				
1.0							
1.5	SP						
2.0							
2.5			SANDY SILT, trace gravel, moist, gray-brown		☒	58.4	1.80
3.0			mottling				
3.5	ML						
4.0							
4.5			SILT, sand, moist, tan to gray				
5.0	ML						
5.5							
6.0			Bottom at 6.0 feet				
6.5							
7.0							
7.5							
8.0							
8.5							
9.0							
9.5							
10.0							

WILDCAT DYNAMIC CONE LOG

Page 1 of 1

Materials Testing and Consulting
805 Dupont, Suite 5
Bellingham, WA 98225

PROJECT NUMBER: 22B116
DATE STARTED: 04-27-2022
DATE COMPLETED: 04-27-2022

HOLE #: DCP-1
CREW: K. Walters
PROJECT: Tulalip Utilities Building
ADDRESS: 3015 Mission Beach Road
LOCATION: Tulalip, WA

SURFACE ELEVATION: Present Grade
WATER ON COMPLETION: Overcast
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

	BLOWS	RESISTANCE	GRAPH OF CONE RESISTANCE		TESTED CONSISTENCY	
DEPTH	PER 10 cm	Kg/cm²	0 50 100 150	N'	SAND & SILT	CLAY
-	15	66.6	•••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
-	20	88.8	•••••••••••••••••••••••••	25	MEDIUM DENSE	VERY STIFF
- 1 ft	15	66.6	•••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
-	40	177.6	••	-	DENSE	HARD
-	13	57.7	••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
- 2 ft	10	44.4	••••••••••••	12	MEDIUM DENSE	STIFF
-	6	26.6	•••••••	7	LOOSE	MEDIUM STIFF
-	4	17.8	•••••	5	LOOSE	MEDIUM STIFF
- 3 ft	2	8.9	••	2	VERY LOOSE	SOFT
- 1 m	4	17.8	•••••	5	LOOSE	MEDIUM STIFF
-	13	50.2	••••••••••••••	14	MEDIUM DENSE	STIFF
- 4 ft	13	50.2	••••••••••••••	14	MEDIUM DENSE	STIFF
-	12	46.3	•••••••••••••	13	MEDIUM DENSE	STIFF
-	15	57.9	••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
- 5 ft	20	77.2	••••••••••••••••••••••	22	MEDIUM DENSE	VERY STIFF
-	30	115.8	•••••••••••••••••••••••••••••••••	-	DENSE	HARD
-	27	104.2	•••••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
- 6 ft	21	81.1	•••••••••••••••••••••••	23	MEDIUM DENSE	VERY STIFF
-	17	65.6	••••••••••••••••••	18	MEDIUM DENSE	VERY STIFF
- 2 m	13	50.2	••••••••••••••	14	MEDIUM DENSE	STIFF
- 7 ft	12	41.0	•••••••••••	11	MEDIUM DENSE	STIFF
-	17	58.1	••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	30	102.6	•••••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
- 8 ft	30	102.6	•••••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
-	30	102.6	•••••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
-	37	126.5	••••••••••••••••••••••••••••••••••••	-	DENSE	HARD
- 9 ft	32	109.4	•••••••••••••••••••••••••••••••	-	DENSE	HARD
-	35	119.7	••••••••••••••••••••••••••••••••••	-	DENSE	HARD
-	31	106.0	••••••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
- 3 m 10 ft	30	102.6	•••••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
-	29	88.7	•••••••••••••••••••••••••	25	MEDIUM DENSE	VERY STIFF
-	41	125.5	•••••••••••••••••••••••••••••••••••	-	DENSE	HARD
-	41	125.5	•••••••••••••••••••••••••••••••••••	-	DENSE	HARD
- 11 ft	50	153.0	•••	-	DENSE	HARD
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT.XLS

WILDCAT DYNAMIC CONE LOG

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Materials Testing and Consulting
805 Dupont, Suite 5
Bellingham, WA 98225

PROJECT NUMBER: 22B116
DATE STARTED: 04-27-2022
DATE COMPLETED: 04-27-2022

HOLE #: DCP-2
CREW: K. Walters
PROJECT: Tulalip Utilities Building
ADDRESS: 3015 Mission Beach Road
LOCATION: Tulalip, WA

SURFACE ELEVATION: Present Grade
WATER ON COMPLETION: Overcast
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

	BLOWS	RESISTANCE	GRAPH OF CONE RESISTANCE		TESTED CONSISTENCY	
DEPTH	PER 10 cm	Kg/cm²	0 50 100 150	N'	SAND & SILT	CLAY
-	22	97.7		-	MEDIUM DENSE	VERY STIFF
-	25	111.0		-	DENSE	HARD
- 1 ft	16	71.0		20	MEDIUM DENSE	VERY STIFF
-	10	44.4		12	MEDIUM DENSE	STIFF
-	12	53.3		15	MEDIUM DENSE	STIFF
- 2 ft	13	57.7		16	MEDIUM DENSE	VERY STIFF
-	16	71.0		20	MEDIUM DENSE	VERY STIFF
-	23	102.1		-	MEDIUM DENSE	VERY STIFF
- 3 ft	16	71.0		20	MEDIUM DENSE	VERY STIFF
- 1 m	26	115.4		-	DENSE	HARD
-	30	115.8		-	DENSE	HARD
- 4 ft	35	135.1		-	DENSE	HARD
-	22	84.9		24	MEDIUM DENSE	VERY STIFF
-	24	92.6		-	MEDIUM DENSE	VERY STIFF
- 5 ft	25	96.5		-	MEDIUM DENSE	VERY STIFF
-	27	104.2		-	MEDIUM DENSE	VERY STIFF
-	25	96.5		-	MEDIUM DENSE	VERY STIFF
- 6 ft	23	88.8		25	MEDIUM DENSE	VERY STIFF
-	26	100.4		-	MEDIUM DENSE	VERY STIFF
- 2 m	33	127.4		-	DENSE	HARD
- 7 ft	30	102.6		-	MEDIUM DENSE	VERY STIFF
-	34	116.3		-	DENSE	HARD
-	30	102.6		-	MEDIUM DENSE	VERY STIFF
- 8 ft	31	106.0		-	MEDIUM DENSE	VERY STIFF
-	27	92.3		-	MEDIUM DENSE	VERY STIFF
-	30	102.6		-	MEDIUM DENSE	VERY STIFF
- 9 ft	35	119.7		-	DENSE	HARD
-	30	102.6		-	MEDIUM DENSE	VERY STIFF
-	33	112.9		-	DENSE	HARD
- 3 m 10 ft	41	140.2		-	DENSE	HARD
-	31	94.9		-	MEDIUM DENSE	VERY STIFF
-	27	82.6		23	MEDIUM DENSE	VERY STIFF
-	45	137.7		-	DENSE	HARD
- 11 ft	52	159.1		-	DENSE	HARD
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT.XLS

WILDCAT DYNAMIC CONE LOG

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Materials Testing and Consulting
805 Dupont, Suite 5
Bellingham, WA 98225

PROJECT NUMBER: 22B116
DATE STARTED: 04-27-2022
DATE COMPLETED: 04-27-2022

HOLE #: DCP-3
CREW: K. Walters
PROJECT: Tulalip Utilities Building
ADDRESS: 3015 Mission Beach Road
LOCATION: Tulalip, WA

