100% Remedial Design Basis of Design Report

Appendix G
Geotechnical Design Analysis

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENTS

ABBREVIATIONS

ARCS	Assessment and Remediation of Contaminated Sediments
BODR	*Basis of Design Report*
CPT	cone penetrometer test
CR	compression ratio
DER	*Pre-Design Investigation Data Evaluation Report*
EAA	early action area
ENR	enhanced natural recovery
EPA	U.S. Environmental Protection Agency
FFP	full-flow penetrometer
FNC	federal navigation channel
ft^2	square foot
GWT	groundwater table elevation
H:V	horizontal to vertical
kip	one thousand pounds
lb/ft	pounds per foot
LDW	Lower Duwamish Waterway
LTMMP	Long-Term Maintenance and Monitoring Plan
MHHW	mean higher high water
MLLW	mean lower low water
N/A	not applicable
pcf	pounds per cubic foot
pci	pounds per cubic inch
PDI	pre-design investigation
PGA	peak ground acceleration
psf	pounds per square foot
RAL	remedial action level
RD	remedial design
RM	river mile
ROD	*Record of Decision*
SPT	standard penetration test
T-117	Terminal 117
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
VST	vane shear testing

1 Introduction

This *Geotechnical Design Analysis* presents the results of the geotechnical engineering evaluation performed by Anchor QEA, LLC, to determine the basis of design for the upper reach (river miles [RMs] 3.0 to 5.0) of the Lower Duwamish Waterway (LDW) Superfund Site in King County, Washington. The remedial actions associated with the upper reach include dredging and capping of areas within the waterway, including areas that have waterfront or overwater structures; placing thin cover of clean material for enhanced natural recovery (ENR); and backfilling dredge areas within elevation ranges that support habitat as described in the Final (100%) Remedial Design (RD) *Basis of Design Report* (BODR) to which this *Geotechnical Design Analysis* is an appendix.

1.1 Locations Studied

The proposed work requires remediation within the actively managed federal navigation channel (FNC), areas adjacent to waterfront and offshore structures, and early action areas (EAAs) over a range of subtidal and intertidal elevations. Subtidal areas are defined as areas below elevation -4 feet mean lower low water (MLLW). Intertidal areas represent elevations between -4 feet MLLW and the mean higher high water line (MHHW; equal to +11.4 feet MLLW), which horizontally defines the limit of sediment cleanup actions in the upper reach. The MHHW line occurs along sloped embankments or vertical bulkheads. Upland areas are locations above MHHW that abut and include shoreline property where buildings and structures may be encountered.

1.2 Report Structure

This *Geotechnical Design Analysis* includes the following six main sections:

- Section 1 is the introduction.
- Section 2 discusses the subsurface conditions underlying the site in more detail than presented in the *Pre-Design Investigation Data Evaluation Report* (DER) (Anchor QEA and Windward 2022); this section also describes the soil engineering parameters assigned to the major stratigraphic units.
- Section 3 describes the geotechnical engineering analyses performed for each of the following design elements:
  - Dredge prism side slope stability
  - Bank side slope stability
  - Cap bearing capacity and settlement evaluations
  - Backfill design
- Section 4 presents geotechnical engineering recommendations to be used by the structural engineer for the assessment of the following:
  - Bulkhead design, including lateral earth pressures and tieback design soil parameters
  - Pile design, including vertical and lateral pile capacity

- Section 5 discusses seismic (earthquake) evaluations for the site.
- Section 6 presents references that were used to support this work.

Attachments to this *Geotechnical Design Analysis* include the following:

- Attachment G.1 – Subsurface Investigation Program and Field Logs
- Attachment G.2 – Geotechnical Laboratory Testing
- Attachment G.3 – Supplemental Geotechnical Information by Others
- Attachment G.4 – Calculations

2 Subsurface Geotechnical Conditions

Subsurface geotechnical conditions at the site were investigated by Anchor QEA to supplement the existing geotechnical information that was collected during past projects in the vicinity of the upper reach. Details regarding these prior investigations can be found in the DER (Anchor QEA and Windward 2022).

Subsurface geotechnical conditions in the upper reach of the LDW were investigated by Anchor QEA as part of the Phase I and Phase II pre-design investigation (PDI) efforts completed in 2021 and 2022. The geotechnical PDI included the following numbers and types of geotechnical investigations, which were advanced to a range of depths below ground surface:

- 29 rotosonic borings
- 20 cone penetrometer tests (CPTs)
- 5 vane shear tests (VSTs)
- 7 full-flow penetrometer (FFP) tests
- 2 hand auger borings
- 2 dynamic CPTs

The locations of these geotechnical investigations are presented in Figures G1-1a and G1-1b. Logs from these investigations are presented in Attachment G.1, and geotechnical laboratory testing results are presented in Attachment G.2.

The scope of the geotechnical PDI was developed considering existing geotechnical information within the upper reach. Studies by others provide supplemental subsurface geotechnical data in upland areas adjacent to the upper reach and at in-water locations. Attachment G.3 presents the locations with supplemental geotechnical information and lists the studies that have been identified as providing useful subsurface geotechnical data in the upper reach.

The following sections provide a more comprehensive discussion of subsurface conditions encountered at the site than is presented in the DER.

2.1 Subsurface Stratigraphy

BODR Section 8.2 summarizes the stratigraphy. The following section provides more detailed information on the geotechnical properties for the three major stratigraphic units described in the DER (Anchor QEA and Windward 2022) and the BODR for the purposes of geotechnical engineering design and analysis later described in this report.

2.1.1 Fill

Fill soils were encountered at two locations during the Phase II PDI and at several other upland locations investigated by others. The specific geologic interpretation of fill is indicated on historical boring logs from Boeing Plant 2, both the east and west banks at the South Park Bridge, and at several properties that are not adjacent to remedial action level (RAL) exceedance areas (e.g., near RM 3.0 west and between RMs 3.5 and 3.6 west at Terminal 117 [T-117]). Given the river history of channelization, fill is likely present along many banks of the upper reach that have not been geotechnically investigated.

Generally, the fill material had been placed to regrade the existing fluvial plain created by the Duwamish River to support shoreline development and re-channelization of the LDW. The unit weight of this material is assumed to vary, but, to prepare design recommendations, the material is assumed to be conservatively represented by an overall average value of 135 pounds per cubic foot (pcf) based on laboratory direct shear test results. Grain size distribution tests show that this material is predominately sand with varying amounts of silt. In areas where fill was more randomly placed, it would be expected to contain anthropogenic materials such as debris, which would be typical of historical shoreline development filling activities in active industrial areas. The moisture content in the fill unit generally ranges from 6% to 28%. Direct shear testing of the fill indicates a peak friction angle average of 36 degrees and a residual friction angle average of 33 degrees.

The findings associated with the two upland borings completed in 2021 are in general agreement with historical investigations completed by others.

2.1.2 Recent Sediments

Recent sediments are defined as material that has deposited on top of the alluvium layer and are distinctly characterized by finer gradation and soft consistency compared to the alluvium layer below. Recent sediments were encountered throughout the intertidal and subtidal areas, having been naturally deposited by flows to the LDW upper reach from Green River upstream. The thickness of this unit across the site varies widely and is observed to be thickest in areas of historical dredge activities in the FNC and Slip 6.

Based on a review of laboratory testing results, a total unit weight of 100 pcf was assumed to best represent average overall conditions, with percent moisture content ranging from 34% to 97%. Atterberg limits (plasticity) testing indicates that this material is typically non-plastic to very low plasticity, an indication that the finer fractions are predominantly silt rather than clay. Direct shear testing indicates a peak friction angle of 34 degrees for the recent sediments and a residual friction angle of 33 degrees, whereas VST and FFP testing indicate undrained shear strengths ranging as shown in Figure G2-1. Grain size analyses indicate that this material is approximately 30% sand and 70% silt and clay, with silt content ranging from 22% to 62% and clay content ranging from 2% to 7%.

2.1.3 Alluvium

Investigations prior to the PDI describe the alluvium by referencing an upper alluvium unit and a lower alluvium unit. Because the distinction between the upper alluvium and lower alluvium is not important in the context of the sediment cleanup, in the DER, the description of the alluvium was simplified by combining the upper alluvium and lower alluvium into a single alluvium unit, recognizing that there are some gradational changes in the alluvium with depth (Anchor QEA and Windward 2022). Alluvium was observed to underly the recent sediments and be predominately coarse-grained material with pockets, lenses, and layers of silt and clay. Silt content of the fine-grained layers was as high as 76%, and clay content was as high as 16%; silt and clay content was observed to be as low as 1.5%. The alluvium unit has a typical specific gravity of 2.5 to 2.7; is non-plastic; and has a typical total unit weight of 125 pcf, a measured peak friction angle ranging from 32 to 40 degrees (average 37 degrees), and a measured residual friction angle ranging from 28 to 37 degrees (average 32 degrees).

2.2 Groundwater and Surface Water Elevations

Groundwater and surface water affect the geotechnical behavior of soils and sediments. Water surface elevations are used in geotechnical engineering evaluations to calculate porewater pressures and effective stresses, which govern the shear strength of soils. Changes in effective stress (which occur due to changes in porewater pressure) also lead to consolidation settlement. Thus, water surface elevations are a key input parameter for geotechnical engineering evaluations. This section summarizes general observations of groundwater and surface water levels made during the geotechnical investigation and as summarized in other reports.

2.2.1 Groundwater

Groundwater has been observed in shoreline groundwater wells along the upper reach. At locations nearest the LDW, groundwater elevations vary regularly in accordance with the water level in the river. Farther from the shoreline, groundwater levels are less affected by the adjacent surface water level but are still expected to vary seasonally. Table G2-1 summarizes typically observed groundwater levels at selected locations along the upper reach for exploration locations adjacent to the LDW, which are used as a basis for geotechnical engineering evaluations described in this report.

Table G2-1
Summary of Selected Groundwater Levels for Exploration Locations Adjacent to the LDW

Location	River Mile	Observed Groundwater Elevation Range (feet above MLLW)	Observed Depth to Groundwater Range Below Ground Surface (feet)	Reference
Boeing Plant 2	2.9 E	7 to 11	6 to 11.5	AMEC 2012
Boeing Isaacson Thompson	3.8 E	3 to 10	11 to 17	Landau and AMEC 2014
T-117	3.6 W	8 to 10	3 to 20	GeoEngineers 2014
Dallas Avenue Drainage Project	3.6 W	8	10	SPU 2014
Delta Boat Lift	4.2 W	8	7	AMEC 2002
SPU Duwamish Substation	4.5 W	6 to 8	10 to 12	SPU 2012

Note:
LDW: Lower Duwamish Waterway
MLLW: mean lower low water
SPU: Seattle Public Utilities
T-117: Terminal 117

2.2.2 Surface Water

The upper reach is tidally influenced, and water levels are also affected by inflows from Green River upstream. Upstream inflows are controlled by the Howard Hansen Dam, so tidal influences tend to dominate the river stage (surface water elevation) on a daily basis. In the project vertical datum, the MHHW elevation is 11.3 feet, and the MLLW elevation is 0 foot.

2.3 Soil Engineering Modeling Parameters

This section summarizes the geotechnical engineering properties that were assigned to each lithologic unit for geotechnical evaluations. Engineering properties were derived using correlations to in situ CPT results, VST results, FFP test results, and geotechnical laboratory testing results. For cap aggregates, habitat materials, and backfill, engineering parameters were assigned using best professional judgment and from past project experience considering the location of placement (beneath the water surface) and the typical materials used for these applications (sand and gravel). Soil parameters are presented in Table G2-2.

Table G2-2
Soil Parameters for Slope Stability Analysis of Dredge Prism Side Slopes

Soil Layer	Total Unit Weight (pcf)	Undrained Shear Strength[1]		Drained Shear Strength		Compressibility
		Cohesion (psf)	Internal Friction Angle, ϕ′ (degrees)	Cohesion (psf)	Internal Friction Angle, ϕ′ (degrees)	Compression Ratio (unitless)
Fill	135	N/A	N/A	0	33	See Note 2
Recent sediments	100	10+38*Z; ≤200	0	0	27	0.17
Alluvium	125	100+30*Z; ≤1800	0	0	32	0.09
Cap, habitat and backfill materials	110	N/A	N/A	0	32	See Note 2
Armor Rock	135	N/A	N/A	0	40	See Note 2

Notes:
1. Z = depth below top of layer surface elevation
2. The fill, cap, habitat, backfill, and armor rock materials, being primarily granular, were not considered compressible for purposes of consolidation calculations. See discussion of compressibility.

N/A: not applicable. See discussion of undrained shear strength (Section 2.3.1).
pcf: pounds per cubic foot
psf: pounds per square foot

2.3.1 Undrained Shear Strength

Undrained shear strength can be directly estimated from the tip resistance measured during advancement of the cone during CPT and FFP testing, allowing for a near-continuous relationship of undrained shear strength versus depth (Robertson and Cabal 2010). For the proposes of this report, undrained shear strength values were determined by inspection of the FFP test and VST results at each location. This inspection was completed by plotting undrained shear strength with depth.

Figure G2-1 presents the measured undrained shear strength with depth. Analysis of this plot shows that the undrained shear strength for the recent sediments, as well as for the compressible layers within the alluvium, increases linearly with depth. Thus, the design assumes undrained shear strength is variable, as presented in Table G2-2. Undrained shear strength is not relevant for cohesionless materials (e.g., sand and gravel), which rely on inter-particle friction to develop strength. Thus, the undrained shear strength for sand and gravel type materials (fill, cap, habitat, and backfill) is not applicable because these materials are not expected to behave in an undrained manner.

2.3.2 Drained Shear Strength

Drained shear strength applies to the long-term behavior of fine-grained materials and both the short- and long-term behavior of granular materials, which drain very rapidly under applied loads.

Drained shear strength can be correlated to in situ tests (e.g., standard penetration test blow counts, CPT records) and can be measured in laboratory geotechnical tests.

For this project, a series of direct shear tests was conducted on representative undisturbed samples from each major stratigraphic unit to evaluate drained shear strength behavior in terms of peak and residual friction angles. In general, average peak friction angles ranged from 34 to 37 degrees, and average residual friction angles ranged from 32 to 33 degrees.

Laboratory testing is conducted under ideal conditions and reflects assumed loading rates and drainage conditions that potentially will not apply under full-scale conditions. It is expected that actual soil behavior will be more variable and reflect inherent uncertainty that cannot be captured by laboratory testing alone. Thus, the laboratory test results were reviewed by an experienced geotechnical engineer, who applied engineering judgment to reduce the friction angle (drained shear strength) selected for design to reflect values more typically used regionally in engineering design. See Table G2-2 for a summary of friction angles that were selected for design for each major geologic unit.

2.3.3 Compressibility

Consolidation settlement (i.e., compression) occurs over time as new loads are applied to fine-grained soil or sediment and as water is driven out of the soil/sediment pore space due to the applied loading (i.e., drainage).

Compressibility parameters were assessed using the laboratory one-dimensional oedometer consolidation test. The test incrementally loads an undisturbed sample and measures the corresponding settlement, which is plotted as a relationship between stress (load) and strain (settlement). When stress is plotted in log scale and strain in natural scale, the resulting plot is generally linear over the range of virgin compression, and the slope of this line is referred to as the Compression Ratio. The Compression Ratio can be used to calculate anticipated consolidation under load.

Four oedometer tests were conducted: one in the recent sediment unit, two within the sandy alluvium, and one in the silty alluvium. The results of these tests were evaluated to develop the consolidation parameters summarized in Table G2-2.

The time rate of consolidation is affected by the distance that water must travel when drainage is occurring. Through inspection of the CPT porewater pressure profiles, a maximum drainage path (H_{dr}) length of 3.5 feet was determined. Lastly, for the purposes of the analysis for this project, a design coefficient of consolidation of 0.08 square feet (ft^2) per day was assumed.

3 Geotechnical Engineering Analysis

This section discusses the following geotechnical engineering analyses prepared in support of the RD:

- Dredge prism side slope stability
- Bank excavation slope stability
- Cap bearing capacity and settlement

3.1 General Dredge Prism Side Slope Stability

Dredge prism side slope stability was evaluated using limit equilibrium methods and confirmed using an alternate method. This section describes the evaluation of dredge prism side slope stability including the following:

- Limit equilibrium model background
- Limit equilibrium model development
- Limit equilibrium method model results
- Alternative method model background, development, and results

3.1.1 Limit Equilibrium Model Background

The stability of dredge prism side slopes was evaluated using Rocscience Slide2 limit equilibrium software model. For a given evaluation, a geologic cross section was developed, and soil layers and soil geotechnical engineering parameters were input into the model.

The limit equilibrium model software calculates load (soil stress) and resistance (soil strength) for numerous trial "slip surface" geometries to generate a factor of safety for each trial slip surface. The slip surface with the lowest factor of safety is considered the "critical" slip surface for a particular stability cross section. Slip surfaces are generated using an automated search routine within the software so that an appropriate number of trial surfaces are checked when identifying the critical slip surface. The calculation method (General Limit Equilibrium) satisfies both force and moment equilibrium for each trial slip surface.

Acceptable (i.e., target) factors of safety are as follows, in accordance with a common U.S. Army Corps of Engineers (USACE) reference for slope stability (USACE 2003):

- Short-term – 1.3 or greater
- Long-term – 1.5 or greater
- Rapid drawdown – 1.3 or greater

The short-term case represents conditions during construction (e.g., for a temporary dredge cut slope prior to backfilling). The long-term case represents conditions once construction is complete (e.g., for backfilled slopes) and soils/sediments have equilibrated to the stress conditions associated with the post-construction slope geometry.

The rapid drawdown condition represents a stability case where changes in water levels along shoreline banks occur when the tide is receding, but adjacent upland water levels have not equilibrated to river water levels. A range (1.1 to 1.3) of acceptable factors of safety is published for the rapid drawdown case in USACE (2003). The high end of the range (1.3) was selected for this evaluation because upland water surface elevations are considered to be more akin to the maximum storage pool case than the maximum surcharge pool case.

3.1.2 Limit Equilibrium Model Development

An assumed dredge cut slope and sediment properties (Table G2-2) were input to the limit equilibrium model, and a search routine was run by the software to locate the critical slip surface. Table G3-1 summarizes the factors of safety calculated in this evaluation.

Stability was evaluated for existing slopes and a range of potential dredge slopes for both short-term (undrained) and long-term (drained) conditions.

Based on bathymetric survey conducted during the PDI, the natural angles of the subtidal to nearshore slopes range from 4 horizontal to 1 vertical (4H:1V) to 17.5H:1V.

The limit equilibrium slope stability evaluation was conducted for two different assumed slope cut angles (2H:1V and 3H:1V) and assuming water levels that correspond to both intertidal and subtidal slopes. For the subtidal evaluation, the dredge cut slope was assumed to be entirely submerged. For the intertidal evaluation, the water level was assumed to be 2 feet below the top of the dredge cut slope.

For the rapid drawdown evaluation, it was assumed that the top of the slope on the upland side of the dredge cut would be fully submerged, and a low tide condition (water level 0 feet MLLW) was assumed on the river side of the dredge cut. It was also assumed the slope itself would not drain during the tidal cycle; thus, undrained shear strength parameters were assumed for the dredge cut slope. The rapid drawdown condition was assessed for intertidal slopes only, where water levels within the slope would be changing. For submerged slopes, the dredge cut would be sufficiently distant from the influence of upland water levels to affect the slope stability factor of safety during changing tides.

3.1.3 Limit Equilibrium Method Model Results

Table G3-1 summarizes the results of the dredge cut slope stability evaluation for the short-term, long-term, and rapid drawdown cases.

Table G3-1
Limit Equilibrium Method Factors of Safety Summary for Dredge Cut Slope Stability

Dredge Cut Thickness (feet)	Scenario	Target Factor of Safety	Side Slope	Factor of Safety	
				Subtidal Slope[1]	Intertidal Slope[2]
5	Short-term	1.3	2H:1V	4.2	2.1
			3H:1V	5.3	2.5
	Long-term	1.5	2H:1V	1.1	N/A
			3H:1V	1.6	N/A
	Rapid drawdown	1.3	2H:1V	N/A	2.1
			3H:1V	N/A	2.5
7	Short-term	1.3	2H:1V	4.5	2.4
			3H:1V	5.0	2.6
	Long-term	1.5	2H:1V	1.0	N/A
			3H:1V	1.6	N/A
	Rapid drawdown	1.3	2H:1V	N/A	2.4
			3H:1V	N/A	2.6

Notes:
1. The rapid drawdown case does not change conditions for the subtidal slopes because all water surfaces are above the submerged slope and the submerged slope is sufficiently distant from the influence of upland water surface conditions; thus, there is no need for a rapid drawdown evaluation of subtidal slopes created by dredging.
2. Intertidal dredge areas will be backfilled in the long-term condition in accordance with the ROD (EPA 2014); thus, there is no long-term intertidal slope condition created by dredging.

H:V: horizontal to vertical (ratio)
N/A: not applicable
ROD: *Record of Decision*

In the short-term condition (i.e., during construction), temporary cut slopes of 2H:1V meet the target factor of safety in both subtidal and intertidal areas.

Long-term slopes constructed at 2H:1V do not meet target factors of safety for subtidal dredged slopes. Long-term subtidal slopes constructed at 3H:1V do meet target factors of safety. In intertidal areas, dredge cut slopes will be backfilled, so there is no need to assess long-term dredge cut stability in these areas.

Conclusions for the rapid drawdown stability assessment are the same as the short-term stability assessment.

Based on the slope stability evaluation, short-term dredge cut slopes of 2H:1V can be used for the temporary scenario prior to backfilling. For long-term dredge cut slopes (i.e., areas that will not be backfilled), 3H:1V slopes should be used.

3.1.4 Alternative Method Model Background, Development, and Results

As required by the U.S. Environmental Protection Agency (EPA), the conclusions of the limit equilibrium modeling method were checked using an alternative method of assessment—specifically slope stability chart solutions, as presented in USACE (2003) Appendix E.

Table G3-2 compares the chart solutions with the limit equilibrium solutions (Table G3-1) for the short-term (undrained) case and a 5-foot-deep dredge cut. As demonstrated by Table G3-2, the limit equilibrium method used provides a more conservative result; therefore, it is being carried forward as the appropriate tool for assessing slope stability. Attachment G.4 provides a copy of the hand calculations.

Table G3-2
Slope Stability Comparison – Alternative Method and Limit Equilibrium Method Solutions

Case	Alternative Method (Chart Solution) Factor of Safety	Limit Equilibrium Method Solution Factor of Safety (Table G3-1)
2H:1V Slope – 5-foot cut depth Subtidal	6.5	4.2
2H:1V Slope – 5-foot cut depth Intertidal	3.6	2.1
3H:1V Slope – 5-foot cut depth Subtidal	8.5	5.3
3H:1V Slope – 5-foot cut depth Intertidal	4.7	2.5

Notes:
Comparison for short term (undrained) evaluations
H:V: horizontal to vertical (ratio)

3.2 Bank Excavation Slope Stability

3.2.1 General Bank Slope Stability Considerations

In most locations along the banks of the upper reach, bank excavations will require removal of surficial soils or sediment. Where excavations on banks are on the order of 1 to 2 feet deep, the evaluation of bank excavation slope stability is not warranted because removal of thin cuts will not materially affect the stability of the bank itself. Experience conducting similar work on other shoreline projects has demonstrated that minor bank excavations (1 to 2 feet deep) can be accomplished without causing slope stability problems. This assumption is reasonable for typical bank conditions and was applied for all thin cut areas for the upper reach but may not be applicable in sensitive areas such as those with low strength soils or visible indications of slope instability.

Bank slope stability is a key consideration for areas where deeper cuts are required at the toe of a bank area or on the bank itself. In these situations, the deeper cut can undermine the toe of the bank and can potentially cause slope instability if not accounted for in the design. The bank adjacent to T-117 (RAA 14/15/16) and the Container Properties (RAA 27) area were identified for location-specific bank slope stability evaluation, as described in this section.

3.2.2 Terminal 117 (RAA 14/15/16)

The Final (100%) RD includes subtidal bank excavation adjacent to T-117 in RAA 14/15/16 (also referred to as SMA 12B). Dredge depths of approximately 20 feet will be required between the toe and top of the slope using a temporary 2H:1V side slope.

Following excavation, an engineered cap will be constructed at the base of the slope, and the subtidal dredge cut slope will be backfilled to reestablish a new slope of 3H:1V. Figure G3-1 depicts the cross section and critical slip surface for the post-dredge (short-term) and post-backfill (long-term) condition for a representative cross section at station 217+40.

Stability analyses were run for the short-term condition (during bank cut) and long-term post-construction condition (including capping and backfill). Because the excavation is entirely subtidal, the rapid drawdown case was not evaluated.

Table G3-3 summarizes the resulting factors of safety for the bank stability evaluation at T-117. Both the short-term and long-term cases have acceptable factors of safety.

Table G3-3
Slope Stability Results – T-117

Case	Side Slope (H:V)	Target Factor of Safety	Modeled Factor of Safety
Short-term	2H:1V	1.3	2.03
Long-term	3H:1V	1.5	1.93

Note:
H:V: horizontal to vertical
T-117: Terminal 117

3.2.3 Container Properties (RAA 27)

The Final (100%) RD includes bank excavation along the slopes at Container Properties (RAA 27; also referred to as SMA 5). The existing bank transitions from the upland to an intertidal mud flat, and dredging and excavation will occur on the mud flat and banks, respectively. Dredge cut depths range from 2.5 to 3.5 feet at the toe of bank, and the same minimum thickness cut will be performed on the bank itself at a slope no steeper than 2H:1V. Additional excavation thickness will be added on the bank and at the toe as necessary so that the final reconstructed bank does not raise the bathymetry above pre-construction conditions.

Following excavation, the bank will be reconstructed with layers of sand backfill beneath armor rock, as described in the BODR. Figure G3-2 depicts the cross section and critical slip surface for the post-construction (long-term) condition at Container Properties.

To evaluate the stability of bank cuts, a limit equilibrium model was developed for the most critical stability case—that is, the cross section corresponding to the deepest dredge cut at the toe of bank. Stability analyses were run for the existing condition to check model calibration and assumed input parameters, and for the short-term condition (during bank cut), the long-term post-construction condition (including backfill sand and armor rock), and the rapid drawdown case, which assumes water levels beneath the armor rock near the face of the slope would correspond to MHHW.

Table G3-4 summarizes the resulting factors of safety for the bank stability evaluation at Container Properties.

Table G3-4
Slope Stability Results – Container Properties (RAA 27)

Case	Side Slope (H:V)	Target Factor of Safety	Modeled Factor of Safety
Existing condition	2H:1V	N/A	1.22
Short-term	2H:1V	1.3	1.33
Long-term	2H:1V	1.5	1.49
Rapid drawdown	2H:1V	1.3	1.29

Notes:
H:V: horizontal to vertical
N/A: not applicable
RAA: remedial action area

As demonstrated in Table G3-4, the short-term, long-term, and rapid drawdown stability cases have acceptable factors of safety, indicating that the temporary slope cut of 2H:1V is appropriate and that the long-term armored slope will be stable after construction.

3.3 Cap Geotechnical Design Evaluation

The Final (100%) RD includes capping as a remedy technology for the dredge and cap area adjacent to T-117 (RAA 14/15/16) and for the reconstructed shoreline slope at Container Properties (RAA 27). Thus, geotechnical capping evaluations prepared for the earlier design phases were updated to support this Final (100%) RD.

This section describes cap bearing capacity and subgrade settlement evaluations completed for the Final (100%) RD of the upper reach sediment remedy and also describes the cap static stability evaluation. Seismic cap performance evaluations are discussed in Section 5.

3.3.1 Bearing Capacity

Bearing capacity caps were evaluated using methods described in *Guidance for In-Situ Subaqueous Capping of Contaminated Sediments* (Palermo et al. 1998). When cap material is placed on the surface of soft sediments, there is the potential for a bearing capacity failure directly through the in situ sediment. The initial cap lift thickness must be thin enough to maintain an acceptable factor of safety under the new loading caused by the weight of the cap.

In typical foundation design problems, a factor of safety of 3.0 is used for calculations wherein there is the potential for structural damage or impacts on human safety. This is the suggested factor of safety presented in the ARCS guidance. However, experience on other capping projects has shown that a factor of safety of 3.0 can be overly conservative when considering cap construction lift thickness. Because life safety and structural foundation stability are not design considerations for caps, and because slope stability evaluations use similar factors of safety, a factor of safety of 1.5 was considered appropriate for use in this analysis for evaluating the cap bearing capacity. Subaquatic cap placement has been successfully demonstrated at other sediment cleanup sites when designed using a bearing capacity factor of safety of 1.5, including the Whatcom Waterway sediment cleanup project (Anchor QEA 2015) and the San Jacinto River Superfund Site Time Critical Removal Action (Anchor QEA 2011).

This analysis evaluates the steady-state, short-term stability of the cap and soft sediments during construction. Once the cap has been placed, consolidation of fine-grained in situ sediments will occur, increasing the shear strength of the sediment. Thus, the long-term stability of the cap against bearing capacity failure will be greater than the short-term stability.

The in situ sediments must have sufficient internal strength to prevent local shear failure. To evaluate this condition, the ultimate bearing capacity was calculated with the Terzaghi equations for local failure (Palermo et al. 1998) using the undrained shear strengths described in Section 2.3:

Equation G3-1

$$q_{ult} = \left(\frac{2}{3}\right) s_u * N_c$$

where:

q_{ult}	=	ultimate bearing capacity of sediment (pounds per square foot [psf])
s_u	=	undrained shear strength of in situ sediments (psf)
N_c	=	bearing capacity factor (dimensionless) = 5.14 for continuous strip footing (Terzaghi and Peck 1967)

This equation applies to a cap placed on the surface of an entirely cohesive soil with an angle of internal friction, ϕ', equal to zero. For the caps placed in RAA 14/15/16, at least 4 feet of dredging would be performed before cap placement. Therefore, the shear strength at the 4-foot depth interval is considered appropriate for evaluating cap bearing capacity. Based on the shear strength assumptions presented in Table G2-2, the undrained shear strength of recent sediments below the 4-foot depth interval is 162 psf.

The ultimate bearing capacity was calculated as follows:

$$q_{ult} = \left(\frac{2}{3}\right) 162 * 5.14 = 555\ psf$$

A factor of safety of 1.5 was used to compute the allowable bearing capacity:

Equation G3-2

$$\mathrm{q_{all}} = \left(\frac{\mathrm{q_{ult}}}{\mathrm{FOS}}\right)$$

where:

$\mathrm{q_{all}}$	=	Allowable bearing capacity (psf)
FOS	=	Factor of Safety = 1.5

$$\mathrm{q_{all}} = \left(\frac{555}{1.5}\right) = 370\ psf$$

The initial cap lift thickness that could be supported by the lowest strength in situ sediments at an appropriate factor of safety was calculated using the allowable bearing capacity and the following equation:

Equation G3-3

$$h = \left(\frac{q_{all}}{\gamma'}\right)$$

where:

h	=	lift thickness
γ'	=	buoyant unit weight of cap material (pcf)
γ'	=	γ - γ_w
γ	=	total unit weight of cap material (pcf)
γ_w	=	unit weight of water (64 pcf)
γ'	=	110 pcf – 64 pcf = 46 pcf

$$h = \frac{370\,psf}{46\,pcf} = 8\,feet$$

This analysis, which uses the post-dredge in situ shear strength selected for modeling, indicates that the 4-foot-thick cap at RAA 14/15/16 can be placed while maintaining an appropriate factor of safety for sediment bearing capacity during construction, assuming a dredge depth of 4 feet prior to capping. In this configuration, the post-cap surface would not project above the pre-construction ground surface.

3.3.2 Subgrade Consolidation Settlement

Subgrade consolidation beneath the load imposed by a cap was assessed for two different scenarios. In both scenarios, the constructed cap would be placed after dredging, and the post-cap grade would be the same as the pre-dredge mudline elevation. The new loads imposed on the subgrade would be caused by the greater unit weight of cap material than the in situ unit weight of the sediments that will have been dredged. Two scenarios were evaluated for post-cap subgrade consolidation for RAA 14/15/16 reflecting different thicknesses of soft sediment beneath the cap, assuming the sediments and cap are entirely submerged.

Both scenarios assume 4 feet of dredging and placement of a 4-foot-thick cap. In Scenario A, 3 feet of soft sediment are assumed to remain beneath the cap. In scenario B, 11 feet of soft sediment are assumed remain beneath the cap. These assumptions allow for bracketing the results to understand the importance of the post-dredge soft sediment thickness that remains. Table G3-5 summarizes the scenarios evaluated for subgrade consolidation.

Table G3-5
Subgrade Consolidation Modeling Scenarios

Scenario	Pre-Dredge Sediment Thickness (feet)	Dredge Depth (feet)	Post-Dredge Sediment Thickness (feet)	Cap Thickness (feet)	Net Stress Increase (psf)
A	7	4	3	4	40
B	15	4	11	4	40

Note:
psf: pounds per square foot

Subgrade consolidation was calculated according to the following relationship:

Equation G3-4

$$\Delta H = H \times CR \times \log\left(\frac{\sigma'_{vo} + \Delta\sigma'_{v}}{\sigma'_{vo}}\right)$$

where:

ΔH	=	consolidation settlement
H	=	consolidating layer thickness
CR	=	compression ratio of subgrade sediment (Table G2-2)
σ'_{vo}	=	in situ vertical effective stress
$\Delta\sigma'_{v}$	=	net stress increase (Table G3-2)

Table G3-6 summarizes the results of the subgrade consolidation evaluation.

Table G3-6
Subgrade Consolidation Summary

Scenario	Estimated Consolidation Settlement (inches)
A	2
B	3

As shown in Table G3-6, the subgrade in RAA 14/15/16 is predicted to settle approximately 2 to 3 inches after cap placement. The magnitude of settlement is not sensitive to the assumed thickness of soft sediment that could remain beneath the cap.

Subgrades can settle differentially under imposed loads. Differential subgrade settlement would manifest itself as a sloping top surface of the cap. In such cases, the cap thickness would not be affected by differential subgrade settlement; therefore, cap performance would not be compromised. Because cap materials are granular, there is no consolidation settlement within the cap layers themselves, and differential settlement is not a consideration for caps.

The time rate over which consolidation occurs is a function of the distance porewater must travel (drainage path length) and the coefficient of consolidation of the subgrade. Time rate of consolidation was evaluated according to the following equation:

Equation G3-5

$$T = \frac{c_v t}{{H_{DR}}^2}$$

where:

T	=	time factor = 0.8 for 90% consolidation (Lambe and Whitman 1969)
c_v	=	coefficient of consolidation (Section 2.3)
t	=	time to achieve 90% consolidation
H_{DR}	=	drainage path length (Section 2.3)

Based on Equation G3-5, it is estimated that subgrade consolidation would be 90% complete approximately 120 days after cap construction.

Subgrade consolidation settlement can confound the interpretation of bathymetric survey results if bathymetry surveys are used to confirm the thickness of caps. When subgrade consolidation settlement occurs, bathymetry comparisons (i.e., isopach mapping) can be incorrectly interpreted as indicating "thinning" of cap material. Therefore, supplemental cap confirmation approaches such as thickness probing would also be included in Long-Term Maintenance and Monitoring Plan (LTMMP) planning to address potential issues associated with subgrade consolidation if caps are to be constructed. If cap thinning occurs, corrective measures could include additional material placement.

3.3.3 Static Slope Stability of Caps

The Final (100%) RD includes a cap within the armored revetment to be constructed along the Container Properties shoreline (RAA 27). The cap at Container Properties would be placed following excavation, resulting in a cap surface that generally matches the pre-construction grade or flatter in the capping area. This section describes the static slope stability evaluation at Container Properties (RAA 27) where an intertidal cap would be constructed on the bank.

Cap slope stability was evaluated using limit equilibrium methods. A geologic profile was developed for Container Properties using the soil and sediment geotechnical engineering parameters presented in Table G2-2. The modeling software was set to search for the critical slip surface for any location within the slope at Container Properties.

Figure G3-2 presents the geologic profile for the Container Properties shoreline and depicts the critical slip surface and factor of safety. The factor of safety for the cap is 1.49, which is considered acceptable.

3.4 Backfill Design

This section describes the gradation and stability design of backfill materials.

3.4.1 Backfill Gradation

The selection of backfill considers several engineering considerations, including the following:

- Commercially available, natural aggregate materials
- Appropriate proportion of gravel within the aggregate mixture to provide stability to backfill placed on slopes, as evaluated in Section 3.4.2
- Limiting the percentage fines (material that passes the U.S. No. 200 Sieve) to protect water quality by minimizing turbidity during placement

Table G3-7 presents a backfill gradation that achieves these objectives and was assumed for geotechnical analysis. The remedial contractor may identify material that is very similar to this gradation and that may be acceptable for use as backfill. The engineer should review any proposed deviations from this specification and may approve an alternate gradation in consultation with EPA.

Table G3-7
Backfill Gradation Specifications

Sieve Size	Percent Passing
4-inch	100
2-inch	70 to 100
U.S. No. 4	50 to 80
U.S. No. 40	0 to 30
U.S. No. 200	0 to 5

In addition to engineering considerations, there may be additional habitat considerations that would be evaluated separately in consultation with EPA. Further, backfill material must meet or be lower than chemical concentration limits that will be defined in the project specifications based on cleanup levels for human health and benthic protection.

3.4.2 Backfill Stability

Backfill will be placed in habitat areas (elevations greater than -10 feet MLLW) in accordance with the ROD (EPA 2014). In some dredge areas, backfill may need to be sloped below elevation -10 feet MLLW until it meets the post-dredge surface at depth. This section presents the evaluation of stable backfill slope angles to support the backfill grading design.

Backfill slope stability was evaluated using infinite slope stability theory, in accordance with Duncan and Wright (2005). For this evaluation, the factor of safety for a 3H:1V backfill slope was computed using the following equation:

Equation G3-6

$$FOS = \frac{\tan(\emptyset')}{\tan(i)}$$

where:

FOS	=	Factor of Safety
ϕ'	=	backfill friction angle (Table G2-2)
I	=	slope angle

The factor of safety for backfill placed at a 3H:1V slope is 1.9, which is greater than the target long-term slope stability factor of safety. Thus, a 3H:1V slope angle should be used for the design of backfill slopes.

Where steeper slopes may be needed, armor rock could be used to protect the backfill surface. Shoreline armor has a higher friction angle than sand and gravel backfill and is typically assumed to range from 38 to 42 degrees for angular rock (USDA 1989). Assuming an armor rock friction angle of 38 degrees, slopes of 2H:1V have a factor of safety of 1.6, which is greater than the minimum long-term factor of safety of 1.5. Thus, backfill can be placed on 2H:1V slopes if angular armor rock is used.

4 Geotechnical Engineering Recommendations to Support Structural Engineering Evaluations

This section presents geotechnical engineering recommendations to support structural evaluations of vertical structures such as bulkheads and bridge piers, and to design replacement piles that may be needed as part of remedy construction in the upper reach. Necessary structural engineering evaluations were developed for the Final (100%) RD based in part on the recommendations provided in this section.

4.1 Vertical Structure Evaluation Geotechnical Recommendations

This section provides recommendations for the structural engineer to use for the evaluation of existing vertical structures adjacent to RAL exceedance areas.

4.1.1 Lateral Earth Pressures for Shoreline Structures

The following lateral earth pressure recommendations are provided for structural evaluation of cantilevered shoreline bulkhead walls. This information can be used to assess the need for offsets or other measures if dredging needs to be performed in front of bulkheads.

Lateral earth pressures acting on the bulkhead will depend primarily on the following:

- Fill material placed behind the wall, and the degree of compaction immediately adjacent to the wall
- Flexibility of the wall, and the degree of movement that the wall undergoes
- The presence of any surcharges or concentrated loads adjacent to the bulkhead
- Wall drainage
- Seismic loading

If the bulkhead is permitted to yield such that the top can move laterally at least 0.1% of the bulkhead's retained height when loaded, active earth pressures will develop. If this level of deflection is intolerable, the wall should be evaluated using at-rest soil pressures.

To design for lateral earth pressures, the parameters provided in Table G4-1 should be used. Earth pressures may be computed assuming a triangular pressure distribution applied from the top of the bulkhead to the base of the sheeting, as shown in Figure G4-1. Passive pressures will also be applied in a triangular distribution, from the mudline downward.

Table G4-1
Bulkhead Lateral Earth Pressure Parameters

Parameter	Design Value
GWT behind bulkhead	6 feet MLLW
Upland soil effective unit weight above GWT	135 pcf
Upland soil effective unit weight below GWT	71 pcf
Upland soil effective friction angle (ϕ')	33 degrees
Upland soil cohesion c	0 psf
Waterway sediment effective unit weight above waterline	100 pcf
Waterway sediment effective unit weight below waterline	36 pcf
Waterway sediment effective friction angle (ϕ')	27 degrees
Waterway sediment cohesion (c)	0 psf
K_A – active pressure coefficient for upland soils – flexible walls	0.29
K_O – at rest pressure coefficient for upland soils – rigid walls	0.46
K_P – passive pressure coefficient for waterway sediments[1]	2.66

Notes:
1. Passive pressures are presented as ultimate values and do not include a factor of safety.
GWT: groundwater table elevation
MLLW: mean lower low weight
pcf: pounds per cubic foot
psf: pounds per square foot

As noted in Table G4-1, using the passive pressure coefficient provided would result in calculating ultimate passive soil resistance, which would be an appropriate assumption for calculating the potential reduction in passive resistance at the toe of the wall when dredging occurs. Figure G4-1 depicts the pressure distribution for active and passive earth pressure conditions and provides recommendations for temporary tieback no-load zone and tentative tieback adhesion values.

4.1.2 Effect of Prohibiting Surcharge Loads Above Bulkheads During Adjacent Dredging

Bulkheads retain soil loads and surcharges in the form of active or at rest lateral earth pressures. These earth pressures are resisted at the toe of the bulkhead by passive earth pressures provided by the sediments in front of the bulkhead. The following discussion evaluates how much of the passive earth pressure is needed to resist surcharge loads alone and the effect to prohibiting surcharge loads during dredging. This assessment was developed using generalized soil and sediment conditions and thus is applicable to structures throughout the upper reach.

It is assumed that shoreline bulkheads were designed and constructed to support temporary surcharge loads at the top of the bulkheads. Typically, a temporary surcharge of 250 psf (or higher) can be accommodated by marine shoreline structures in good condition. Assuming a bulkhead backfill unit weight of 135 pcf, 250 psf is effectively equivalent to a soil surcharge height of approximately 2 feet.

One way to protect structures during adjacent dredging is to prohibit surcharge loading during dredging. This effectively allows for the "design surcharge capacity" of the wall to be used to offset the temporary loss of passive pressure in front of the wall due to dredging.

To evaluate this factor, the bulkhead adjacent to CenterPoint Properties was selected as a representative example. The bulkhead at this location currently has a retained soil height of approximately 15 feet. The active lateral earth pressure behind the wall (no surcharge) is calculated as follows:

Equation G4-1

$$P_A = {}^{1}/_{2}\, K_A \gamma h^2$$

where:

P_A	=	Active earth pressure resultant force (pounds per foot [lb/ft])
K_A	=	Active earth pressure coefficient for retained soil (Table G4-1)
γ	=	unit weight of retained soil (Table G4-1)
h	=	retained height of soil (feet)

For the CenterPoint Properties bulkhead, the resultant active earth pressure is calculated to be 4,400 pounds per foot (lb/ft).

Adding 1.85 feet of retained height for the surcharge loading condition (equivalent to a retained soil height of 16.85 feet), the active lateral earth pressure is calculated to be 5,560 lb/ft, which means that prohibiting surcharge during dredging could offset the loss of 1,160 lb/ft of passive pressure.

Passive earth pressure is calculated as follows:

Equation G4-2

$$P_P = {}^1\!/_2\, K_P \gamma d^2$$

where:

P_P	=	passive earth pressure resultant force (lb/ft)
K_P	=	passive earth pressure coefficient for sediments (Table G4-1)
γ	=	unit weight of sediments (Table G4-1)
d	=	depth below mudline (feet)

For the passive pressure coefficients for sediments presented in Table G4-1, a depth of approximately 5 feet below mudline is required to achieve a passive pressure of 1,160 lb/ft when sediments are submerged (buoyant unit weight providing passive pressure) or approximately 3 feet below mudline when sediments are not submerged (total unit weight providing passive pressure).

Based on this evaluation, for shoreline bulkheads in good condition that were designed to support an upland surcharge of at least 250 psf, prohibiting surcharges during dredging would allow for 3 to 5 feet of dredging to occur while maintaining passive pressure support comparable to the surcharge loading condition with no dredging.

Note that this assessment considers the soil loads only and does not account for the condition of the bulkhead wall nor the stresses in the wall structure that might be imposed by removing passive support during dredging.

4.1.3 Effect of Dredging on Passive Pressure

As previously discussed, dredging adjacent to structures reduces lateral toe support (i.e., passive pressure), which can increase the loads on the structure. This section describes the evaluations performed to determine appropriate reductions in passive pressure considering the following:

- Dredge cut slope angle
- Dredge cut depth
- Horizontal offset of dredge cut from the structure

The analyses presented in this section were developed specific to the Recent Sediments material that would be removed by dredging and is applicable to any vertical structure in the upper reach (e.g., bulkheads, bridge piers). To conduct this analysis, the total available passive pressure (no dredging) was compared to the weight of the passive wedge that would remain after dredging. The reduction factor was calculated as follows:

Equation G4-3

$$Reduction\ Factor = \frac{w_w}{P_R}$$

where:

W_w	=	Buoyant weight of passive soil wedge between structure and toe of dredge cut (lb/ft)
P_R	=	Passive earth pressure force for the no dredging scenario calculated at the evaluated depth of dredging (lb/ft)

Offsets of 0, 2, and 4 feet from the structure were considered. A range of dredge depths from 5 to 15 feet deep was evaluated. Dredge cut side slopes of 2H:1V, 1.5H:1V, and 1H:1V were assessed.

Key conclusions from this evaluation, in the form of passive earth pressure reduction factors, are presented in Table G4-2.

Table G4-2
Passive Earth Pressure Reduction Factors

Offset Distance (feet)	Reduction Factor		
	2H:1V	1.5H:1V	1H:1V
0	0.75	0.56	0.38
2	0.85	0.66	0.48
4	0.95	0.76	0.58

Note:
H:V: horizontal to vertical (ratio)

As shown in Table G4-2, when the dredge prism is not offset, the passive earth pressure could be significantly reduced, particularly if the dredge cut is oversteepened beyond the recommended 2H:1V temporary cut slope. Reduced passive pressure increases the risk of damaging structures.

The reduction factors presented in Table G4-2, in conjunction with the earth pressure recommendations in Table G4-1, can be used by the structural engineer to determine recommended structural offsets for dredging.

4.2 Pile Design Recommendations

Miscellaneous single piles or dolphin pile groups may need to be removed to accomplish construction. This section presents geotechnical engineering pile design recommendations for the structural engineer's use in designing replacement piles.