SURFACE ELEVATION: Present Grade
WATER ON COMPLETION: Overcast
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY SAND & SILT	CLAY
-	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
-	9	40.0	•••••••••••	11	MEDIUM DENSE	STIFF
- 1 ft	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
-	10	44.4	••••••••••••	12	MEDIUM DENSE	STIFF
-	9	40.0	•••••••••••	11	MEDIUM DENSE	STIFF
- 2 ft	9	40.0	•••••••••••	11	MEDIUM DENSE	STIFF
-	12	53.3	•••••••••••••••	15	MEDIUM DENSE	STIFF
-	13	57.7	••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
- 3 ft	13	57.7	••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
- 1 m	14	62.2	••••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	17	65.6	•••••••••••••••••••	18	MEDIUM DENSE	VERY STIFF
- 4 ft	15	57.9	••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	18	69.5	••••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
-	18	69.5	••••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
- 5 ft	18	69.5	••••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
-	16	61.8	•••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	20	77.2	••••••••••••••••••••••	22	MEDIUM DENSE	VERY STIFF
- 6 ft	19	73.3	•••••••••••••••••••••	20	MEDIUM DENSE	VERY STIFF
-	23	88.8	•••••••••••••••••••••••••	25	MEDIUM DENSE	VERY STIFF
- 2 m	26	100.4	•••••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
- 7 ft	23	78.7	••••••••••••••••••••••	22	MEDIUM DENSE	VERY STIFF
-	32	109.4	•••••••••••••••••••••••••••••••	-	DENSE	HARD
-	32	109.4	•••••••••••••••••••••••••••••••	-	DENSE	HARD
- 8 ft	27	92.3	••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
-	25	85.5	••••••••••••••••••••••••	24	MEDIUM DENSE	VERY STIFF
-	27	92.3	••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
- 9 ft	30	102.6	•••••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
-	28	95.8	•••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
-	28	95.8	•••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
- 3 m 10 ft	26	88.9	•••••••••••••••••••••••••	25	MEDIUM DENSE	VERY STIFF
-	24	73.4	•••••••••••••••••••••	20	MEDIUM DENSE	VERY STIFF
-	22	67.3	•••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
-	22	67.3	•••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
- 11 ft	22	67.3	•••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
-	25	76.5	••••••••••••••••••••••	21	MEDIUM DENSE	VERY STIFF
-	25	76.5	••••••••••••••••••••••	21	MEDIUM DENSE	VERY STIFF
- 12 ft	30	91.8	••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
-	30	91.8	••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
-	35	107.1	•••••••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
- 4 m 13 ft	41	125.5	••••••••••••••••••••••••••••••••••••	-	DENSE	HARD

HOLE #: DCP-3

WILDCAT DYNAMIC CONE LOG

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PROJECT: Tulalip Utilities Building

PROJECT NUMBER: 22B116

	BLOWS	RESISTANCE	GRAPH OF CONE RESISTANCE		TESTED CONSISTENCY	
DEPTH	PER 10 cm	Kg/cm²	0 50 100 150	N'	SAND & SILT	CLAY
-	50	138.5	••	-	DENSE	HARD
-						
- 14 ft						
-						
-						
- 15 ft						
-						
-						
- 16 ft						
- 5 m						
-						
- 17 ft						
-						
-						
- 18 ft						
-						
-						
- 19 ft						
-						
- 6 m						
- 20 ft						
-						
-						
- 21 ft						
-						
-						
- 22 ft						
-						
-						
- 7 m 23 ft						
-						
-						
- 24 ft						
-						
-						
- 25 ft						
-						
-						
- 26 ft						
- 8 m						
-						
- 27 ft						
-						
-						
- 28 ft						
-						
-						
- 29 ft						
-						
- 9 m						

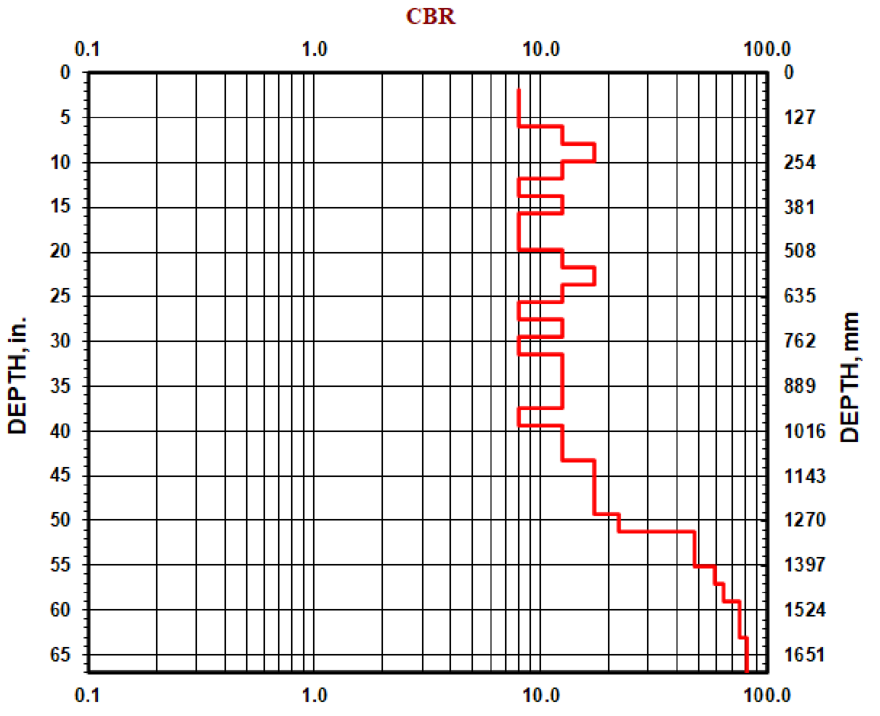
Kessler DCP TEST DATA

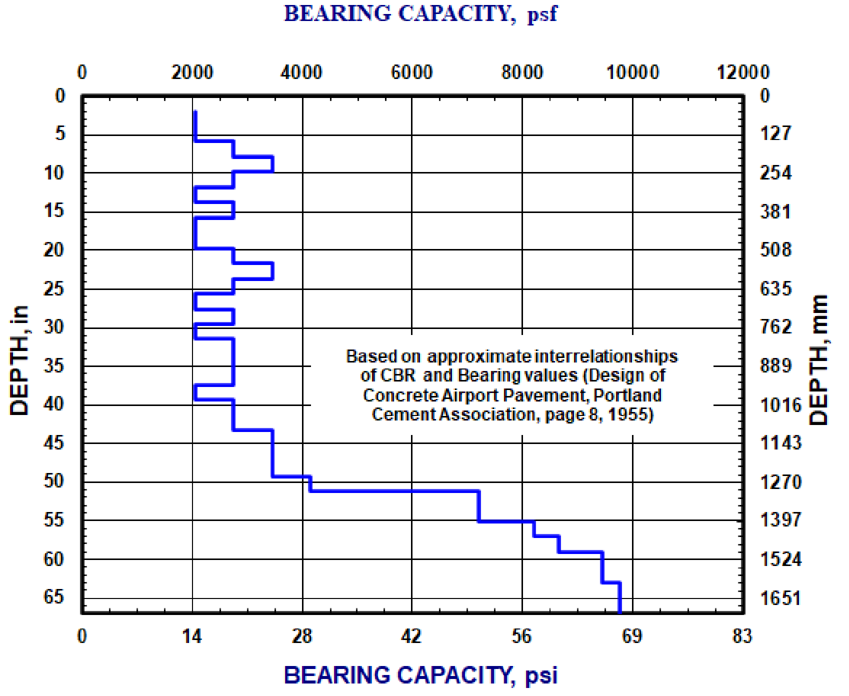
Project: *Tulalip Utilities Bldg - 22B116*
Date: 27-Apr-22
Location: kDCP-3 (East of Main Bldg)
Soil Type(s): Silty Sand