Based on discussion with the project structural engineer, replacement piles are likely to be hollow steel pipe piles, which lend themselves to vibratory installation and are capable of supporting the range of loads anticipated for this project. Timber piles are not considered for new installations for the upper reach because timber piles require chemical treatment to prevent decay.

Replacement piles are expected to be primarily laterally loaded. Pile design to resist lateral loads can be accomplished using L-PILE or similar software to assess pile deflection under loading and required depth to fixity below the mudline. Table G4-3 presents recommended L-PILE parameters to model the recent sediments and alluvium. .

Table G4-3
L-PILE Modeling Parameters

Layer	Effective Unit Weight γ' (pcf)	Friction Angle ϕ (°)	Undrained Shear Strength c_u (kip/ft^2)	P-Y Curve Model	Spring Constant; K (Es=Kx) k (pci)	Strain Factor; @50% max E ε_{50}
Recent sediment	36	27	0.08	Soft clay (Matlock)	N/A	0.020
Alluvium	61	32	N/A	Sand (Reese)	20	N/A

Notes:
ft^2: square foot
kip: one thousand pounds
N/A: not applicable
pcf: pounds per cubic foot
pci: pounds per cubic inch

5 Seismic Design

The upper reach of the LDW is located within the seismically active Puget Lowland, a region characterized by bedrock faults and tectonic plate movement and that has a documented history of earthquake activity. Earthquakes occur when energy accumulated during fault or tectonic plate movement is suddenly released over a short time span. The location of energy release, known as the epicenter of an earthquake, can occur at different places in a fault system.

The ground shaking caused by an earthquake can cause loose soils to lose strength as porewater pressure increases. This phenomenon, known as liquefaction, can cause soil movement and ground settlement. Earthquakes can also shake structures and impose loads on structural elements and foundations. Seismic risks are assessed in geotechnical engineering using a variety of tools.

This section describes the seismic design of the sediment remedy for the upper reach with a focus on the anticipated performance of remedial elements (primarily sediment caps) under earthquake loading. This section also provides recommended seismic design parameters for use by the structural engineer, as appropriate.

5.1 Seismic Site Class

Seismic behavior is generally assessed by evaluating the relative density of near-surface soils (the upper 100 feet below ground surface). For seismic design, relative density is often characterized by the average shear wave velocity of the soil column, which governs how earthquake energy is amplified or dampened by the near-surface soils. A Washington State-wide study by Cakir and Walsh (undated) summarized measurements of shear wave velocity at different sites across the state, including three locations in the Duwamish River basin near the upper reach. This study identified a typical seismic site class between Class D and Class E based on average shear wave velocities between 131 and 183 meters per second for the Duwamish River area in the vicinity of the upper reach.

5.2 Strong Motion Design Input Parameters

For seismic evaluations, earthquake peak ground acceleration (presented as a percentage of the force of gravity) and earthquake magnitude are key input parameters.

The U.S. Geological Survey (USGS) provides internet-based tools that, using mapped locations and seismic site classes, output peak ground accelerations, and earthquake magnitudes for different recurrence interval earthquakes.

For the upper reach sediment remedy, two different earthquake types were considered:

- A 100-year recurrence interval earthquake, consistent with typical protectiveness evaluations for other remedy elements such as cap contaminant modeling
- A 475-year recurrence interval earthquake, which has traditionally been the size of event considered on other regional Superfund projects based on a 10% probability of exceedance in a 50-year time frame

Table G5-1 provides the key USGS output parameters used for geotechnical seismic assessment for both events.

Table G5-1
Earthquake Parameters used in Geotechnical Engineering Evaluations

Event Recurrence Interval	PGA (% gravity)	Mean Magnitude
100 years	0.19	6.7
475 years	0.41	7.0

Notes:
Data developed for latitude 47.522, longitude -122.306.
Site Class D/E; Dynamic Conterminous United States model (2014 edition v4.2.0).
Model source: https://earthquake.usgs.gov/hazards/interactive.
PGA: peak ground acceleration

5.3 Liquefaction Evaluation

As described in Section 2, the site investigation included CPTs at 20 different locations in the upper reach. Digital records from these CPTs were processed by the analytical software Cliq (version 3.3.1.14), which facilitates liquefaction assessment and estimates of liquefaction-induced settlement using CPT measured parameters, earthquake peak ground accelerations, and earthquake magnitude.

For all locations investigated with a CPT, liquefaction was predicted during both the 100- and 475-year earthquakes. The estimated magnitude of liquefaction-induced settlement did not significantly vary between the two earthquakes, ranging from 3 to 14 (median 7) inches of settlement in the upper 30 feet below ground surface.

5.4 Seismic Performance of Capped Slopes

The seismic performance of capped slopes was evaluated using limit equilibrium methods, as described for the slope stability discussions in Section 3. A geologic cross section of the slope at Container Properties (RAA 27) was modeled, and seismic forces associated with both the 100- and 475-year earthquakes were added. For the 475-year earthquake, the resulting factor of safety was less than 1.0, indicating that some movement of the capped slope can be expected during a significant earthquake. For the 100-year earthquake, the factor of safety was 1.15 at Container Properties. Figure G5-1 depicts the cross section evaluated for Container Properties (RAA 27), as well as the critical slip surface and factors of safety for the 100-year earthquake at this location.

In general, shoreline slopes are susceptible to movement during strong earthquake shaking. Slopes designed to resist movement could require significant structural reinforcement that is not compatible with the habitat and human uses of shorelines. In part, due to issues like this, the geotechnical engineering community is moving toward a performance-based assessment of slopes, when appropriate, for seismic design. In the case of shoreline slopes where life safety and structures are not at risk, this type of assessment does not attempt to design for preventing movement; rather, a performance-based approach evaluates how much movement could be expected during an earthquake and what mitigation measures, if any, would need to be implemented after the earthquake had occurred.

Slope displacement was estimated for both the 100- and 475-year earthquakes in accordance with the methods presented by the National Cooperative Highway Research Program (NCHRP 2008). Table G5-2 presents the estimated slope displacement for Container Properties under both earthquake scenarios. Because the cap in RAA 14/15/16 is not on a slope, slope displacement estimates are not applicable.

Table G5-2
Seismic Slope Displacement for Container Properties (RAA 27) Cap

Earthquake Return Interval	Container Properties Cap Estimated Displacement
100 years	< 0.5 inch
475 years	8 to 16 inches

Note:
RAA: remedial action area

5.5 Conclusions on Seismic Performance of Sediment Remedy

Based on the liquefaction assessment and slope displacement estimates, the sediment remedy is expected to have acceptable seismic performance. Anticipated settlement and displacement under the 100-year event is expected to be significantly less than any design cap thicknesses. During a larger earthquake, the cap and sediments beneath may move down the slope, but any cap damage from such movement is expected to be easily repaired.

Post-earthquake mitigation measures could include visual inspections and bathymetry surveys to evaluate cap condition. Cap repairs, if needed, could be readily implemented by adding more cap substrate to address any local thinning associated with post-earthquake deformation or settlement.

The LTMMP will consider these evaluations and set criteria for inspections following seismic events.

6 References

AMEC, 2002. *Limited Geotechnical Engineering Report Delta Marine Industries Boat Lift Pier 1608 S. 96th Street Seattle Washington*. May 2002.

AMEC, 2012. *Geotechnical Engineering Report Habitat Project Boeing Plant 2 Seattle/Tukwila Washington*. October 2012.

Anchor QEA (Anchor QEA, LLC), 2011. *Final Removal Action Work Plan San Jacinto River Waste Pits Superfund Site*. Prepared for EPA Region 6. Revised February 2011.

Anchor QEA, 2015. *Whatcom Waterway Final Engineering Design Report*, Appendix B. Prepared for the Port of Bellingham. March 16, 2015.

Anchor QEA and Windward (Anchor QEA, LLC; Windward Environmental LLC), 2022. *Pre-Design Investigation Data Evaluation Report*. Final. Submitted to EPA July 15, 2022.

Cakir, R., and T. Walsh (undated). *Shallow Seismic Site Characterizations of Near-Surface Geology at 20 Strong Motion Stations in Washington State*. Final Technical Report USCS/NEHRP Award Number G09AP00021. Washington Department of Natural Resources.

Duncan, J.M., and S.G. Wright, 2005. *Soil Strength and Slope Stability*. First Edition. New Jersey: John Wiley and Sons.

EPA (U.S. Environmental Protection Agency), 2014. *Record of Decision*. Lower Duwamish Waterway Superfund Site.

GeoEngineers, 2014. *Geotechnical Engineering Services Terminal 117 Site Restoration for Port of Seattle*. May 2014.

Lambe, T., and R. Whitman, 1969. *Soil Mechanics*. John Wiley and Sons.

Landau and AMEC (Landau Associates; AMEC), 2014. *Final Remedial Investigation Report Boeing Isaacson-Thompson Site Tukwila Washington*. Prepared for The Boeing Company. April 21, 2014.

NCHRP (National Cooperative Highway Research Program), 2008. *Seismic Analysis and Design of Retaining Walls, Buried Structures, Slopes and Embankments*. National Cooperative Highway Research Program Report 611. Transportation Research Board.

Palermo, M., S. Maynord, J. Miller, and D. Reible, 1998. *Guidance for In-Situ Subaqueous Capping of Contaminated Sediments*. Great Lakes National Program Office, Chicago, Illinois. EPA 905-B96-004.

Robertson, P.K., and K.L. Cabal, 2010. *Guide to Cone Penetration Testing for Geotechnical Engineering*. Gregg Drilling and Testing, Inc. July 2010.

SPU (Seattle Public Utilities), 2012. *Draft Geotechnical Report Seattle Substation Evaluation Seattle, Washington Duwamish Substation*. Work Authorization NS12212 MG1. November 2012.

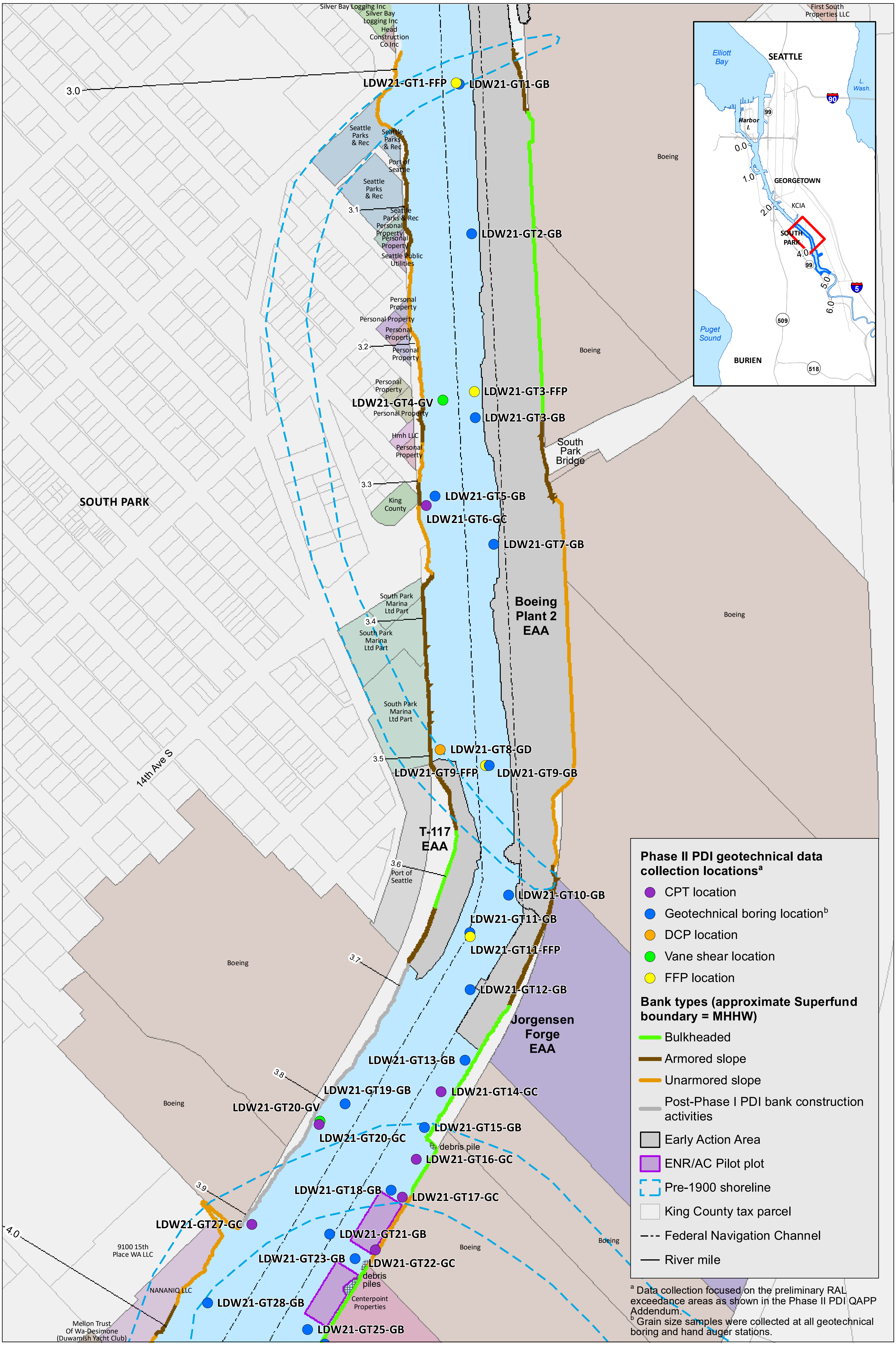
SPU, 2014. Geotechnical Memorandum Dallas Avenue South Drainage Project Subsurface Infiltration Recommendations. June 2014.

Terzaghi, K., and R. Peck, 1967. *Soil Mechanics in Engineering Practice*. Second edition. Wiley.

USACE (U.S. Army Corps of Engineers), 2003. *Slope Stability*. Engineering Manual EM 1110-2-1902.

USDA (U.S. Department of Agriculture), 1989. Loose Riprap Protection Minnesota Technical Note 3. United States Department of Agriculture Soil Conservation Service. July 1989.

Figures



Prepared by craigh, 10/24/23; W:\Projects\Duwamish AOC4\GIS\Maps and Analyses\Remedial Design\App G Geotech\Fig G1-1a 7281 PhII PDI Geotech locations RM3-4.mxd

Windward environmental LLC

ANCHOR QEA

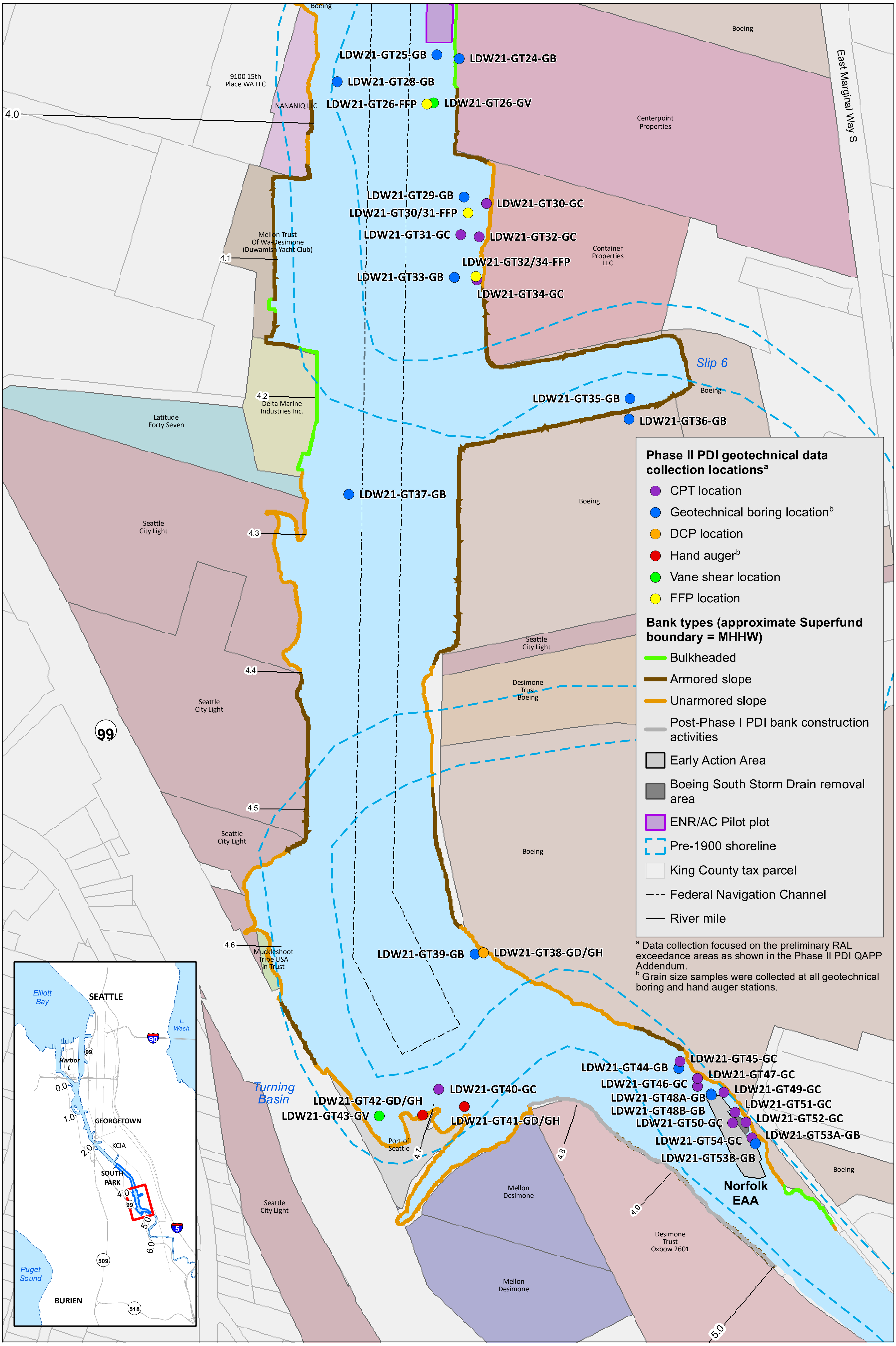
Lower Duwamish Waterway Group
City of Seattle / King County / The Boeing Company

N

0 250 500 Feet

0 100 200 Meters

Figure G1-1a. Phase II PDI geotechnical data locations, RMs 3.0 to 4.0



Windward environmental LLC

ANCHOR QEA

Lower Duwamish Waterway Group
City of Seattle / King County / The Boeing Company

N

0 250 500 Feet

0 100 200 Meters

Figure G1-1b. Phase II PDI geotechnical data locations, RMs 4.0 to 5.0

Prepared by craigh, 10/24/23; W:\Projects\Duwamish AOC4\GIS\Maps and Analyses\Remedial Design\App G Geotech\Fig G1-1b 7281 PhII PDI Geotech locations RM4-5.mxd

Figure G2-1
Undrained Shear Strength Test Results and Design Assumptions

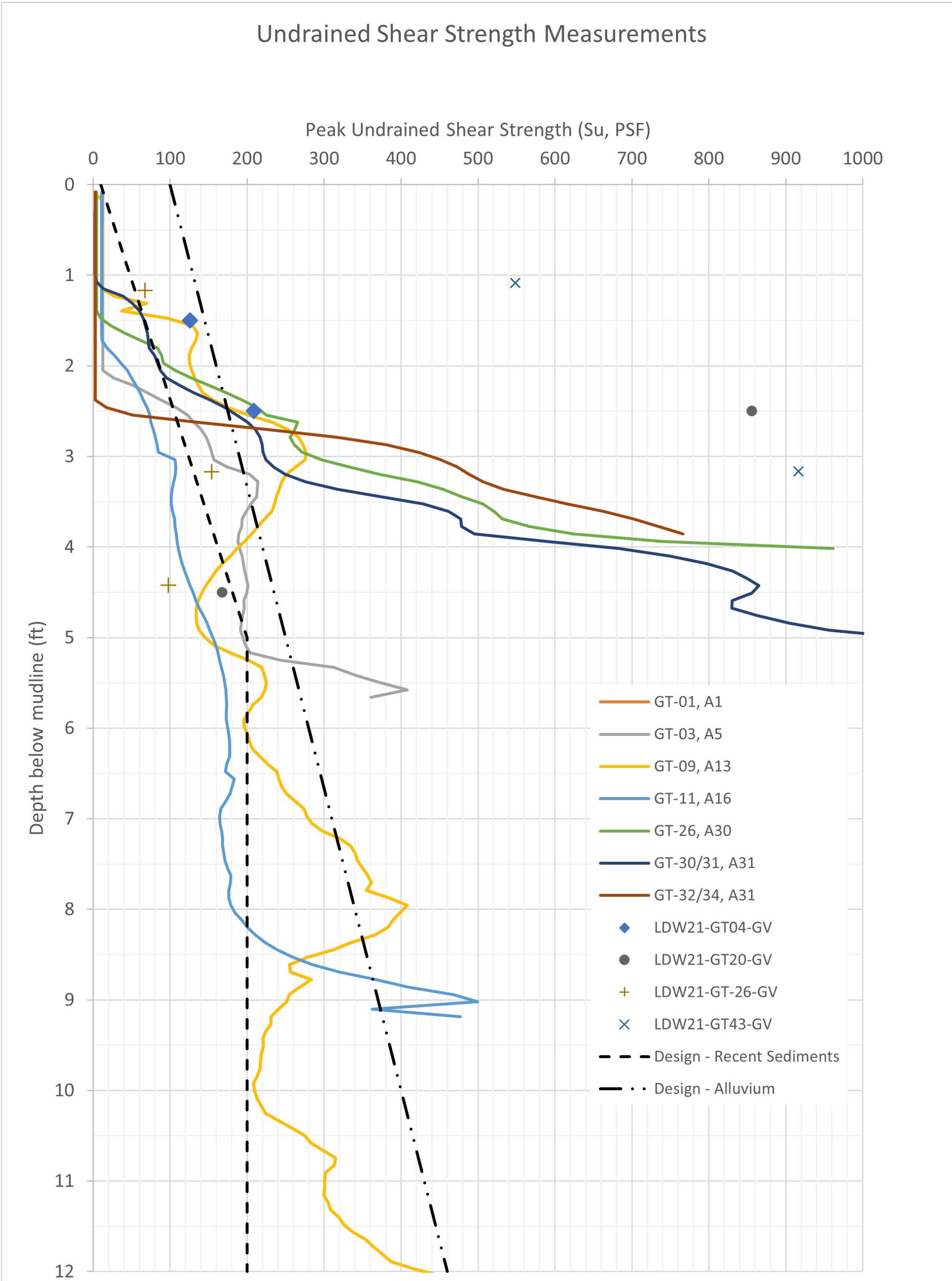
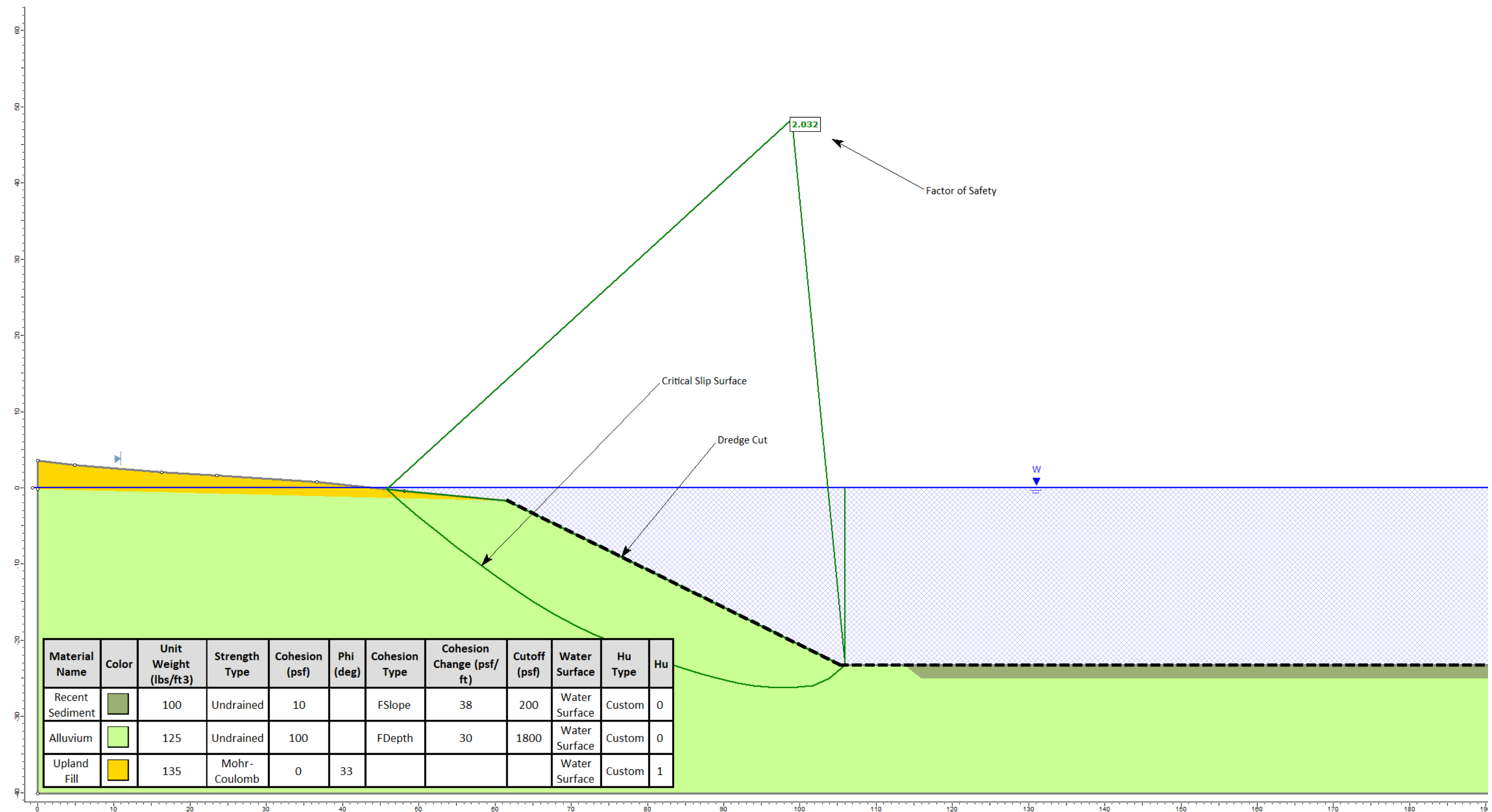
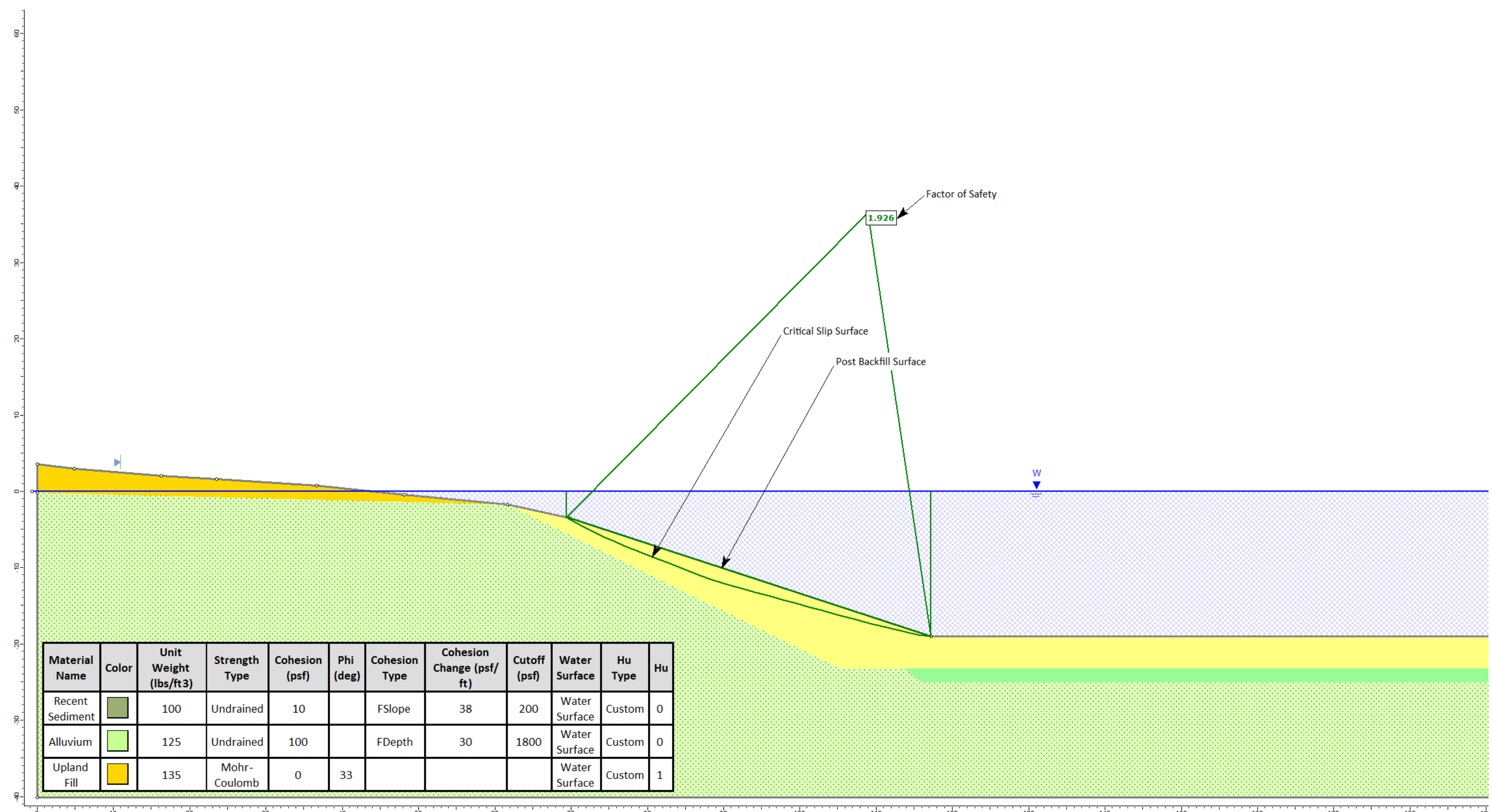


Figure G3-1
Slope Stability – Short Term and Long Term Offshore of T-117

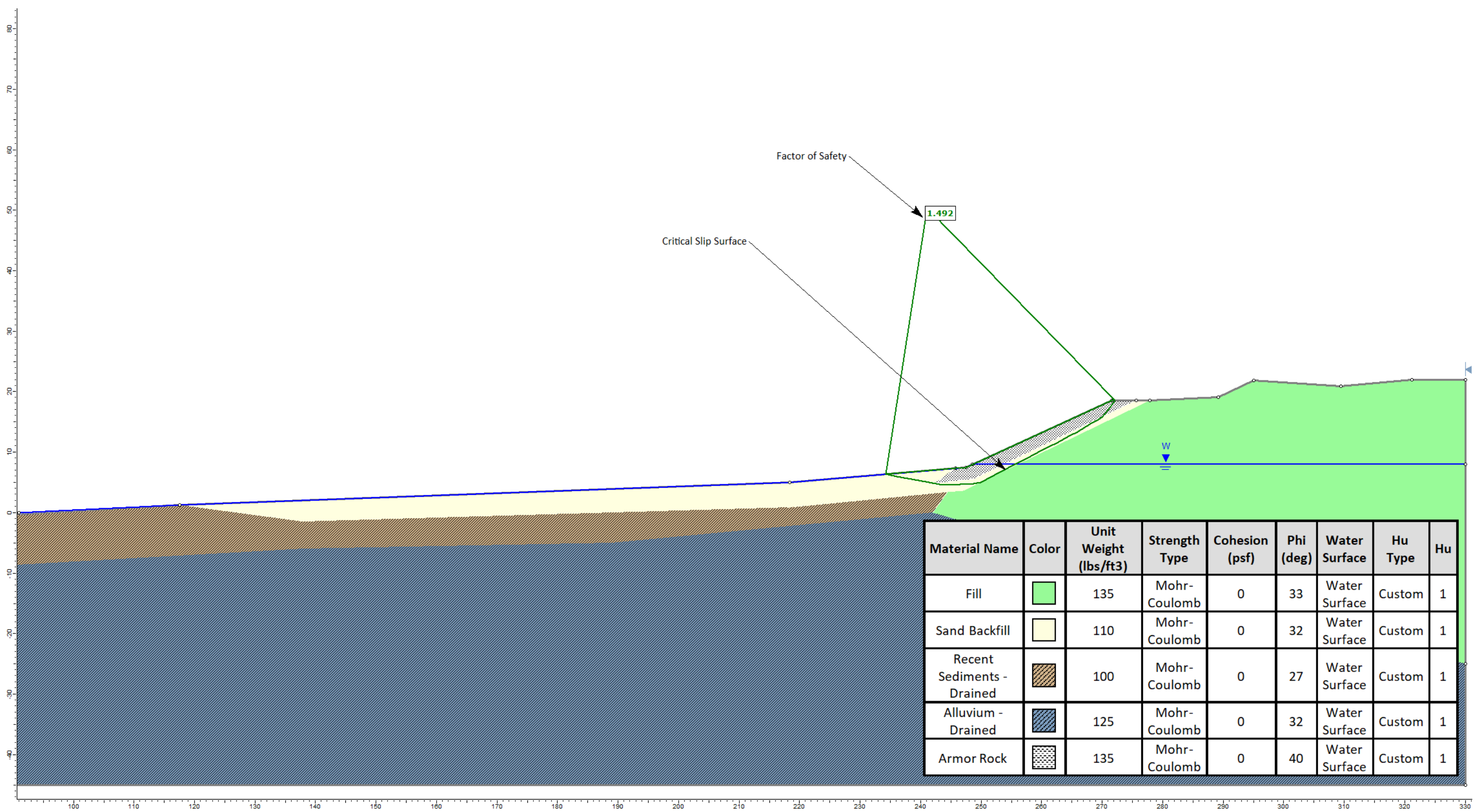


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Cutoff (psf)	Water Surface	Hu Type	Hu
Recent Sediment		100	Undrained	10		FSlope	38	200	Water Surface	Custom	0
Alluvium		125	Undrained	100		FDepth	30	1800	Water Surface	Custom	0
Upland Fill		135	Mohr-Coulomb	0	33				Water Surface	Custom	1



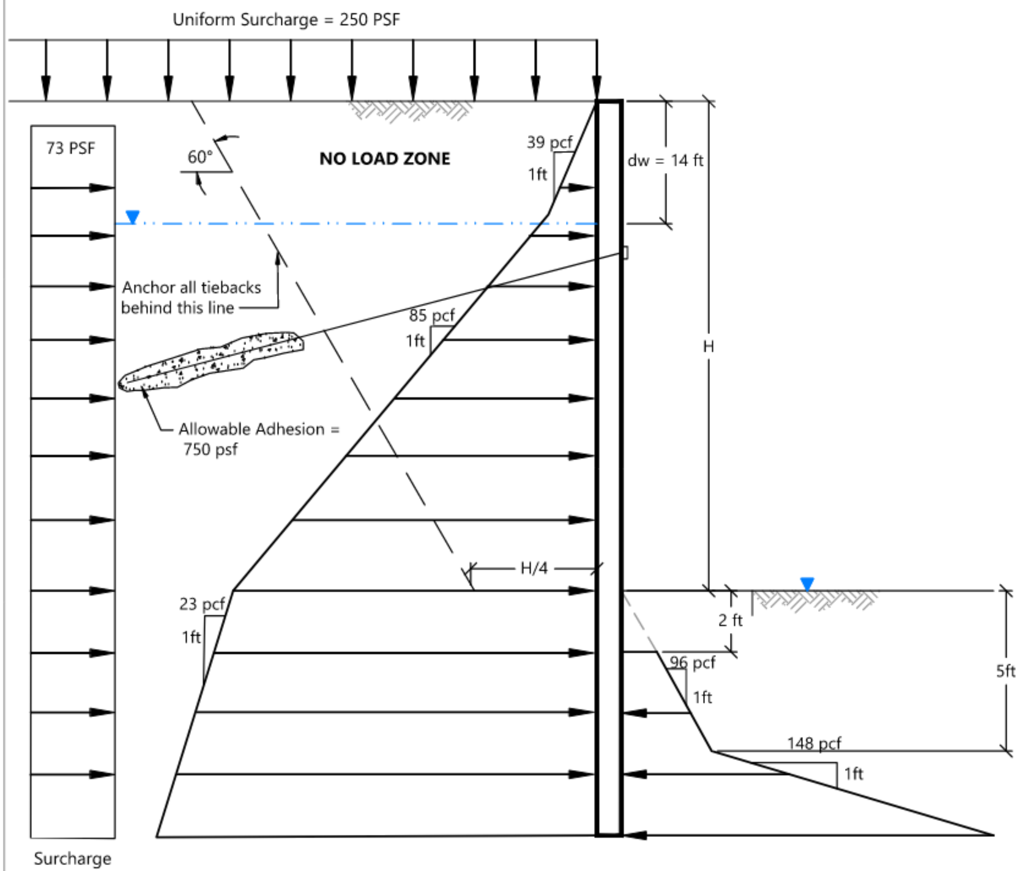
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Cutoff (psf)	Water Surface	Hu Type	Hu
Recent Sediment		100	Undrained	10		FSlope	38	200	Water Surface	Custom	0
Alluvium		125	Undrained	100		FDepth	30	1800	Water Surface	Custom	0
Upland Fill		135	Mohr-Coulomb	0	33				Water Surface	Custom	1

Figure G3-2
Container Properties Slope Stability Results – Long Term



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Fill		135	Mohr-Coulomb	0	33	Water Surface	Custom	1
Sand Backfill		110	Mohr-Coulomb	0	32	Water Surface	Custom	1
Recent Sediments - Drained		100	Mohr-Coulomb	0	27	Water Surface	Custom	1
Alluvium - Drained		125	Mohr-Coulomb	0	32	Water Surface	Custom	1
Armor Rock		135	Mohr-Coulomb	0	40	Water Surface	Custom	1

Figure G4-1
Lateral Earth Pressures



NOTES:

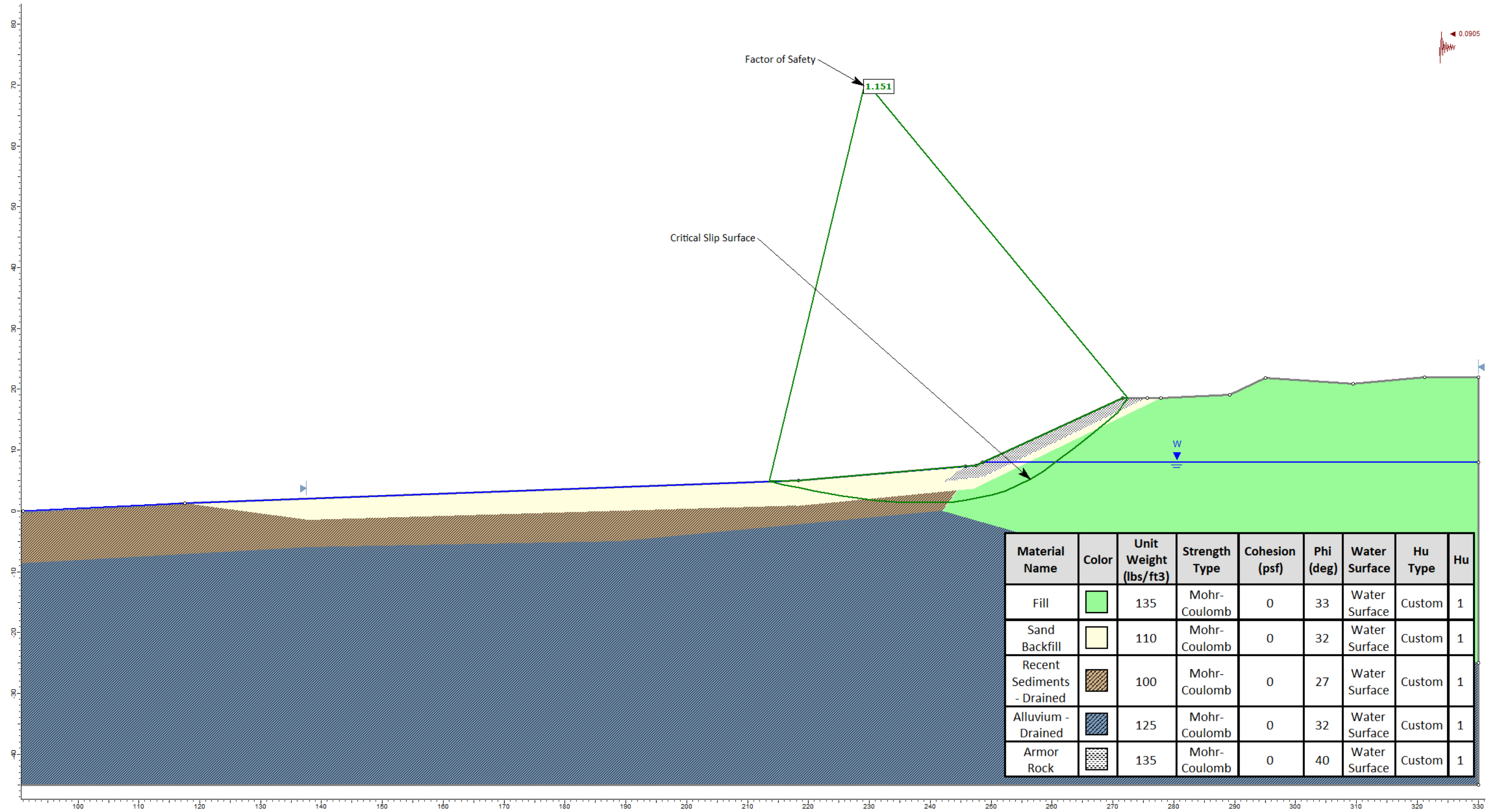
1. Yielding walls are those walls that will deform at least 0.001 times the height of the wall.
2. Passive pressures are Ultimate values and do not include a factor of safety. We recommend applying a factor of safety of at least 1.5 when computing static passive pressures.
3. Ignore the contribution of the upper 2 feet of soil at the base of the wall when computing passive pressures.
4. Active and at-rest earth pressures are for cantilever walls or walls supported by a single row of tiebacks.
5. Anchor pull out resistance is based on non-pressure-grouted straight shaft anchors. These values should be considered tentative and for planning purposes only. Actual values will need to be determined on the basis of field testing prior to construction.
6. Passive Pressure acts over 2 pile diameters.