Hammer
○ 10.1 lbs.
● 17.6 lbs.
○ Both hammers used

Soil Type
○ CH
○ CL
● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
1	50	1
2	100	1
2	150	1
3	200	1
4	250	1
3	300	1
2	350	1
3	400	1
2	450	1
2	500	1
3	550	1
4	600	1
3	650	1
2	700	1
3	750	1
2	800	1
3	850	1
3	900	1
3	950	1
2	1000	1
3	1050	1
3	1100	1
4	1150	1
4	1200	1
4	1250	1
5	1300	1
10	1350	1
10	1400	1
12	1450	1
13	1500	1
15	1550	1
15	1600	1
16	1650	1
16	1700	1





WILDCAT DYNAMIC CONE LOG

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Materials Testing and Consulting
805 Dupont, Suite 5
Bellingham, WA 98225

PROJECT NUMBER: 22B116
DATE STARTED: 04-27-2022
DATE COMPLETED: 04-27-2022

HOLE #: DCP-4A
CREW: K. Walters
PROJECT: Tulalip Utilities Building
ADDRESS: 3015 Mission Beach Road
LOCATION: Tulalip, WA

SURFACE ELEVATION: Present Grade
WATER ON COMPLETION: Overcast
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

	BLOWS	RESISTANCE	GRAPH OF CONE RESISTANCE		TESTED CONSISTENCY	
DEPTH	PER 10 cm	Kg/cm^2	0 50 100 150	N'	SAND & SILT	CLAY
-	12	53.3	•••••••••••••••	15	MEDIUM DENSE	STIFF
-	12	53.3	•••••••••••••••	15	MEDIUM DENSE	STIFF
- 1 ft	13	57.7	••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	10	44.4	••••••••••••	12	MEDIUM DENSE	STIFF
-	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
- 2 ft	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
-	13	57.7	••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	9	40.0	•••••••••••	11	MEDIUM DENSE	STIFF
- 3 ft	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
- 1 m	50	222.0	••	-	VERY DENSE	HARD
-						
- 4 ft						
-						
-						
- 5 ft						
-						
-						
- 6 ft						
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT.XLS

WILDCAT DYNAMIC CONE LOG

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Materials Testing and Consulting
805 Dupont, Suite 5
Bellingham, WA 98225

PROJECT NUMBER: 22B116
DATE STARTED: 04-27-2022
DATE COMPLETED: 04-27-2022

HOLE #: DCP-4B
CREW: K. Walters
PROJECT: Tulalip Utilities Building
ADDRESS: 3015 Mission Beach Road
LOCATION: Tulalip, WA

SURFACE ELEVATION: Present Grade
WATER ON COMPLETION: Overcast
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

	BLOWS	RESISTANCE	GRAPH OF CONE RESISTANCE		TESTED CONSISTENCY	
DEPTH	PER 10 cm	Kg/cm²	0 50 100 150	N'	SAND & SILT	CLAY
-	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
-	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
- 1 ft	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
-	6	26.6	•••••••	7	LOOSE	MEDIUM STIFF
-	4	17.8	•••••	5	LOOSE	MEDIUM STIFF
- 2 ft	3	13.3	•••	3	VERY LOOSE	SOFT
-	3	13.3	•••	3	VERY LOOSE	SOFT
-	2	8.9	••	2	VERY LOOSE	SOFT
- 3 ft	2	8.9	••	2	VERY LOOSE	SOFT
- 1 m	12	53.3	•••••••••••••••	15	MEDIUM DENSE	STIFF
-	17	65.6	•••••••••••••••••••	18	MEDIUM DENSE	VERY STIFF
- 4 ft	18	69.5	••••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
-	17	65.6	•••••••••••••••••••	18	MEDIUM DENSE	VERY STIFF
-	16	61.8	•••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
- 5 ft	16	61.8	•••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	19	73.3	•••••••••••••••••••••	20	MEDIUM DENSE	VERY STIFF
-	17	65.6	•••••••••••••••••••	18	MEDIUM DENSE	VERY STIFF
- 6 ft	18	69.5	••••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
-	16	61.8	•••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
- 2 m	16	61.8	•••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
- 7 ft	15	51.3	••••••••••••••	14	MEDIUM DENSE	STIFF
-	16	54.7	•••••••••••••••	15	MEDIUM DENSE	STIFF
-	28	95.8	•••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
- 8 ft	30	102.6	•••••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
-	25	85.5	••••••••••••••••••••••••	24	MEDIUM DENSE	VERY STIFF
-	22	75.2	•••••••••••••••••••••	21	MEDIUM DENSE	VERY STIFF
- 9 ft	22	75.2	•••••••••••••••••••••	21	MEDIUM DENSE	VERY STIFF
-	17	58.1	••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	15	51.3	••••••••••••••	14	MEDIUM DENSE	STIFF
- 3 m 10 ft	17	58.1	••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	17	52.0	•••••••••••••••	14	MEDIUM DENSE	STIFF
-	17	52.0	•••••••••••••••	14	MEDIUM DENSE	STIFF
-	17	52.0	•••••••••••••••	14	MEDIUM DENSE	STIFF
- 11 ft	15	45.9	•••••••••••••	13	MEDIUM DENSE	STIFF
-	17	52.0	•••••••••••••••	14	MEDIUM DENSE	STIFF
-	20	61.2	•••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
- 12 ft	30	91.8	••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
-	42	128.5	•••••••••••••••••••••••••••••••••••••	-	DENSE	HARD
-						
- 4 m 13 ft						

WILDCAT.XLS

WILDCAT DYNAMIC CONE LOG

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Materials Testing and Consulting
805 Dupont, Suite 5
Bellingham, WA 98225

PROJECT NUMBER: 22B116
DATE STARTED: 04-27-2022
DATE COMPLETED: 04-27-2022

HOLE #: DCP-5
CREW: K. Walters
PROJECT: Tulalip Utilities Building
ADDRESS: 3015 Mission Beach Road
LOCATION: Tulalip, WA

SURFACE ELEVATION: Present Grade
WATER ON COMPLETION: Overcast
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

	BLOWS	RESISTANCE	GRAPH OF CONE RESISTANCE		TESTED CONSISTENCY	
DEPTH	PER 10 cm	Kg/cm²	0 50 100 150	N'	SAND & SILT	CLAY
-	12	53.3	•••••••••••••••	15	MEDIUM DENSE	STIFF
-	10	44.4	••••••••••••	12	MEDIUM DENSE	STIFF
- 1 ft	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
-	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
-	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
- 2 ft	4	17.8	•••••	5	LOOSE	MEDIUM STIFF
-	3	13.3	•••	3	VERY LOOSE	SOFT
-	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
- 3 ft	12	53.3	•••••••••••••••	15	MEDIUM DENSE	STIFF
- 1 m	10	44.4	••••••••••••	12	MEDIUM DENSE	STIFF
-	10	38.6	•••••••••••	11	MEDIUM DENSE	STIFF
- 4 ft	11	42.5	••••••••••••	12	MEDIUM DENSE	STIFF
-	15	57.9	••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	13	50.2	••••••••••••••	14	MEDIUM DENSE	STIFF
- 5 ft	13	50.2	••••••••••••••	14	MEDIUM DENSE	STIFF
-	15	57.9	••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	13	50.2	••••••••••••••	14	MEDIUM DENSE	STIFF
- 6 ft	15	57.9	••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	18	69.5	••••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
- 2 m	24	92.6	••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
- 7 ft	30	102.6	•••••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
-	31	106.0	••••••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
-	28	95.8	•••••••••••••••••••••••••••	-	MEDIUM DENSE	VERY STIFF
- 8 ft	32	109.4	•••••••••••••••••••••••••••••••	-	DENSE	HARD
-	45	153.9	••	-	DENSE	HARD
-	50	171.0	••	-	DENSE	HARD
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT.XLS

Appendix D. LABORATORY RESULTS

Laboratory tests were conducted on several representative soil samples to better identify the soil classification of the units encountered and to evaluate the material's general physical properties and engineering characteristics. A brief description of the tests performed for this study is provided below. The results of laboratory tests performed on specific samples are provided at the appropriate sample depths on the individual boring logs. However, it is important to note that these test results may not accurately represent in situ soil conditions. All of our recommendations are based on our interpretation of these test results and their use in guiding our engineering judgment. MTC cannot be responsible for the interpretation of these data by others.

Soil samples for this project will be retained for a period of 3 months following completion of this report, unless we are otherwise directed in writing.

SOIL CLASSIFICATION

Soil samples were visually examined in the field by our representative at the time they were obtained. They were subsequently packaged and returned to our laboratory where they were reexamined, and the original description checked and verified or modified. With the help of information obtained from the other classification tests, described below, the samples were described in general accordance with ASTM Standard D2487. The resulting descriptions are provided at the appropriate locations on the individual exploration logs, located in Appendix C, and are qualitative only.

GRAIN-SIZE DISTRIBUTION

Grain-size distribution analyses were conducted in general accordance with ASTM Standard D422 on representative soil samples to determine the grain-size distribution of the on-site soil. The information gained from these analyses allows us to provide a description and classification of the in-place materials. In turn, this information helps us to understand engineering properties of the soil and thus how the in-place materials will react to conditions such as heavy seepage, traffic action, loading, potential liquefaction, and so forth. The results are presented in this Appendix.

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Sieve Report

Project: Tulalip Utilities Building Geotechnical Investigation
Project #: 22B116
Client: Tulalip Utilities Authority
Source: TP-2 @ 2.9 ft
Sample#: B22-0417

Date Received: 12-May-22
Sampled By: K. Walters
Date Tested: 16-May-22
Tested By: K. Mendez

Unified Soil Classification System, ASTM-2487
SM, Silty Sand
Sample Color:
gray-brown

ACCREDITED
Certificate #: 1366.01

ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs

Sample Meets Specs ? N/A

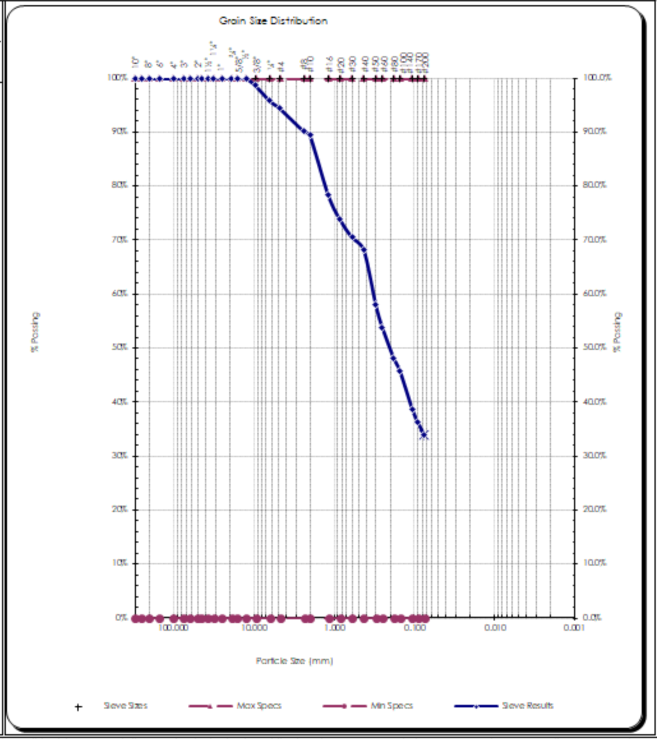
$D_{(5)}$ = 0.011 mm
$D_{(10)}$ = 0.022 mm
$D_{(15)}$ = 0.033 mm
$D_{(30)}$ = 0.066 mm
$D_{(50)}$ = 0.203 mm
$D_{(60)}$ = 0.325 mm
$D_{(90)}$ = 2.290 mm
Dust Ratio = 1/2

% Gravel = 5.6%
% Sand = 60.6%
% Silt & Clay = 33.9%
Liquid Limit = n/a
Plasticity Index = n/a
Sand Equivalent = n/a
Fracture %, 1 Face = n/a
Fracture %, 2+ Faces = n/a

Coeff. of Curvature, C_C = 0.61
Coeff. of Uniformity, C_U = 14.67
Fineness Modulus = 1.64
Plastic Limit = n/a
Moisture %, as sampled = 14.1%
Req'd Sand Equivalent =
Req'd Fracture %, 1 Face =
Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117, ASTM D1140

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	99%	99%	100.0%	0.0%
1/4"	6.30		96%	100.0%	0.0%
#4	4.75	94%	94%	100.0%	0.0%
#8	2.36		90%	100.0%	0.0%
#10	2.00	89%	89%	100.0%	0.0%
#16	1.18		78%	100.0%	0.0%
#20	0.850		74%	100.0%	0.0%
#30	0.600		71%	100.0%	0.0%
#40	0.425	68%	68%	100.0%	0.0%
#50	0.300		58%	100.0%	0.0%
#60	0.250		54%	100.0%	0.0%
#80	0.180		48%	100.0%	0.0%
#100	0.150	46%	46%	100.0%	0.0%
#140	0.106		39%	100.0%	0.0%
#170	0.090		36%	100.0%	0.0%
#200	0.075	33.9%	33.9%	100.0%	0.0%



Comments:

Reviewed by: Alex Eifrig

Alex Eifrig

Materials Testing & Consulting, Inc. 777 Chrysler Drive Burlington, WA 98233	**Lab Sample: TP-2 @ 2.9** Tulalip Utilities Building 3015 Mission Beach Rd Tulalip, WA	**FIGURE** **5**

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Tulalip Utilities Building Geotechnical Investigation
Project #: 22B116
Client: Tulalip Utilities Authority
Source: TP-3 @ 2.5 ft
Sample#: B22-0418

Date Received: 12-May-22
Sampled By: K. Walters
Date Tested: 16-May-22
Tested By: K. Mendez