Not to Scale

Passive Earth Pressure Reduction Factors			
Offset Distance	Reduction Factor		
	2H:1V	1.5H:1V	1H:1V
0	0.75	0.56	0.38
2	0.85	0.66	0.48
4	0.95	0.76	0.58

Publish Date: 2023/01/23 10:03 AM | User: jfoster
Filepath: K:\Projects\0067-King County\LDW Upper Reach Engineering Services\0067-RP-032 Lateral Earth Pressures.dwg Figure X

Figure G5-1
Seismic Performance of Caps on Slopes – Container Properties 100-Year Event



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Fill		135	Mohr-Coulomb	0	33	Water Surface	Custom	1
Sand Backfill		110	Mohr-Coulomb	0	32	Water Surface	Custom	1
Recent Sediments - Drained		100	Mohr-Coulomb	0	27	Water Surface	Custom	1
Alluvium - Drained		125	Mohr-Coulomb	0	32	Water Surface	Custom	1
Armor Rock		135	Mohr-Coulomb	0	40	Water Surface	Custom	1

Attachment G.1
Subsurface Investigation Program and Field Logs

Boring Location: 47.511241606, -122.302597174 N:1277329.59455 E:189951.293072	Hand Auger GT41 Date 8/3/21 Sheet 1 of 2
	Job LDW21 Job No. 180067-02.03
	Logged By Garrett Timm, Andrew B Weather 85 degrees & sunny
	Excavated By Anchor QEA
	Excavation Method Hand Auger 3.5' O.D.
	Sampling Method NA
	Bottom of Hand Auger 2 ft.
Elevation: Datum:	

SIZE (%) G Max.	S Range	F Att. Limits	PID or other	SAMPLE Type	SAMPLE Number	SAMPLE RECOVERY	DESCRIPTION: Den., moist., color, minor, MAJOR CONSTITUENT, NON-SOIL SUBSTANCES: Odor, staining, sheen, scrag, slag, etc.
NA	90	10	NA	soil	1	0	(0 to 1.3 ft.) SM. very soft, moist, light brown and grey, medium grained SAND w/ pockets of silt, occasional organics.
						1	
NA	90	10	NA	soil	2		(1.3 to 2 ft.)SP. very loose, wet, dark grey, SAND, minor black staining, some silt. WT encountered @ 1.8ft.
						2	End of Boring @ 2 feet
						3	
						4	
						5	
						6	
						7	
						8	
						9	
						10	

Notes:

ANCHOR QEA

Boring Location: 47.511450999, -122.302013485 N: 1277475.27698 E: 190024.904784999	Hand Auger GT42 Date 8/3/21 Sheet 2 of 2 Job LDW21 Job No. 180067-02.03 Logged By Garrett Timm, Andrew B Weather 85 degrees & sunny Excavated By Anchor QEA Excavation Method Hand Auger 3.5' O.D. Sampling Method NA Bottom of Hand Auger 2.3 ft.
Elevation: Datum:	

SIZE (%)			PID or other	SAMPLE		SAMPLE RECOVERY	
G	S	F		Type	Number		
Max.	Range	Att. Limits					DESCRIPTION: Den., moist., color, minor, MAJOR CONSTITUENT, NON-SOIL SUBSTANCES: Odor, staining, sheen, scrag, slag, etc.
NA	< 25	> 75	NA	soil	1	0	(0 to 0.2 ft.) ML. organic SILT, roots
< 5	< 10	> 85	NA	soil	2	1	(0.2 to 1.5 ft.)ML. very soft, moist, grey, SILT. Contains ocassional organics and brick pieces (fill) <0.5 inches
NA	> 95	< 5	NA	soil	3	2	(1.5 to 2.3 ft.)SP. loose, moist, grey, SAND, medium grained.
							End of Boring @ 2.3 feet
						3	
						4	
						5	
						6	
						7	
						8	
						9	
						10	

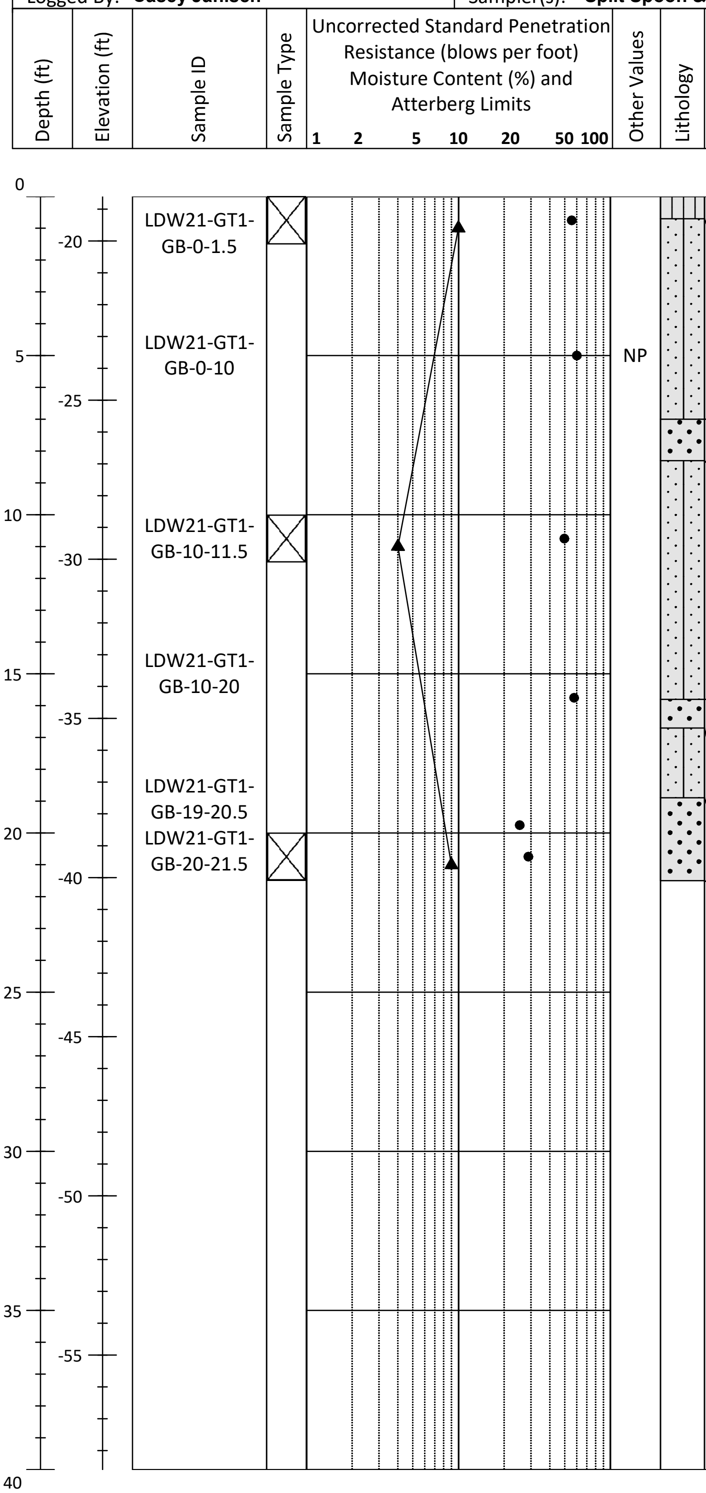
Notes:

Soil Boring Log

LDW21-GT1-GB

Sheet 1 of 1

Project #: 180067-02.03	Project: LDW Upper Reach Phase 2 Investigation	Method: Rotary Sonic
Location: Seattle, WA	N/LAT: 197701.636 E/LONG: 1273353.682	Total Depth (ft): 21.5
Client: Lower Duwamish Waterway Group	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Observed Depth to Mudline (ft): 27.2
Collection Date: 07.09.21		Mudline Elevation (ft): -18.6
Contractor: Holocene Drilling, Inc	Vert. Datum: Mean Lower Low Water (MLLW)	Hammer: 140-lb, 30-in drop, Auto
Logged By: Casey Janisch	Sampler(s): Split Spoon & Shelby Tube Sampler	Hammer Efficiency (%): 99



Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
(0 to 0.7') [Soft], wet, black, SILT (ML). Trace organics (fibers).	%M
(0.7 to 7') Loose, moist, black, SILTY SAND (SM), fine grained sand, trace organics (wood debris).	%M, SG, ATT
(7 to 8.3') [Loose], moist, black, poorly graded SAND (SP).	
(8.3 to 15.8') Loose, moist, black, SILTY SAND (SM), trace organics (wood debris).	%M %M, SG, GSDH
(15.8 to 16.7') [Loose], moist, black, poorly graded SAND (SP), fine grained sand.	
(16.7 to 18.9') [Loose], moist, black, SILTY SAND (SM)	%M
(18.9 to 21.5') Loose, moist, black, poorly graded SAND (SP).	%M
End of Boring at 21.5 ft	

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
☒ Split Spoon/Grab

Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.
Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

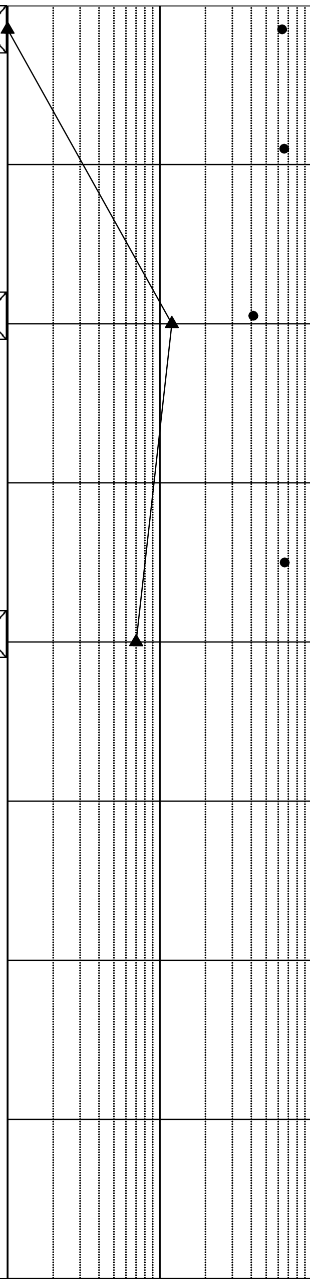
LDW21-GT2-GB

Sheet 1 of 1

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **197328.101** E/LONG: **1273794.399**	Total Depth (ft): **20.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **23.2**
Collection Date: **07.09.21**		Mudline Elevation (ft): **-21.9**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
0		LDW21-GT2-GB-0-1.5	Split Spoon/Grab		WOR		(0 to 1.3') Very soft, wet, black, SILT (ML), trace organics (fibers)	%M
	-25						@1.1: Substantial organics (wood debris)	
5		LDW21-GT2-GB-0-9			NP		(1.3 to 3.7') [Loose], damp, black, SILTY SAND (SM)	%M, ATT
							(3.7 to 5.3') [Very soft], wet, black, non-plastic, SILT (ML)	
	-30						(5.3 to 6.8') [Loose], moist, black, poorly graded SAND (SP) with silt, fine grained sand, trace organics.	
10		LDW21-GT2-GB-9-10.5	Split Spoon/Grab				(6.8 to 7.5') [Medium stiff], moist, dark gray, SILT (ML) PP=0 TSF	%M
	-35						(7.5 to 16') Stiff, damp, dark gray, SANDY SILT (ML), [non plastic]. @7.5-7.6': Substantial organic debris	
15	-40	LDW21-GT2-GB-16-19					(16 to 18.5') [Loose], moist, dark gray, SANDY SILT (ML), occasional organics (wood debris).	%M, ATT, GSDH, DS
20			Split Spoon/Grab				(18.5 to 21.5') Loose, moist, dark gray, poorly graded SAND (SP).	
							End of Boring 21.5 ft.	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40. Elevation scale: -25, -30, -35, -40, -45, -50, -55, -60.



ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

- ▲ SPT N-Value
- ● Moisture Content (%)
- ■ Atterberg Limits
- Shelby Tube
- ☒ Split Spoon/Grab

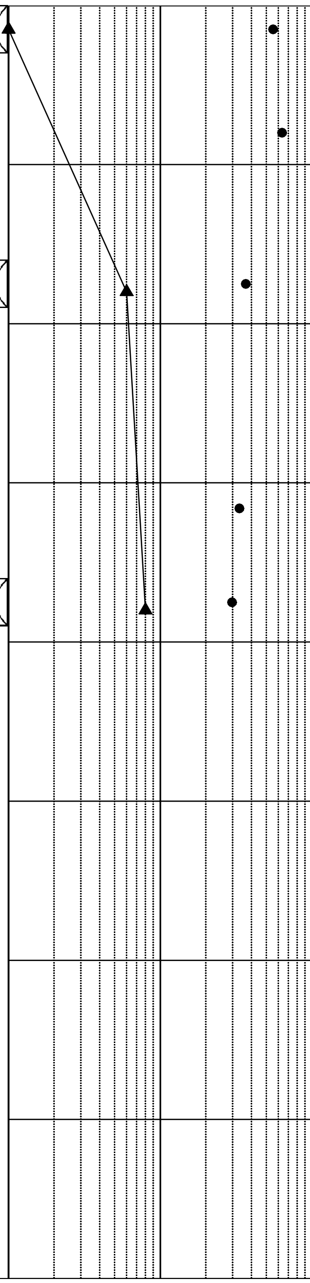
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT3-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **196838.0251** E/LONG: **1274303.5483**	Total Depth (ft): **19.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **18**
Collection Date: **07.14.21**		Mudline Elevation (ft): **-17.8**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (scale: 1 2 5 10 20 50 100)



Soil Description
Samples and descriptions are in recovered depths.
Classification scheme: USCS

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Other Values	Soil Description	Lab Test
0–1.5		LDW21-GT3-GB-0-1.5	Split Spoon/Grab	WOR	(0 to 1.3') [Very soft], wet, black, SILT (ML), trace organics (fibers), trace shells.	%M
		LDW21-GT3-GB-0-8		NP	(1.3 to 12.2') Loose, wet, black, SILTY SAND (SM), contains silt, fine grained sand.	%M, ATT
8–9.5		LDW21-GT3-GB-8-9.5	Split Spoon/Grab			%M, GSD, DS
					(12.2 to 13.6') [Soft], moist, black, SILT WITH SAND (ML)	
		LDW21-GT3-GB-13.6-18			(13.6 to 19.5') Loose, moist, black, poorly graded SAND (SP), fine grained sand, trace organics (wood debris). @16.7: Pocket of medium stiff, moist, light gray, SILT (ML) @17 to 17.1': Substantial wood debris encountered @17.6': Pocket of medium stiff, moist, light gray, SILT (ML)	%M, SG, GSD
18–19.5		LDW21-GT3-GB-18-19.5	Split Spoon/Grab			%M
					End of Boring at 19.5 ft	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40. Elevation scale: -20, -25, -30, -35, -40, -45, -50, -55.

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
☒ Split Spoon/Grab

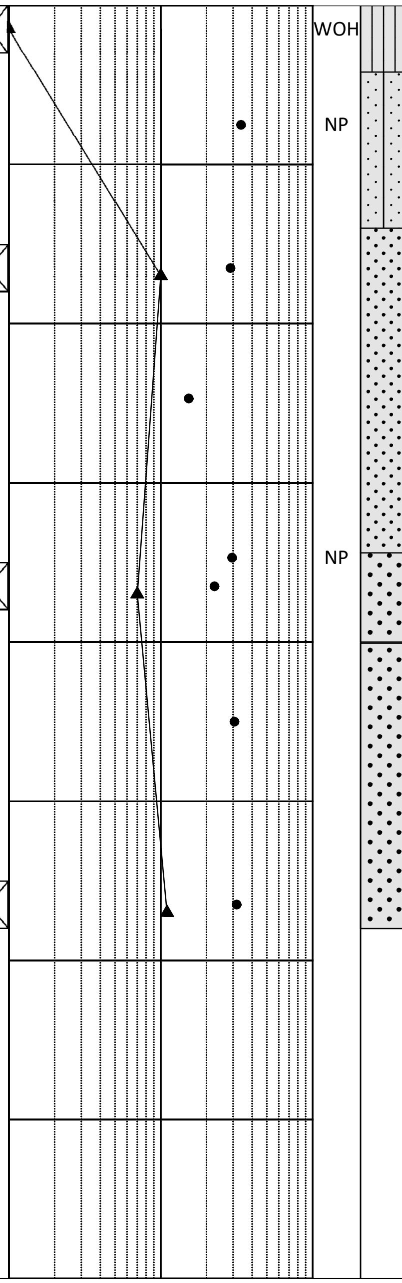
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT5-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **196515.647** E/LONG: **1274408.737**	Total Depth (ft): **29**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **8.5**
Collection Date: **07.19.21**		Mudline Elevation (ft): **0.1**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
0	0	LDW21-GT5-GB-0-1.5	Split Spoon/Grab		WOH		(0 to 2.1') Very soft, wet, brown to black, SILT to SANDY SILT (ML), trace organics (wood debris), occasional anthropogenic debris (glass), trace rainbow sheen.	%M
		LDW21-GT5-GB-0-7.5			NP		(2.1 to 7.0') [Loose], moist, black, SILTY SAND (SM).	%M, ATT
5	-5							
		LDW21-GT5-GB-7.5-9	Split Spoon/Grab				(7.0 to 17.2') Loose to medium dense, moist, black, poorly graded SAND WITH SILT and GRAVEL (SW-SM), fine grained, trace gravel.	%M
10	-10	LDW21-GT5-GB-7.5-17.2					@11.8-12': Pocket of [loose], moist, dark olive gray SILTY SAND (SM)	%M, SG, GSD, DS
15	-15	LDW21-GT5-GB-17.2-17.5			NP			%M, ATT
		LDW21-GT5-GB-17.5-19	Split Spoon/Grab				(17.2 to 29') Medium stiff, moist, olive gray, poorly graded SAND WITH SILT (SP-SM), non-plastic, high dilatancy. PP=0.5 TSF	%M
20	-20	LDW21-GT5-GB-17.5-27.5						%M, SG, GSDH
25	-25						@25.2': Grades to slightly silty	
		LDW21-GT5-GB-27.5-29	Split Spoon/Grab					%M
30	-30						End of Boring at 29 ft	
35	-35							
40								



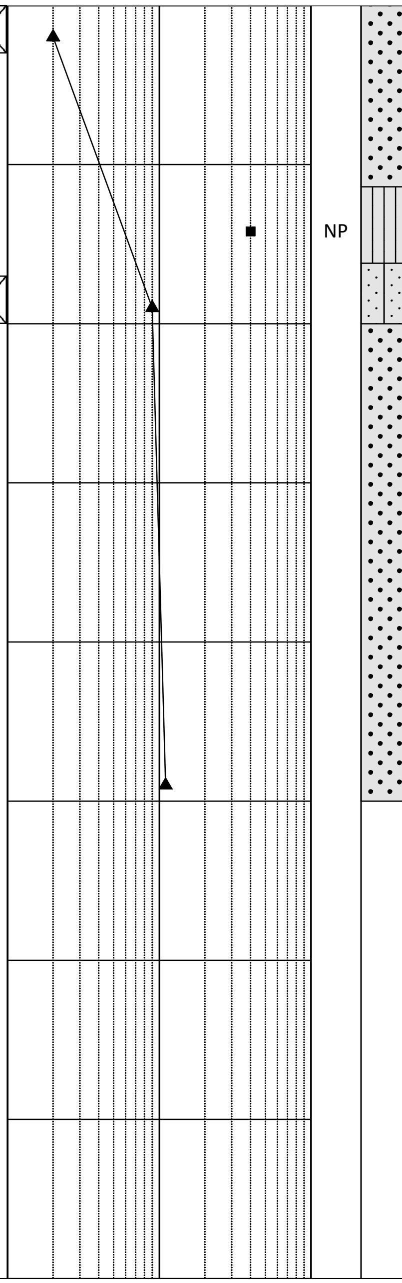
ANCHOR QEA 1201 Third Avenue Suite 2600 Seattle, WA 98101	▲ SPT N-Value ● Moisture Content (%) ■ Atterberg Limits Shelby Tube ☒ Split Spoon/Grab	**Notes:** **%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.** **Mudline elevations determined from leadline measurements and Site tide gage levels** **WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic**

Soil Boring Log

LDW21-GT7-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **196544.595** E/LONG: **1274698.428**	Total Depth (ft): **25**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **17.5**
Collection Date: **07.09.21**		Mudline Elevation (ft): **-18.7**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Columns: Depth (ft) | Elevation (ft) | Sample ID | Sample Type | Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100) | Other Values | Lithology | Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS) | Lab Test



Sample ID	Soil Description	Lab Test
LDW21-GT7-GB-0-1.5 LDW21-GT7-GB-0-5.7	(0 to 5.7') Very loose, wet, dark brown to black, poorly graded SAND (SP), fine grained, occasional organics (wood debris).	%M %M, SG, GSD
LDW21-GT7-GB-5.7-8.5	(5.7 to 8.1') [Medium stiff], moist, black, SILT WITH SAND (ML), non-plastic, occasional organics. @6.6': Lamination of 100% wood debris @7.3-7.5': Substantial wood debris	%M, ATT
LDW21-GT7-GB-8.5-10	(8.1 to 10'): Loose, damp, dark dray, SILTY SAND (SM), fine grained sand.	%M
LDW21-GT7-GB-8.5-18.5	(10 to 25'): Medium dense, moist, dark gray, poorly graded SAND (SP), fine grained. @16-16.4': Layer of [medium dense], damp, dark gray, SILTY SAND (SM) @18': Interbedded layers of SILTY SAND (SM) @19.2-19.9': Layer of [medium dense], damp, dark gray, SILTY SAND (SM)	%M, GSD, DS
LDW21-GT7-GB-18.5-23.5	@21.1-22': Layer of [medium dense], damp, dark gray, SILTY SAND (SM) @22.5-22.9': Substantial wood debris	%M, SG, GSD
LDW21-GT7-GB-23.5-25		%M
	End of Boring at 25 ft	

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40
Elevation (ft): -20, -25, -30, -35, -40, -45, -50, -55

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
⊠ Split Spoon/Grab

Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

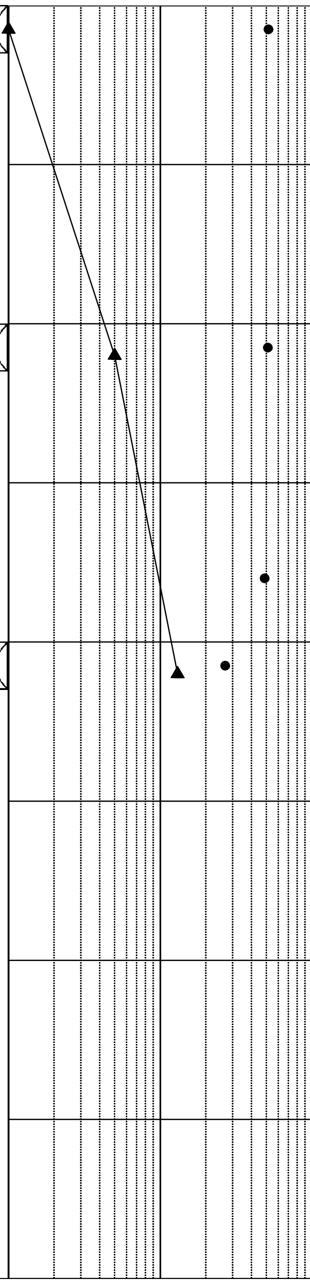
Soil Boring Log

Sheet 1 of 1

LDW21-GT9-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **195927.181** E/LONG: **1275283.558**	Total Depth (ft): **21.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **11.2**
Collection Date: **07.08.21**		Mudline Elevation (ft): **-0.7**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits: 1 2 5 10 20 50 100



Soil Description
Samples and descriptions are in recovered depths.
Classification scheme: USCS

Depth (ft)	Sample ID	Sample Type	Other Values	Soil Description	Lab Test
0–1.5	LDW21-GT9-GB-0-1.5	Split Spoon/Grab	WOR, NP	(0 to 1.5') Very soft, moist, black, SILT (ML), non-plastic, with fine grained sand, trace organics (wood debris).	SG, ATT
1.5–10				(1.5 to 10') No recovery.	
10–11.5	LDW21-GT9-GB-10-11.5	Split Spoon/Grab		(10 to 19.8') Soft, moist, black, SILT to SILT WITH SAND (ML), trace organics (wood debris).	%M
	LDW21-GT9-GB-10-20		NP		
16				@16': Grades to [medium stiff], occasional organics (fibers) @16.6 to 17.2': Substantial organic matter (wood)	
	LDW21-GT9-GB-16-20				%M, ATT
18.8				@18.8': Striations of olive gray SANDY SILT (ML)	
20–21.5	LDW21-GT9-GB-20-21.5	Split Spoon/Grab		(19.8 to 21.5'): Stiff, moist, gray, SILTY SAND (ML), low plasticity.	%M, GSDH, DS
				End of Boring at 21.5 ft.	

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
Split Spoon/Grab

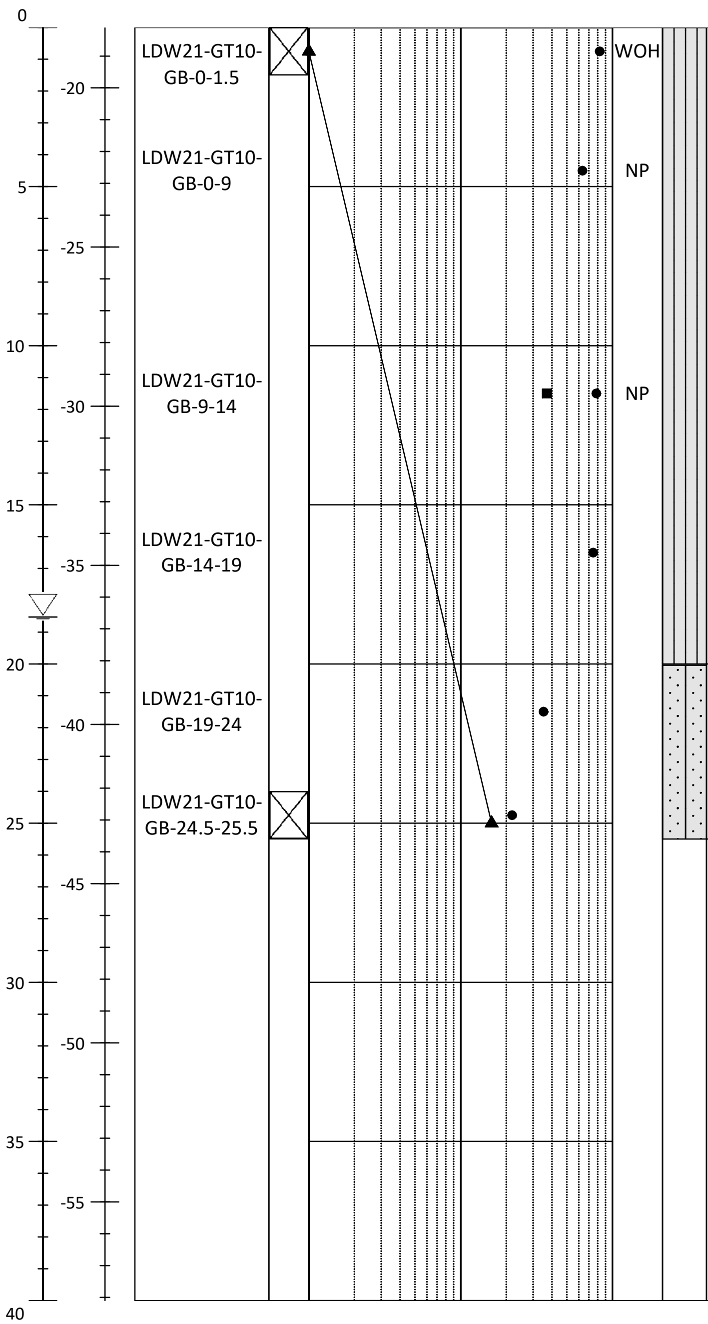
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.
Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT10-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **195631.266** E/LONG: **1275691.841**	Total Depth (ft): **25.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **18.2**
Collection Date: **07.07.21**		Mudline Elevation (ft): **-18.1**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
0		LDW21-GT10-GB-0-1.5	Split Spoon/Grab		WOH	ML	(0 to 20') Very soft, wet, black, SILT (ML), non-plastic, trace organics (wood debris).	%M
							@2-7': Trace silvery sheen, non-brittle, trace H2S odor.	
		LDW21-GT10-GB-0-9			NP			%M, SG, ATT
							@7': Grades [to soft to medium stiff], moist, no odor, no sheen.	
							@8.5-9.0': Grades sandier, sandy silt (ML)	
		LDW21-GT10-GB-9-14			NP			%M, ATT
							@14': Grades to [medium stiff to stiff], damp, black, SANDY SILT (ML), medium plasticity. PP=0-0.25 TSF.	
		LDW21-GT10-GB-14-19						%M, GSDH, DS
20		LDW21-GT10-GB-19-24				SM	(20 to 25.5') Medium dense, damp to moist, black, SILTY SAND (SM), trace silt, fine grained sand, laminations of silty sand and silt throughout.	%M, SG, GSD
		LDW21-GT10-GB-24.5-25.5	Split Spoon/Grab					%M
							End of Boring at 25.5 ft.	



ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

- ▲ SPT N-Value
- ● Moisture Content (%)
- ■ Atterberg Limits
- Shelby Tube
- ☒ Split Spoon/Grab

Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.
Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

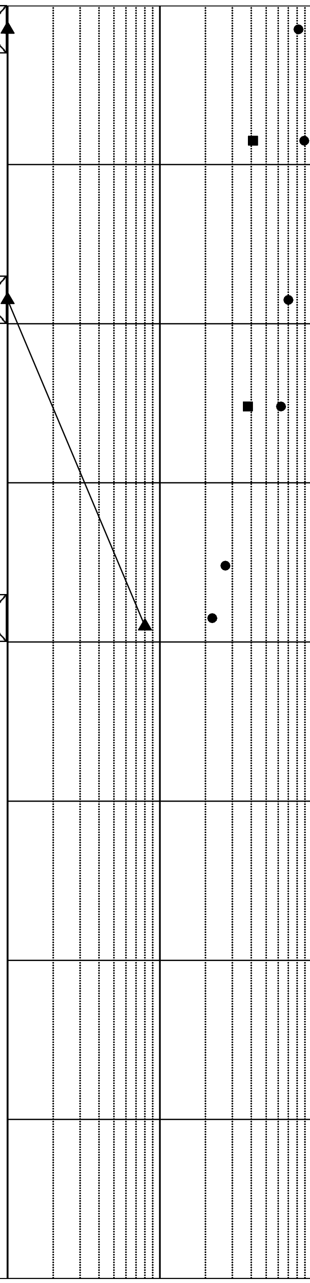
Soil Boring Log

LDW21-GT11-GB

Sheet 1 of 1

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **195423.544** E/LONG: **1275688.731**	Total Depth (ft): **20**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **18.7**
Collection Date: **07.08.21**		Mudline Elevation (ft): **-12.3**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
0		LDW21-GT11-GB-0-1.5	Split Spoon/Grab		WOR		(0 to 16.7') Very soft, wet to moist, black, SANDY SILT (ML), non-plastic, occasional organics (wood debris), trace biota (shells).	%M
	-15	LDW21-GT11-GB-0-8.5			NP			%M, ATT, GSDH, DS
5	-20							
		LDW21-GT11-GB-8.5-10	Split Spoon/Grab		WOH			%M
10	-25	LDW21-GT11-GB-8.5-16.7			NP			%M, ATT
15							@14': Grades to [medium stiff]. PP=0.125 TSF.	
	-30	LDW21-GT11-GB-16.7-18.5					(16.7 to 20'): Loose, moist, black, SILTY SAND (SM), fine grained sand.	%M, GSD
		LDW21-GT11-GB-18.5-20	Split Spoon/Grab					%M
20							End of Boring at 20 ft	
25	-35, -40							
30	-45							
35	-50							
40								



ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

- ▲ SPT N-Value
- ● Moisture Content (%)
- ■ Atterberg Limits
- Shelby Tube
- ☒ Split Spoon/Grab

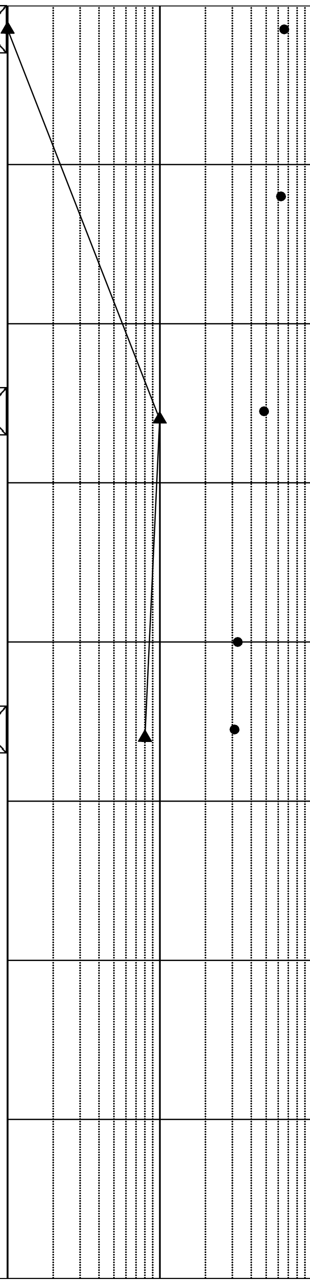
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.
Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT12-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **195269.116** E/LONG: **1275845.395**	Total Depth (ft): **23.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **15.2**
Collection Date: **07.08.21**		Mudline Elevation (ft): **-13.9**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
0		LDW21-GT12-GB-0-1.5	Split Spoon/Grab		WOR		(0 to 1.5') Very soft, moist to wet, black, SILT (ML), non-plastic. No sonic core recovery from 0 to 9 ft	%M
5	-20	LDW21-GT12-GB-0-12			NP			%M, SG, ATT
10	-25						@9-10.9': [Soft], moist, black, SILT (ML), low plasticity	
		LDW21-GT12-GB-12-13.5	Split Spoon/Grab				(10.9 to 22.5') Soft to medium dense, moist, dark gray, SILTY SAND (SM), interbedded lithology.	%M
20	-35	LDW21-GT12-GB-18-22					@20.3-20.8': Pocket of [medium stiff], moist, black, SILT (ML)	%M, SG, GSDH, DS
		LDW21-GT12-GB-22-23.5	Split Spoon/Grab				(22.5 to 23.5') Loose, dark gray, moist, SILTY SAND (SM), fine grained sand.	%M
25	-40						End of Boring at 23.5 ft.	



Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40. Elevation scale: -15, -20, -25, -30, -35, -40, -45, -50.

ANCHOR QEA

1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
☒ Split Spoon/Grab

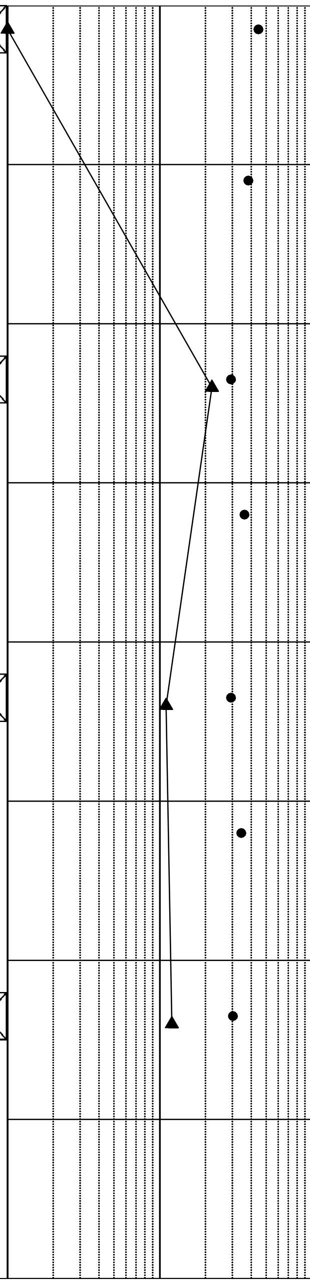
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.
Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT13-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **195063.55** E/LONG: **1276022.385**	Total Depth (ft): **32.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **5.0**
Collection Date: **07.12.21**		Mudline Elevation (ft): **-0.5**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits	Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
0		LDW21-GT13-GB-0-1.5	Split Spoon/Grab		WOH		(0 to 0.9') Very soft, moist, black, SILT (ML).	%M
							(0.9 to 32.5') Loose to medium dense, moist, black, SILTY SAND (SM), fine grained sand.	
5	-5	LDW21-GT13-GB-0-11						%M, SG, GSDH, DS
10	-10	LDW21-GT13-GB-11-12.5	Split Spoon/Grab				@10.4-10.9': Pocket of [medium stiff], damp, dark gray, SANDY SILT (ML), non plastic	%M
15	-15	LDW21-GT13-GB-11-21						%M, GSD
20	-20	LDW21-GT13-GB-21-22.5	Split Spoon/Grab					%M
25	-25	LDW21-GT13-GB-21-31						%M, SG, GSD
30	-30	LDW21-GT13-GB-31-32.5	Split Spoon/Grab					%M
							End of boring at 32.5 ft	
35	-35							
40	-40							



ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
☒ Split Spoon/Grab

Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.
Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

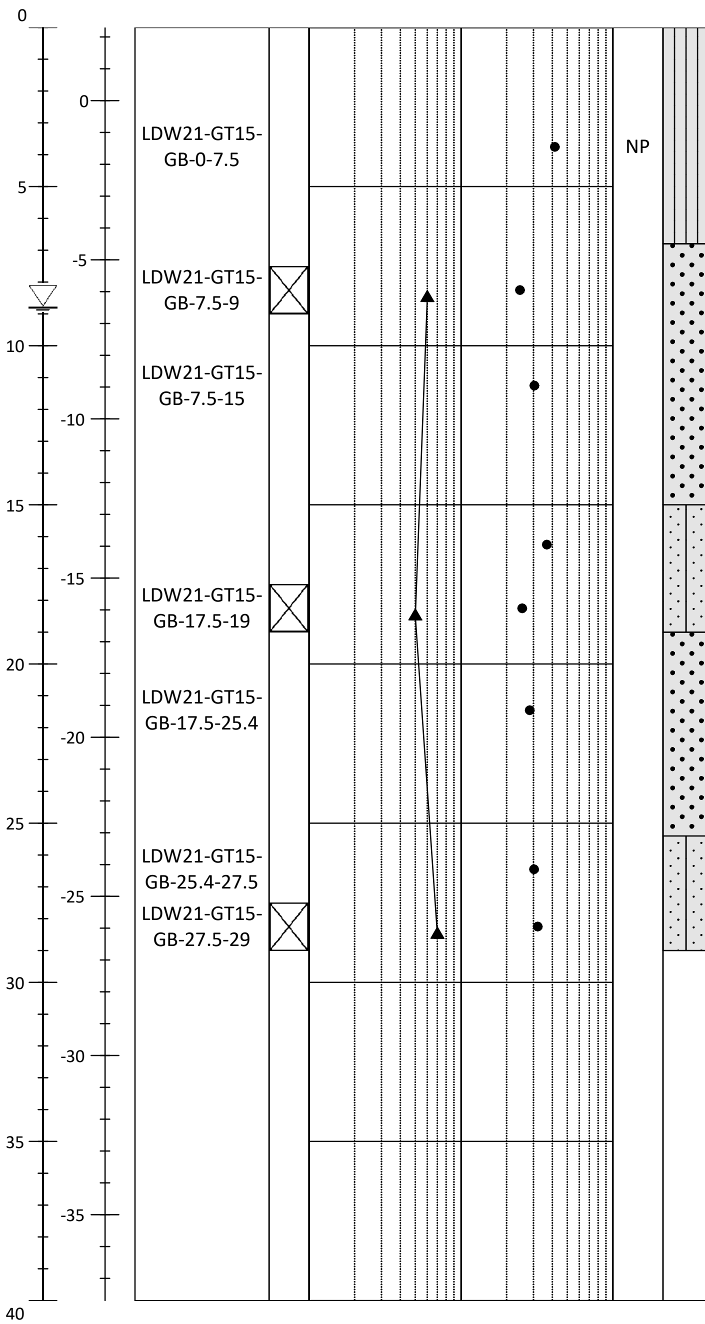
Soil Boring Log

LDW21-GT15-GB

Sheet 1 of 1

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **194770.977** E/LONG: **1276096.292**	Total Depth (ft): **29**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **7.5**
Collection Date: **07.12.21**		Mudline Elevation (ft): **2.3**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
0–7.5		LDW21-GT15-GB-0-7.5			NP		(0 to 6.8') [Soft], wet, black, SILT (ML), non-plastic. No Recovery from 0 to 1.5 ft @5.4-5.9': Substantial slag and occasional gravel @6.2: Grades to [medium stiff] and moist	%M, SG, ATT
7.5–9		LDW21-GT15-GB-7.5-9	Split Spoon/Grab				(6.8 to 15') Loose, moist, black, poorly graded SAND (SP), fine grained sand.	%M
7.5–15		LDW21-GT15-GB-7.5-15						%M, GSD, DS
15–19							(15 to 19') Loose, moist, olive gray, SILTY SAND (SM), fine grained sand, non plastic silt. @15.9 to 16.3': Layer of medium stiff, moist, olive gray, SILT (ML), non plastic, high dilatancy.	%M, GSDH
17.5–19		LDW21-GT15-GB-17.5-19	Split Spoon/Grab					%M, GSDH
17.5–25.4		LDW21-GT15-GB-17.5-25.4					(19 to 25.4') [Loose], moist, black, SILTY SAND (SM) with silt.	%M, SG, GSD
25.4–27.5		LDW21-GT15-GB-25.4-27.5					(25.4 to 29') Loose, moist, olive gray, SILTY SAND (SM), fine grained sand, non plastic silt. @26.7-27.4': Lens of [medium stiff], moist, olive gray, non plastic silt, high dilatancy.	%M, SG, GSDH
27.5–29		LDW21-GT15-GB-27.5-29	Split Spoon/Grab					%M
29							End of Boring at 29 ft.	



ANCHOR QEA

1201 Third Avenue
Suite 2600 Seattle, WA 98101

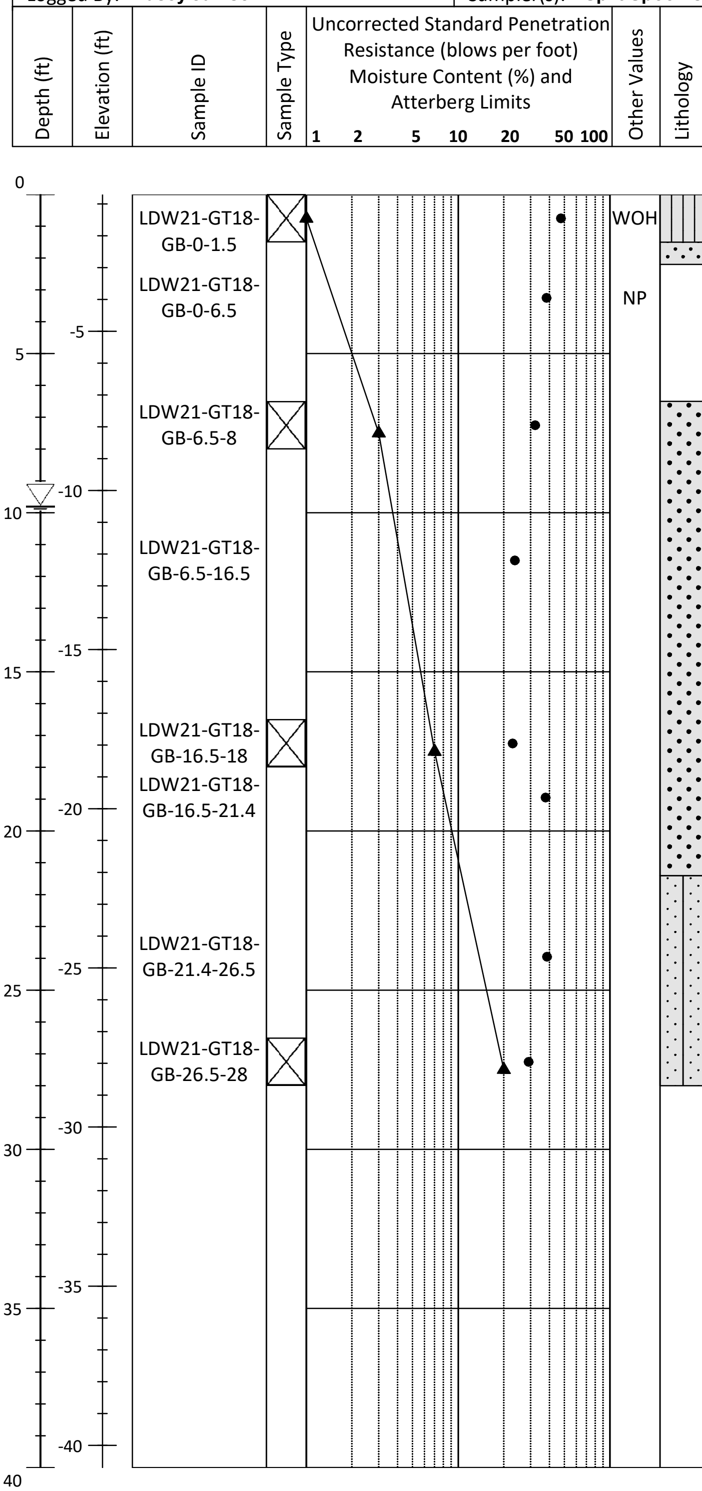
- ▲ SPT N-Value
- ● Moisture Content (%)
- ■ Atterberg Limits
- Shelby Tube
- ☒ Split Spoon/Grab

Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.
Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT18-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **194509.577** E/LONG: **1276175.936**	Total Depth (ft): **28**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **9.5**
Collection Date: **07.13.21**		Mudline Elevation (ft): **-0.7**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**



Sample ID	Other Values	Soil Description	Lab Test
LDW21-GT18-GB-0-1.5	WOH	(0 to 1.5') Very soft, wet, black, SILT (ML) with trace organics (wood debris, fibers).	%M
LDW21-GT18-GB-0-6.5	NP	(1.5 to 2.2') [Loose], wet, black, well sorted SAND (SW), fine to coarse grained sand. (Fill).	%M, SG, ATT
		(2.2 to 6.5') No Recovery between 2.2 and 6.5 ft.	
LDW21-GT18-GB-6.5-8		(6.5 to 21.4') Very loose, moist, black, poorly graded SAND (SP), fine grained sand.	%M
LDW21-GT18-GB-6.5-16.5			%M, SG, GSD
		@13-13.4': Contains trace medium to coarse grained sand	
LDW21-GT18-GB-16.5-18		@16.5': Grades to SILTY SAND (SM)	%M
LDW21-GT18-GB-16.5-21.4		@17.7-18': [Medium stiff], moist, dark olive gray, SANDY SILT (ML), non plastic. @19.3': Grades to fine to medium grained sand	%M, GSDH, DS
		(21.4 to 28') Loose to medium dense, moist, black, SILTY SAND (SM), fine grained sand, trace silt.	
LDW21-GT18-GB-21.4-26.5		@22-22.8': Soft, moist, dark olive gray, SANDY SILT (ML), non plastic, high dilatancy. PP=0.25 TSF	%M, SG, GSD
LDW21-GT18-GB-26.5-28			%M
		End of Boring at 28 ft.	

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
Split Spoon/Grab

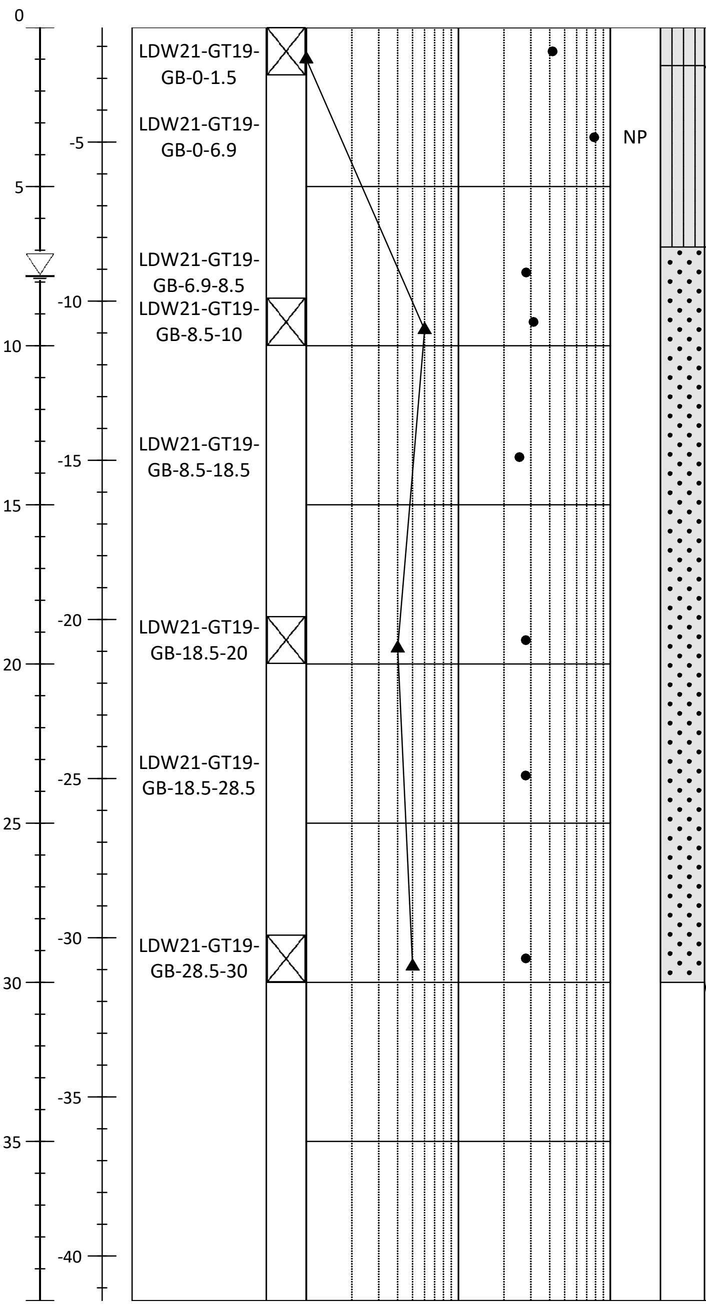
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.
Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT19-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **194619.686** E/LONG: **1275815.459**	Total Depth (ft): **30**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **7.5**
Collection Date: **07.13.21**		Mudline Elevation (ft): **-1.4**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits: 1 2 5 10 20 50 100



Depth (ft)	Sample ID	Sample Type	Other Values	Lab Test
0–1.5	LDW21-GT19-GB-0-1.5	Split Spoon/Grab		%M
0–6.9	LDW21-GT19-GB-0-6.9		NP	%M, SG, ATT, GSDH
6.9–8.5	LDW21-GT19-GB-6.9-8.5			%M, GSD
8.5–10	LDW21-GT19-GB-8.5-10	Split Spoon/Grab		%M
8.5–18.5	LDW21-GT19-GB-8.5-18.5			%M, SG, GSD, DS
18.5–20	LDW21-GT19-GB-18.5-20	Split Spoon/Grab		%M
18.5–28.5	LDW21-GT19-GB-18.5-28.5			%M, GSD
28.5–30	LDW21-GT19-GB-28.5-30	Split Spoon/Grab		%M

Soil Description

Samples and descriptions are in recovered depths.
Classification scheme: USCS

(0 to 1.2') Very soft, wet, black, SANDY SILT (ML).

(1.2 to 6.9') Very soft, moist, black, SANDY SILT (ML), non-plastic.

(6.9 to 30') Loose, moist, black, poorly graded SAND (SP), fine grained sand.