Visual Soils Identification
Sandy Silt with Gravel
Sample Color:
gray-brown

ACCREDITED
Certificate #: 1366.01

ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

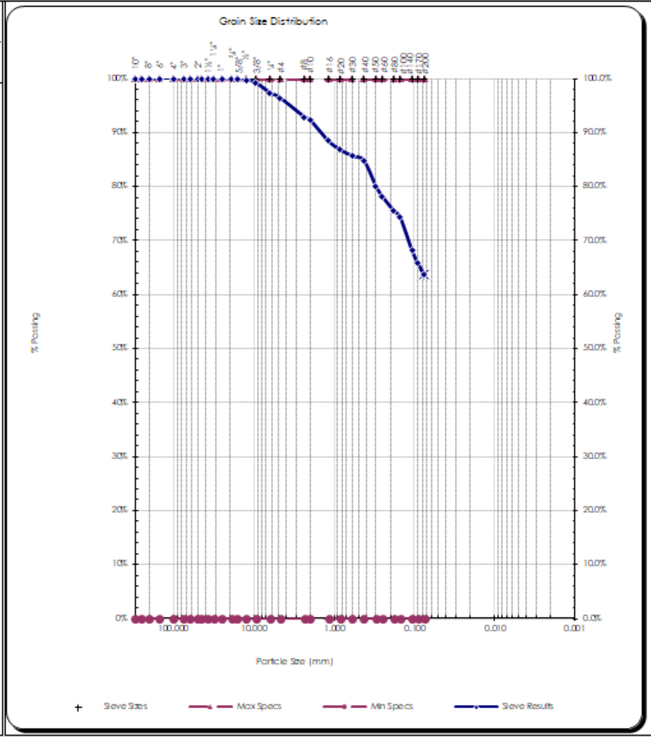
$D_{(5)}$ = 0.006 mm
$D_{(10)}$ = 0.012 mm
$D_{(15)}$ = 0.018 mm
$D_{(30)}$ = 0.035 mm
$D_{(50)}$ = 0.059 mm
$D_{(60)}$ = 0.071 mm
$D_{(90)}$ = 1.503 mm
Dust Ratio = 3/4

% Gravel = 3.6%
% Sand = 32.6%
% Silt & Clay = 63.8%
Liquid Limit = n/a
Plasticity Index = n/a
Sand Equivalent = n/a
Fracture %, 1 Face = n/a
Fracture %, 2+ Faces = n/a

Coeff. of Curvature, C_C = 1.50
Coeff. of Uniformity, C_U = 6.00
Fineness Modulus = 0.83
Plastic Limit = n/a
Moisture %, as sampled = 21.4%
Req'd Sand Equivalent =
Req'd Fracture %, 1 Face =
Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117, ASTM D1140

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	99%	99%	100.0%	0.0%
1/4"	6.30		97%	100.0%	0.0%
#4	4.75	96%	96%	100.0%	0.0%
#8	2.36		93%	100.0%	0.0%
#10	2.00	92%	92%	100.0%	0.0%
#16	1.18		88%	100.0%	0.0%
#20	0.850		87%	100.0%	0.0%
#30	0.600		86%	100.0%	0.0%
#40	0.425	85%	85%	100.0%	0.0%
#50	0.300		80%	100.0%	0.0%
#60	0.250		78%	100.0%	0.0%
#80	0.180		76%	100.0%	0.0%
#100	0.150	74%	74%	100.0%	0.0%
#140	0.106		68%	100.0%	0.0%
#170	0.090		66%	100.0%	0.0%
#200	0.075	63.8%	63.8%	100.0%	0.0%



Comments:

Reviewed by: Alex Eifrig

Alex Eifrig

Materials Testing & Consulting, Inc.
777 Chrysler Drive
Burlington, WA 98233

Lab Sample: TP-3 @ 2.5
Tulalip Utilities Building
3015 Mission Beach Rd
Tulalip, WA

FIGURE
6

Soil PAP
NAPT
2022

soiltest
farm consultants, inc.
2925 Driggs Dr., Moses Lake, Wa 98837 - www.soiltestlab.com
Office: (509)765-1622 - Fax:(509)765-0314 - (800)764-1622

Soil & Plant Program
2022
NAPT
Participating Laboratory

MATERIALS TESTING
777 CHRYSLER DR

Burlington , WA 98233

Laboratory #: S22-08135

Date Received: 5/16/2022
Grower: PROJ# 22B116
Field: B22-0418 TP-3 AT 2.5FT
Sampled By:
Customer Account #:
Customer Sample ID:

Soil Test Results

Cation Exchange	CEC	meq/100g	10.4

pH 1:1
E.C. 1:1 m.mhos/cm
Est Sat Paste E.C. m.mhos/cm
Effervescence

Lbs/Acre

Ammonium - N mg/kg
Organic Matter W.B. % ENR:

Other Tests:

Organic Matter (LOI 360) 1.1 %:

We make every effort to provide an accurate analysis of your sample. For reasonable cause we will repeat tests, but because of factors beyond our control in sampling procedures and the inherent variability of soil, our liability is limited to the price of the tests. Recommendations are to be used as general guides and should be modified for specific field conditions and situations. Note: "u" indicates that the element was analyzed for but not detected

This is your Invoice #: S22-08135 Account #: 234500 Reviewed by: K. Bair, PhD, C

Materials Testing & Consulting, Inc. 777 Chrysler Drive Burlington, WA 98233	**Lab Sample: TP-3 @ 2.5** Tulalip Utilities Building 3015 Mission Beach Rd Tulalip, WA	**FIGURE** **7**

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Tulalip Utilities Building Geotechnical Investigation
Project #: 22B116
Client: Tulalip Utilities Authority
Source: TP-5 @ 2.7 ft
Sample#: B22-0419

Date Received: 12-May-22
Sampled By: K. Walters
Date Tested: 16-May-22
Tested By: K. Mendez

Visual Soils Identification
Sandy Silt with Gravel
Sample Color:
gray-brown

ACCREDITED
Certificate #: 1366.01

ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? **N/A**

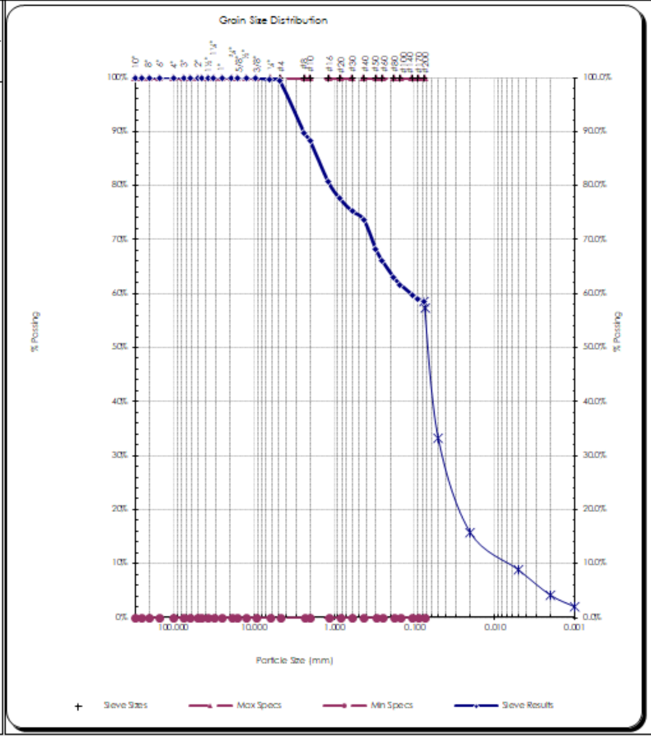
$D_{(5)}$ = 0.002 mm
$D_{(10)}$ = 0.006 mm
$D_{(15)}$ = 0.012 mm
$D_{(30)}$ = 0.047 mm
$D_{(50)}$ = 0.067 mm
$D_{(60)}$ = 0.111 mm
$D_{(90)}$ = 2.420 mm
Dust Ratio = 77/97

% Gravel = 0.7%
% Sand = 40.9%
% Silt & Clay = 58.4%
Liquid Limit = n/a
Plasticity Index = n/a
Sand Equivalent = n/a
Fracture %, 1 Face = n/a
Fracture %, 2+ Faces = n/a