End of Boring at 30 ft.

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

- ▲ SPT N-Value
- ● Moisture Content (%)
- ■ Atterberg Limits
- Shelby Tube
- ☒ Split Spoon/Grab

Notes:
**%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic**

Soil Boring Log

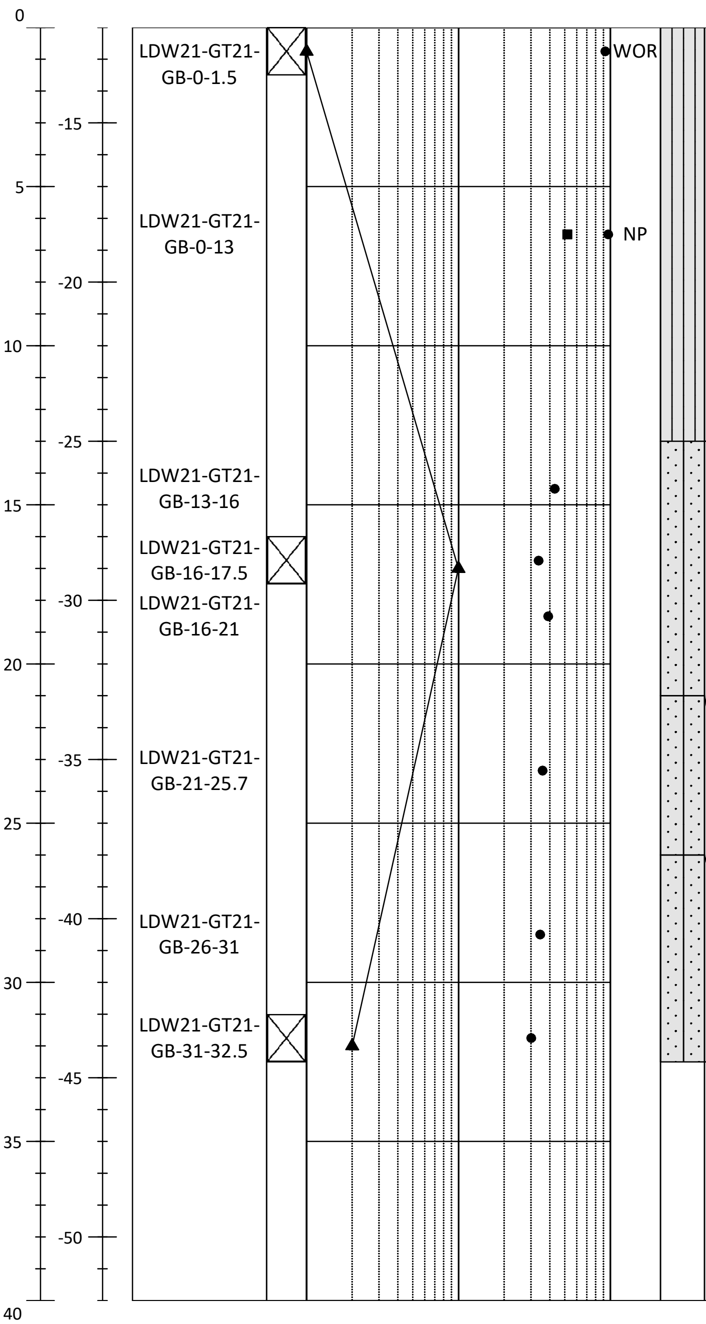
LDW21-GT21-GB

Sheet 1 of 1

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **194223.416** E/LONG: **1276127.19**	Total Depth (ft): **32.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **11.2**
Collection Date: **07.08.21**		Mudline Elevation (ft): **-12.0**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Columns: Depth (ft) | Elevation (ft) | Sample ID | Sample Type | Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1, 2, 5, 10, 20, 50, 100) | Other Values | Lithology | Soil Description | Lab Test

Soil Description
Samples and descriptions are in recovered depths.
Classification scheme: USCS



Sample ID	Sample Type	Other Values	Lab Test
LDW21-GT21-GB-0-1.5	Split Spoon/Grab	WOR	%M
LDW21-GT21-GB-0-13		NP	%M, ATT
LDW21-GT21-GB-13-16			%M, SG, GSD
LDW21-GT21-GB-16-17.5	Split Spoon/Grab		%M
LDW21-GT21-GB-16-21			%M, GSD, DS
LDW21-GT21-GB-21-25.7			%M, SG, GSDH
LDW21-GT21-GB-26-31			%M, GSD
LDW21-GT21-GB-31-32.5	Split Spoon/Grab		%M

(0 to 13'): Very soft, wet, black, SILT (ML), non-plastic, trace organics (fibers), trace biota (shells).

(13 to 21'): Loose to medium dense, moist, black, SILTY SAND (SM), fine grained.

@14.2 to 15.6': Layer of [medium dense], moist, gray, SILTY SAND (SM)

@20.4 to 20.8': Pocket of [medium stiff], moist, gray, SILT (ML), low plasticity

(21 to 26') [Medium dense], moist, olive gray, SILTY SAND (SM), highly silty, low plasticity, high dilatancy.

@25.7': Lens of poorly graded SAND (SP)

(26 to 32'): Loose moist, black, SILTY SAND (SM)

@30.3 to 31.6': Layer of poorly graded SAND (SP)

End of Boring at 32.5 ft.

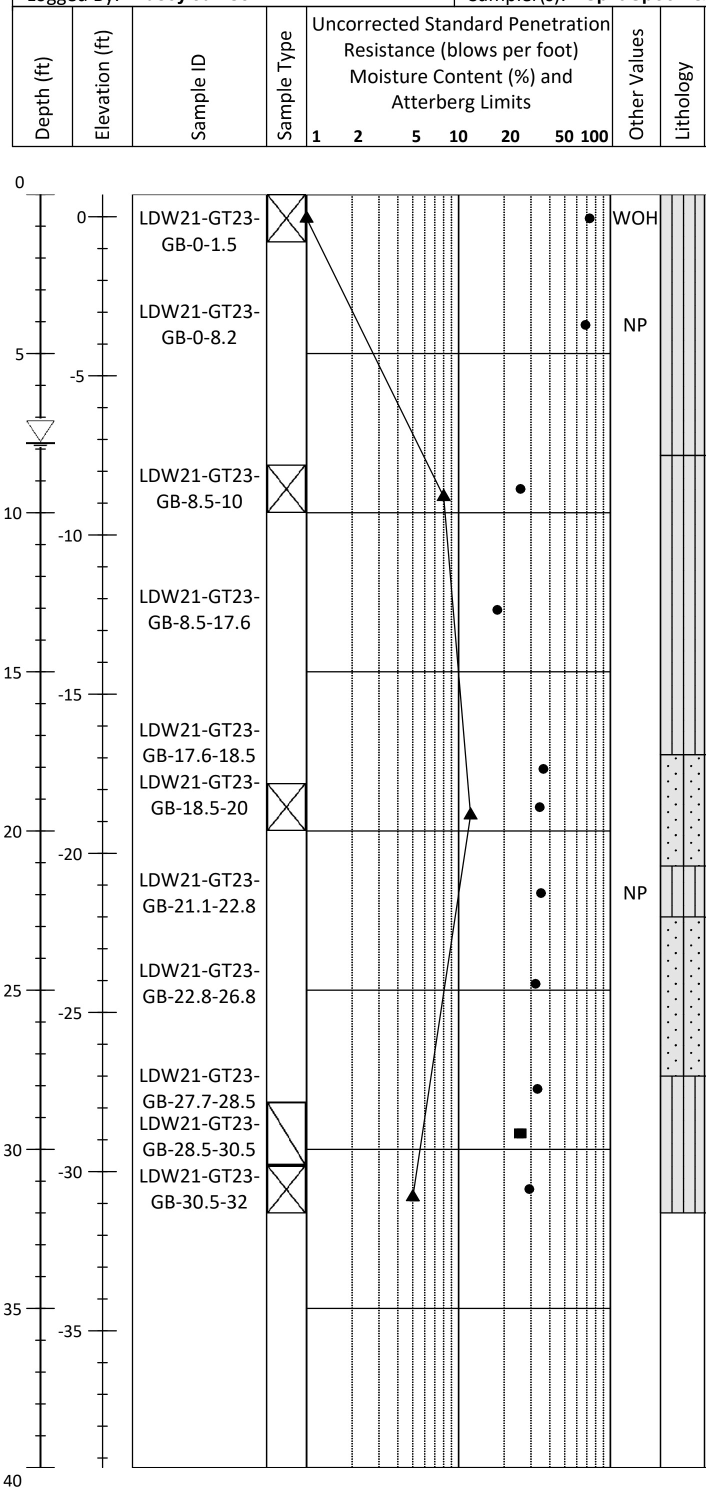
ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
☒ Split Spoon/Grab

Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log
LDW21-GT23-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **194225.679** E/LONG: **1276262.681**	Total Depth (ft): **32**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **7.5**
Collection Date: **07.16.21**		Mudline Elevation (ft): **0.7**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**



Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
(0 to 8.2') Very soft, wet, black, SILT (ML). @0.2 to 0.4': Olive gray mottling	%M
@1.6 to 2.8': Moderate petroleum odor, occasional rainbow sheen, occasional organic matter (fibers) PP=0-0.125 TSF	%M, SG, ATT
(8.2 to 17.6') Loose, moist, black, poorly graded SAND (SP), fine grained.	%M
	%M, GSD, DS
@16.5 to 16.7': Pocket of [medium stiff], moist, olive gray SILT (ML)	
(17.6 to 21.1') Medium dense, moist, dark gray, SILTY SAND (SM), very fine grained sand.	%M, GSDH %M
(21.1 to 22.7') [Medium stiff], moist, olive gray, SILT (ML)	%M, ATT
(22.7 to 27.7') [Medium dense], moist, dark gray, SILTY SAND (SM), fine grained sand.	%M, GSDH
	%M
(27.7 to 32') Medium stiff, moist, olive gray, SILT (ML)	%M, SG, ATT, 1-D, CU %M
End of Boring at 32 ft	

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
Split Spoon/Grab

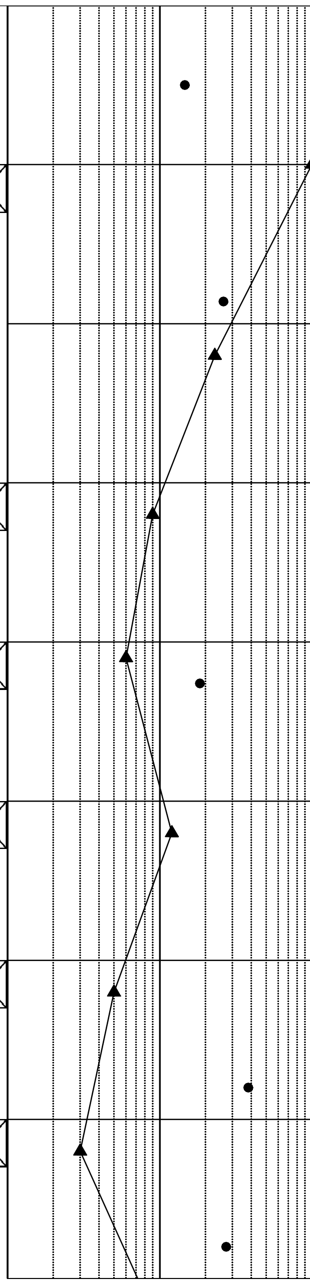
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT24-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **193910.921** E/LONG: **1276412.765**	Total Depth (ft): **61.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **NA**
Collection Date: **7.26.21**		Mudline Elevation (ft): **15.2**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Sam Giannakos**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
0	15						(0 to 2.8') Concrete surface.	
		LDW21-GT24-GB-0-5						%M
							(2.8-4.5') [Medium stiff], damp, brown, SILTY SAND (SM), fine grained sand, occasional gravel (up to 1-in), occasional organics (wood fibers)	
5	10		Split Spoon		50/6"		(4.5-7') Very dense, dry, white, concrete dust, large gravel, up to 2-in.	
		LDW21-GT24-GB-5-13.6					(7 to 13.6') Medium dense, moist, brown, poorly graded SAND (SP). @8': Grades to dark brown @9.1-9.6': Lens of tan, very silty sand. @11': Grades to orangish brown	%M, GSD, DS
10	5							
							(13.6 to 41') Loose, wet, black/red/white, SAND (SP).	
15	0		Split Spoon					
20	-5	LDW21-GT24-GB-13.6-29	Split Spoon					%M, SG, GSD
25	-10		Split Spoon				@26-26.3': Wood piece, brittle, branch-like, gray	
30	-15		Split Spoon				@29.2': Large tree knot (4-inch) @29.2-29.8': Pocket of clayey silt, interbedded	
		LDW21-GT24-GB-33-35			NP		@33': Grades to moist to wet, olive gray, more fine grained sand	%M, ATT
35	-20		Split Spoon					
		LDW21-GT24-GB-35-43						%M, GSD
40	-25							



ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

- ▲ SPT N-Value
- ● Moisture Content (%)
- ■ Atterberg Limits
- Shelby Tube
- ☒ Split Spoon/Grab

Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT24-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **193910.921** E/LONG: **1276412.765**	Total Depth (ft): **61.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **NA**
Collection Date: **7.26.21**		Mudline Elevation (ft): **15.2**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Sam Giannakos**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
40	-25		Split Spoon				(13.6 to 41') Loose, moist to wet, olive gray, SAND (SP).	
							(41 to 43') Loose, moist, brown, SILTY SAND (SM).	
45	-30	LDW21-GT24-GB-43-50	Split Spoon		NP		(46 to 53.3') Stiff, damp to wet, gray to brown, SANDY SILT (ML), pockets of coarse silt.	%M, SG, ATT
50	-35		Split Spoon					
55	-40	LDW21-GT24-GB-53.3-59					(53.3 to 59') Loose, damp, olive gray to black, medium dense, poorly graded, SILTY SAND (SM), fine grained sand.	%M, GSD
60	-45						(59 to 60.5') [Medium dense], damp, olive gray, SANDY SILT (ML).	
							(60.5 to 61.5') Medium dense, damp, SILTY SAND (SM).	
							End of Boring at 61.5 ft	
65	-50							
70	-55							
75	-60							
80								

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
☒ Split Spoon/Grab

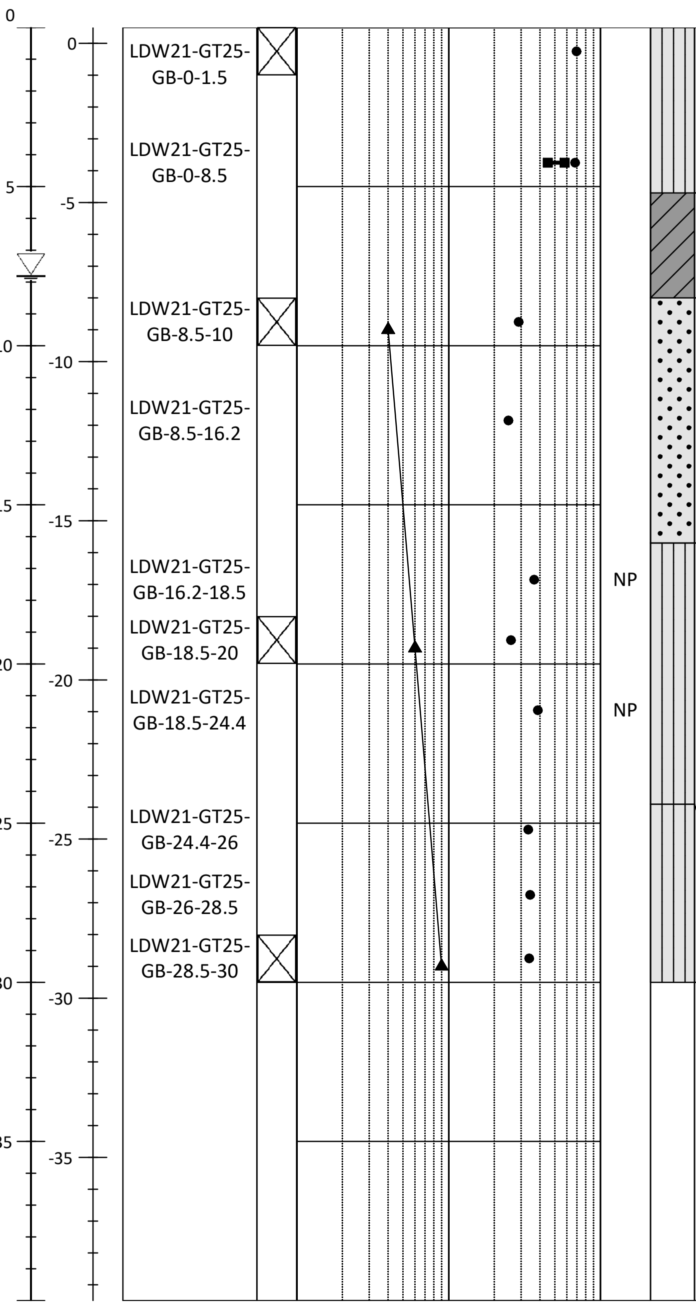
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.
Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT25-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **193902.768** E/LONG: **1276326.832**	Total Depth (ft): **30**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **7.5**
Collection Date: **07.15.21**		Mudline Elevation (ft): **0.5**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits: 1 2 5 10 20 50 100



Sample ID	Other Values	Lab Test
LDW21-GT25-GB-0-1.5		%M
LDW21-GT25-GB-0-8.5		%M, SG, ATT
LDW21-GT25-GB-8.5-10		%M
LDW21-GT25-GB-8.5-16.2		%M, GSD, DS
LDW21-GT25-GB-16.2-18.5	NP	%M, ATT
LDW21-GT25-GB-18.5-20		%M
LDW21-GT25-GB-18.5-24.4	NP	%M, ATT
LDW21-GT25-GB-24.4-26		%M
LDW21-GT25-GB-26-28.5		%M, GSD, GSDH
LDW21-GT25-GB-28.5-30		%M

Soil Description

Samples and descriptions are in recovered depths.
Classification scheme: USCS

(0 to 5.2') [Very soft], wet, dark brown to black, SILT (ML), medium plasticity, trace organics.

(5.2 to 8.5') [Medium stiff], moist, black, CLAYEY SILT (CL-ML), medium plasticity, trace organics (wood fibers)

(8.5 to 14.2') Loose, moist, black, poorly graded SAND (SP), fine grained, trace organics (wood debris)

@14.2': Occasional wood debris encountered

(16.2 to 24.4') Medium stiff, moist, olive gray, SANDY SILT (ML).

@23.5': Lamination of shell hash and occasional organics (wood debris)

(24.4 to 30') Loose, moist, dark gray, SANDY SILT (ML), fine grained sand.
@26 to 30': Becomes olive gray and siltier

End of Boring at 30 ft

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

- ▲ SPT N-Value
- ● Moisture Content (%)
- ■ Atterberg Limits
- Shelby Tube
- ☒ Split Spoon/Grab

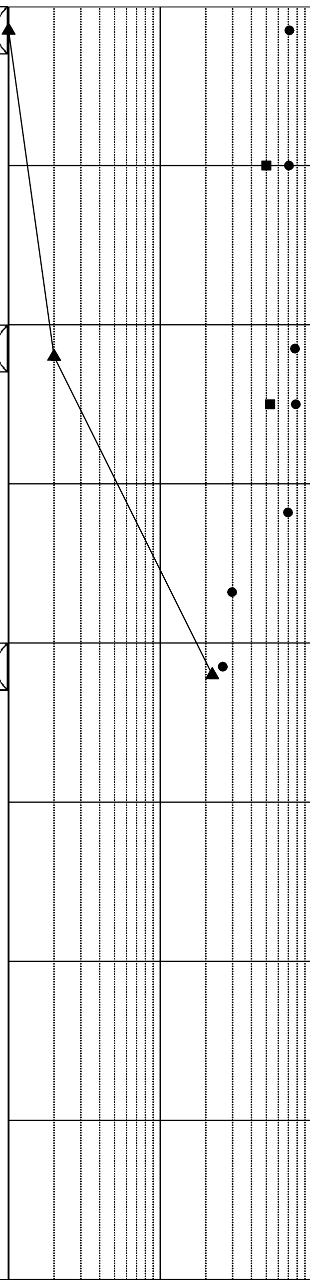
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT28-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **193703.693** E/LONG: **1275982.714**	Total Depth (ft): **21.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **12.2**
Collection Date: **07.07.21**		Mudline Elevation (ft): **-2.7**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits: 1 2 5 10 20 50 100



Depth (ft)	Sample ID	Sample Type	Other Values	Lithology	Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
0	LDW21-GT28-GB-0-1.5	Split Spoon/Grab	WOH	ML	(0 to 16.8'): Very soft, moist to wet, black, SILT (ML), non-plastic, trace organics (wood debris).	%M
5	LDW21-GT28-GB-0-10		NP			%M, ATT
10	LDW21-GT28-GB-10-11.5	Split Spoon/Grab			@10': Grades to soft and moist	%M
	LDW21-GT28-GB-10-15		NP			%M, ATT
15	LDW21-GT28-GB-15-16.8		NP		@16 to 16.8': Layer of [medium stiff], damp, brown, SILT (ML), medium plasticity.	%M, ATT
	LDW21-GT28-GB-16.8-20			SP	(16.8 to 21.5'): Medium dense, moist, black, poorly graded SAND (SP), fine grained, trace organics (twigs).	%M, GSD, DS
20	LDW21-GT28-GB-20-21.5	Split Spoon/Grab			@16.8 to 17.4': Trace fine grained gravel encountered	%M
					End of Boring at 21.5 ft.	

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40
Elevation (ft): -5, -10, -15, -20, -25, -30, -35, -40

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
☒ Split Spoon/Grab

Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.
Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

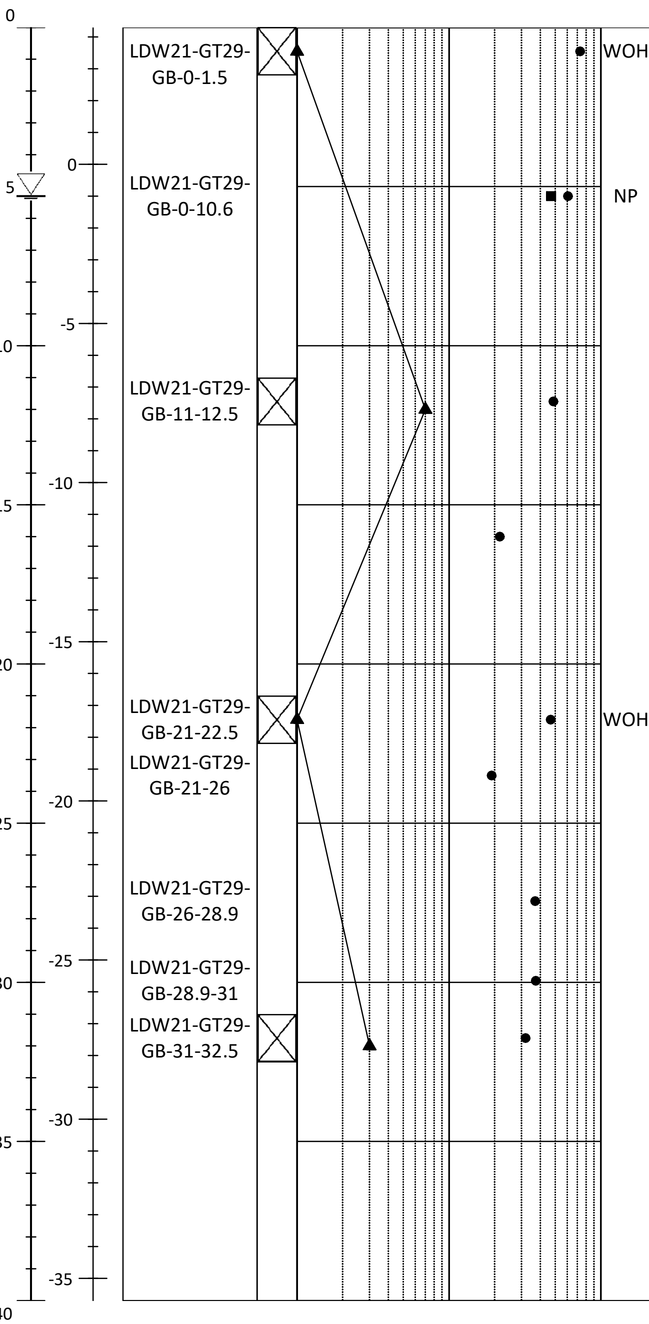
Soil Boring Log

LDW21-GT29-GB

Sheet 1 of 1

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **193401.625** E/LONG: **1276568.528**	Total Depth (ft): **32.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **5.0**
Collection Date: **07.14.21**		Mudline Elevation (ft): **4.3**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description: Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
0–1.5		LDW21-GT29-GB-0-1.5	Split Spoon		WOH		(0 to 6.1') Very soft, wet, black, SILT (ML), non-plastic, trace organics.	%M
		LDW21-GT29-GB-0-10.6			NP			%M, GSD, ATT
							(6.1 to 10.6') [Medium stiff], moist, black, SILT (ML), trace fine grained sand. @7.4 to 7.6': Lamination of loose, moist, black, fine grained sand with silt. @8.3 to 8.8': Substantial organics debris (wood)	
11–12.5		LDW21-GT29-GB-11-12.5	Split Spoon				(10.6 to 26') Very loose to loose, moist, black, poorly graded SAND (SP), fine grained sand.	%M
21–22.5		LDW21-GT29-GB-21-22.5	Split Spoon		WOH			%M, SG
		LDW21-GT29-GB-21-26						%M, GSD
		LDW21-GT29-GB-26-28.9					(26 to 32.5') Very loose, moist, black, SILTY SAND (SM), fine grained sand.	%M, GSD, DS
		LDW21-GT29-GB-28.9-31						%M, GSD
31–32.5		LDW21-GT29-GB-31-32.5	Split Spoon					%M
							End of Boring at 32.5 ft	



ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

- ▲ SPT N-Value
- ● Moisture Content (%)
- ■ Atterberg Limits
- Shelby Tube
- ☒ Split Spoon/Grab

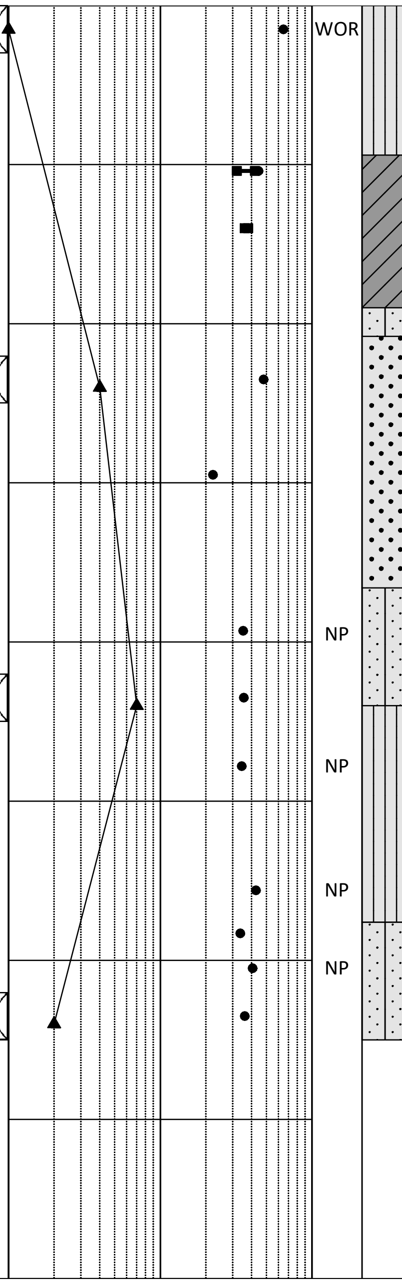
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.
Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT33-GB

Project #: 180067-02.03	Project: LDW Upper Reach Phase 2 Investigation	Method: Rotary Sonic
Location: Seattle, WA	N/LAT: 193093.668 E/LONG: 1276612.259	Total Depth (ft): 32.5
Client: Lower Duwamish Waterway Group	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Observed Depth to Mudline (ft): 0.1
Collection Date: 07.15.21		Mudline Elevation (ft): 8.5
Contractor: Holocene Drilling, Inc	Vert. Datum: Mean Lower Low Water (MLLW)	Hammer: 140-lb, 30-in drop, Auto
Logged By: Casey Janisch	Sampler(s): Split Spoon & Shelby Tube Sampler	Hammer Efficiency (%): 99

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
0		LDW21-GT33-GB-0-1.5	Split Spoon/Grab		WOR		(0 to 4.7') Very soft, wet, black to dark brown, SILT (ML), trace petroleum-like odor, trace rainbow sheen, non-brittle.	%M
5	5	LDW21-GT33-GB-0-10.4					(4.7 to 9.5') [Medium stiff], moist, olive gray with black mottling, CLAYEY SILT (CL-ML), trace organics (wood debris, 2"x1.5"). PP	%M, ATT
		LDW21-GT33-GB-6-8						%M, SG, ATT, 1-D, CU
10	0						(9.5 to 10.4') [Loose], moist to wet, dark olive gray with black mottling, SILTY SAND (SM)	
		LDW21-GT33-GB-11-12.5	Split Spoon/Grab				(10.4 to 18.3') Loose, moist, black, SILTY SAND (SM), fine grained.	%M
15	-5	LDW21-GT33-GB-11-18.5						%M, SG, GSD, DS
	-10	LDW21-GT33-GB-18.5-21			NP		(18.3 to 22') Medium stiff, moist, dark olive gray, SILT WITH SAND (SM). PP=0.25-0.5 TSF	%M, ATT
20		LDW21-GT33-GB-21-22.5						%M
		LDW21-GT33-GB-21-23	Split Spoon/Grab				(22 to 28.8') [Soft], moist, dark gray, SILT to SANDY SILT (ML).	%M, GSD, ATT, 1-D, CU
25	-15	LDW21-GT33-GB-21-26.8			NP		@24': Becomes [medium stiff] and grades to SANDY SILT (ML)	%M, ATT, GSDH
	-20	LDW21-GT33-GB-26.8-28.8			NP		@27 to 29': Large wood chunks encountered	%M, ATT
		LDW21-GT33-GB-28.8-29.5					(28.8 to 32.5') Very loose, moist, dark gray, SILTY SAND (SM).	%M, GSDH
30		LDW21-GT33-GB-29.5-31			NP			%M, ATT
		LDW21-GT33-GB-31-32.5	Split Spoon/Grab					%M
35	-25						End of Boring at 32.5 ft	
40	-30							



ANCHOR QEA

1201 Third Avenue
Suite 2600 Seattle, WA 98101

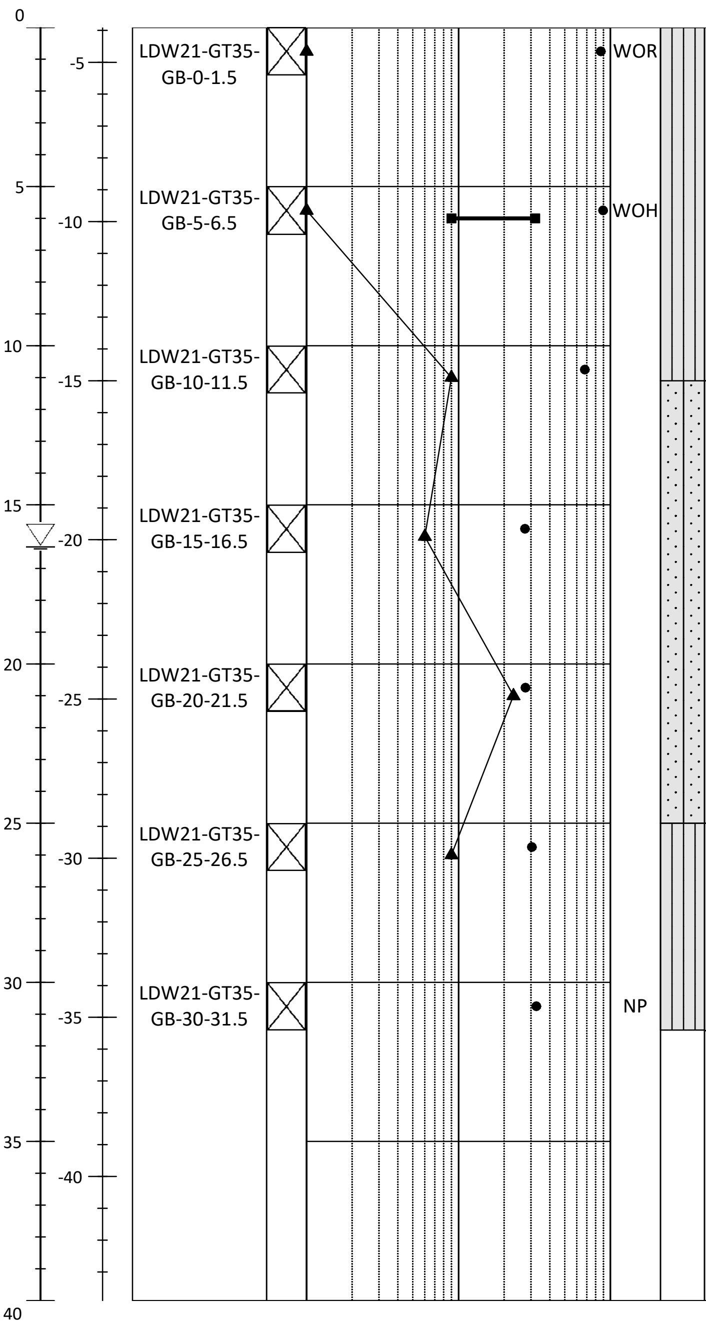
- ▲ SPT N-Value
- ● Moisture Content (%)
- ■ Atterberg Limits
- Shelby Tube
- ☒ Split Spoon/Grab

Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log
LDW-GT35-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **192818.4** E/LONG: **1277387**	Total Depth (ft): **31.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North**	Observed Depth to Mudline (ft): **11.3**
Collection Date: **07.20.21**	**North American Datum of 1983, U.S. Feet**	Mudline Elevation (ft): **-3.9**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test



Sample ID	Other Values	Soil Description	Lab Test
LDW21-GT35-GB-0-1.5	WOR	(0 to 11.1') Very soft, wet, black, SILT (ML), with trace organics.	%M
LDW21-GT35-GB-5-6.5	WOH		%M, ATT
LDW21-GT35-GB-10-11.5			%M
		(11.1 to 25') Loose to medium dense, moist, dark brown, SILTY SAND (SM).	
LDW21-GT35-GB-15-16.5			%M, SG, GSDH, DS
LDW21-GT35-GB-20-21.5		@21': Grades to slightly silty, poorly graded sand (SP).	%M, GSD
LDW21-GT35-GB-25-26.5		(25 to 31.5') Medium stiff, moist, olive gray SILT WITH SAND (ML). PP=0.5 TSF	%M
LDW21-GT35-GB-30-31.5	NP	@30.7 to 31.2': Lens of CLAYEY SILT (CL-ML), low dilatancy.	%M, ATT
		End of Boring at 31.5 ft	

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
Split Spoon/Grab

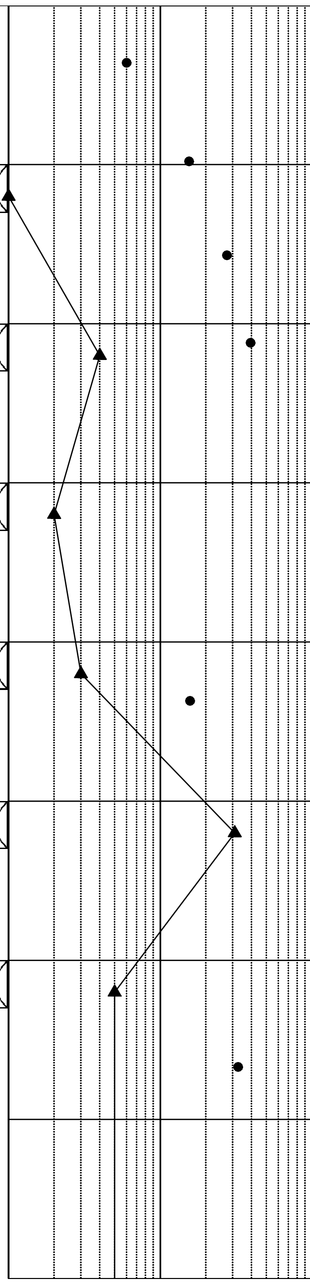
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.
Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT36-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **192741.238** E/LONG: **1277403.821**	Total Depth (ft): **61.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **NE**
Collection Date: **07.27.21**		Mudline Elevation (ft): **15.5**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Sam Giannakos**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits	Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
0	15	LDW21-GT36-GB-0-3.6					(0 to 3.6') [Loose], dry, brown, SILTY GRAVEL WITH SAND (GM) @1.5': 2-in angular gravel piece	%M
5	10	LDW21-GT36-GB-3.6-6.2			WOH		(3.6 to 6.2') Very loose, damp, brown, SILTY SAND (SM), trace gravel. @4.1': Grades to no gravel	%M, GSDH, DS
		LDW21-GT36-GB-6.2-9.5					(6.2 to 9.5') Very lose, damp, dark brown, poorly graded SAND (SP) @8.1-8.3': Lens of siltier sand	%M, GSD
10	5	LDW21-GT36-GB-9.5-11.7					(9.5 to 11.7') Loose, moist to wet, dark gray, SILTY SAND (SM), fine to medium grained sand.	%M
							(11.7 to 61.5') Very loose to loose, moist to wet, black/white/red, poorly graded SAND (SP), fine to medium grained sand, trace silt.	
15	0							
20	-5	LDW21-GT36-GB-11.7-32					@20.7': Frequent pockets of silty sand	%M, SG, GSD
25	-10						@25': Grades to medium dense	
30	-15						@30.8-31.3': Lens of siltier sand (SP-SM)	
		LDW21-GT36-GB-32-34.7			NP		@32.1': Soft, moist to wet, olive gray, SILT (ML), coarse grained sand, non-plastic.	%M, ATT
35	-20						@34.7': Loose, damp, dark gray, poorly graded SAND (SP), trace silt.	
							@37.7-38.5': Lens of silty sand (SM) @39.4-39.7': Pocket of silt (ML)	
40								



ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
⊠ Split Spoon/Grab

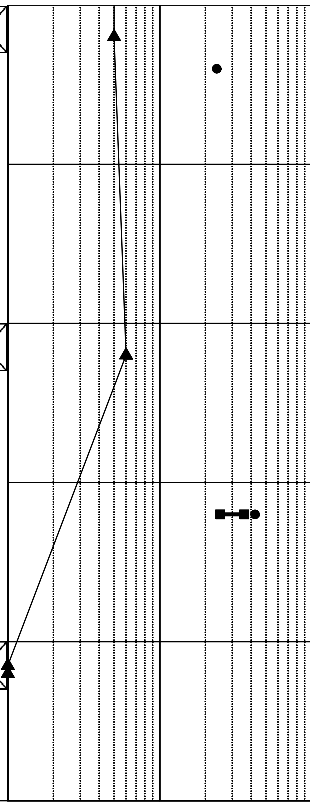
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log
LDW21-GT36-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **192741.238** E/LONG: **1277403.821**	Total Depth (ft): **61.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **NE**
Collection Date: **07.27.21**		Mudline Elevation (ft): **15.5**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Sam Giannakos**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
40–50	-25 to -35	LDW21-GT36-GB-34.7-50	Split Spoon			SP	(11.7 to 61.5') Very loose to loose, moist to wet, black/white/red, poorly graded SAND (SP), fine to medium grained sand. @41.5': Lens of silt @48.2-49.2': Layer of wet, dark gray, silty sand (SM), fine grained sand.	%M, GSD
50–61.5	-35 to -46	LDW21-GT36-GB-50.5-61.5	Split Spoon				@50.5': Layer of soft, moist, olive gray with black mottling, CLAYEY SILT (CL-ML), non plastic. No recovery from 50 to 60 ft.	%M, SG, ATT
60–61.5	-45	LDW21-GT36-GB-60-61.5	Split Spoon		WOH			
61.5							End of Boring 61.5 ft. SPT Samples from 50 to 51.5' and 60 to 61.5' were combined for tesing, which is displayed as being located between 55 and 65.5'.	

Depth scale: 40, 45, 50, 55, 60, 65. Elevation scale: -25, -30, -35, -40, -45.



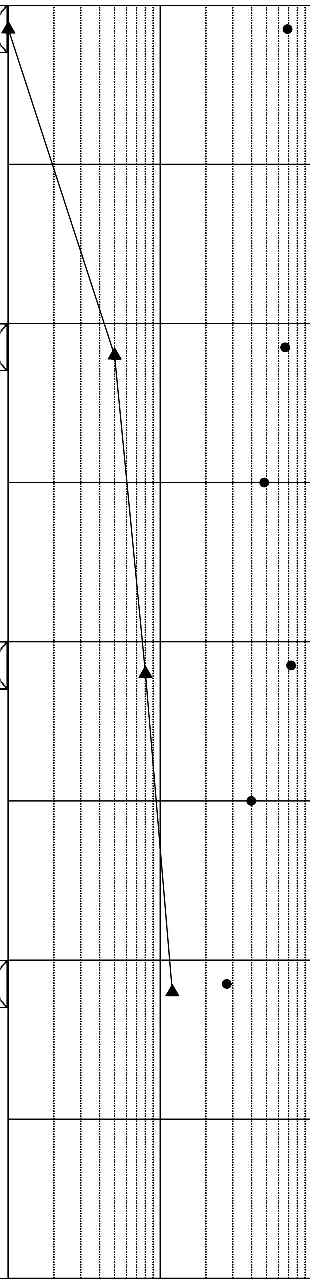
ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

Legend:
- ▲ SPT N-Value
- ● Moisture Content (%)
- ■ Atterberg Limits
- Shelby Tube
- ☒ Split Spoon/Grab

Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log
LDW21-GT37-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **192182.064** E/LONG: **1276436.379**	Total Depth (ft): **31.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **6.0**
Collection Date: **07.14.21**		Mudline Elevation (ft): **-1.4**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**



Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1 2 5 10 20 50 100)	Other Values	Lithology	Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
0		LDW21-GT37-GB-0-1.5	Split Spoon/Grab		WOH		(0 to 1.5') Very soft, wet, black, SILT (ML), trace organics (wood). @1.2': Grades to SANDY SILT (ML)	%M
							(1.5 to 10') No Recovery.	
10		LDW21-GT37-GB-10-11.5	Split Spoon/Grab				(10 to 20.6') Medium stiff, moist, black, SANDY SILT (ML), no to low plasticity, moderate dilatancy.	%M
		LDW21-GT37-GB-10-20						%M, SG, GDSH, DS
20		LDW21-GT37-GB-20-21.5	Split Spoon/Grab				(20.6 to 21.3') Medium stiff, moist, black, SILT (ML) @20.8': Grades to olive brown, odor @21.2- 21.3': Lamination of SILTY SAND (SM). @21.3': Wood debris encountered	%M
25		LDW21-GT37-GB-20-30			NP		(21.3 to 26.9') Loose, moist, black, SILTY SAND (SM), trace organics (wood debris).	%M, SG, ATT, GSD
							(26.9 to 31.5') Stiff, moist, dark olive gray, SILT (ML) with occasional lenses of loose, moist, SILTY SAND (SM).	
30		LDW21-GT37-GB-30-31.5	Split Spoon/Grab					%M
							End of Boring at 31.5 ft	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40
Elevation scale: -5, -10, -15, -20, -25, -30, -35, -40

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

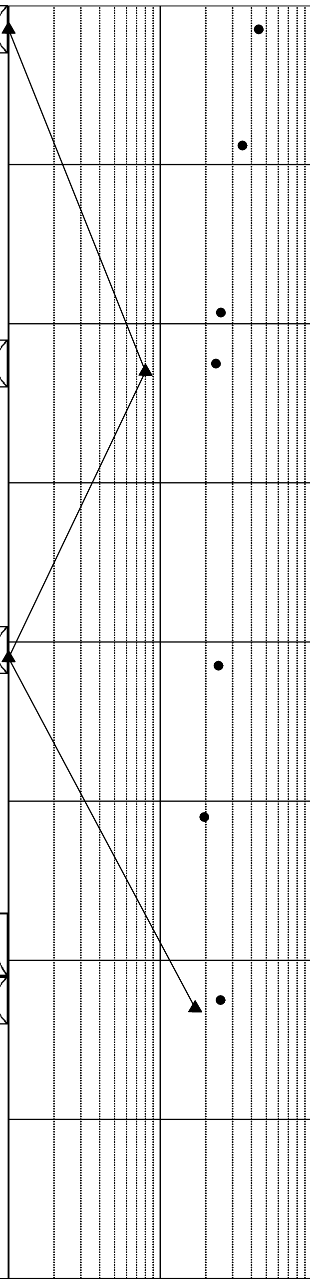
- ▲ SPT N-Value
- ● Moisture Content (%)
- ■ Atterberg Limits
- Shelby Tube
- ☒ Split Spoon/Grab

Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log
LDW21-GT39-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **190600.557** E/LONG: **1277362.3**	Total Depth (ft): **32**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **5.5**
Collection Date: **07.16.21**		Mudline Elevation (ft): **1.3**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Casey Janisch**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits



Depth (ft)	Sample ID	Other Values	Soil Description	Lab Test
0–1.5	LDW21-GT39-GB-0-1.5	WOH	(0 to 7.6') Very soft, wet, dark olive gray to black, SILT (ML), occasional sand and gravel.	%M
0–8.8	LDW21-GT39-GB-0-8.8	NP	@3 to 7.6': Grades to [soft], and to sandy and gravelly SILT (ML)	%M, ATT
8.8–10.5	LDW21-GT39-GB-8.8-10.5		(7.6 to 8.5') Soft, moist, olive gray with light gray mottling, CLAYEY SILT (CL-ML). @8.1 to 8.5': Substantial gravel encountered	%M, GSD
10.5–12	LDW21-GT39-GB-10.5-12		@8.4': Grades to SANDY SILT (ML)	%M
10.5–20.5	LDW21-GT39-GB-10.5-20.5		(8.8 to 32') Very loose to medium dense, moist, black, poorly graded SAND WITH SILT (SP-SM), fine grained. @10.5': Grades to poorly graded SAND (SP)	%M, SG, GSD, DS
20.5–21	LDW21-GT39-GB-20.5-21	WOH		%M
20.5–30.5	LDW21-GT39-GB-20.5-30.5			%M, GSD
30.5–32	LDW21-GT39-GB-30.5-32		@31.8': Grades to SILTY SAND (SM)	%M

End of Boring at 32 ft

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
Split Spoon/Grab

Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.
Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

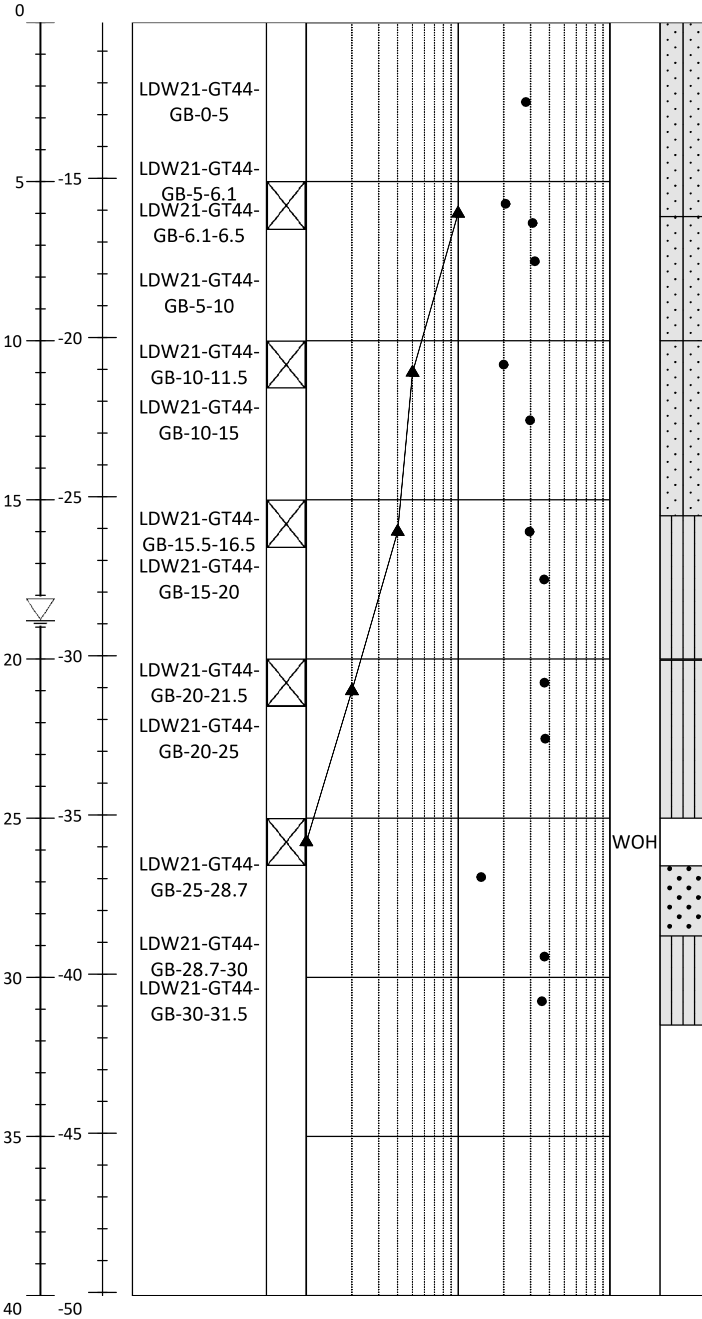
LDW21-GT44-GB

Sheet 1 of 1

Project #: 180067-02.03	Project: LDW Upper Reach Phase 2 Investigation	Method: Rotary Sonic
Location: Seattle, WA	N/LAT: 190379.661 E/LONG: 1278233.2	Total Depth (ft): 31.5
Client: Lower Duwamish Waterway Group	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Observed Depth to Mudline (ft): 18.5
Collection Date: 08.04.21		Mudline Elevation (ft): -10.1
Contractor: Holocene Drilling, Inc	Vert. Datum: Mean Lower Low Water (MLLW)	Hammer: 140-lb, 30-in drop, Auto
Logged By: Garrett Timm	Sampler(s): Split Spoon & Shelby Tube Sampler	Hammer Efficiency (%): 99

Columns: Depth (ft) | Elevation (ft) | Sample ID | Sample Type | Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1, 2, 5, 10, 20, 50, 100) | Other Values | Lithology | Soil Description | Lab Test

Soil Description: Samples and descriptions are in recovered depths. Classification scheme: USCS



Sample ID	Lab Test
LDW21-GT44-GB-0-5	%M, GSD, DS
LDW21-GT44-GB-5-6.1	%M
LDW21-GT44-GB-6.1-6.5	%M
LDW21-GT44-GB-5-10	%M, GSD
LDW21-GT44-GB-10-11.5	%M
LDW21-GT44-GB-10-15	%M, SG, GSD
LDW21-GT44-GB-15.5-16.5	%M
LDW21-GT44-GB-15-20	%M, GSD
LDW21-GT44-GB-20-21.5	%M
LDW21-GT44-GB-20-25	%M, GSDH
LDW21-GT44-GB-25-28.7	%M, GSD
LDW21-GT44-GB-28.7-30	%M, GSD
LDW21-GT44-GB-30-31.5	%M

Other Values: WOH (at 25 ft)

(0 to 6.1') [Very loose], wet, dark gray to black, poorly graded SAND WITH SILT (SP-SM), some silt, large wood chunks, brick pieces, occasional gravel, medium to coarse grained gravel.

@5.9 to 6.1': Grades coarser

(6.1 to 10'): Loose to medium dense, wet, dark gray to black, poorly graded SAND with silt (SP-SM), occasional organics (wood debris), sulfur-like odor.

(10 to 15.5') Loose, wet, dark gray, black, red, white, poorly graded SAND WITH SILT (SP-SM), medium to coarse grained.

(15.5 to 25'): Very loose to loose, wet, light gray, SANDY SILT (ML), fine grained.

@20': Grades to occasional pockets of silt

@23 to 25': Grades to siltier

(25 to 26.5'): No Recovery.

(26.5 to 28.7') [Very loose], wet, white, red, black, poorly graded SAND (SP), coarse grained, occasional well rounded coarse gravel pieces.

(28.7 to 31.5') [Very loose], wet, gray, SILT WITH SAND (ML), very fine grained.

End of Boring at 31.5 ft

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

- ▲ SPT N-Value
- ● Moisture Content (%)
- ■ Atterberg Limits
- Shelby Tube
- ☒ Split Spoon/Grab

Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT48-GB

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **190317.6** E/LONG: **1278379.433**	Total Depth (ft): **35**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **12**
Collection Date: **08.05.21**		Mudline Elevation (ft): **-5.9**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Garrett Timm**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Columns: Depth (ft) | Elevation (ft) | Sample ID | Sample Type | Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits (1, 2, 5, 10, 20, 50, 100) | Other Values | Lithology | Soil Description | Lab Test

Soil Description
Samples and descriptions are in recovered depths.
Classification scheme: USCS

Sample ID	Other Values	Soil Description	Lab Test
		(0 to 2'): Concrete or wood debris.	
LDW21-GT48GB-GB-0-5		(2 to 3.5'): No Recovery.	%M, GSD
		(3.5 to 7'): [Very loose], wet, red, white, black, poorly graded coarse grained SAND (SP).	
LDW21-GT48GB-GB-5-10		@4.5 to 5': Significant cedar wood chunk and rock piece encountered	%M, GSD, DS
		(7 to 15') [Very loose], wet, gray, SILTY SAND (SM), occasional organics, fine to medium grained. @8.7 to 9': Significant organics	
LDW21-GT48GB-GB-10-15		@12.7 to 12.9': Grades to siltier @14 to 15': Organic odor	%M, SG, GSDH
LDW21-GT48GB-GB-15-18.2		(15 to 18.2') [Very loose], wet, gray, poorly graded SAND (SP), occasional organics, fine to medium grained.	%M, GSD
LDW21-GT48GB-GB-18.2-19.5		(18.2 to 19.5') [Very soft], wet, light gray, SANDY SILT (ML).	%M, GSD
LDW21-GT48GB-GB-20-21.6		(19.5 to 21.6') [Very loose], wet, white, black, red, poorly graded SAND (SP), fine grained.	%M, GSD
LDW21-GT48GB-GB-21.6-25	NP	(21.6 to 35') [Very soft], wet, light gray, SILT (ML).	%M, SG, ATT, GSDH
LDW21-GT48GB-GB-25-30	NP		%M, ATT
LDW21-GT48GB-GB-30-35		@32 to 33': Black mottling, grades to stiffer	%M, ATT
		End of Boring at 35 ft	

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40
Elevation (ft): -10, -15, -20, -25, -30, -35, -40, -45

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
Split Spoon/Grab

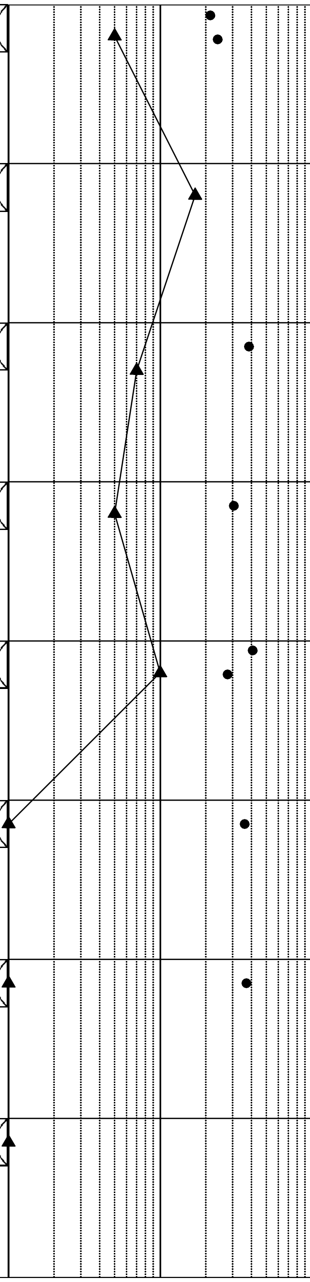
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

Sheet 1 of 1

LDW21-GT48-SPT

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **190313.244** E/LONG: **1278382.172**	Total Depth (ft): **36.5**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **14.0**
Collection Date: **08.05.21**		Mudline Elevation (ft): **-5.2**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Garrett Timm**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**



Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Other Values	Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
0		LDW21-GT48SPT-GB-0-1.5	Split Spoon/Grab		(0 to 0.7') Loose, wet, poorly graded SAND (SP), coarse grained.	%M
					(0.7 to 1.5') Loose, wet, SAND WITH SILT (ML), medium grained, glass debris.	%M
5	-10	LDW21-GT48GB-GB-5-6.5	Split Spoon/Grab		(5 to 6.5') Medium dense, wet, red, black, white, poorly graded SAND WITH SILT (SM), medium grained.	%M
10	-15	LDW21-GT48SPT-GB-10-11.5	Split Spoon/Grab		(10 to 11.5') Loose, wet, light to dark gray, poorly graded SAND (SP), slight organic odor, occasional organics (sticks) @10.4': Lens of coarse grained sand	%M
15	-20	LDW21-GT48SPT-GB-15-16.5	Split Spoon/Grab		(15 to 16.5') Loose, wet, dark gray, poorly graded SAND (SP), little silt.	%M
		LDW21-GT48SPT-GB-20-20.6				%M
20	-25	LDW21-GT48SPT-GB-20.6-21.5	Split Spoon/Grab		(20 to 20.6') Stiff, wet, gray, SILT (ML).	%M
					(20.6 to 21.5') Medium dense, wet, dark gray, SAND WITH SILT (SM), fine to medium grained.	
25	-30	LDW21-GT48SPT-GB-25-26.5	Split Spoon/Grab	WOR	(25 to 26.5') Very loose, wet, dark gray, SILTY SAND (SM) to SANDY SILT (ML).	%M
30	-35	LDW21-GT48SPT-GB-30-31.5	Split Spoon/Grab	WOR	(30 to 31.5') Very loose, wet, dark gray, SILTY SAND (SM) to SANDY SILT (ML).	%M
35	-40	LDW21-GT48GB-GB-35-36.5	Split Spoon/Grab	WOH	(35 to 36.5') Very soft, wet, gray with black mottling, SILT (ML).	%M
					End of Boring at 36.5 ft.	
40	-45					

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
☒ Split Spoon/Grab

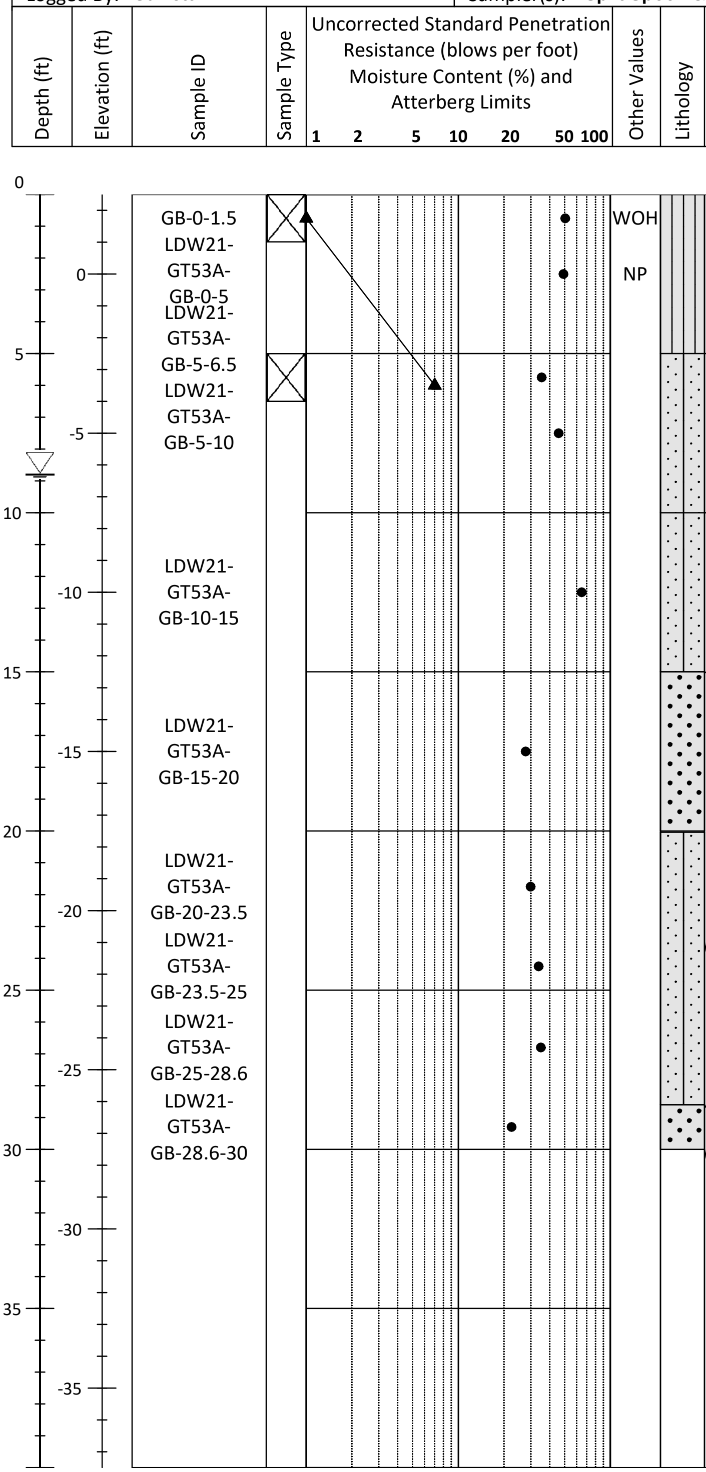
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

Sheet 1 of 1

LDW21-GT53-A

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **190178.63** E/LONG: **1278593.074**	Total Depth (ft): **30**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **8.5**
Collection Date: **08.05.21**		Mudline Elevation (ft): **2.5**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Garrett Timm**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**



Sample ID	Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
GB-0-1.5	(0 to 5') Very soft, wet, black, SILTY SAND (SM) to SANDY SILT (ML).	%M
LDW21-GT53A-GB-0-5		%M, SG, ATT
LDW21-GT53A-GB-5-6.5	(5 to 10') Loose, wet, black, white, red, SILTY SAND (SM), fine grained, with organics (wood chunks).	%M
LDW21-GT53A-GB-5-10	@5.8 to 6': Significant wood debris @6.2 to 6.3': Orange mottling @8': Grades to sandier	%M, GSDH, DS
LDW21-GT53A-GB-10-15	(10 to 15') [Very loose], wet, dark gray, SILTY SAND (SM), fine grained. @14 to 15': Significant wood chunks	%M, GSD
LDW21-GT53A-GB-15-20	(15 to 23.5') [Very loose], wet, dark gray, poorly graded SAND (SP). @16 to 16.3': Significant wood chunks @17': Brick pieces debris @20': Grades siltier	%M, SG, GSD
LDW21-GT53A-GB-20-23.5	@21.5 to 22': Significant wood piece	%M, GSD
LDW21-GT53A-GB-23.5-25	@23.5': Grades to siltier and gray	%M, GSD
LDW21-GT53A-GB-25-28.6	@24.8': Brick pieces debris (3-inch diam.) @27.5 to 28.5': Grades to siltier	%M, SG, GSDH
LDW21-GT53A-GB-28.6-30	(28.6 to 30') [Loose], wet, black, white, red, poorly graded SAND (SP), fine grained.	%M, GSD
	End of Boring at 30 ft. Pivot barge to acquire SPT samples as 10, 15, 20, 25, 30, 35 ft.	

ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
☒ Split Spoon/Grab

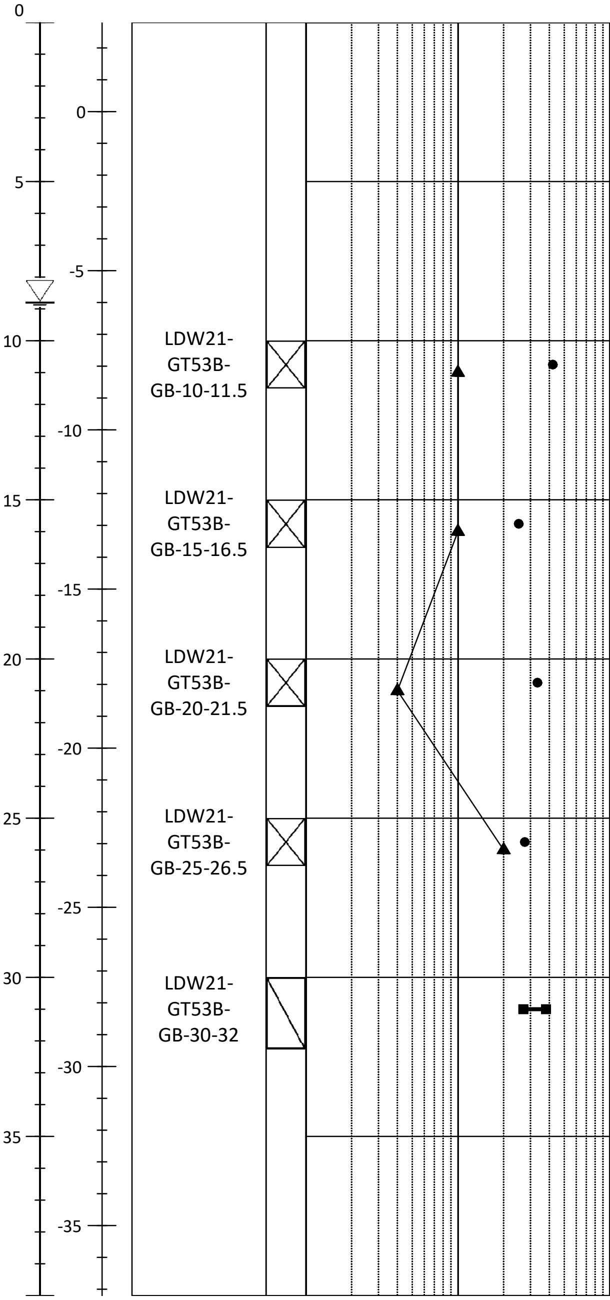
Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp.
Mudline elevations determined from leadline measurements and Site tide gage levels
WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

Soil Boring Log

LDW21-GT53-B

Project #: **180067-02.03**	Project: **LDW Upper Reach Phase 2 Investigation**	Method: **Rotary Sonic**
Location: **Seattle, WA**	N/LAT: **190175.401** E/LONG: **1278593.916**	Total Depth (ft): **32**
Client: **Lower Duwamish Waterway Group**	Horiz. Datum: **Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet**	Observed Depth to Mudline (ft): **9.2**
Collection Date: **08.05.21**		Mudline Elevation (ft): **2.8**
Contractor: **Holocene Drilling, Inc**	Vert. Datum: **Mean Lower Low Water (MLLW)**	Hammer: **140-lb, 30-in drop, Auto**
Logged By: **Garrett Timm**	Sampler(s): **Split Spoon & Shelby Tube Sampler**	Hammer Efficiency (%): **99**

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits	Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
0							(0 to 10') Not sampled. See GT-53A-GB boring log.	
10		LDW21-GT53B-GB-10-11.5	Split Spoon/Grab			SP	(10 to 11.5') Loose to medium dense, wet, red, white, black, poorly graded SAND (SP), little silt. @11.4': Wood chunk	%M
15		LDW21-GT53B-GB-15-16.5	Split Spoon/Grab			SP	(15 to 16.5') Loose to medium dense, wet, red, white, black, poorly graded SAND (SP), little silt.	%M
20		LDW21-GT53B-GB-20-21.5	Split Spoon/Grab			SP	(20 to 21.5') Very loose to loose, wet, red, white, black, poorly graded SAND (SP), little silt, occasional organics (wood pieces)	%M
25		LDW21-GT53B-GB-25-26.5	Split Spoon/Grab			SM	(25 to 26.5': Medium dense, wet, red, white, black, SILTY SAND (SM).	%M
30		LDW21-GT53B-GB-30-32	Shelby Tube			ML	(30 to 32') SILT WITH SAND (ML). End of Boring at 32 ft	%M, SG, ATT, 1-D, CU



ANCHOR QEA
1201 Third Avenue
Suite 2600 Seattle, WA 98101

▲ SPT N-Value
● Moisture Content (%)
■ Atterberg Limits
Shelby Tube
Split Spoon/Grab

Notes:
%M=Percent Moisture Content,SG=Specific Gravity,ATT=Atterberg Limits,GSD=Grainsize Distribution, GSDH=Grainsize Distribution+Hydrometer,1-D: One-densional Consolidation,CU=Unconsolidated Comp. Mudline elevations determined from leadline measurements and Site tide gage levels WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic

PRESENTATION OF SITE INVESTIGATION RESULTS

LDW Phase 3

Prepared for:

Anchor QEA

ConeTec Job No: 21-59-22445

Project Start Date: 06-JUL-2021
Project End Date: 29-JUL-2021
Report Date: 9-AUG-2021

Prepared by:

ConeTec Inc.
1508 O Street SW, Unit 103-104
Auburn, WA 98001

Tel: (253) 397-4861

ConeTecWA@conetec.com
www.conetec.com
www.conetecdataservices.com

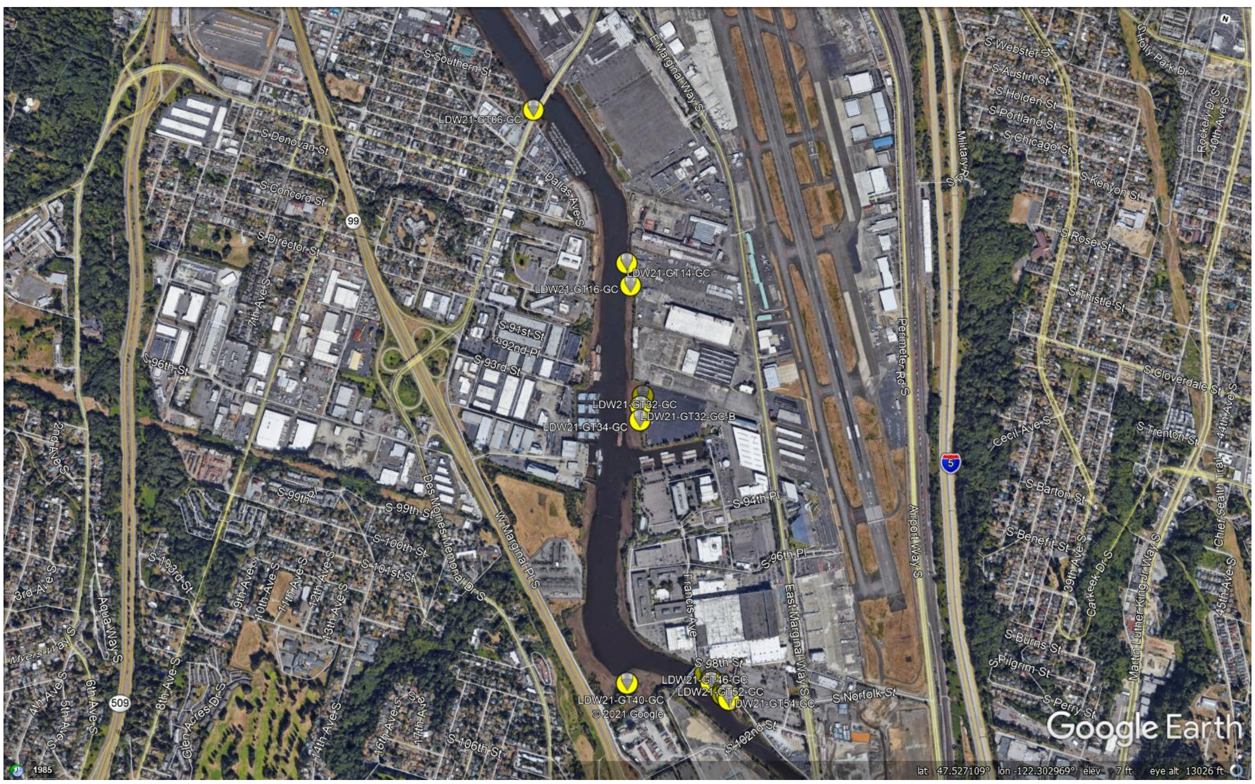
Introduction

The enclosed report presents the results of the site investigation program conducted by ConeTec Inc. for Anchor QEA along mile 3-5 of the Duwamish River located in Seattle WA. The program consisted of cone penetration tests, full flow penetration tests & electronic vane testing

Project Information

Project	
Client	Anchor QEA
Project	LDW Phase 3
ConeTec project number	21-59-22445

An aerial overview from Google Earth including the CPTu test locations is presented below.



Rig Description	Deployment System	Test Type
C05-023 Track Rig	Integrated Push System	CPT, BCPT, VST
A07-018 Amphibious Rig	Integrated Push System	CPT
Barge Support	Auxiliary Push Boat	CPT, BCPT, VST

Coordinates			
Test Type	Collection Method	EPSG Number	Comments
CPT, BCPT, VST	Client provided	4326	Coordinates converted from State Plane

Cone Penetrometers Used for this Project						
Cone Description	Cone Number	Cross Sectional Area (cm^2)	Sleeve Area (cm^2)	Tip Capacity (bar)	Sleeve Capacity (bar)	Pore Pressure Capacity (bar)
681:T375F10U35	681	15	225	375	10	35
Cone 681 was used for all CPTu soundings.						

Cone Penetration Test (CPTu)	
Depth reference	Depths are referenced to the existing mudline at the time of each test.
Tip and sleeve data offset	0.1 meter This has been accounted for in the CPT data files.
Additional plots	• Advanced plots with Ic, Su, phi and N1(60) • Soil Behaviour Type (SBT) scatter plots
Additional comments	A negative water table has been applied to all soundings completed from barge deck. All CPT data files begin at mudline (mudline = 0.0ft)

Calculated Geotechnical Parameter Tables	
Additional information	The Normalized Soil Behaviour Type Chart based on Q_{tn} (SBT Q_{tn}) (Robertson, 2009) was used to classify the soil for this project. A detailed set of calculated CPTu parameters have been generated and are provided in Excel format files in the release folder. The CPTu parameter calculations are based on values of corrected tip resistance (q_t) sleeve friction (f_s) and pore pressure (u_2). Effective stresses are calculated based on unit weights that have been assigned to the individual soil behaviour type zones and the assumed equilibrium pore pressure profile.

Full-Flow Cone Penetration Test (BCPTu)	
Depth reference	All soundings were started slightly above the mudline in the water column. Mudline is clearly indicated on all plots and clearly visible within the data set.
Unit weight profiles	• A unit weight of 62.43pcf was applied to data collected within the water column above mudline • A unit weight of 111.37pcf was applied to data collected below mudline The unit weight is clearly indicated in the data set.

Electric Field Vane Shear Test (VST)	
Depth reference	Depths are referenced to depth below mudline at the time of each test
Load cell capacity	100 N·m
Load cell location	Uphole
Additional comments	All vane tests were completed from the floating barge platform. The vane test results were affected by barge movement from local waves, local vessel traffic and river flow. Additionally, the vane results were susceptible to elevation charge from either rising or falling tide. Over the course of a vane test the barge would gain/lose approximately 2”-4” of elevation due to tidal effects.

Limitations

This report has been prepared for the exclusive use of Anchor QEA (Client) for the project titled “LDW Phase 3”. The report’s contents may not be relied upon by any other party without the express written permission of ConeTec Inc. (ConeTec). ConeTec has provided site investigation services, prepared the factual data reporting and provided geotechnical parameter calculations consistent with current best practices. No other warranty, expressed or implied, is made.

The information presented in the report document and the accompanying data set pertain to the specific project, site conditions and objectives described to ConeTec by the Client. In order to properly understand the factual data, assumptions and calculations, reference must be made to the documents provided and their accompanying data sets, in their entirety.

Cone penetration tests (CPTu) are conducted using an integrated electronic piezocone penetrometer and data acquisition system manufactured by Adara Systems Ltd., a subsidiary of ConeTec.

ConeTec's piezocone penetrometers are compression type designs in which the tip and friction sleeve load cells are independent and have separate load capacities. The piezocones use strain gauged load cells for tip and sleeve friction and a strain gauged diaphragm type transducer for recording pore pressure. The piezocones also have a platinum resistive temperature device (RTD) for monitoring the temperature of the sensors, an accelerometer type dual axis inclinometer and two geophone sensors for recording seismic signals. All signals are amplified and measured with minimum sixteen-bit resolution down hole within the cone body, and the signals are sent to the surface using a high bandwidth, error corrected digital interface through a shielded cable.

ConeTec penetrometers are manufactured with various tip, friction and pore pressure capacities in both 10 cm^2 and 15 cm^2 tip base area configurations in order to maximize signal resolution for various soil conditions. The specific piezocone used for each test is described in the CPT summary table presented in the first appendix. The 15 cm^2 penetrometers do not require friction reducers as they have a diameter larger than the deployment rods. The 10 cm^2 piezocones use a friction reducer consisting of a rod adapter extension behind the main cone body with an enlarged cross sectional area (typically 44 millimeters diameter over a length of 32 millimeters with tapered leading and trailing edges) located at a distance of 585 millimeters above the cone tip.

The penetrometers are designed with equal end area friction sleeves, a net end area ratio of 0.8 and cone tips with a 60 degree apex angle.

All ConeTec piezocones can record pore pressure at various locations. Unless otherwise noted, the pore pressure filter is located directly behind the cone tip in the "u_2" position (ASTM Type 2). The filter is six millimeters thick, made of porous plastic (polyethylene) having an average pore size of 125 microns (90-160 microns). The function of the filter is to allow rapid movements of extremely small volumes of water needed to activate the pressure transducer while preventing soil ingress or blockage.

The piezocone penetrometers are manufactured with dimensions, tolerances and sensor characteristics that are in general accordance with the current ASTM D5778 standard. ConeTec's calibration criteria also meets or exceeds those of the current ASTM D5778 standard. An illustration of the piezocone penetrometer is presented in Figure CPTu.

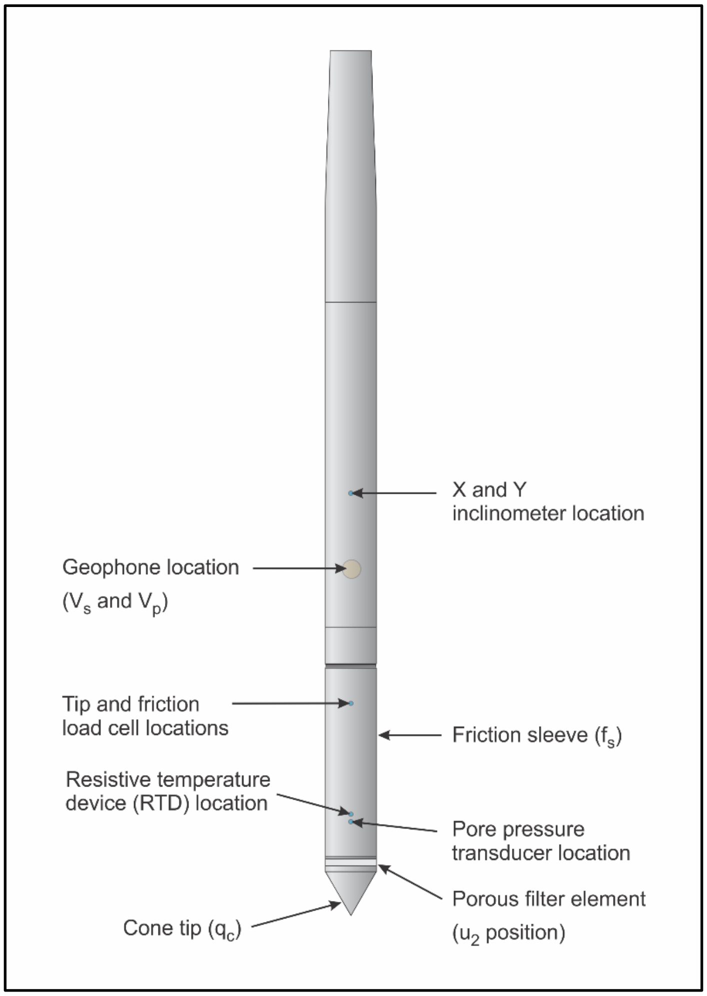


Figure CPTu. Piezocone Penetrometer (15 cm^2)

The ConeTec data acquisition systems consist of a Windows based computer and a signal interface box and power supply. The signal interface combines depth increment signals, seismic trigger signals and the downhole digital data. This combined data is then sent to the Windows based computer for collection and presentation. The data is recorded at fixed depth increments using a depth wheel attached to the push cylinders or by using a spring loaded rubber depth wheel that is held against the cone rods. The typical recording interval is 2.5 centimeters; custom recording intervals are possible.

The system displays the CPTu data in real time and records the following parameters to a storage media during penetration:

- Depth
- Uncorrected tip resistance (q_c)
- Sleeve friction (f_s)
- Dynamic pore pressure (u)
- Additional sensors such as resistivity, passive gamma, ultra violet induced fluorescence, if applicable

All testing is performed in accordance to ConeTec's CPTu operating procedures which are in general accordance with the current ASTM D5778 standard.

Prior to the start of a CPTu sounding a suitable cone is selected, the cone and data acquisition system are powered on, the pore pressure system is saturated with silicone oil and the baseline readings are recorded with the cone hanging freely in a vertical position.

The CPTu is conducted at a steady rate of two centimeters per second, within acceptable tolerances. Typically one meter length rods with an outer diameter of 1.5 inches (38.1 millimeters) are added to advance the cone to the sounding termination depth. After cone retraction final baselines are recorded.

Additional information pertaining to ConeTec's cone penetration testing procedures:

- Each filter is saturated in silicone oil under vacuum pressure prior to use
- Baseline readings are compared to previous readings
- Soundings are terminated at the client's target depth or at a depth where an obstruction is encountered, excessive rod flex occurs, excessive inclination occurs, equipment damage is likely to take place, or a dangerous working environment arises
- Differences between initial and final baselines are calculated to ensure zero load offsets have not occurred and to ensure compliance with ASTM standards

The interpretation of piezocone data for this report is based on the corrected tip resistance (q_t), sleeve friction (f_s) and pore water pressure (u). The interpretation of soil type is based on the correlations developed by Robertson et al. (1986) and Robertson (1990, 2009). It should be noted that it is not always possible to accurately identify a soil behavior type based on these parameters. In these situations, experience, judgment and an assessment of other parameters may be used to infer soil behavior type.

The recorded tip resistance (q_c) is the total force acting on the piezocone tip divided by its base area. The tip resistance is corrected for pore pressure effects and termed corrected tip resistance (q_t) according to the following expression presented in Robertson et al. (1986):

$$q_t = q_c + (1-a) \bullet u_2$$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the piezocone (0.8 for ConeTec probes)

The sleeve friction (f_s) is the frictional force on the sleeve divided by its surface area. As all ConeTec piezocones have equal end area friction sleeves, pore pressure corrections to the sleeve data are not required.

The dynamic pore pressure (u) is a measure of the pore pressures generated during cone penetration. To record equilibrium pore pressure, the penetration must be stopped to allow the dynamic pore pressures to stabilize. The rate at which this occurs is predominantly a function of the permeability of the soil and the diameter of the cone.

The friction ratio (R_f) is a calculated parameter. It is defined as the ratio of sleeve friction to the tip resistance expressed as a percentage. Generally, saturated cohesive soils have low tip resistance, high friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

A summary of the CPTu soundings along with test details and individual plots are provided in the appendices. A set of files with calculated geotechnical parameters were generated for each sounding based on published correlations and are provided in Excel format in the data release folder. Information regarding the methods used is also included in the data release folder.

For additional information on CPTu interpretations and calculated geotechnical parameters, refer to Robertson et al. (1986), Lunne et al. (1997), Robertson (2009), Mayne (2013, 2014) and Mayne and Peuchen (2012).

The cone penetration test is halted at specific depths to carry out pore pressure dissipation (PPD) tests, shown in Figure PPD-1. For each dissipation test the cone and rods are decoupled from the rig and the data acquisition system measures and records the variation of the pore pressure (u) with time (t).

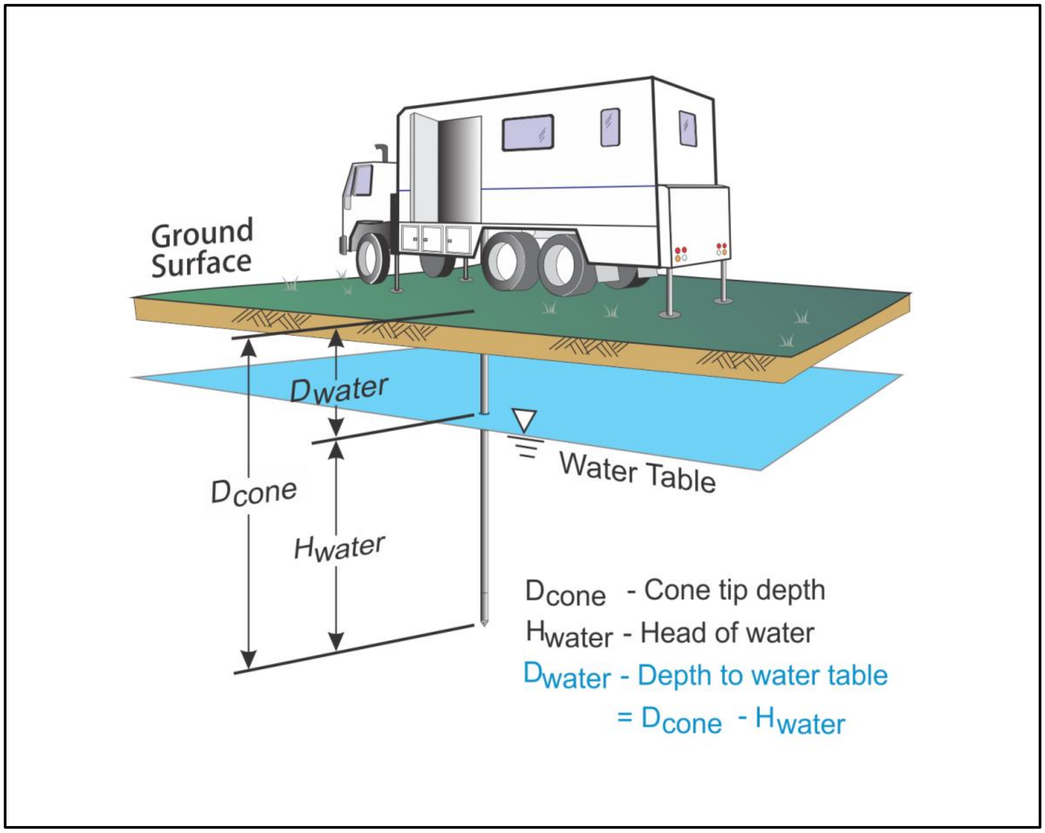


Figure PPD-1. Pore pressure dissipation test setup

Pore pressure dissipation data can be interpreted to provide estimates of ground water conditions, permeability, consolidation characteristics and soil behavior.

The typical shapes of dissipation curves shown in Figure PPD-2 are very useful in assessing soil type, drainage, in situ pore pressure and soil properties. A flat curve that stabilizes quickly is typical of a freely draining sand. Undrained soils such as clays will typically show positive excess pore pressure and have long dissipation times. Dilative soils will often exhibit dynamic pore pressures below equilibrium that then rise over time. Overconsolidated fine-grained soils will often exhibit an initial dilatory response where there is an initial rise in pore pressure before reaching a peak and dissipating.

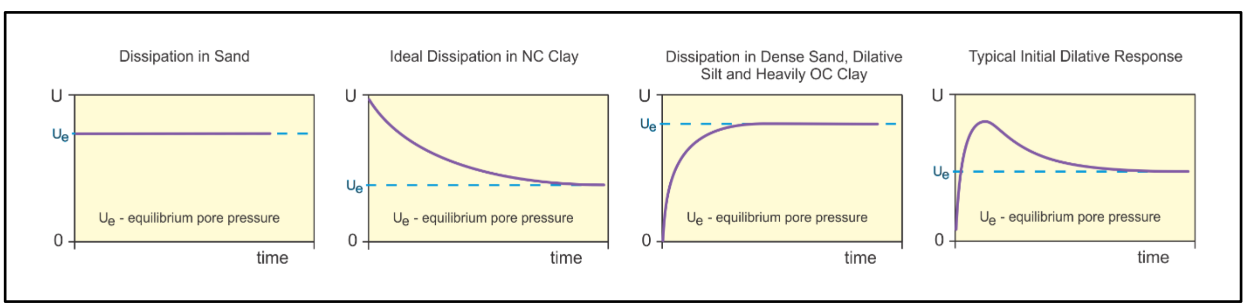


Figure PPD-2. Pore pressure dissipation curve examples

In order to interpret the equilibrium pore pressure (u_{eq}) and the apparent phreatic surface, the pore pressure should be monitored until such time as there is no variation in pore pressure with time as shown for each curve in Figure PPD-2.

In fine grained deposits the point at which 100% of the excess pore pressure has dissipated is known as t_{100}. In some cases this can take an excessive amount of time and it may be impractical to take the dissipation to t_{100}. A theoretical analysis of pore pressure dissipations by Teh and Houlsby (1991) showed that a single curve relating degree of dissipation versus theoretical time factor (T*) may be used to calculate the coefficient of consolidation (c_h) at various degrees of dissipation resulting in the expression for c_h shown below.

$$c_h = \frac{T^* \cdot a^2 \cdot \sqrt{I_r}}{t}$$

Where:

T* is the dimensionless time factor (Table Time Factor)
a is the radius of the cone
I_r is the rigidity index
t is the time at the degree of consolidation

Table Time Factor. T* versus degree of dissipation (Teh and Houlsby (1991))

Degree of Dissipation (%)	20	30	40	50	60	70	80
T* (u_2)	0.038	0.078	0.142	0.245	0.439	0.804	1.60

The coefficient of consolidation is typically analyzed using the time (t_{50}) corresponding to a degree of dissipation of 50% (u_{50}). In order to determine t_{50}, dissipation tests must be taken to a pressure less than u_{50}. The u_{50} value is half way between the initial maximum pore pressure and the equilibrium pore pressure value, known as u_{100}. To estimate u_{50}, both the initial maximum pore pressure and u_{100} must be known or estimated. Other degrees of dissipations may be considered, particularly for extremely long dissipations.

At any specific degree of dissipation the equilibrium pore pressure (u at t_{100}) must be estimated at the depth of interest. The equilibrium value may be determined from one or more sources such as measuring the value directly (u_{100}), estimating it from other dissipations in the same profile, estimating the phreatic surface and assuming hydrostatic conditions, from nearby soundings, from client provided information, from site observations and/or past experience, or from other site instrumentation.

For calculations of c_h (Teh and Houlsby (1991)), t_{50} values are estimated from the corresponding pore pressure dissipation curve and a rigidity index (I_r) is assumed. For curves having an initial dilatory response in which an initial rise in pore pressure occurs before reaching a peak, the relative time from the peak value is used in determining t_{50}. In cases where the time to peak is excessive, t_{50} values are not calculated.

Due to possible inherent uncertainties in estimating I_r, the equilibrium pore pressure and the effect of an initial dilatory response on calculating t_{50}, other methods should be applied to confirm the results for c_h.

Additional published methods for estimating the coefficient of consolidation from a piezocone test are described in Burns and Mayne (1998, 2002), Jones and Van Zyl (1981), Robertson et al. (1992) and Sully et al. (1999).

A summary of the pore pressure dissipation tests and dissipation plots are presented in the relevant appendix.

ASTM D5778-12, 2012, "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils", ASTM International, West Conshohocken, PA. DOI: 10.1520/D5778-12.

Burns, S.E. and Mayne, P.W., 1998, "Monotonic and dilatory pore pressure decay during piezocone tests", Canadian Geotechnical Journal 26 (4): 1063-1073. DOI: 1063-1073/T98-062.

Burns, S.E. and Mayne, P.W., 2002, "Analytical cavity expansion-critical state model cone dissipation in fine-grained soils", Soils & Foundations, Vol. 42(2): 131-137.

Jones, G.A. and Van Zyl, D.J.A., 1981, "The piezometer probe: a useful investigation tool", Proceedings, 10th International Conference on Soil Mechanics and Foundation Engineering, Vol. 3, Stockholm: 489-495.

Lunne, T., Robertson, P.K. and Powell, J. J. M., 1997, "Cone Penetration Testing in Geotechnical Practice", Blackie Academic and Professional.

Mayne, P.W., 2013, "Evaluating yield stress of soils from laboratory consolidation and in-situ cone penetration tests", Sound Geotechnical Research to Practice (Holtz Volume) GSP 230, ASCE, Reston/VA: 406-420. DOI: 10.1061/9780784412770.027.

Mayne, P.W. and Peuchen, J., 2012, "Unit weight trends with cone resistance in soft to firm clays", Geotechnical and Geophysical Site Characterization *4,* Vol. 1 (Proc. ISC-4, Pernambuco), CRC Press, London: 903-910.

Mayne, P.W., 2014, "Interpretation of geotechnical parameters from seismic piezocone tests", CPT'14 Keynote Address, Las Vegas, NV, May 2014.

Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.

Robertson, P.K., 1990, "Soil Classification Using the Cone Penetration Test", Canadian Geotechnical Journal, Volume 27: 151-158. DOI: 10.1139/T90-014.

Robertson, P.K., Sully, J.P., Woeller, D.J., Lunne, T., Powell, J.J.M. and Gillespie, D.G., 1992, "Estimating coefficient of consolidation from piezocone tests", Canadian Geotechnical Journal, 29(4): 539-550. DOI: 10.1139/T92-061.

Robertson, P.K., 2009, "Interpretation of cone penetration tests – a unified approach", Canadian Geotechnical Journal, Volume 46: 1337-1355. DOI: 10.1139/T09-065.