Coeff. of Curvature, C_C = 3.27
Coeff. of Uniformity, C_U = 18.33
Fineness Modulus = 1.25
Plastic Limit = n/a
Moisture %, as sampled = n/a
Req'd Sand Equivalent =
Req'd Fracture %, 1 Face =
Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117, ASTM D1140

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
US	Metric				
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	99%	99%	100.0%	0.0%
#8	2.36		90%	100.0%	0.0%
#10	2.00	88%	88%	100.0%	0.0%
#16	1.18		81%	100.0%	0.0%
#20	0.850		78%	100.0%	0.0%
#30	0.600		75%	100.0%	0.0%
#40	0.425	74%	74%	100.0%	0.0%
#50	0.300		68%	100.0%	0.0%
#60	0.250		66%	100.0%	0.0%
#80	0.180		63%	100.0%	0.0%
#100	0.150		62%	100.0%	0.0%
#140	0.106		60%	100.0%	0.0%
#170	0.090		59%	100.0%	0.0%
#200	0.075	58.4%	58.4%	100.0%	0.0%



Comments: ______

Reviewed by: Alex Eifrig

Alex Eifrig

Materials Testing & Consulting, Inc. 777 Chrysler Drive Burlington, WA 98233	**Lab Sample: TP-5 @ 2.7** Tulalip Utilities Building 3015 Mission Beach Rd Tulalip, WA	**FIGURE** **8**

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

Hydrometer Report

Project: Tulalip Utilities Building Geotechnical Investigation
Project #: 22B116
Client : Tulalip Utilities Authority
Source: TP-5 @ 2.7 ft
Sample#: B22-0419

Date Received: 12-May-22
Sampled By: K. Walters
Date Tested: 16-May-22
Tested By: K. Mendez

Visual Soils Identification
Sandy Silt with Gravel
Sample Color
gray-brown

ASTM D422, HYDROMETER ANALYSIS

Assumed Sp Gr : 2.70
Sample Weight: 75.13 grams
Hydroscopic Moist.: 1.80%
Adj. Sample Wgt : 73.80 grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
2	15.5	18.4%	0.0353 mm
5	13.5	16.0%	0.0226 mm
15	13	15.4%	0.0131 mm
30	11.5	13.6%	0.0093 mm
60	9	10.7%	0.0067 mm
250	6	7.1%	0.0033 mm
1440	2.5	3.0%	0.0014 mm

% Gravel: 0.7%
% Sand: 40.9%
% Silt: 49.6%
% Clay: 8.9%

Liquid Limit: n/a
Plastic Limit: n/a
Plasticity Index: n/a

ASTM C136

Sieve Analysis
Grain Size Distribution

Sieve Size	Percent Passing	Soils Particle Diameter
3.0"	100%	75.000 mm
2.0"	100%	50.000 mm
1.5"	100%	37.500 mm
1.25"	100%	31.500 mm
1.0"	100%	25.000 mm
3/4"	100%	19.000 mm
5/8"	100%	16.000 mm
1/2"	100%	12.500 mm
3/8"	100%	9.500 mm
1/4"	100%	6.300 mm
#4	99%	4.750 mm
#10	88%	2.000 mm
#20	78%	0.850 mm
#40	74%	0.425 mm
#100	62%	0.150 mm
#200	58.4%	0.075 mm
Silts	57.4%	0.074 mm
	33.2%	0.050 mm
	15.8%	0.020 mm
Clays	8.9%	0.005 mm
	4.2%	0.002 mm
Colloids	2.1%	0.001 mm

USDA Soil Textural Classification

	Particle Size
% Sand:	2.0 - 0.05 mm
% Silt:	0.05 - 0.002 mm
% Clay:	< 0.002 mm

USDA Soil Textural Classification
Sandy Loam

Comments: ____________________

Reviewed by: Alex Eifrig
Alex Eifrig

Materials Testing & Consulting, Inc.
777 Chrysler Drive
Burlington, WA 98233

Lab Sample: TP-5 @ 2.7
Tulalip Utilities Building
3015 Mission Beach Rd
Tulalip, WA

FIGURE
9

Soil PAP
NAPT
2022

soiltest
farm consultants, inc.
2925 Driggs Dr., Moses Lake, Wa 98837 - www.soiltestlab.com
Office: (509)765-1622 - Fax:(509)765-0314 - (800)764-1622

Soil & Plant Program
2022
NAPT
Participating Laboratory

MATERIALS TESTING
777 CHRYSLER DR

Burlington , WA 98233

Laboratory #: S22-08136

Date Received: 5/16/2022
Grower: PROJ# 22B116
Field: B22-0419 TP-5 AT 2.7FT
Sampled By:
Customer Account #:
Customer Sample ID:

Soil Test Results

Cation Exchange	CEC	meq/100g	9.2

pH 1:1
E.C. 1:1 m.mhos/cm
Est Sat Paste E.C. m.mhos/cm
Effervescence

Lbs/Acre

Ammonium - N mg/kg
Organic Matter W.B. % ENR:

Other Tests:

Organic Matter (LOI 360) 1.2 %:

We make every effort to provide an accurate analysis of your sample. For reasonable cause we will repeat tests, but because of factors beyond our control in sampling procedures and the inherent variability of soil, our liability is limited to the price of the tests. Recommendations are to be used as general guides and should be modified for specific field conditions and situations. Note: "u" indicates that the element was analyzed for but not detected

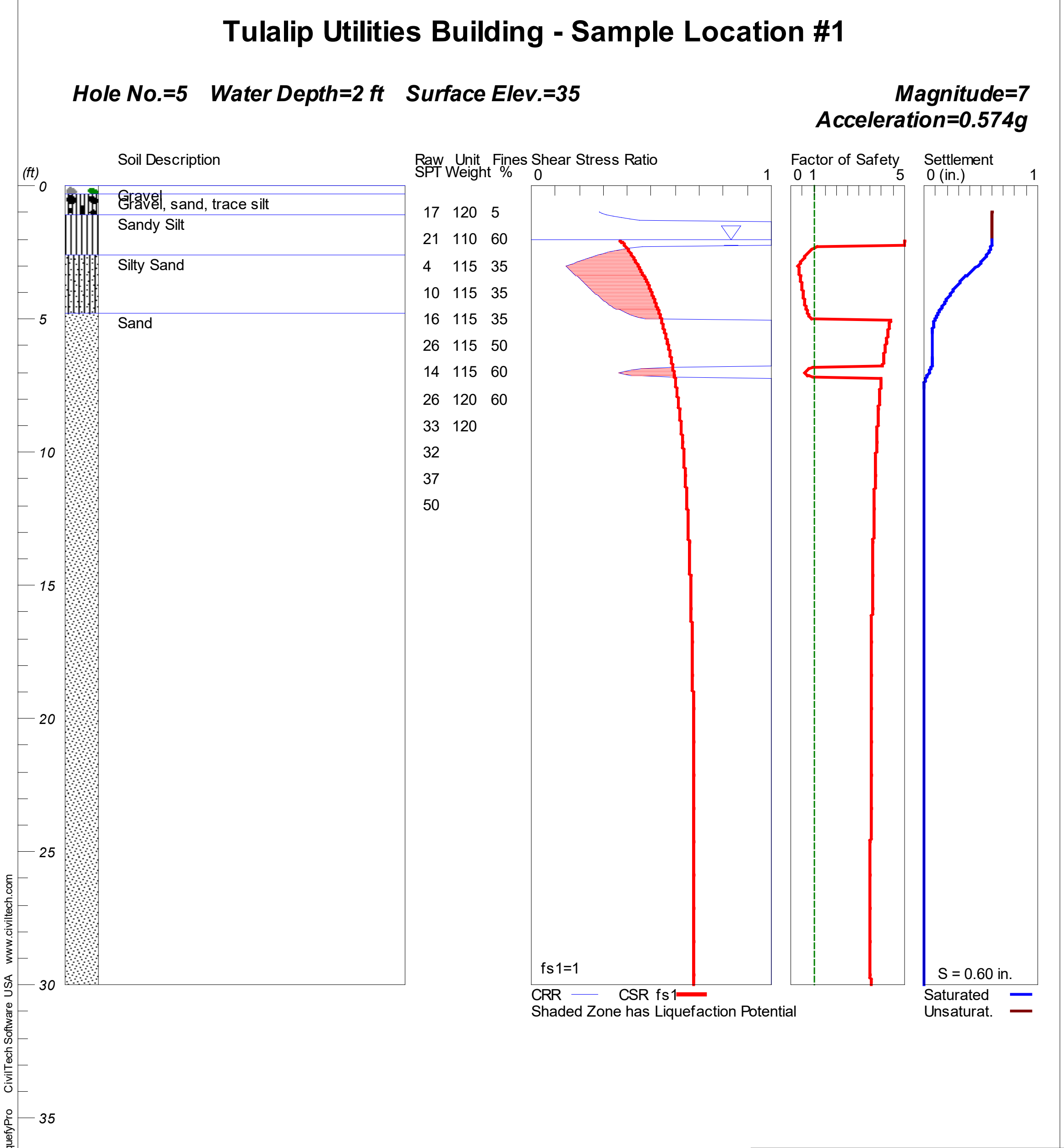
This is your Invoice #: S22-08136 Account #: 234500 Reviewed by: K. Bair, PhD, C