Sully, J.P., Robertson, P.K., Campanella, R.G. and Woeller, D.J., 1999, "An approach to evaluation of field CPTU dissipation data in overconsolidated fine-grained soils", Canadian Geotechnical Journal, 36(2): 369-381. DOI: 10.1139/T98-105.

Teh, C.I., and Houlsby, G.T., 1991, "An analytical study of the cone penetration test in clay", Geotechnique, 41(1): 17-34. DOI: 10.1680/geot.1991.41.1.17.

Full flow penetration testing (BCPTu) is performed in conjunction with a piezocone penetration test using an integrated electronic piezocone with a spherical attachment and a data acquisition system manufactured by Adara Systems Ltd., a subsidiary of ConeTec.

ConeTec's piezocone penetrometers are compression type designs in which the tip and friction sleeve load cells are independent and have separate load capacities. The piezocones use strain gauged load cells for tip and sleeve friction and a strain gauged diaphragm type transducer for recording pore pressure. The piezocones also have a platinum resistive temperature device (RTD) for monitoring the temperature of the sensors, an accelerometer type dual axis inclinometer and a geophone sensor for recording seismic signals. All signals are amplified downhole within the cone body and the analog signals are sent to the surface through a shielded cable.

ConeTec penetrometers are manufactured with various tip, friction and pore pressure capacities in 5 cm^2, 10 cm^2 and 15 cm^2 tip base area configurations in order to maximize signal resolution for various soil conditions. The 15 cm^2 penetrometers do not require friction reducers as they have a diameter larger than the deployment rods. The 5 cm^2 and 10 cm^2 piezocones use a friction reducer consisting of a rod adapter extension behind the main cone body with an enlarged cross-sectional area (typically forty-four millimeter diameter over a length of thirty-two millimeters with tapered leading and trailing edges) located at a distance of 585 millimeters above the cone tip.

The penetrometers are designed with equal end area friction sleeves, a net end area ratio of 0.8 and cone tips with a sixty-degree apex angle.

The piezocone penetrometers are manufactured with dimensions, tolerances and sensor characteristics that are in general accordance with the current ASTM D5778 standard. ConeTec's calibration criteria also meet or exceed those of the current ASTM D5778 standard.

For ball full flow penetration tests, the cone tip is replaced with a spherical attachment that can have projected plan areas of 40 cm^2, 60 cm^2, 100 cm^2 or 150 cm^2. The selection of the size is based on soil strength and deployment limitations. An illustration of the piezocone with a spherical attachment is presented in Figure BCPTu.

The specific piezocone and ball area used for each test is described in the ball full flow penetration test summary presented in the relevant appendix.

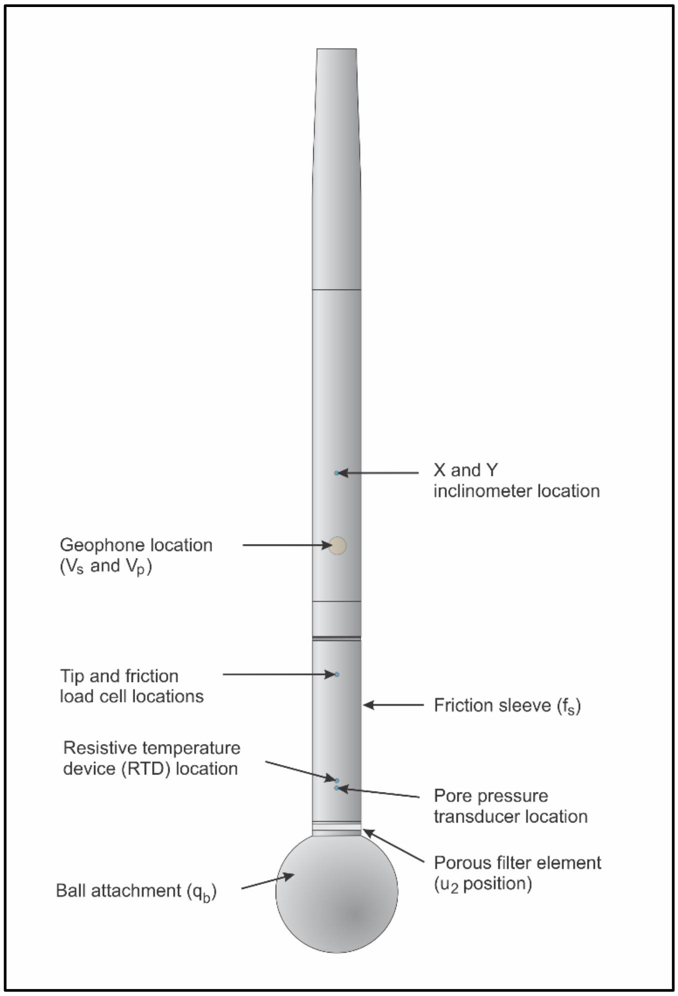


Figure BCPTu. Piezocone penetrometer with a spherical attachment

The ConeTec data acquisition systems consist of a Windows based computer and a signal conditioner and power supply interface box with a sixteen-bit (or greater) analog to digital (A/D) converter. The data is recorded in fixed depth increments using a depth wheel attached to the push cylinders or by using a spring loaded rubber depth wheel that is held against the cone rods. The typical recording interval is 2.5 centimeters; custom recording intervals are possible.

The system displays the data in real time and records the following parameters to a storage media during penetration:

- Depth
- Uncorrected ball tip resistance (q_b)
- Sleeve friction (f_s)
- Dynamic pore pressure (u) at the shoulder (u_2) or at the equator of the ball
- Additional sensors such as resistivity, passive gamma, ultra violet induced fluorescence, if applicable

Prior to the start of a BCPTu sounding a suitable cone and spherical attachment are selected, the cone and data acquisition system are powered on, the pore pressure system is saturated with silicone oil and the baseline readings are recorded with the ball hanging freely in a vertical position.

The BCPTu is conducted at a steady rate of two centimeters per second, within acceptable tolerances. Typically, one-meter length rods with an outer diameter of 38.1 millimeters are added to advance the ball to the sounding termination depth. The test may be interrupted at selected depths to cycle the probe up and down in order to achieve a completely remolded soil state. Cycling is typically conducted during retraction of the ball and the number of conducted cycles is dependent on reaching a consistent tip value. After ball retraction the final baselines are recorded.

The full flow penetration test can be halted at specific depths to carry out pore pressure dissipation (PPD) tests. For each dissipation test the data acquisition system measures and records the variation of the pore pressure (u) with time (t). Pore pressure dissipation data can be interpreted to provide estimates of equilibrium pore pressures (u_{eq}).

Additional information pertaining to ConeTec's full flow penetration testing procedures:

- Each filter is saturated in silicone oil under vacuum pressure prior to use
- Recorded baselines are checked with an independent multi-meter
- Baseline readings are compared to previous readings verifying compliance with ASTM standards
- Soundings are terminated at the client's target depth or at a depth where an obstruction is encountered, excessive rod flex occurs or excessive inclination occurs, equipment damage is likely to take place or a dangerous working environment arises
- Differences between initial and final baselines are calculated to ensure zero load offsets have not occurred and to ensure compliance with ASTM standards

Full flow penetration tests are conducted to assess the undrained shear strength (Su) of low to medium strength soils. During penetration, the soil flows around the penetrometer significantly reducing the influence of overburden stress as compared to the cone penetration test (CPTu). For the test to be valid, the soil must flow around the penetrometer. Cycling is conducted in order to achieve a completely remolded soil state to provide an indication of sensitivity in soft soils.

The recorded ball tip resistance (q_b) is the total force acting on the piezocone spherical attachment divided by its base area. The ball tip resistance is corrected for pore pressure effects and termed corrected ball tip resistance (q_{bt}) according to the following expression:

$$q_{bt}=q_b+[(1-a)u_2]\frac{A_s}{A_p}$$

where: q_{bt} is the corrected ball tip resistance
q_b is the recorded ball tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the piezocone (0.8 for ConeTec probes)
A_s is the shaft area
A_p is the ball plan area

The undrained shear strength (Su) derived from the full flow penetration test is related to the net ball tip resistance (q_{btnet}) and ball factor (N_{ball}) using the following relationship:

$$Su = \frac{q_{btnet}}{N_{ball}}$$

Due to different geometry and the subdued sleeve and pore pressure response, full flow penetration test results are not used for the interpretation of other geotechnical parameters or for soil classification.

A summary of the BCPTu soundings along with test details and individual plots are provided in the appendices. Tabular results generated for each sounding are provided in Excel format in the data release folder. Information regarding the calculated parameters is also included in the data release folder.

For additional information on full flow penetrometer testing, refer to Weemees et al. (2006).

References

ASTM D5778-12, 2012, "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils", ASTM International, West Conshohocken, PA. DOI: 10.1520/D5778-12.

Weemees, I., Howie, J., Woeller, D.J., Sharp, J.T., Cargill, E., Greig, J., 2006, “Improved Techniques for the In-Situ Determination of Undrained Shear Strength in Soft Clays,” Sea to Sky Geotechnics, Proceedings of the 59th Canadian Geotechnical Conference, Vancouver, B.C., 1–4 October. BiTech Publishers Ltd., Richmond, B.C. pp. 89–95.

The electric field vane system is manufactured by Adara Systems Ltd., a subsidiary of ConeTec. An illustration of the uphole vane system configuration is presented in Figure eVST.

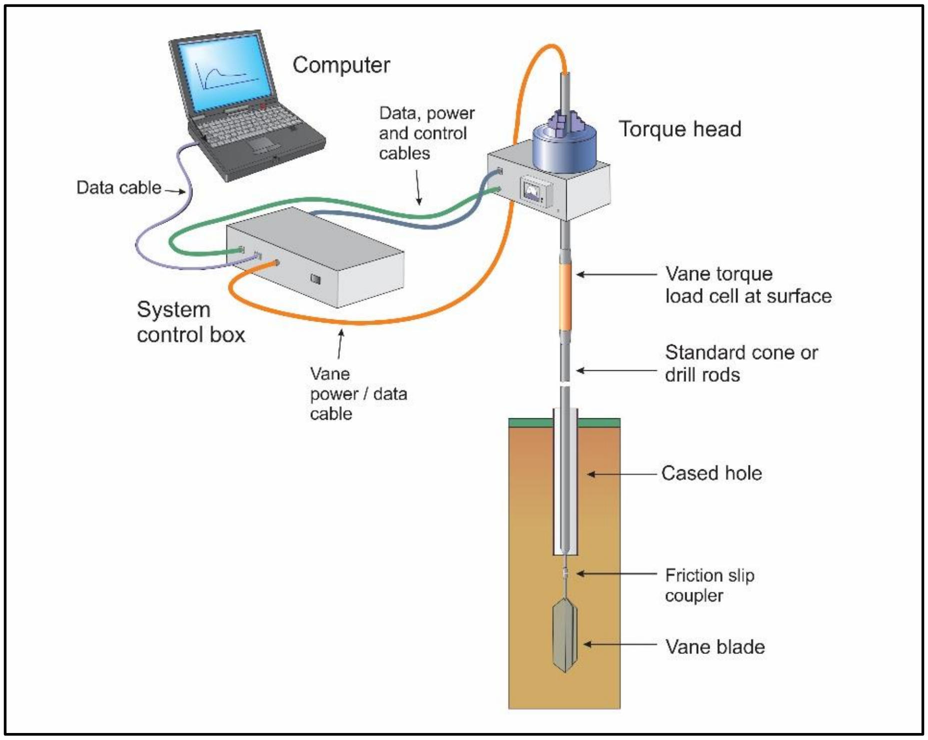


Figure eVST. Illustration of the uphole electric field vane system configuration

The vane system is designed with an array of strain gauges in a load cell that measure the applied torque. The torque signal is amplified and converted to digital data within the tool and transmitted to the data acquisition system through a shielded cable. The system uses a friction slip coupler to permit the free slip or play of approximately fifteen degrees between the rods and the vane blade in order to isolate and record rod friction from the soil before rotation of the vane blade starts. The system is designed to use vane blades of various sizes and configurations that connect to the friction slip coupler. The vane blades manufactured by Adara have dimensions and tolerances that are in general accordance with the current ASTM D2573 standards. In very soft soil conditions and at the request of the client, ConeTec may use a large diameter vane blade that exceeds the ASTM D2573 maximum size specifications in order to maximize torque resolution. In very stiff soil conditions and at the request of the client, ConeTec may use a smaller diameter vane blade than the minimum size specified in ASTM D2573 in order to obtain a peak torque below the capacity of the load cell.

The electric motor (capable of 100 Newton-meters of torque) is designed to clamp onto and rotate the rods and vane blade at a constant rate.

ConeTec's calibration criteria of the load cells are in accordance with the current ASTM D2573 standard.

The data acquisition system consists of a computer that records the vane data every 0.2 degrees of rotation. The system records the following parameters and saves them to a file as the test is conducted:

- Torque in Newton-meters
- Rotation in degrees
- Elapsed time in seconds (from the start of the test)

All testing is performed in accordance to ConeTec's field vane testing operating procedures and in general accordance with the current ASTM D2573 standard. For additional information on vane shear testing refer to Greig et al. (1987).

Prior to the start of a vane shear test profile, a suitable sized vane blade is selected, the vane system is powered on and the vane load cell baseline reading is recorded with the load cell hanging freely in a vertical position.

The vane blade, slip coupler and rods are advanced to the desired test depth through a cased hole, typically using AWJ drill rods or one-meter length rods with an outer diameter of 1.5 inches (38.1 millimeters). Test depths are referenced to the middle of the rectangular portion of the vane blade. The motor rotates the rods at a near constant rate up to and beyond the yield stress (peak) until the load remains near constant (post peak). Following post peak readings, the vane blade is then rapidly rotated clockwise ten times to completely remold the soil. The test procedure is repeated in order to record the remolded strength of the soil. The vane blade is then advanced to the next depth and the procedure is repeated or the vane blade is retracted to allow for drilling and vane blade size changes. Once the vane profile is complete, the final baseline of the load cell is recorded and compared to previous reading as a QA/QC check.

Undrained shear strength from the field vane, $(S_u)_{fv}$, is calculated from torque measurements using the following general equation (ASTM D2573) taking into consideration the case of rectangular or tapered ends at the top and/or bottom of the vane blade.

$$(S_u)_{fv} = \frac{12 \cdot T_{max}}{\pi D^2 \left(\frac{D}{\cos(i_T)} + \frac{D}{\cos(i_B)} + 6H \right)}$$

where:

$(S_u)_{fv}$ = undrained shear strength from the field vane

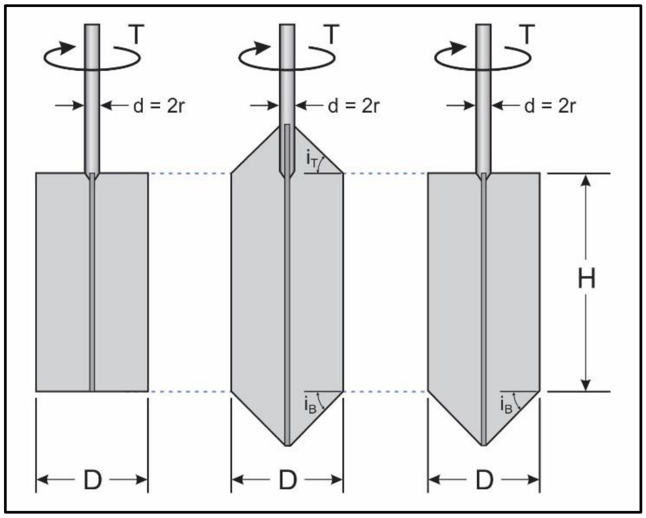
T_{max} = maximum value of torque

D = vane diameter

H = height of the rectangular portion of the vane

i_T = angle of taper at vane top (with respect to horizontal)

i_B = angle of taper at vane bottom (with respect to horizontal)



For rectangular vane blades where H/D = 2, the above equation simplifies to:

$$(S_u)_{fv} = \frac{6 \cdot T_{max}}{7\pi D^3}$$

The recorded rod friction is subtracted from the peak and remolded torque. No correction factors are applied to the vane results to derive the mobilized shear strength ($\tau_{mobilized}$).

A summary of the vane shear tests, a table of results and individual VST plots are provided in the relevant appendices. Tabular data in Excel format is provided in the data release folder.

References

ASTM D2573 / D2573M-18, 2018, “Standard Test Method for Field Vane Shear Test in Saturated Fine-Grained Soils”, ASTM International, West Conshohocken, PA. DOI: 10.1520/D2573_D2573M-18.

Greig, J.W., R.G. Campanella and P.K. Robertson, 1987, “Comparison of Field Vane Results With Other In-Situ Test Results”, International Symposium on Laboratory and Field Vane Shear Strength Testing, ASTM, Tampa, FL, Proceedings.

The appendices listed below are included in the report:

- Cone Penetration Test Summary and Standard Cone Penetration Test Plots
- Advanced Cone Penetration Test Plots with Ic, Su(Nkt), Phi and N(60)Ic/N1(60)Ic
- Soil Behavior Type (SBT) Scatter Plots
- Ball Cone Penetration Test Summary and Plots
- Electronic Vane Test Summary and Results
- Electronic Vane Test Plots

Cone Penetration Test Summary and Standard Cone Penetration Test Plots

CONETEC

Job No:	21-59-22445
Client:	Anchor QEA
Project:	LDW Phase 3
Start Date:	06-Jul-2021
End Date:	29-Jul-2021

CONE PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Assumed Phreatic Surface[1] (ft)	Final Depth (ft)	Latitude[3] (deg)	Longitude[3] (deg)	Refer to Notation Number
LDW21-GT06-GC	21-59-22445_CP06	22-Jul-2021	681:T375F10U35	-5.0	31.1	47.52892	-122.31483	
LDW21-GT14-GC	21-59-22445_CP14	08-Jul-2021	681:T375F10U35	-5.6	28.7	47.52477	-122.30819	
LDW21-GT16-GC	21-59-22445_CP16	08-Jul-2021	681:T375F10U35	-8.4	29.8	47.52409	-122.30770	
LDW21-GT17-GC	21-59-22445_CP17	12-Jul-2021	681:T375F10U35	-6.6	30.3			4
LDW21-GT20-GC	21-59-22445_CP20	16-Jul-2021	681:T375F10U35	-6.6	23.0			4
LDW21-GT22-GC	21-59-22445_CP22	13-Jul-2021	681:T375F10U35	-7.7	28.8			4
LDW21-GT27-GC	21-59-22445_CP27	16-Jul-2021	681:T375F10U35	-3.0	30.4			4
LDW21-GT30-GC	21-59-22445_CP30	21-Jul-2021	681:T375F10U35	-7.0	30.1	47.52066	-122.30558	
LDW21-GT31-GC	21-59-22445_CP31	09-Jul-2021	681:T375F10U35	2.0	11.4			4,2
LDW21-GT31-GC-B	21-59-22445_CP31B	13-Jul-2021	681:T375F10U35	-5.0	27.3			4
LDW21-GT32-GC	21-59-22445_CP32	09-Jul-2021	681:T375F10U35	2.0	5.8	47.52028	-122.30553	2
LDW21-GT32-GC-B	21-59-22445_CP32B	21-Jul-2021	681:T375F10U35	-2.0	30.8	47.52030	-122.30555	
LDW21-GT34-GC	21-59-22445_CP34	21-Jul-2021	681:T375F10U35	-2.8	30.3	47.51986	-122.30540	
LDW21-GT40-GC	21-59-22445_CP40	19-Jul-2021	681:T375F10U35	-4.9	31.7	47.51155	-122.30247	
LDW21-GT45-GC	21-59-22445_CP45	28-Jul-2021	681:T375F10U35	-7.2	31.6	47.51254	-122.29899	
LDW21-GT46-GC	21-59-22445_CP46	26-Jul-2021	681:T375F10U35	-13.2	9.8	47.51233	-122.29862	
LDW21-GT47-GC	21-59-22445_CP47	27-Jul-2021	681:T375F10U35	-12.5	31.2	47.51242	-122.29865	
LDW21-GT49-GC	21-59-22445_CP49	28-Jul-2021	681:T375F10U35	-6.5	32.5	47.51235	-122.29820	
LDW21-GT50-GC	21-59-22445_CP50	23-Jul-2021	681:T375F10U35	-11.6	5.5	47.51207	-122.29793	

Job No:	21-59-22445
Client:	Anchor QEA
Project:	LDW Phase 3
Start Date:	06-Jul-2021
End Date:	29-Jul-2021

CONE PENETRATION TEST SUMMARY

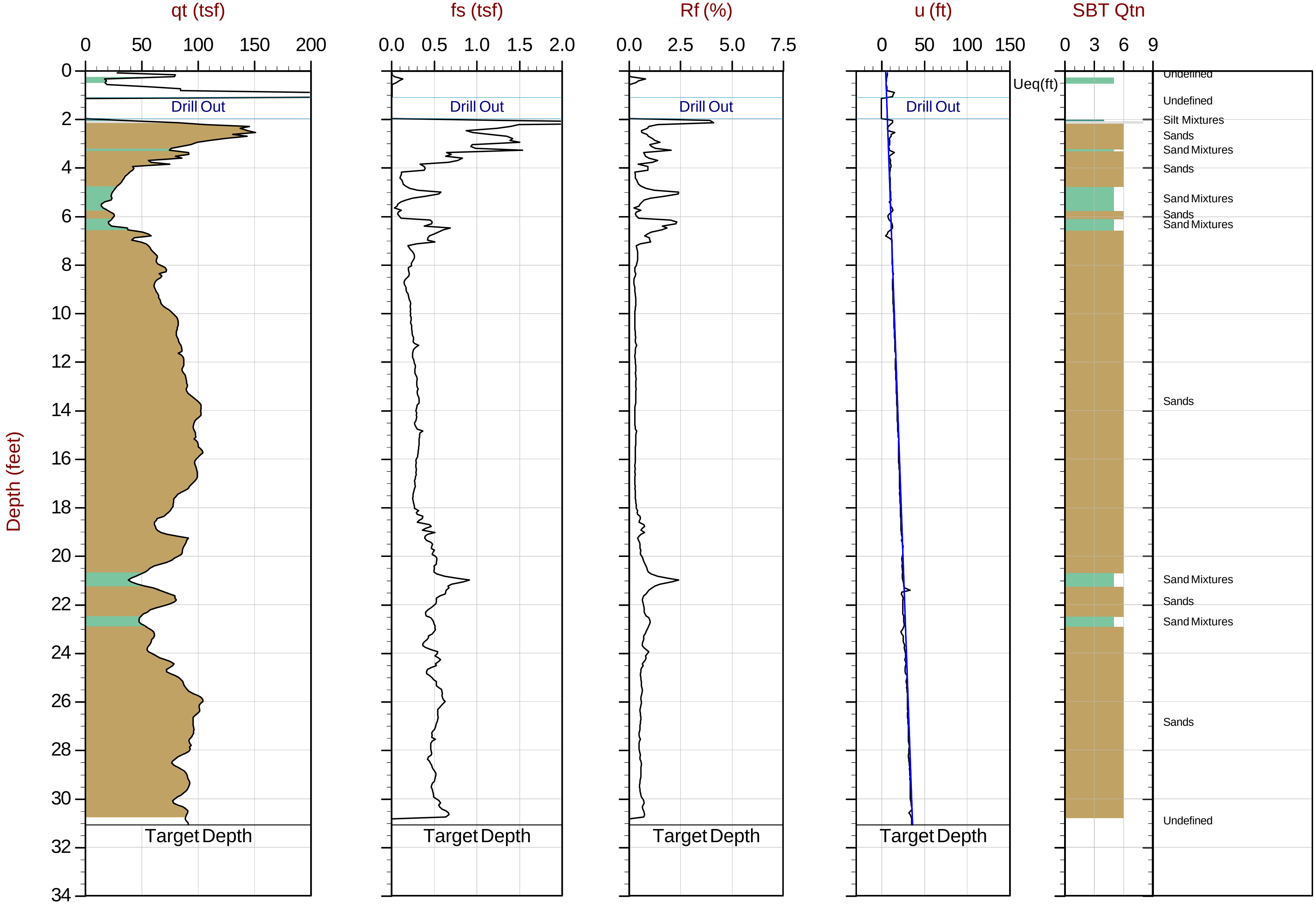
Sounding ID	File Name	Date	Cone	Assumed Phreatic Surface[1] (ft)	Final Depth (ft)	Latitude[3] (deg)	Longitude[3] (deg)	Refer to Notation Number
LDW21-GT51-GC	21-59-22445_CP51	26-Jul-2021	681:T375F10U35	-6.4	6.6	47.51218	-122.29794	
LDW21-GT52-GC	21-59-22445_CP52	27-Jul-2021	681:T375F10U35	-6.9	30.4	47.51211	-122.29774	
LDW21-GT54-GC	21-59-22445_CP54	27-Jul-2021	681:T375F10U35	-6.0	30.8	47.51197	-122.29758	
Totals	22 soundings				547.89			

1. Phreatic surface measured from barge deck with weighted tip tape at each location. Hydrostatic profile applied to interpretation tables
2. CPT sounding completed from land based machine - all other locations completed from floating barge platform.
3. Coordinates were provided by client
4. Coordinates currently not available. Coordinates will be provided by client at a later date

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-22 17:30
Site: LDW Phase 3

Sounding: LDW21-GT06-GC
Cone: 681:T375F10U35



Max Depth: 9.475 m / 31.09 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP06.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.52892 Long: -122.31483

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

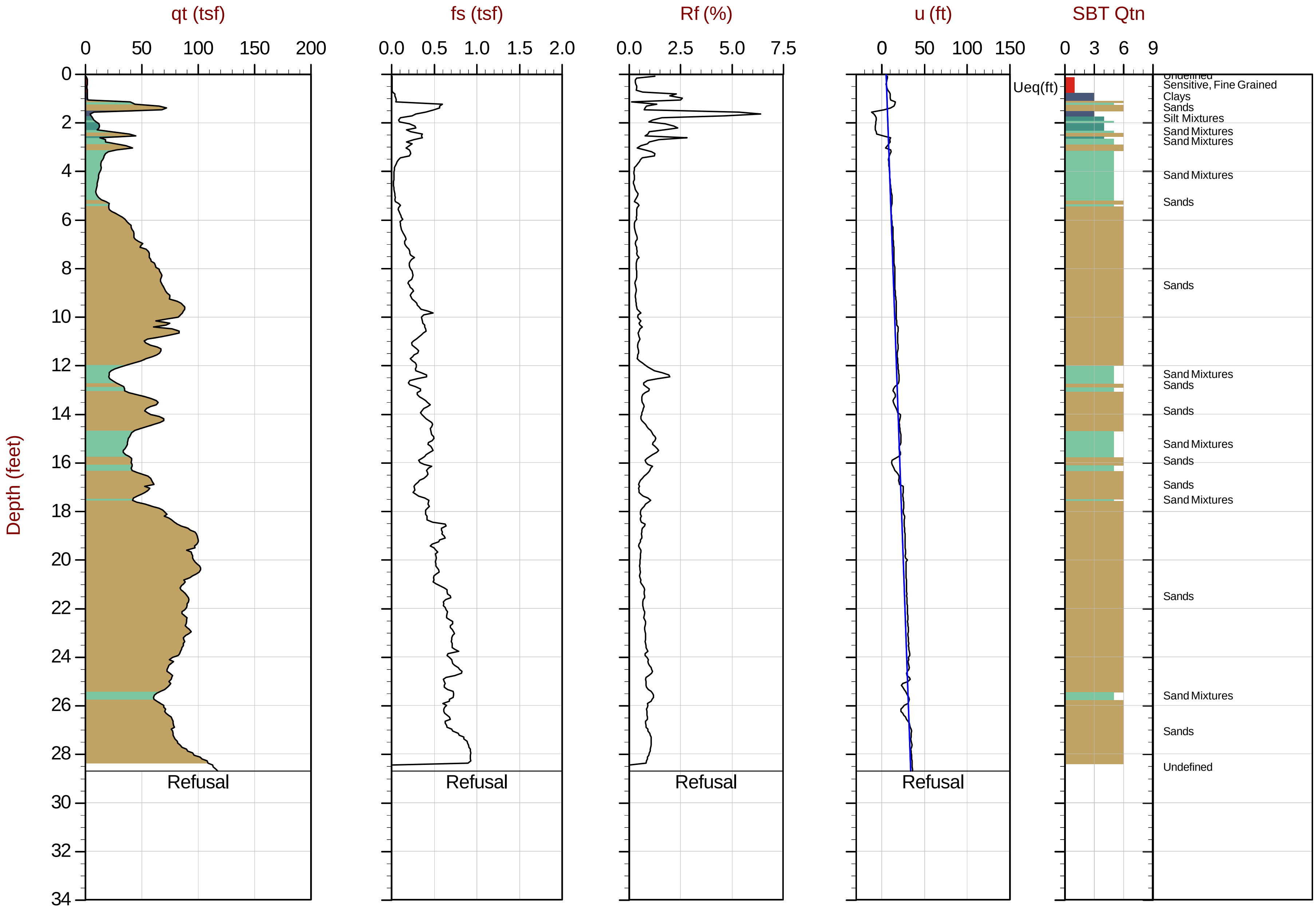
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-08 14:11
Site: LDW Phase 3

Sounding: LDW21-GT14-GC
Cone: 681:T375F10U35



Max Depth: 8.750 m / 28.71 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP14.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.52477 Long: -122.30819

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

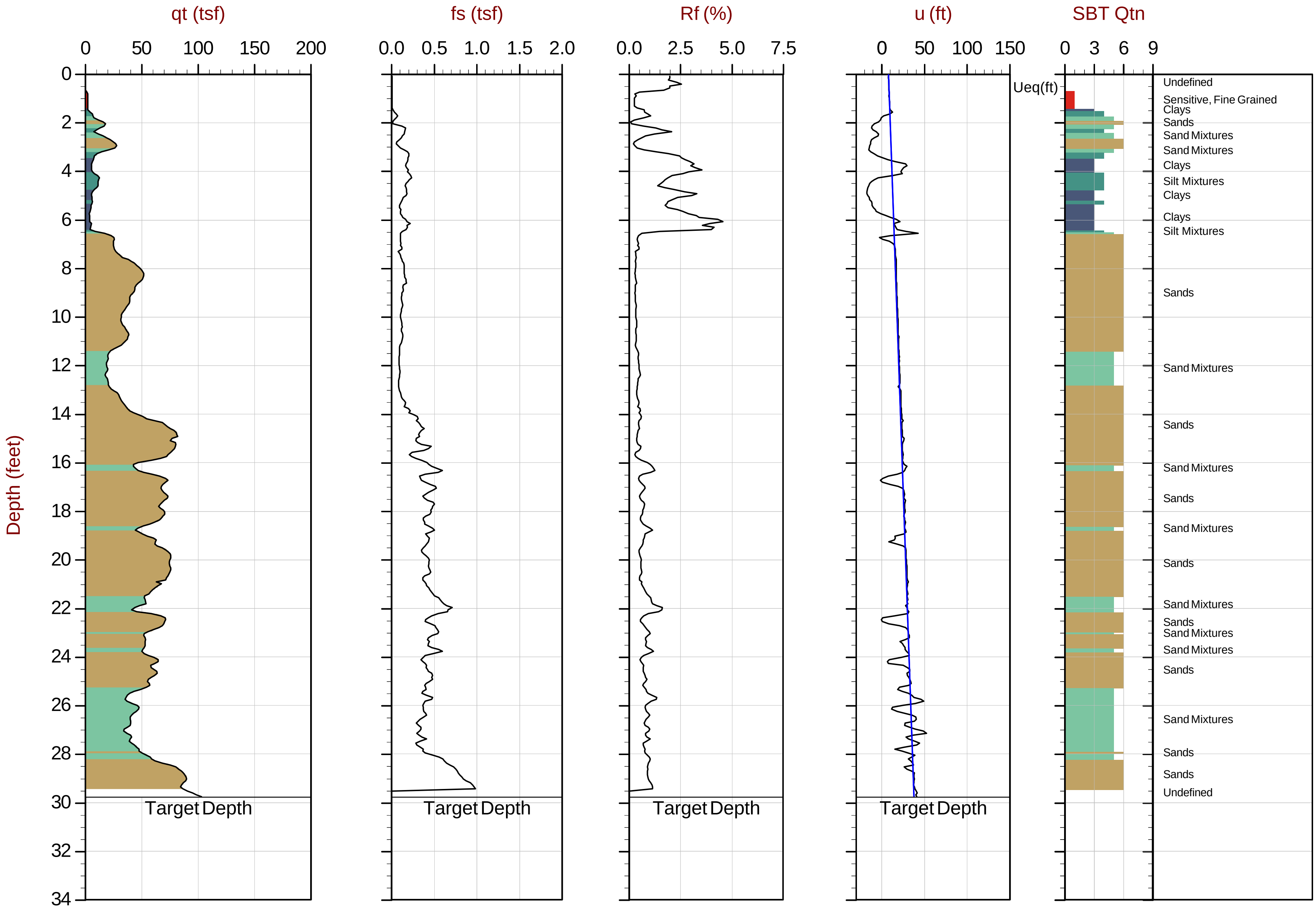
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-08 16:24
Site: LDW Phase 3

Sounding: LDW21-GT16-GC
Cone: 681:T375F10U35



Max Depth: 9.075 m / 29.77 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP16.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.52409 Long: -122.30770

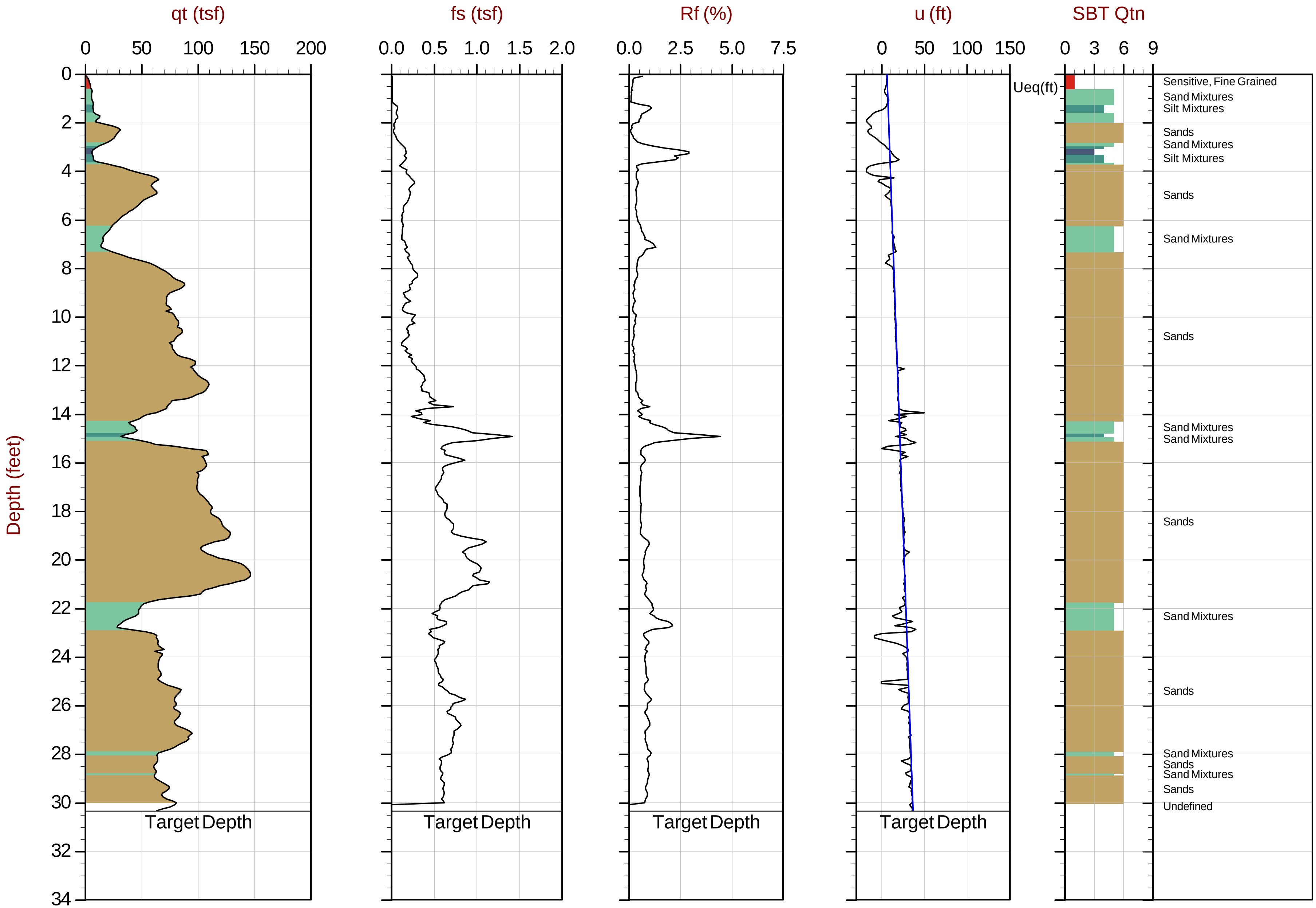
Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-12 19:15
Site: LDW Phase 3
Sounding: LDW21-GT17-GC
Cone: 681:T375F10U35



Max Depth: 9.250 m / 30.35 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP17.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: N/A Long: N/A

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

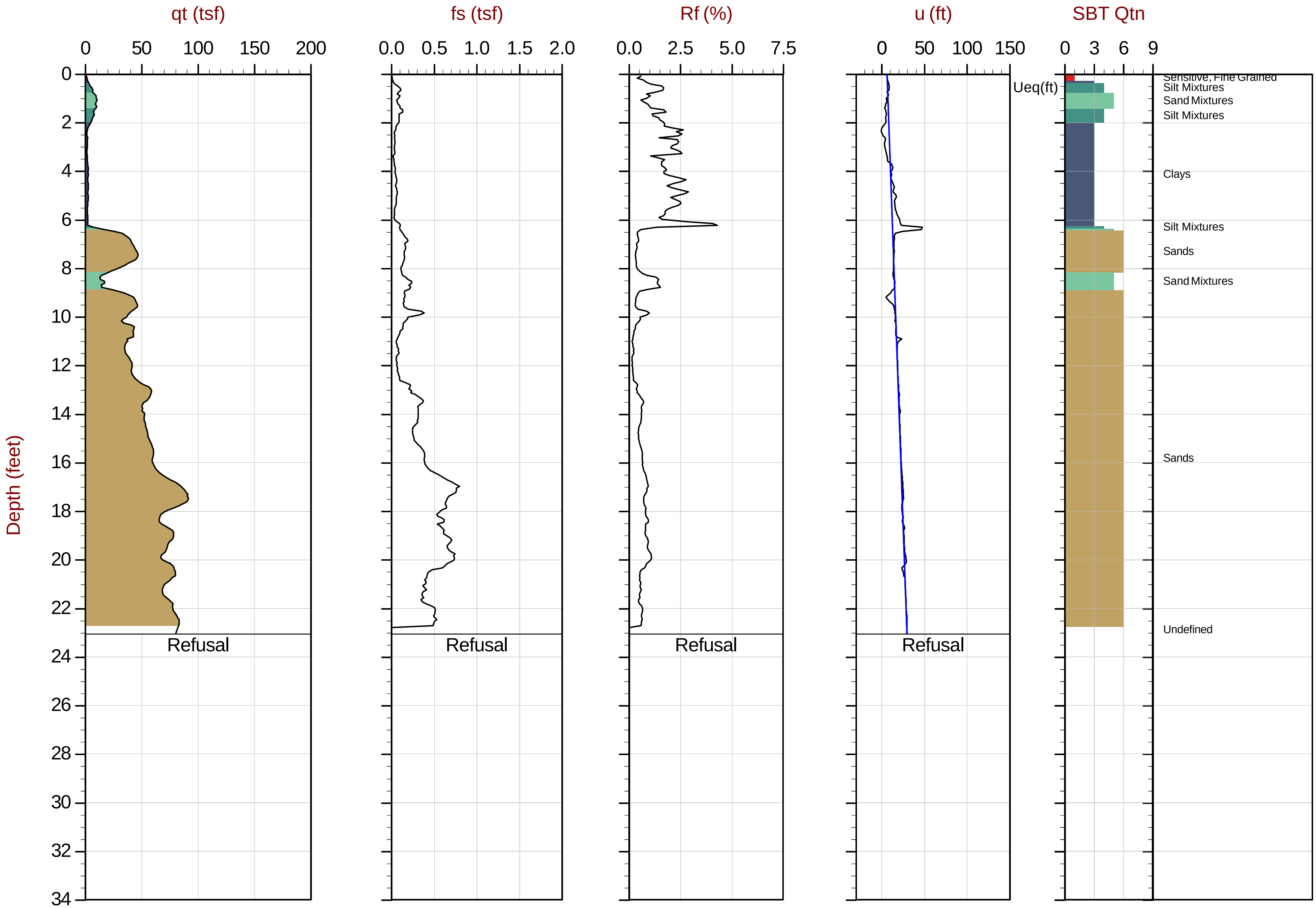
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-16 09:40
Site: LDW Phase 3

Sounding: LDW21-GT20-GC
Cone: 681:T375F10U35



Max Depth: 7.025 m / 23.05 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP20.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: N/A Long: N/A

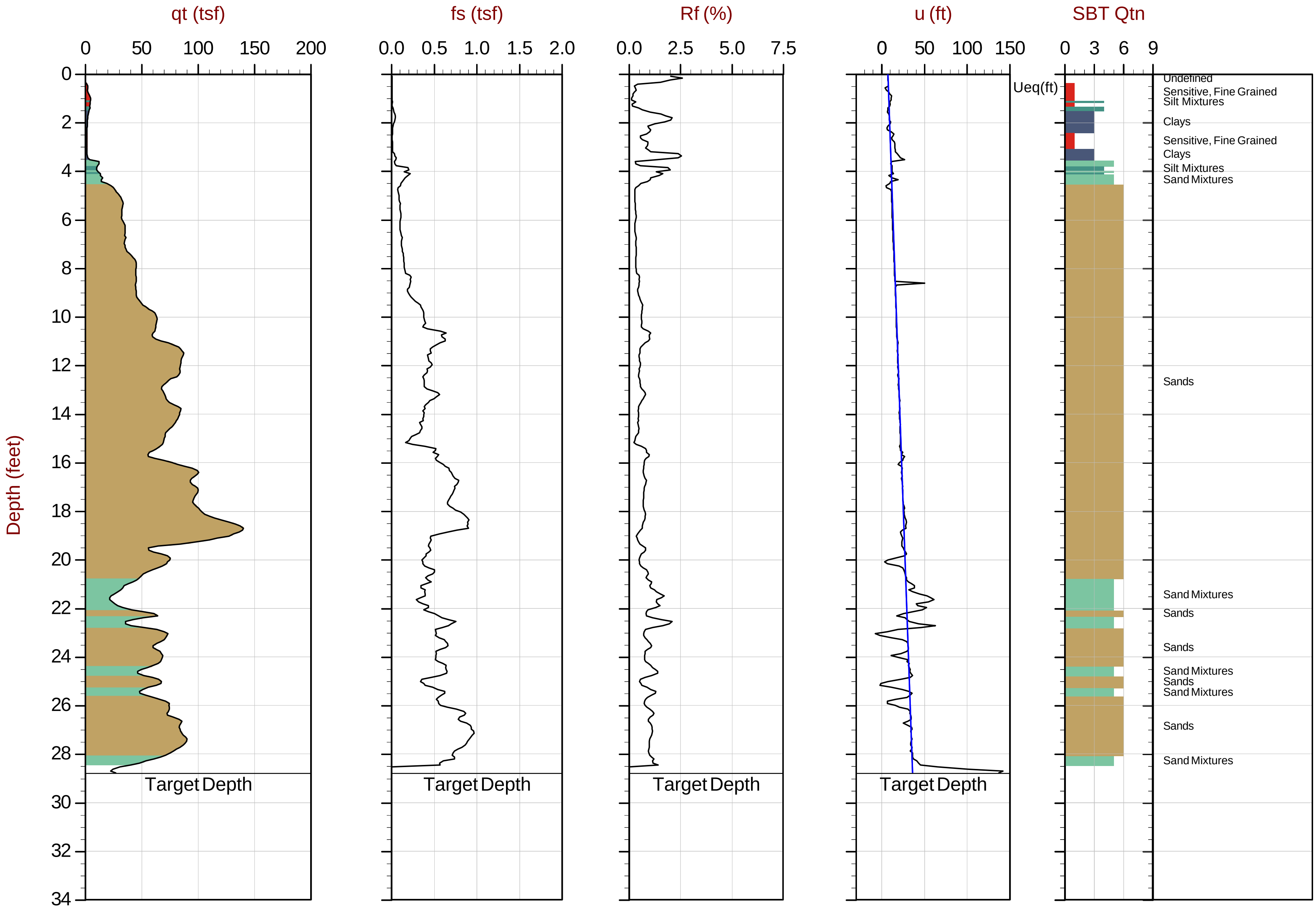
Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-13 19:06
Site: LDW Phase 3
Sounding: LDW21-GT22-GC
Cone: 681:T375F10U35



Max Depth: 8.775 m / 28.79 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP22.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: N/A Long: N/A

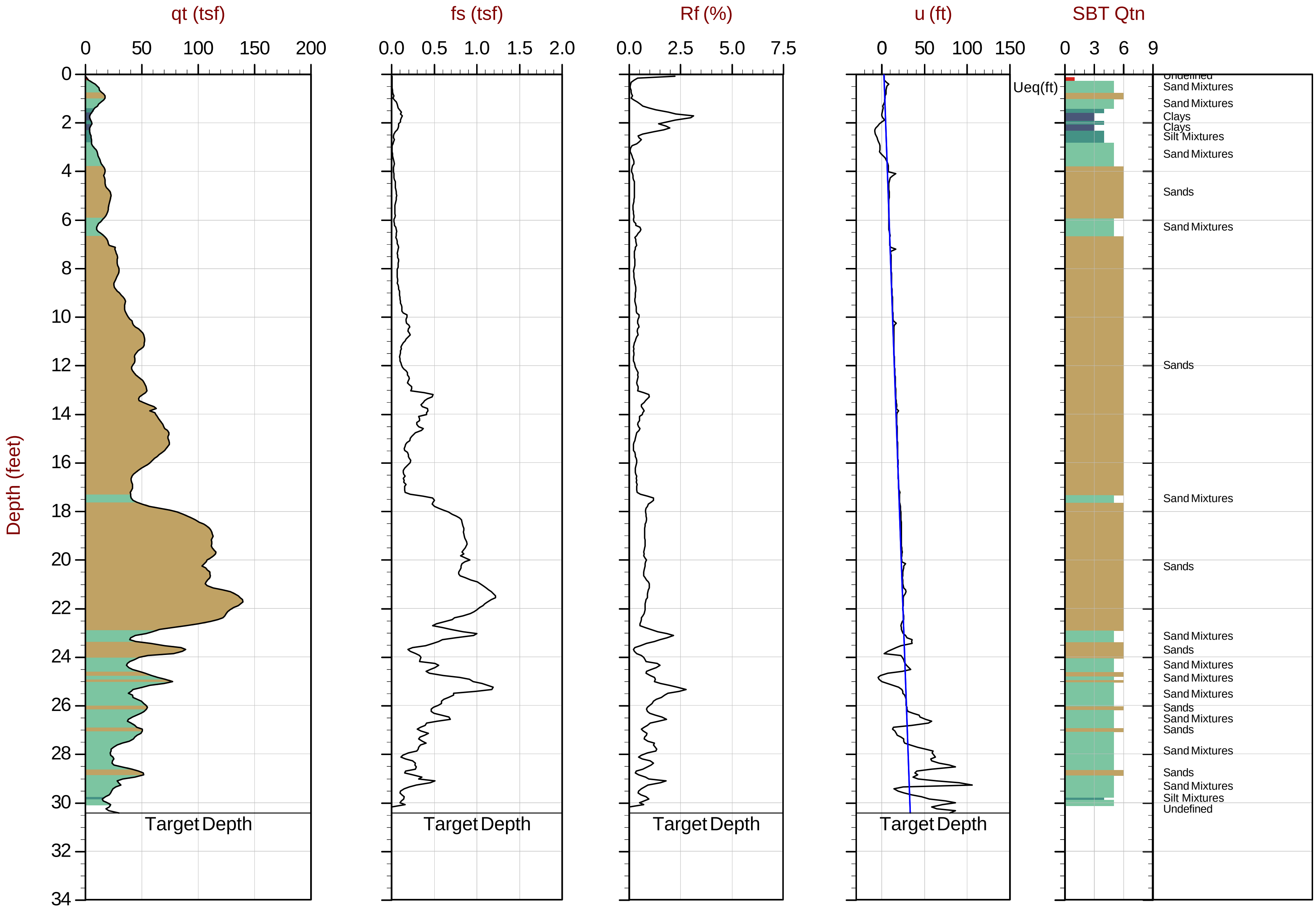
Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-16 08:30
Site: LDW Phase 3
Sounding: LDW21-GT27-GC
Cone: 681:T375F10U35



Max Depth: 9.275 m / 30.43 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP27.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: N/A Long: N/A

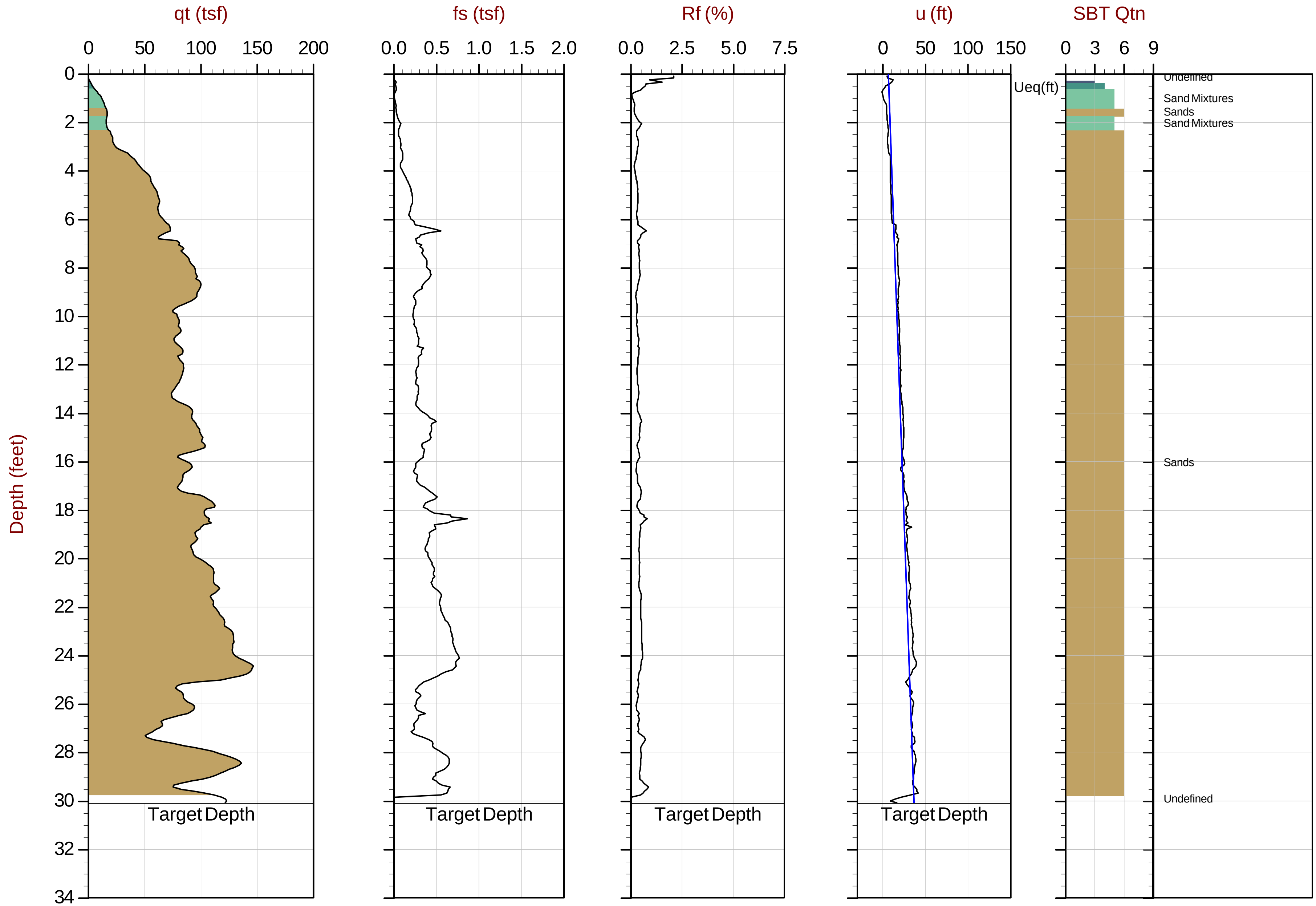
Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

ConeTec

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-21 15:09
Site: LDW Phase 3
Sounding: LDW21-GT30-GC
Cone: 681:T375F10U35



Max Depth: 9.175 m / 30.10 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP30.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.52066 Long: -122.30558

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

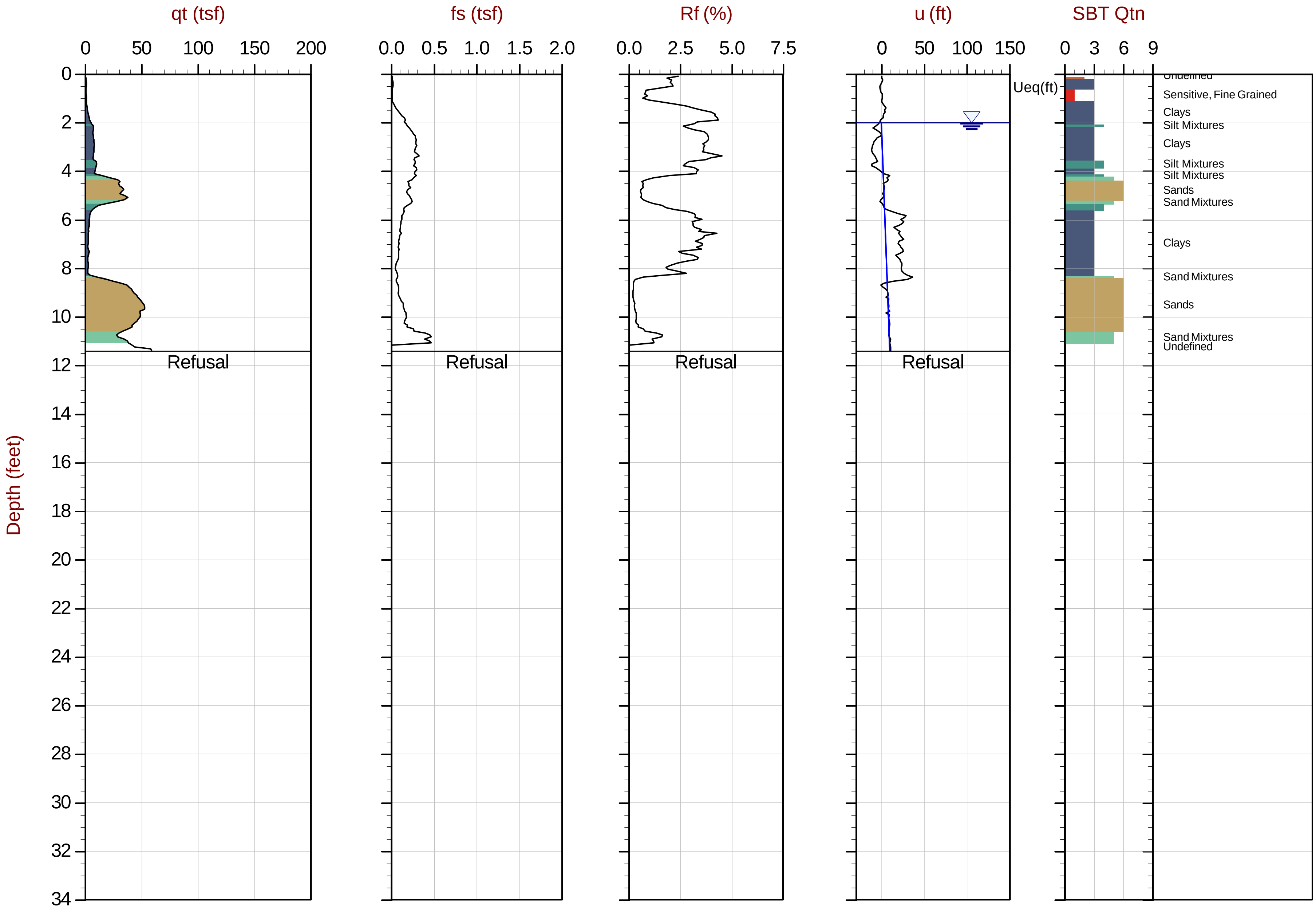
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-09 10:35
Site: LDW Phase 3

Sounding: LDW21-GT31-GC
Cone: 681:T375F10U35



Max Depth: 3.475 m / 11.40 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP31.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: N/A Long: N/A

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

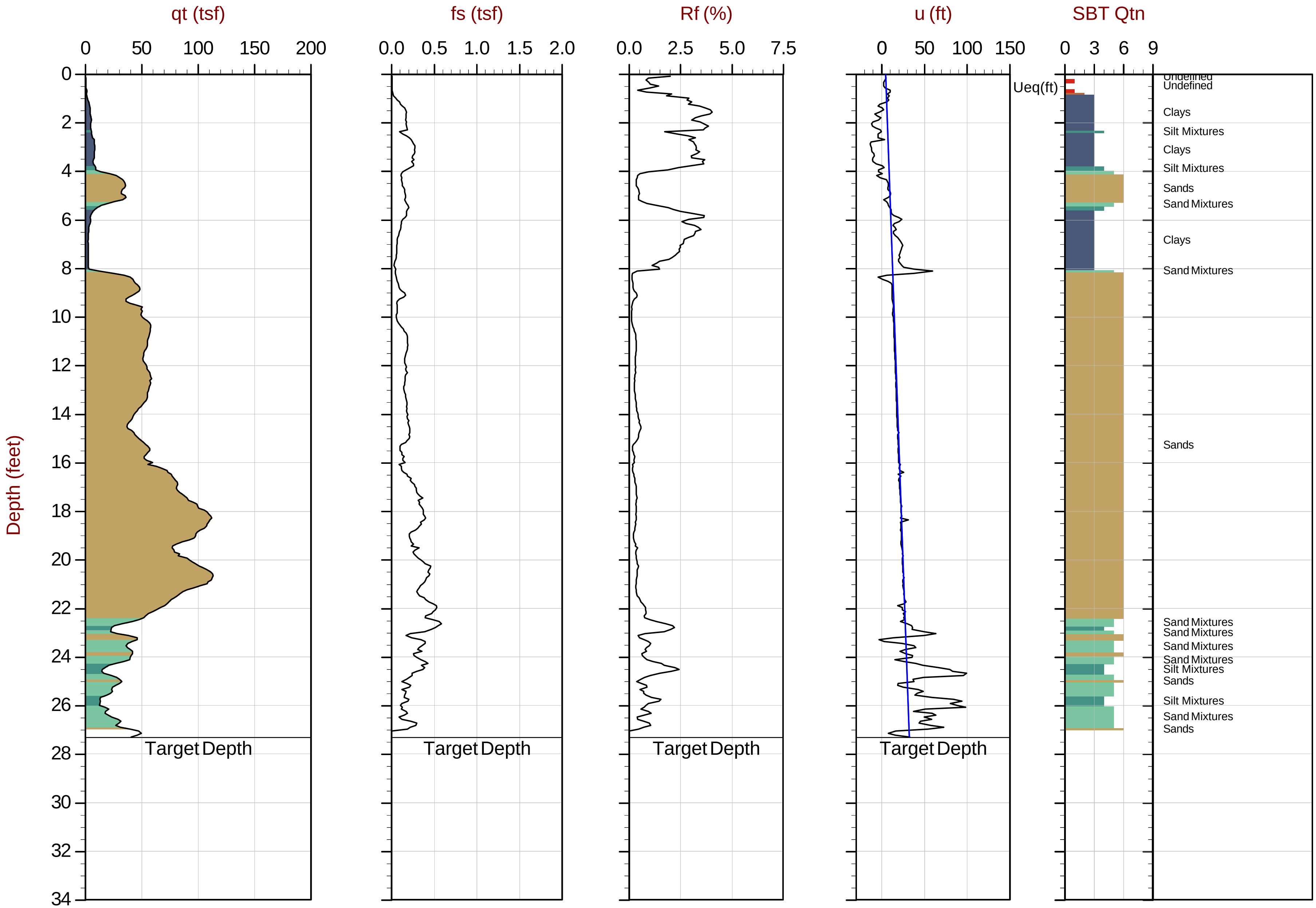
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

ConeTec

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-13 17:56
Site: LDW Phase 3

Sounding: LDW21-GT31-GC-B
Cone: 681:T375F10U35



Max Depth: 8.325 m / 27.31 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP31B.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: N/A Long: N/A

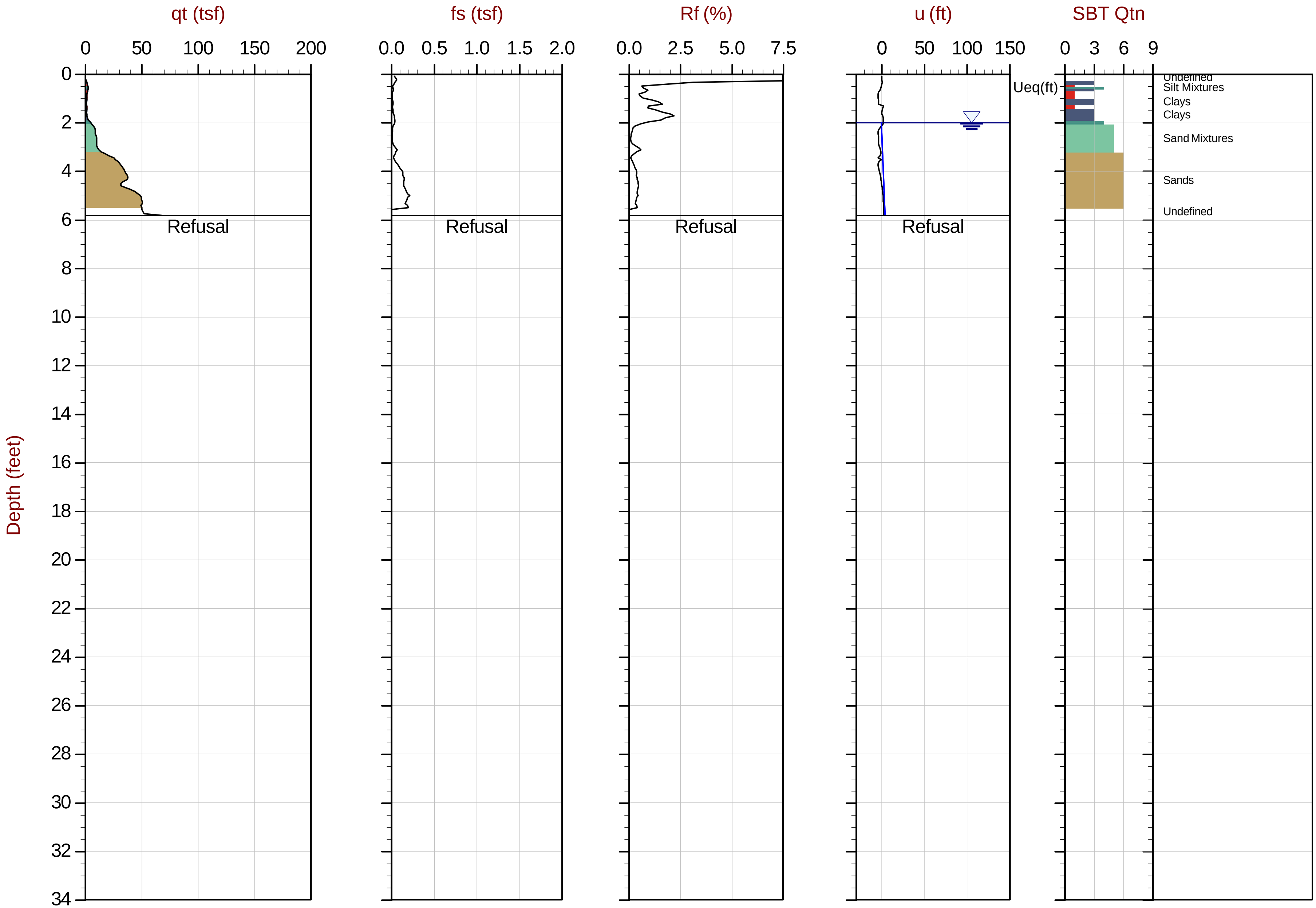
Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-09 11:18
Site: LDW Phase 3

Sounding: LDW21-GT32-GC
Cone: 681:T375F10U35



Max Depth: 1.775 m / 5.82 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP32.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.52028 Long: -122.30553

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

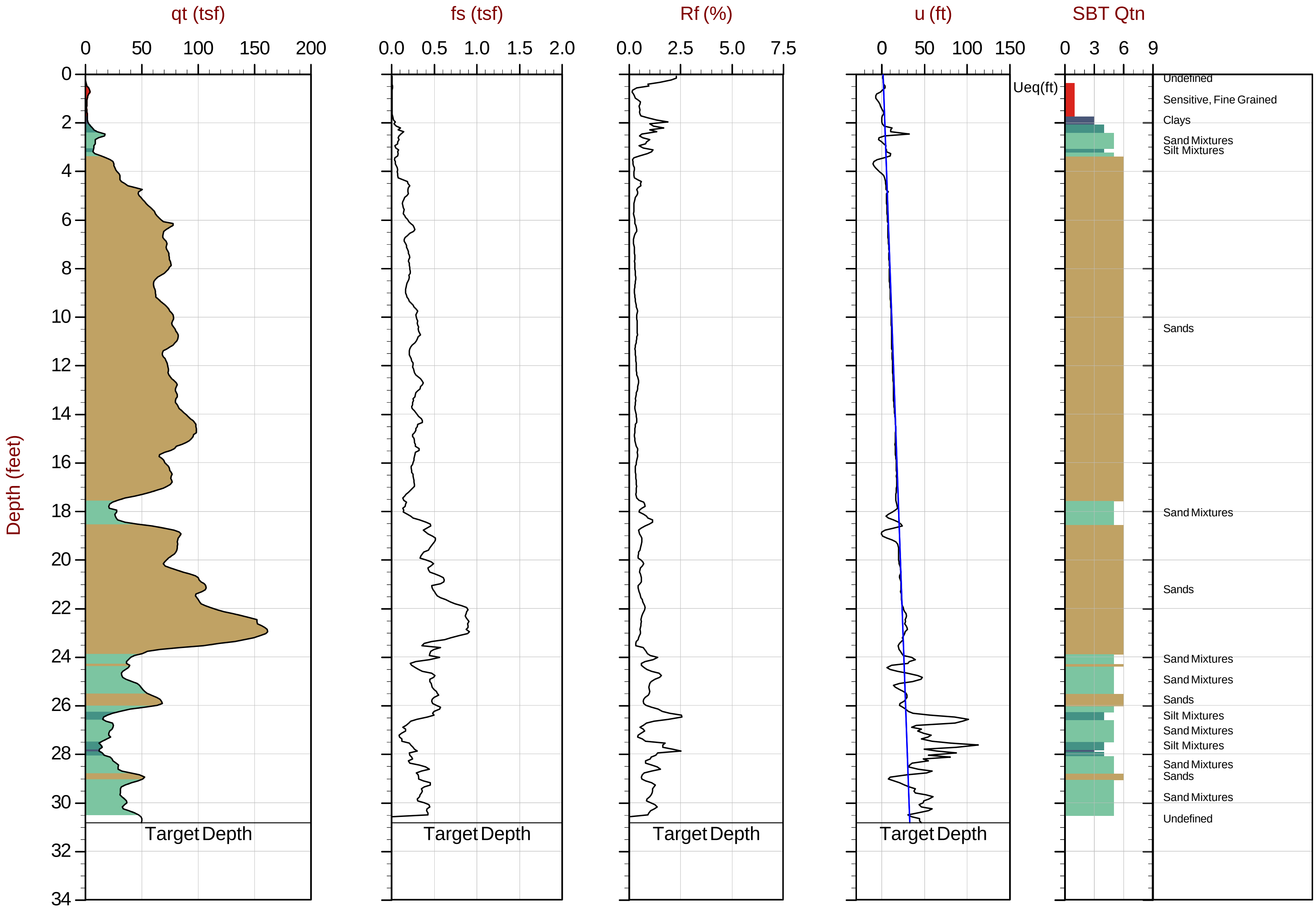
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-21 13:24
Site: LDW Phase 3

Sounding: LDW21-GT32-GC-B
Cone: 681:T375F10U35



Max Depth: 9.400 m / 30.84 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP32B.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.52030 Long: -122.30555

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

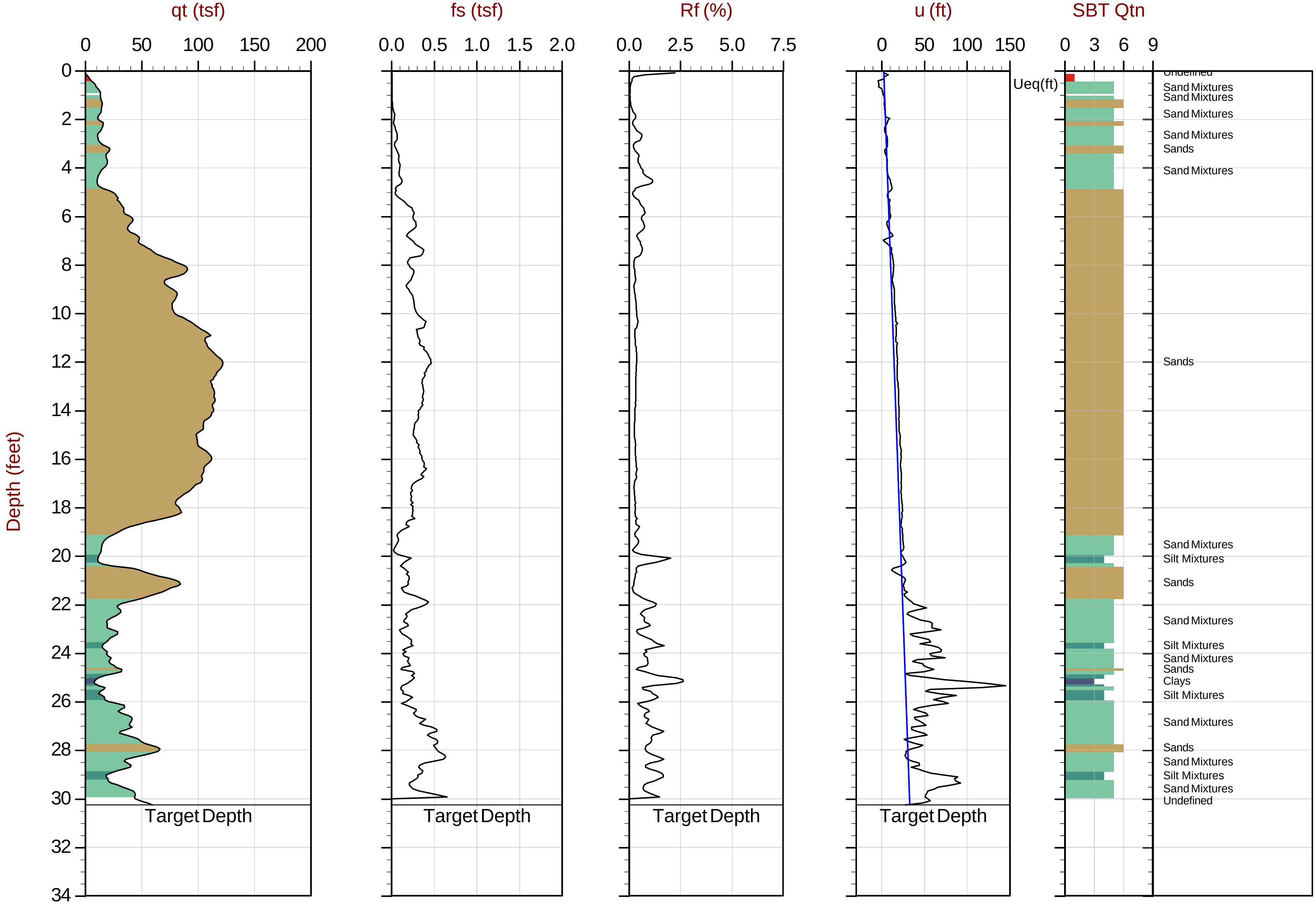
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-21 14:17
Site: LDW Phase 3

Sounding: LDW21-GT34-GC
Cone: 681:T375F10U35



Max Depth: 9.225 m / 30.27 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP34.COR
Unit Wt: SBTQtn (PKR2009)

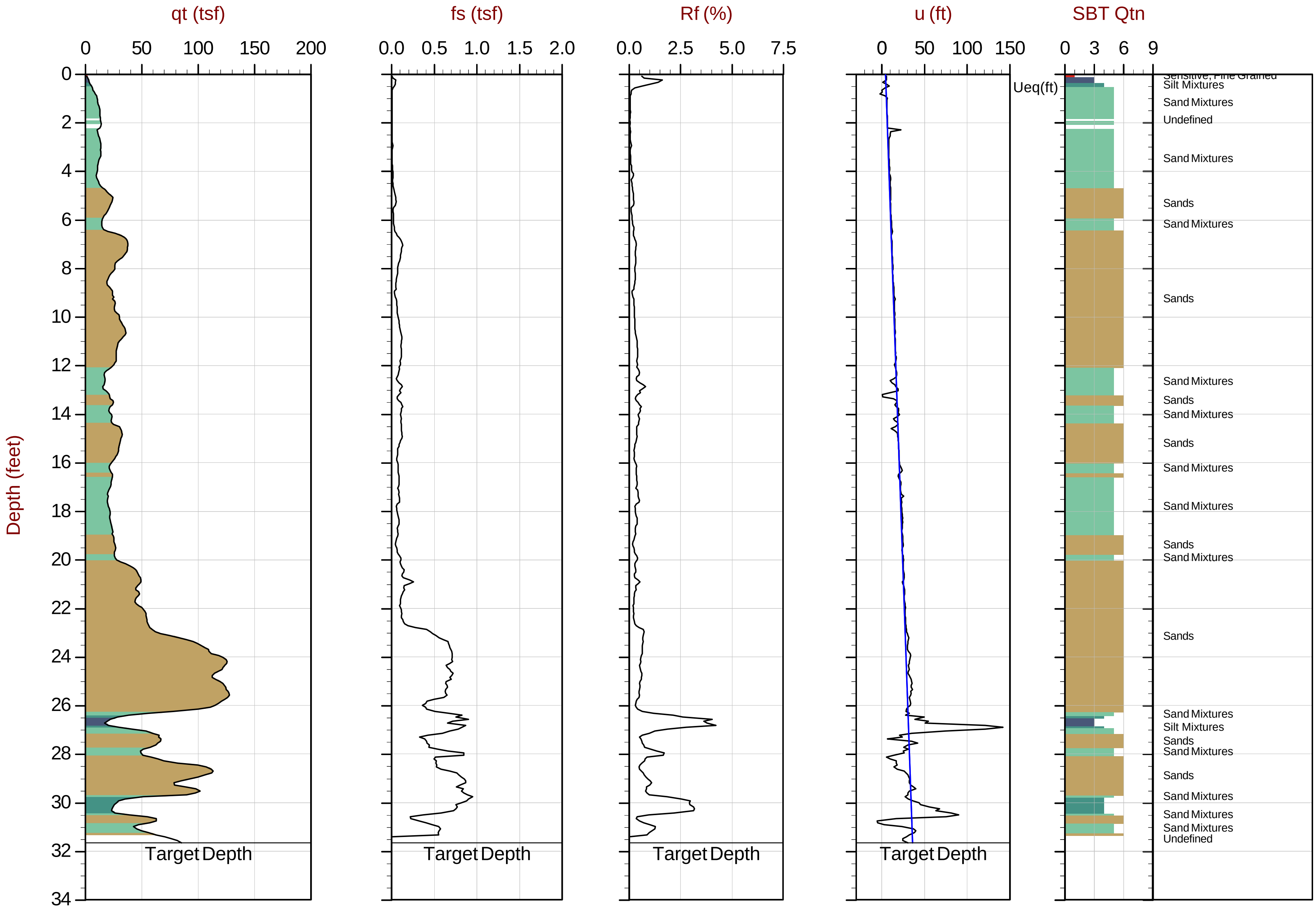
SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51986 Long: -122.30540

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-19 13:58
Site: LDW Phase 3
Sounding: LDW21-GT40-GC
Cone: 681:T375F10U35



Max Depth: 9.650 m / 31.66 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP40.COR
Unit Wt: SBTQtn (PKR2009)

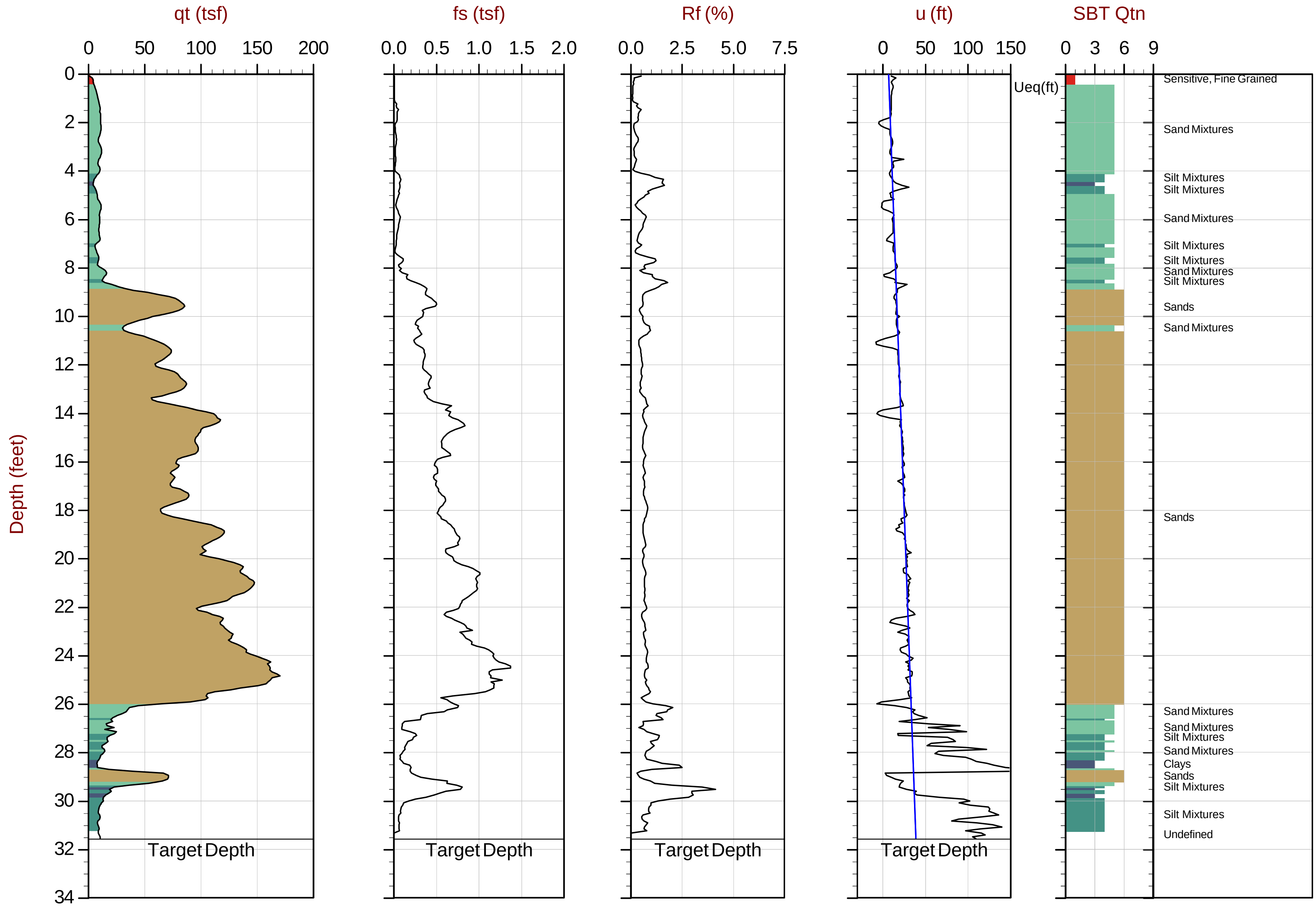
SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51155 Long: -122.30247

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Job No: 21-59-22445
Date: 2021-07-28 18:24
Site: LDW Phase 3
Sounding: LDW21-GT45-GC
Cone: 681:T375F10U35

Anchor QEA



Max Depth: 9.625 m / 31.58 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP45.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51253 Long: -122.29899

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

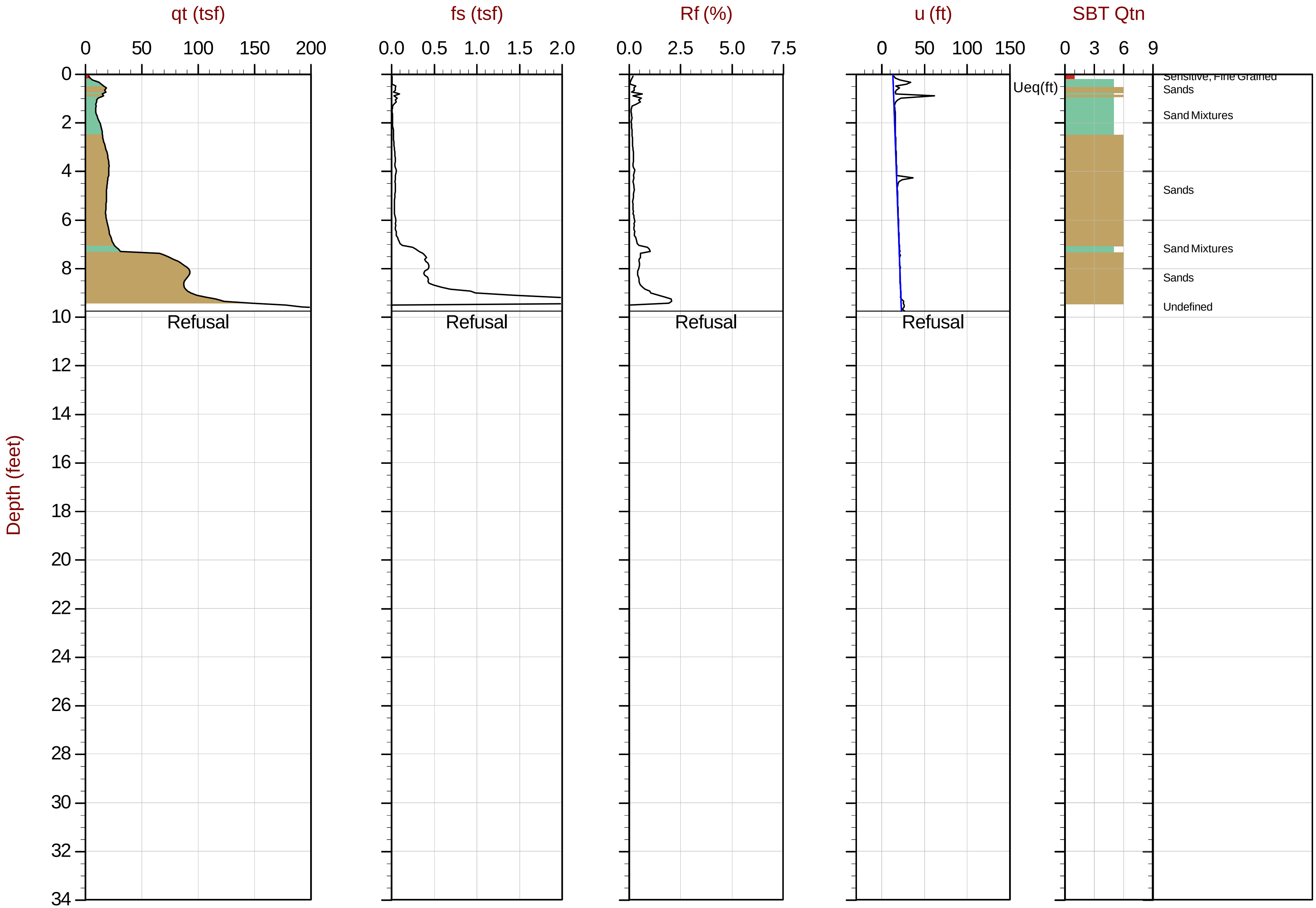
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

ConeTec

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-26 09:49
Site: LDW Phase 3

Sounding: LDW21-GT46-GC
Cone: 681:T375F10U35



Max Depth: 2.975 m / 9.76 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP46.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51233 Long: -122.29862

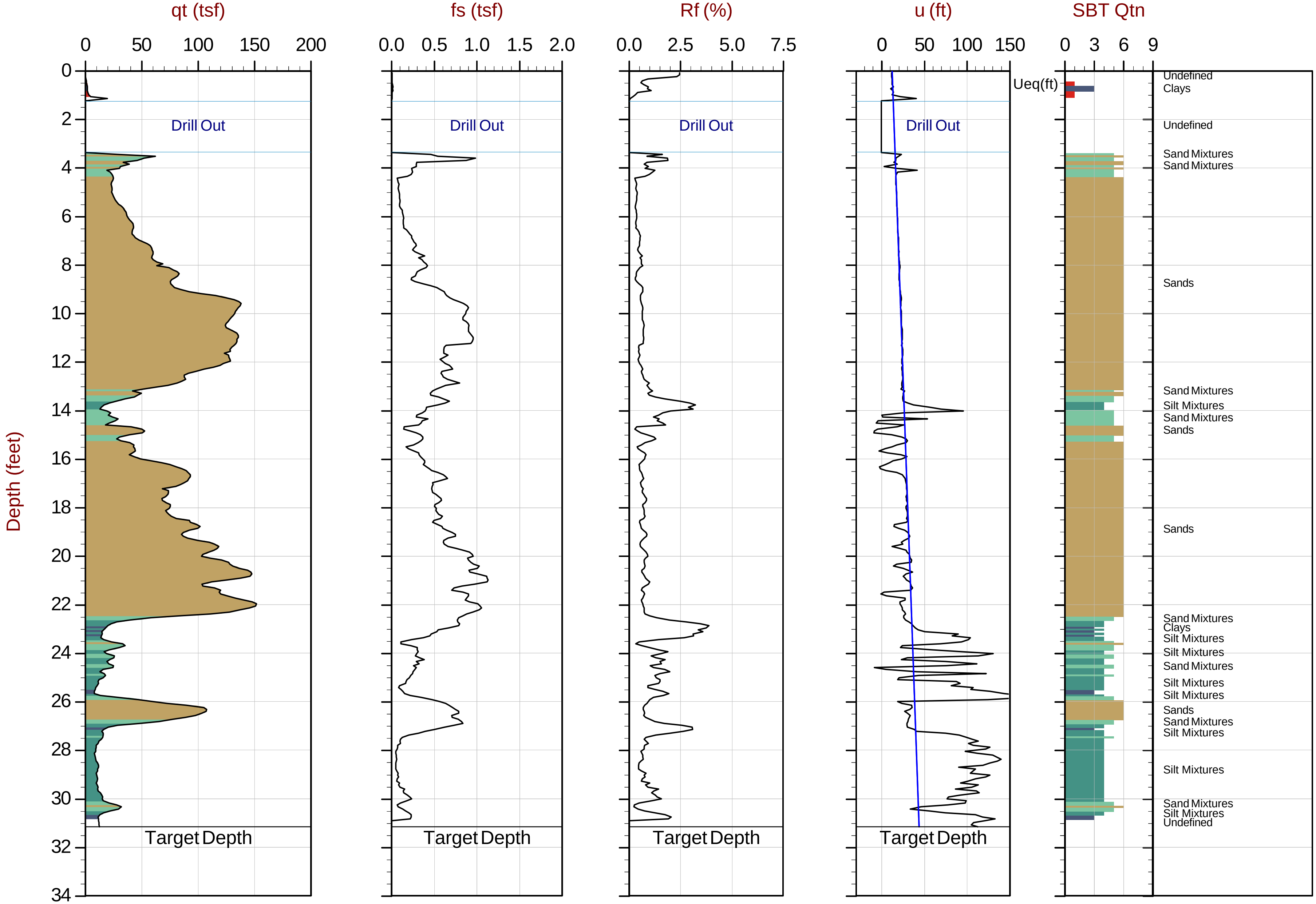
Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-27 20:39
Site: LDW Phase 3
Sounding: LDW21-GT47-GC
Cone: 681:T375F10U35



Max Depth: 9.500 m / 31.17 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP47.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51242 Long: -122.29865

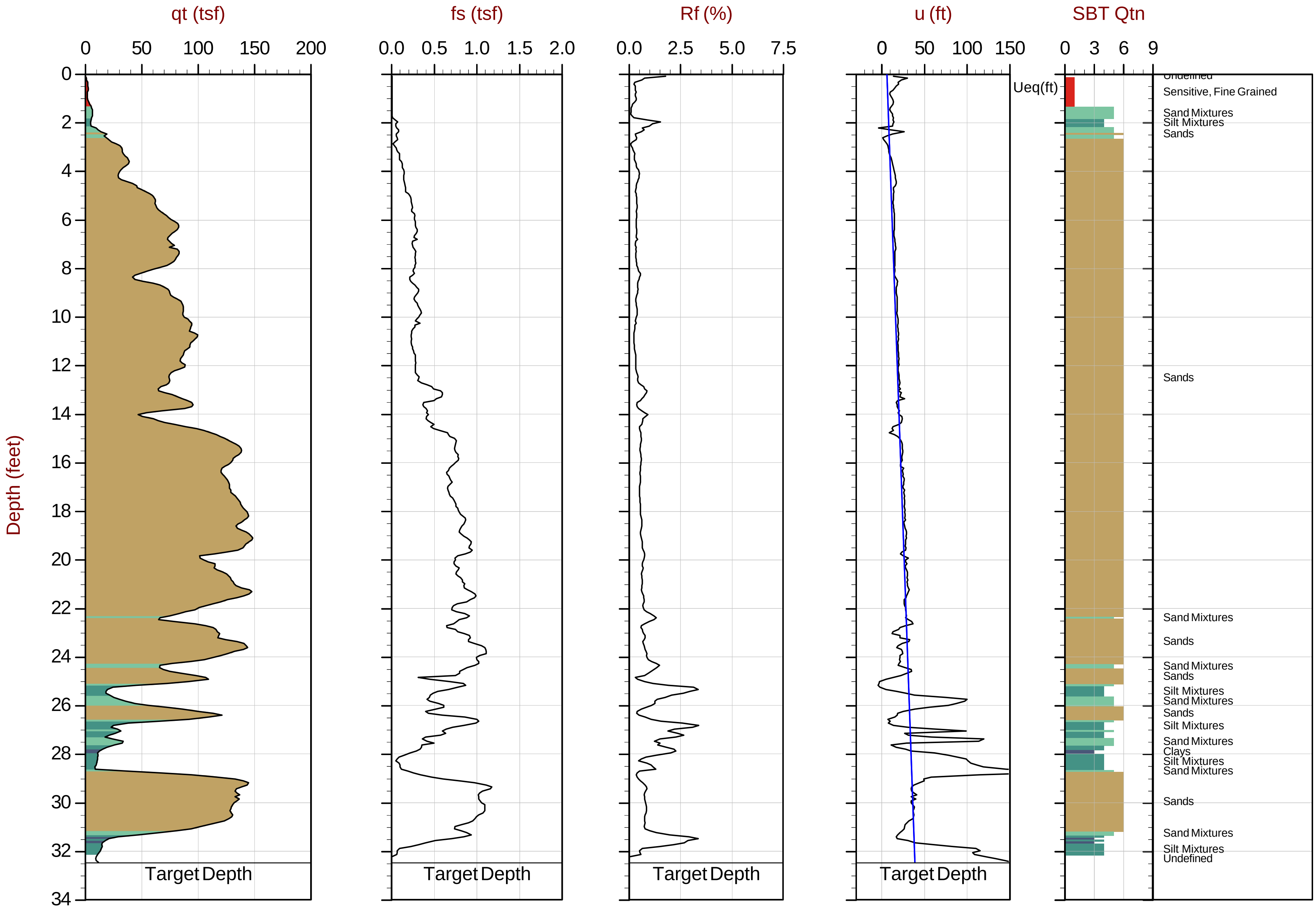
Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-28 19:27
Site: LDW Phase 3
Sounding: LDW21-GT49-GC
Cone: 681:T375F10U35



Max Depth: 9.900 m / 32.48 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP49.COR
Unit Wt: SBTQtn (PKR2009)