Materials Testing & Consulting, Inc.
777 Chrysler Drive
Burlington, WA 98233

Lab Sample: TP-5 @ 2.7
Tulalip Utilities Building
3015 Mission Beach Rd
Tulalip, WA

FIGURE
10

Appendix E. LIQUEFACTION ANALYSIS



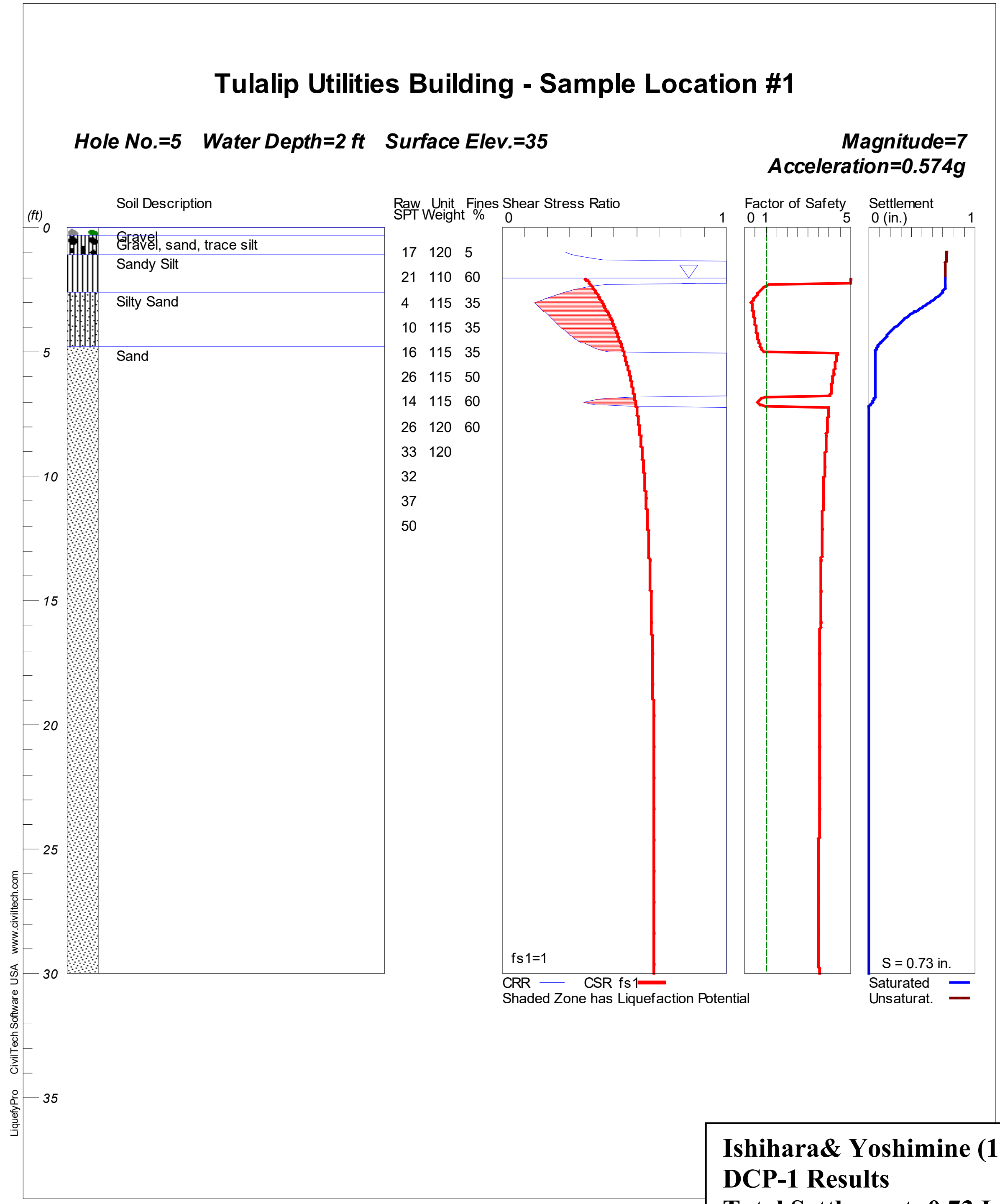
Tokimatsu | Seed Analysis

Tokimatsu & Seed (1987)
DCP-1 Results
Total Settlement=0.60 Inches

Materials Testing & Consulting, Inc.
777 Chrysler Drive
Burlington, WA 98233

Results of Liquefaction Analysis
Tulalip Utilities Building
3015 Mission Beach Rd
Tulalip, WA

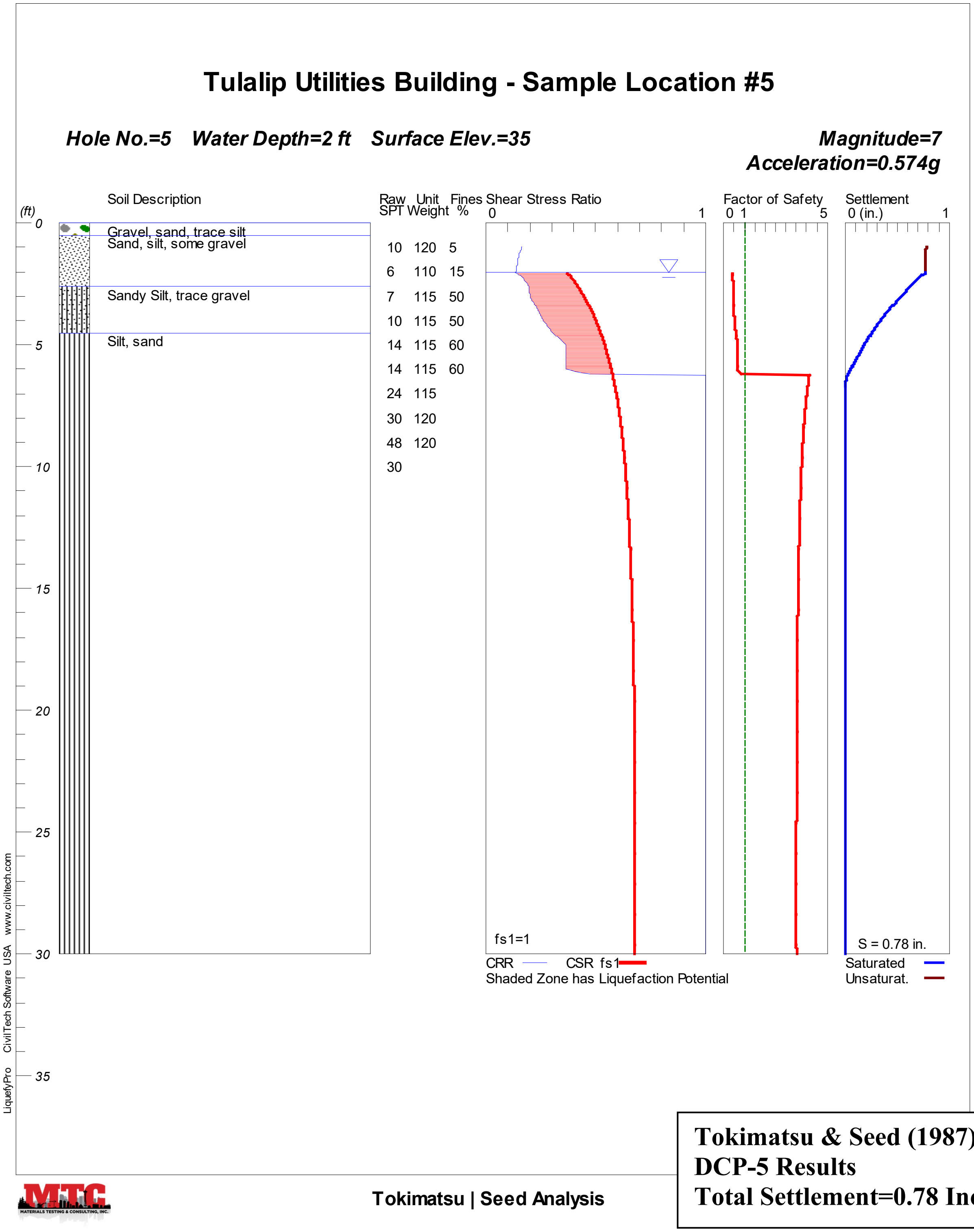
FIGURE
11



Ishihara | Yoshimine Analysis

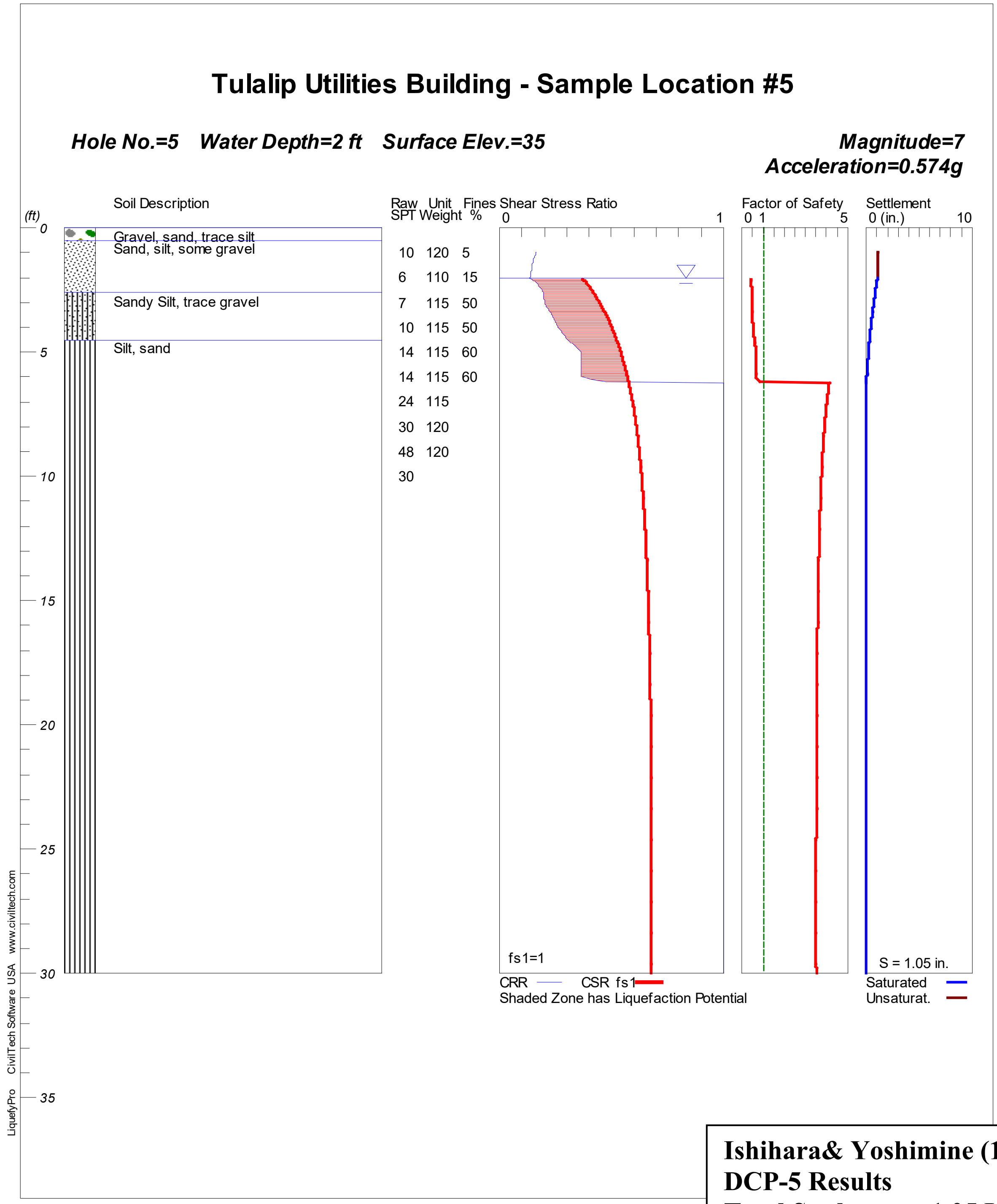
Ishihara& Yoshimine (1990)
DCP-1 Results
Total Settlement=0.73 Inches

Materials Testing & Consulting, Inc. 777 Chrysler Drive Burlington, WA 98233	**Results of Liquefaction Analysis** Tulalip Utilities Building 3015 Mission Beach Rd Tulalip, WA	**FIGURE** **12**



Tokimatsu & Seed (1987)
DCP-5 Results
Total Settlement=0.78 Inches

Materials Testing & Consulting, Inc. 777 Chrysler Drive Burlington, WA 98233	**Results of Liquefaction Analysis** Tulalip Utilities Building 3015 Mission Beach Rd Tulalip, WA	**FIGURE** **13**



Ishihara& Yoshimine (1990)
DCP-5 Results
Total Settlement=1.05 Inches

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Results of Liquefaction Analysis
Tulalip Utilities Building
3015 Mission Beach Rd
Tulalip, WA

FIGURE
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