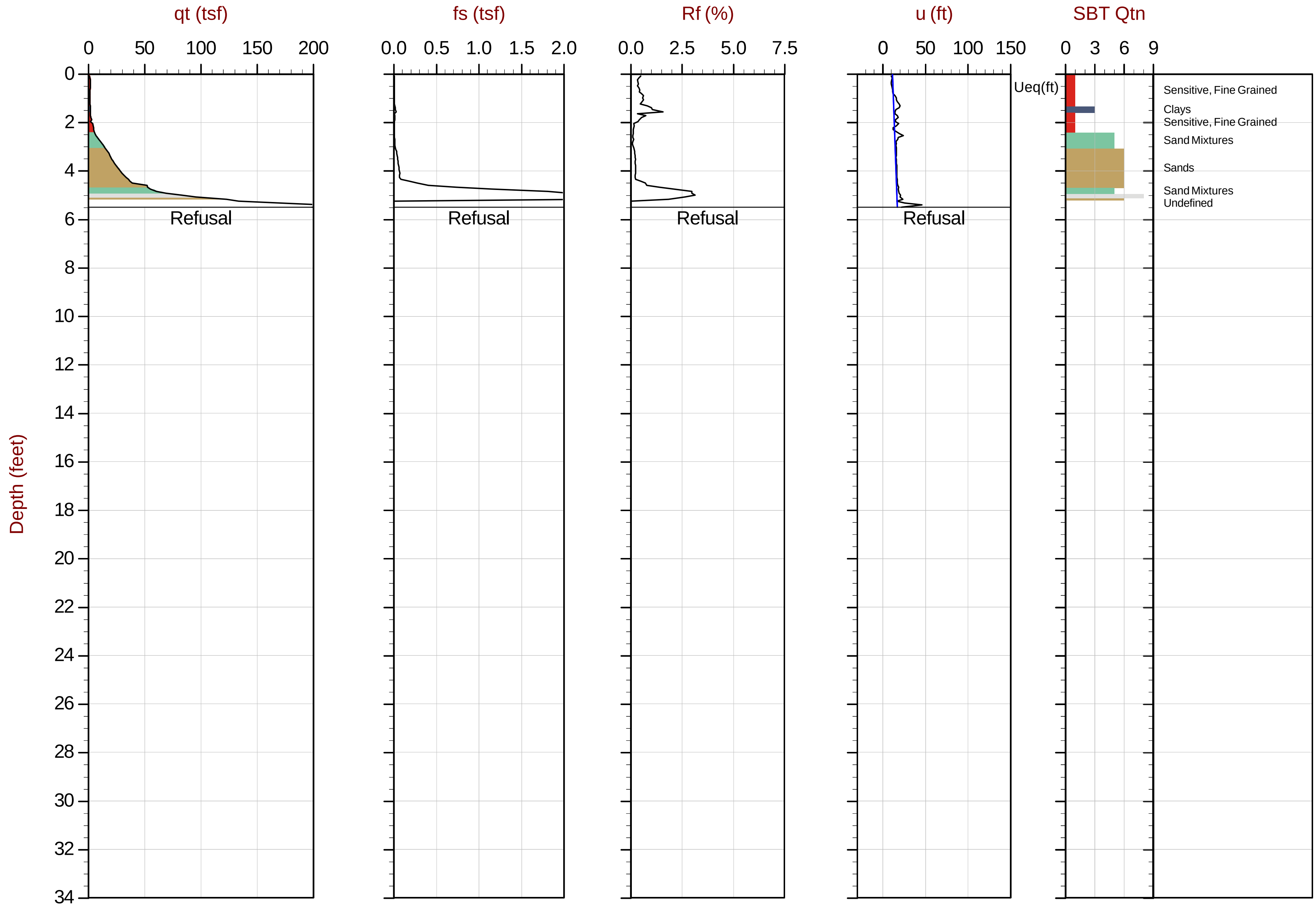
SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51235 Long: -122.29820

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-23 15:21
Site: LDW Phase 3
Sounding: LDW21-GT50-GC
Cone: 681:T375F10U35



Max Depth: 1.675 m / 5.50 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP50.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51207 Long: -122.29793

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

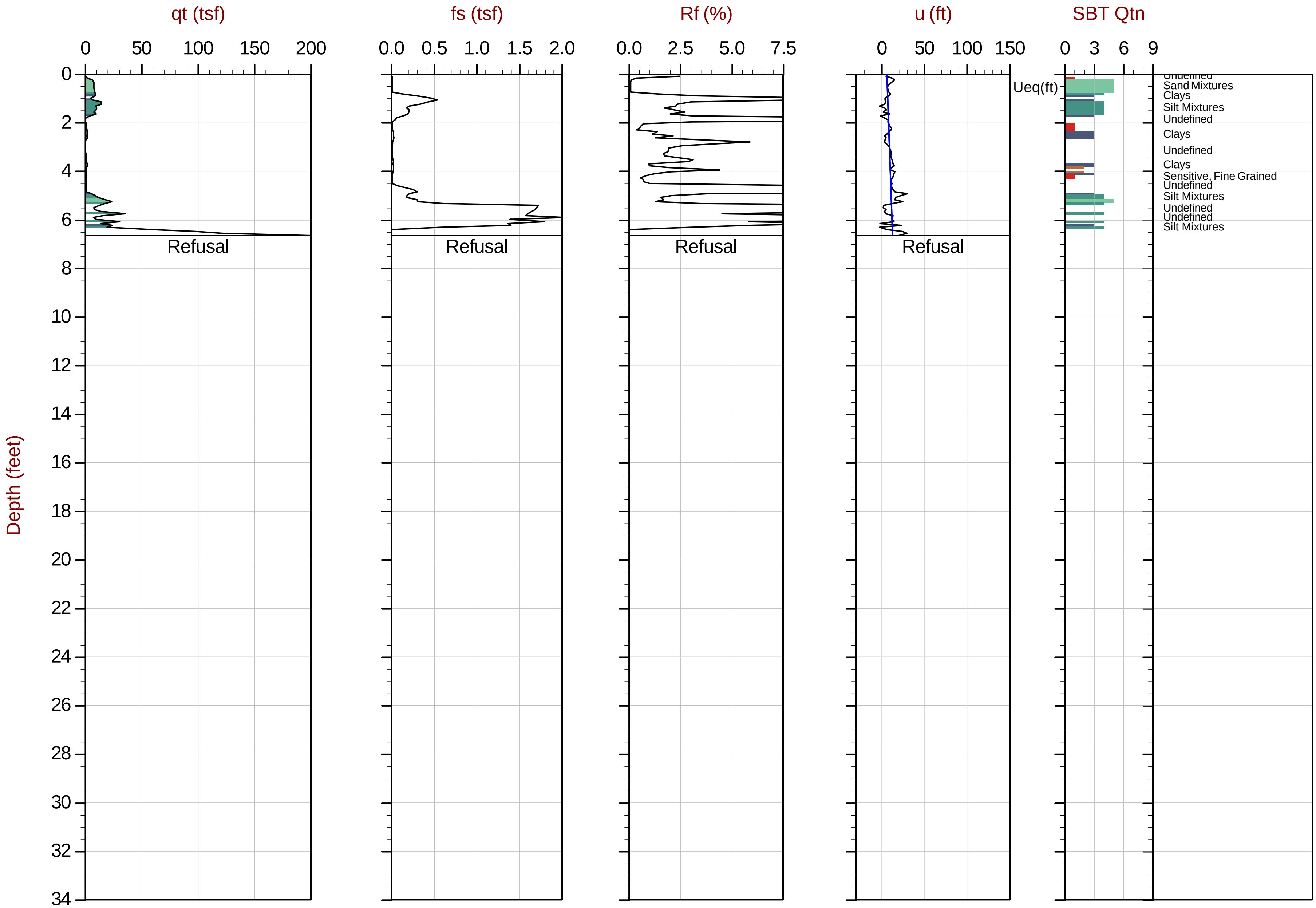
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-26 19:23
Site: LDW Phase 3

Sounding: LDW21-GT51-GC
Cone: 681:T375F10U35



Max Depth: 2.025 m / 6.64 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP51.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51218 Long: -122.29794

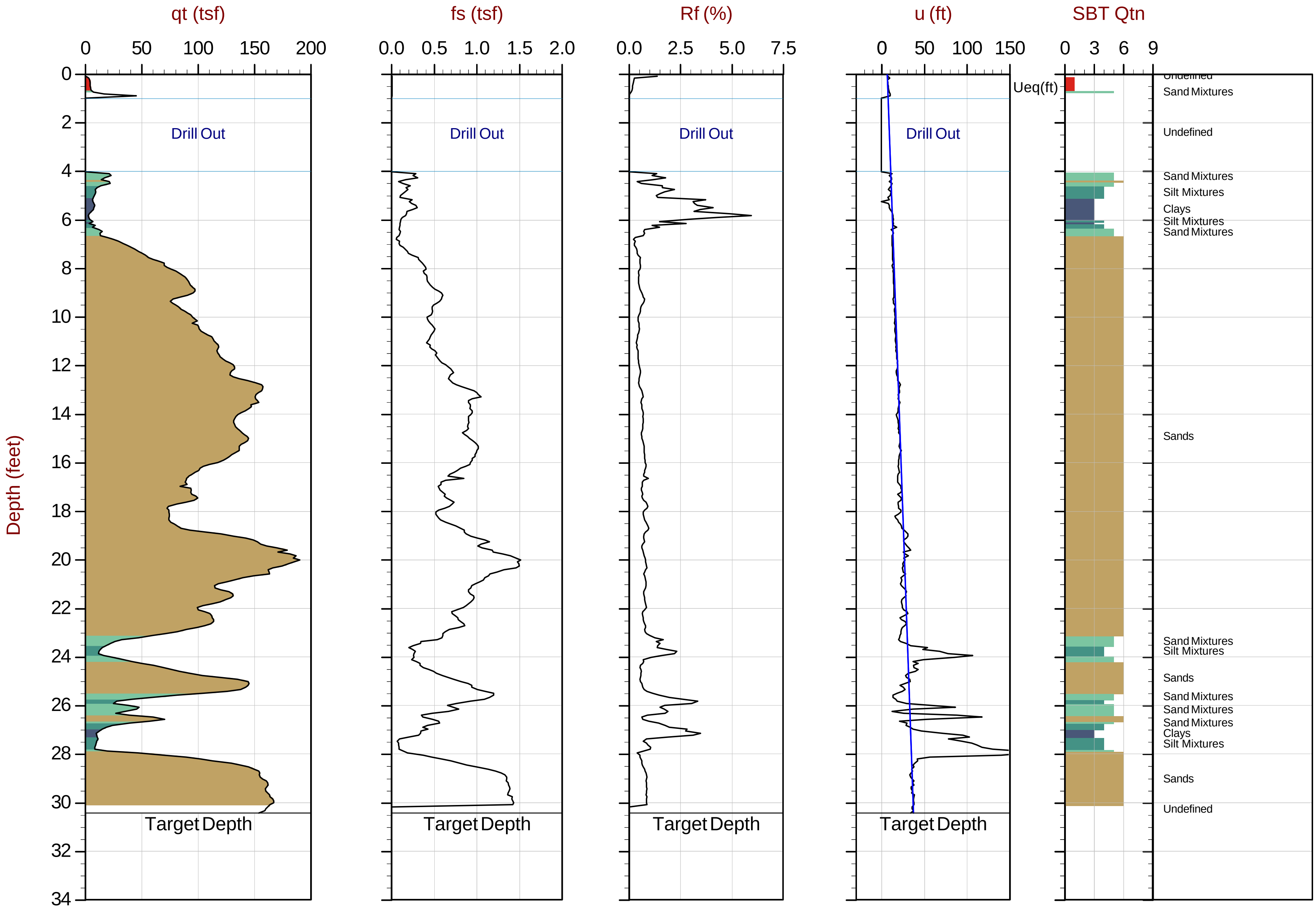
Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

ConeTec

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-27 19:40
Site: LDW Phase 3
Sounding: LDW21-GT52-GC
Cone: 681:T375F10U35



Max Depth: 9.275 m / 30.43 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP52.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51211 Long: -122.29774

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

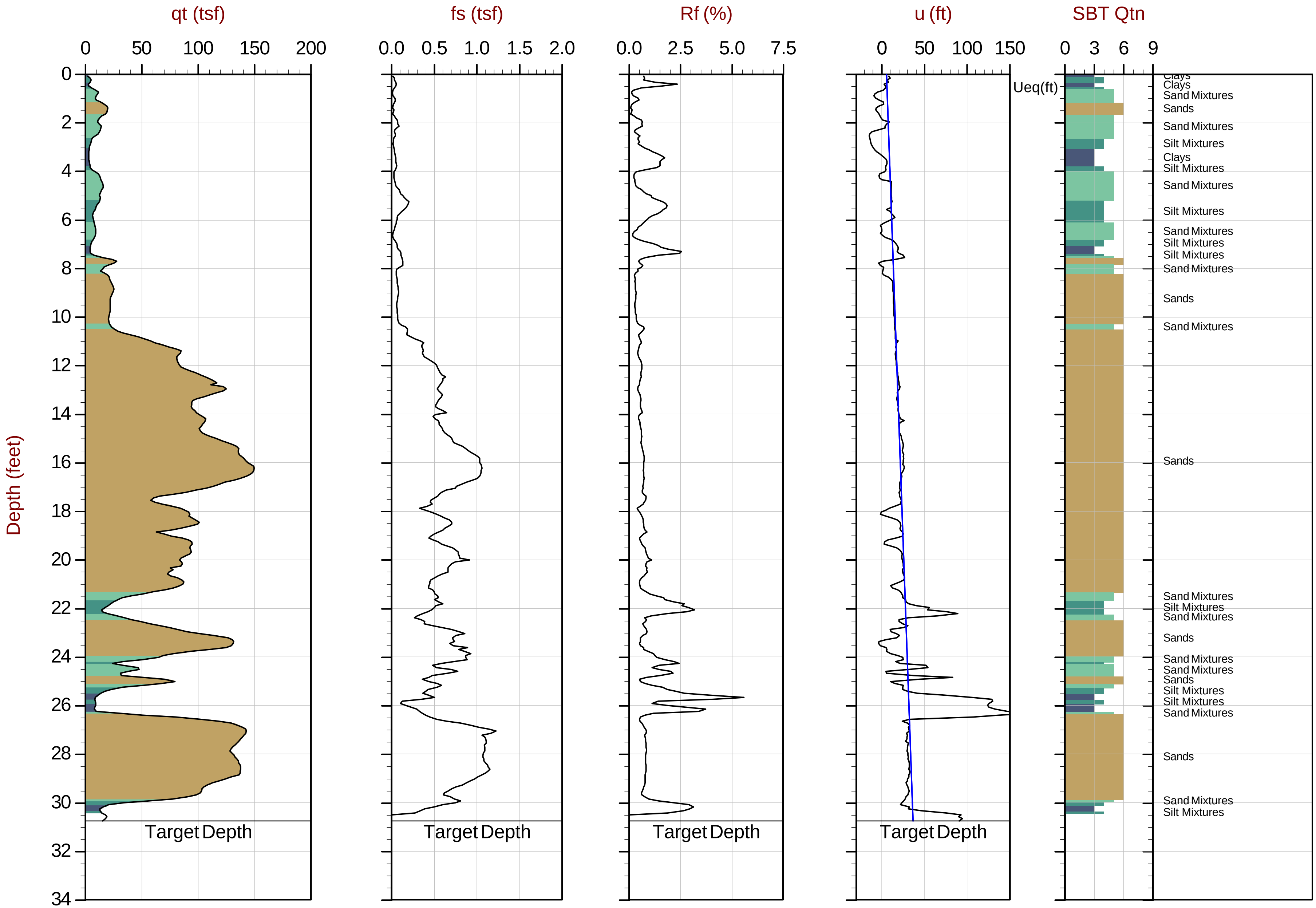
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-27 18:31
Site: LDW Phase 3

Sounding: LDW21-GT54-GC
Cone: 681:T375F10U35



Max Depth: 9.375 m / 30.76 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP54.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51197 Long: -122.29758

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

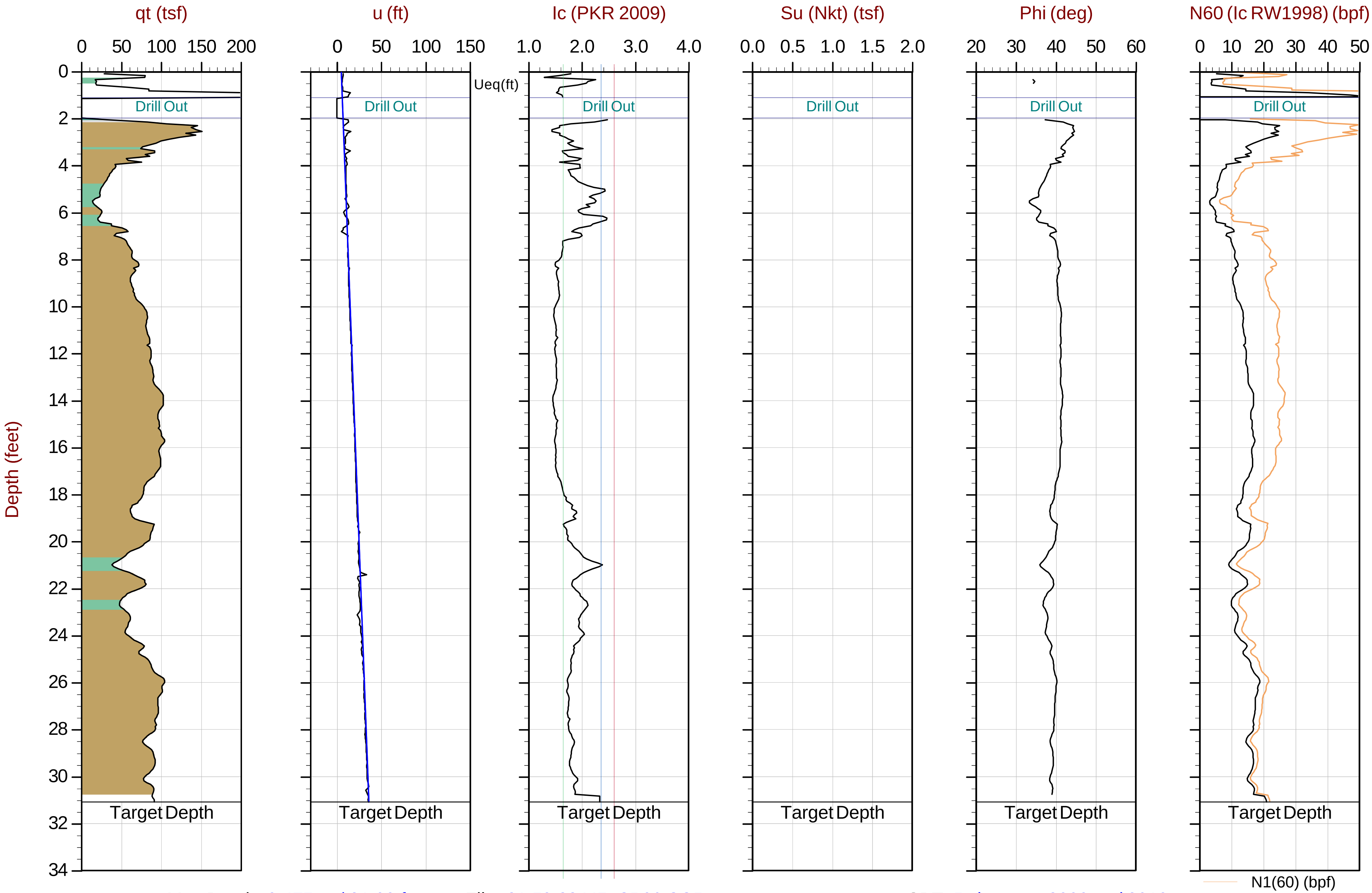
Advanced Cone Penetration Test Plots with Ic, Su, Phi and N(60)/N1(60)

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-22 17:30
Site: LDW Phase 3

Sounding: LDW21-GT06-GC
Cone: 681:T375F10U35



Max Depth: 9.475 m / 31.09 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP06.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.52892 Long: -122.31483

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

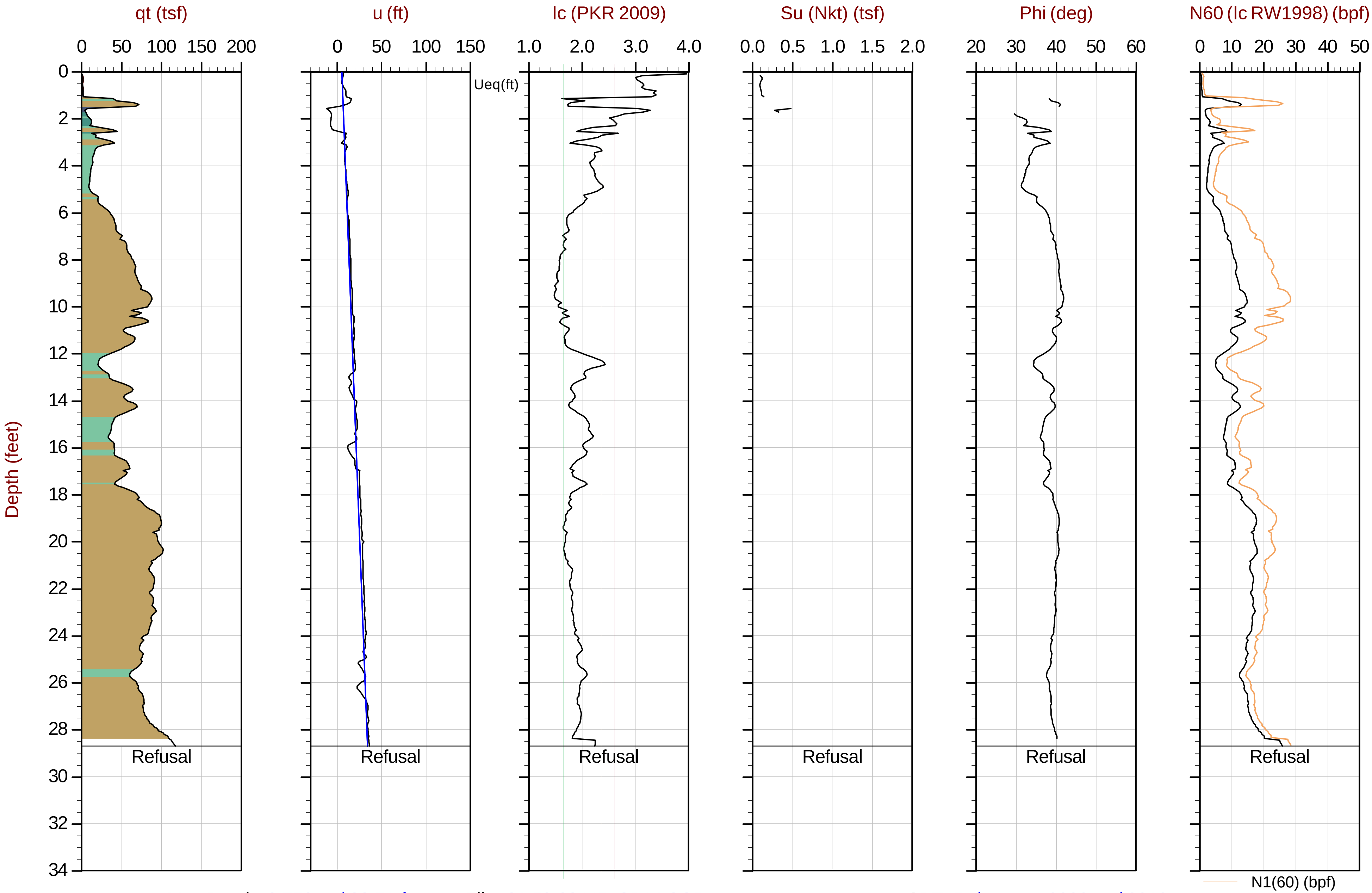
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-08 14:11
Site: LDW Phase 3

Sounding: LDW21-GT14-GC
Cone: 681:T375F10U35



Max Depth: 8.750 m / 28.71 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP14.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.52477 Long: -122.30819

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

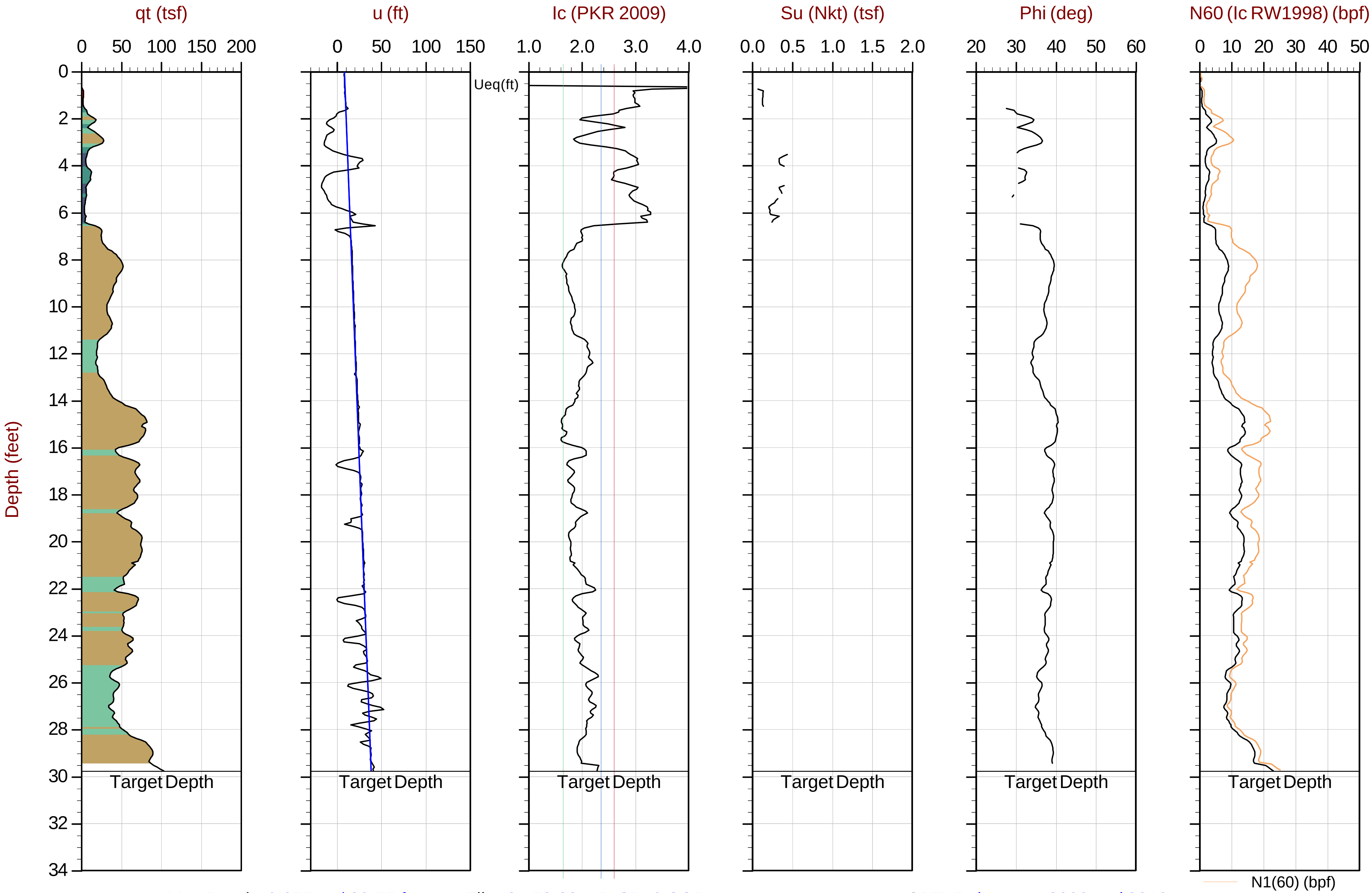
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-08 16:24
Site: LDW Phase 3

Sounding: LDW21-GT16-GC
Cone: 681:T375F10U35



Max Depth: 9.075 m / 29.77 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP16.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.52409 Long: -122.30770

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

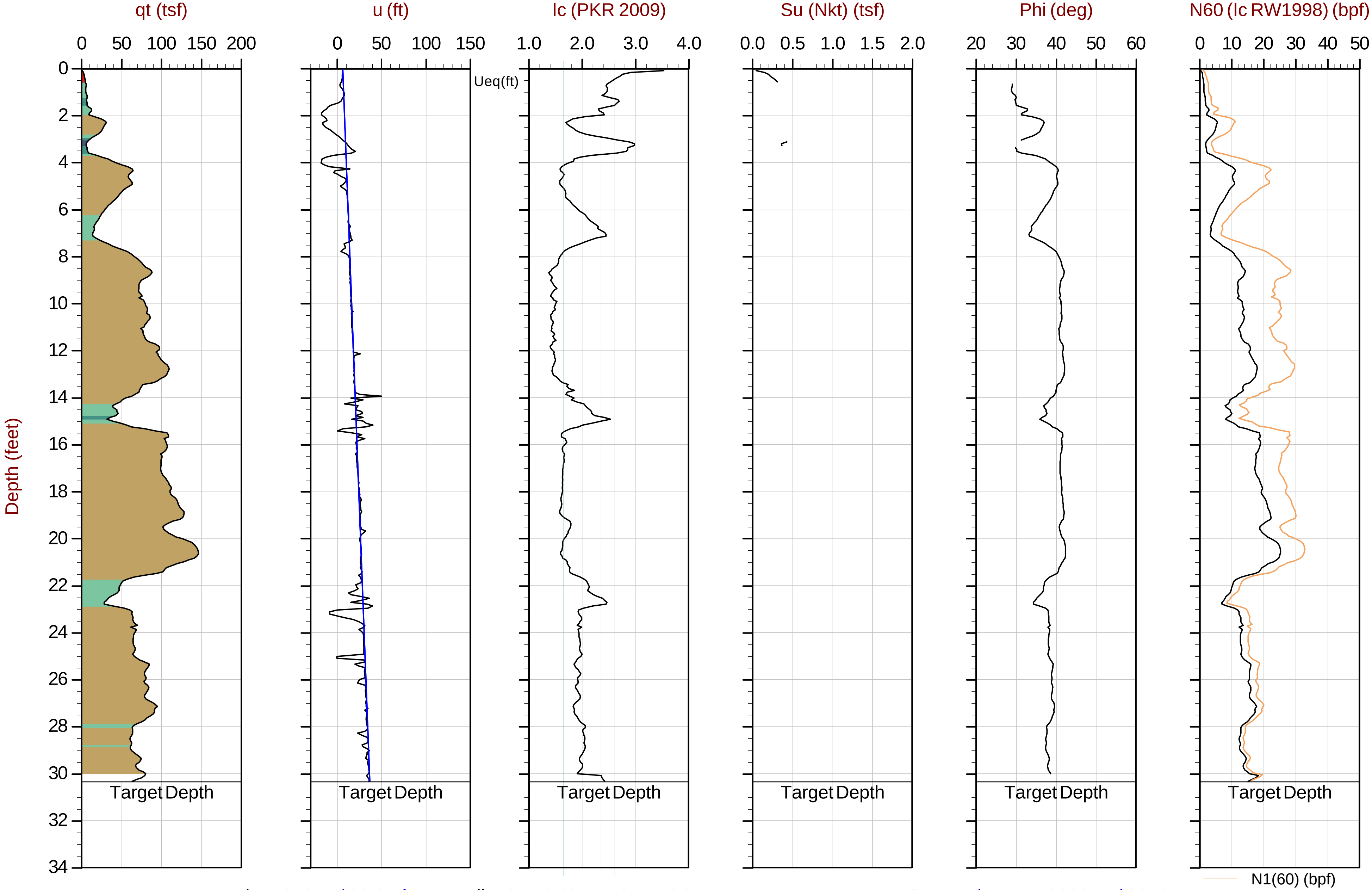
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-12 19:15
Site: LDW Phase 3

Sounding: LDW21-GT17-GC
Cone: 681:T375F10U35



Max Depth: 9.250 m / 30.35 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP17.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: N/A Long: N/A

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

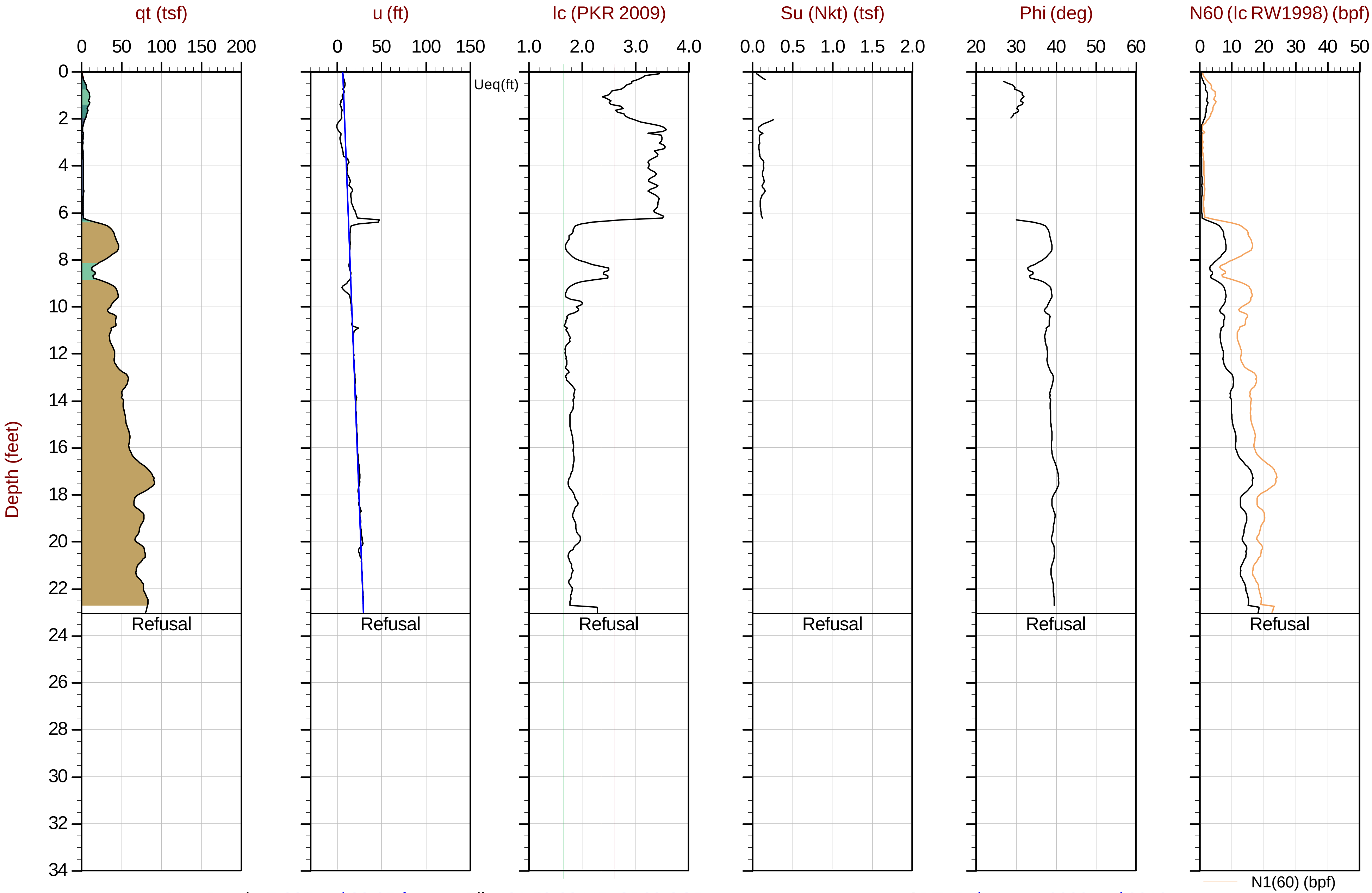
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-16 09:40
Site: LDW Phase 3

Sounding: LDW21-GT20-GC
Cone: 681:T375F10U35



Max Depth: 7.025 m / 23.05 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP20.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: N/A Long: N/A

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

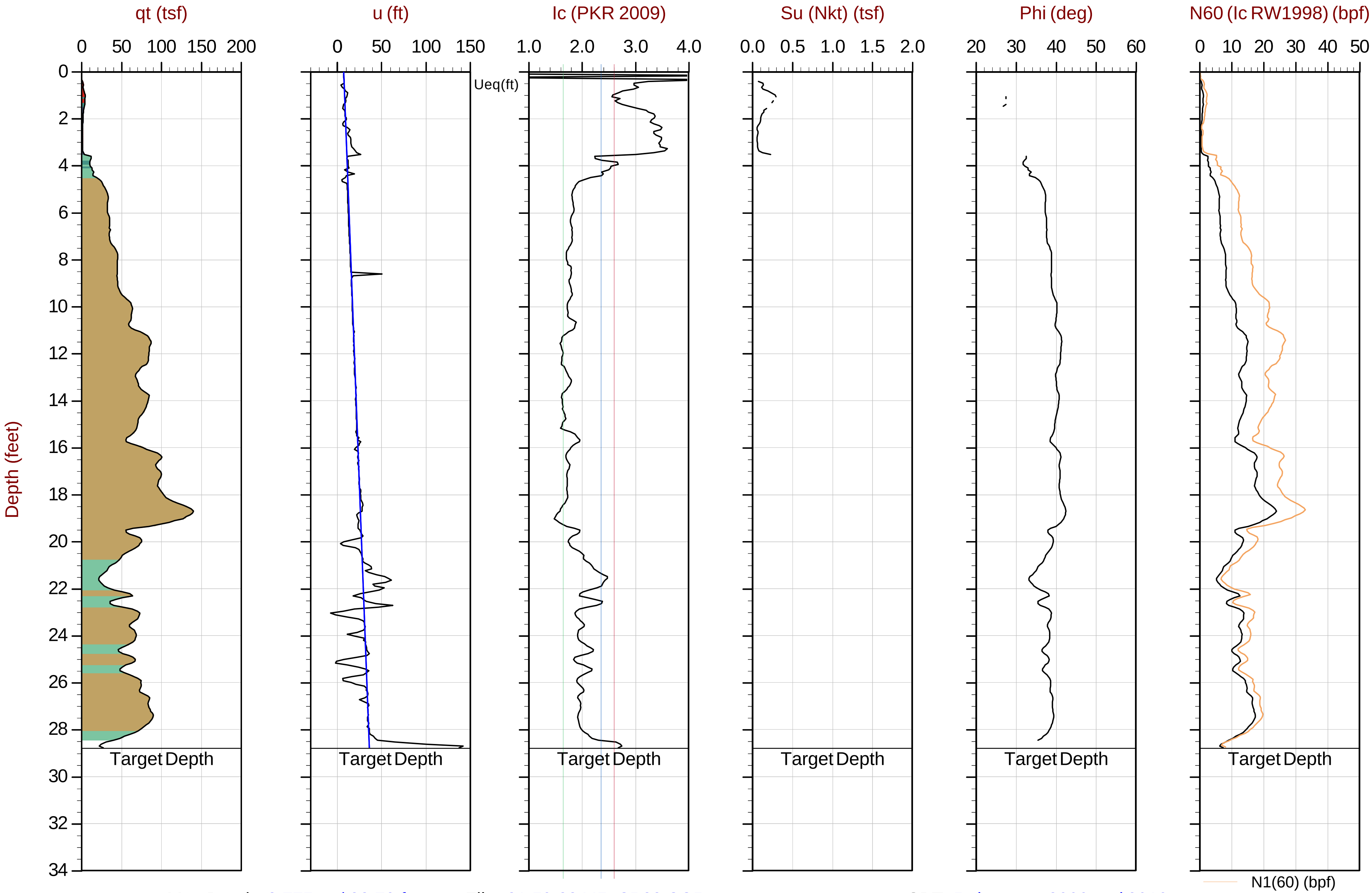
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-13 19:06
Site: LDW Phase 3

Sounding: LDW21-GT22-GC
Cone: 681:T375F10U35



Max Depth: 8.775 m / 28.79 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

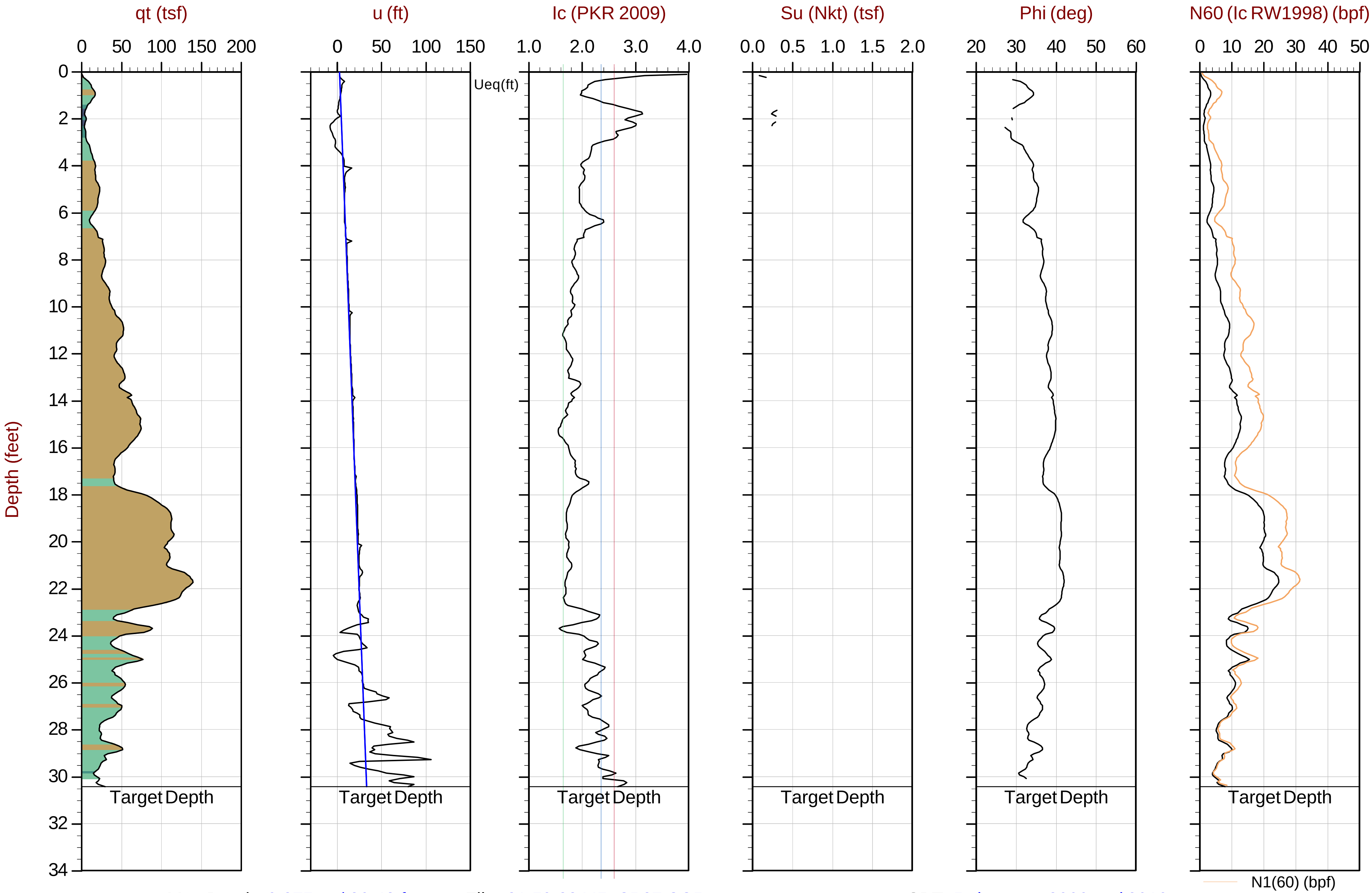
File: 21-59-22445_CP22.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: N/A Long: N/A

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC	*Anchor QEA*	Job No: 21-59-22445 Date: 2021-07-16 08:30 Site: LDW Phase 3	Sounding: LDW21-GT27-GC Cone: 681:T375F10U35



Max Depth: 9.275 m / 30.43 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP27.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: N/A Long: N/A

Equilibrium Pore Pressure (Ueq) · Assumed Ueq · Dissipation, Ueq achieved · Dissipation, Ueq not achieved · Hydrostatic Line

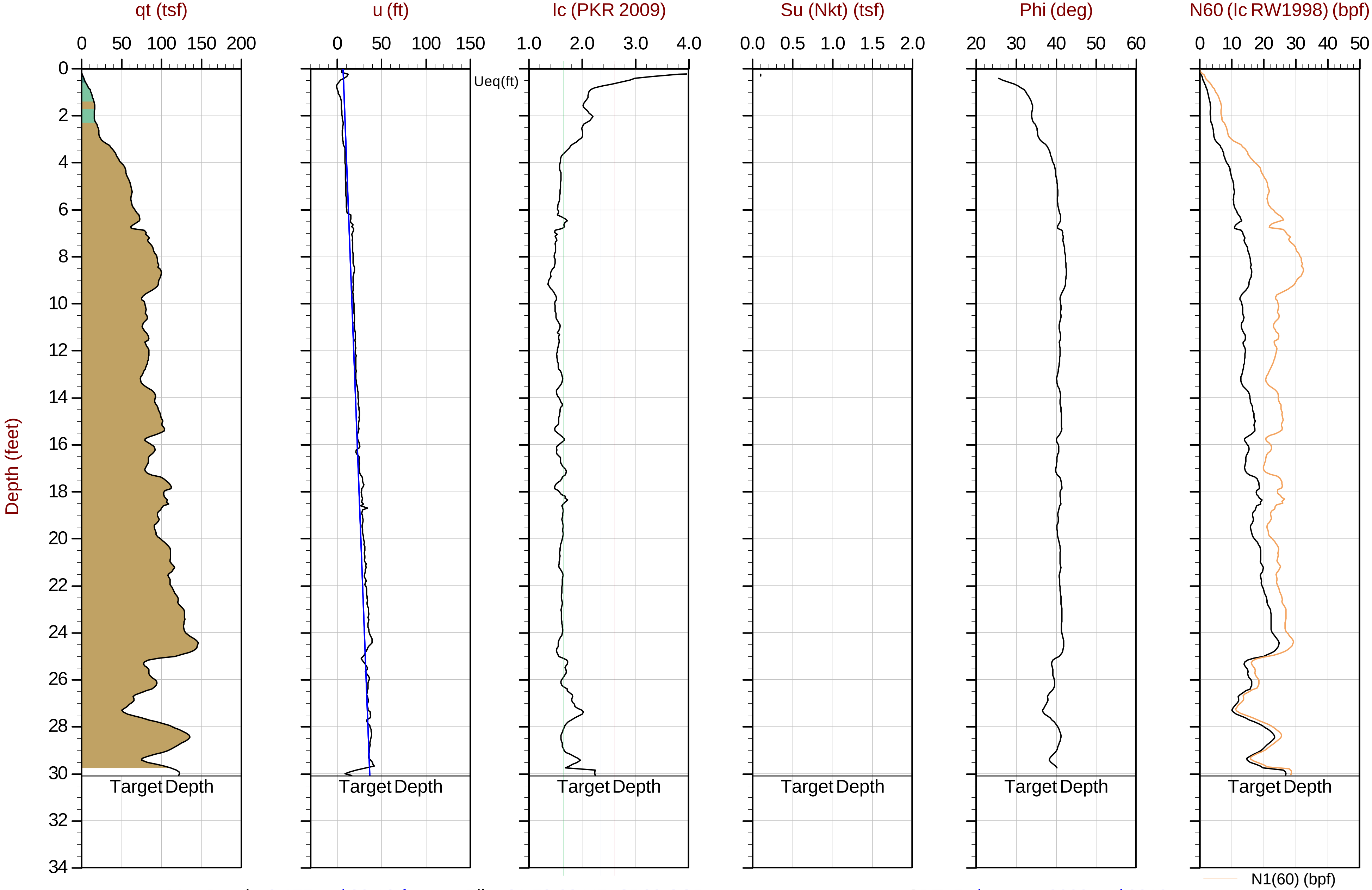
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-21 15:09
Site: LDW Phase 3

Sounding: LDW21-GT30-GC
Cone: 681:T375F10U35



Max Depth: 9.175 m / 30.10 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP30.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.52066 Long: -122.30558

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

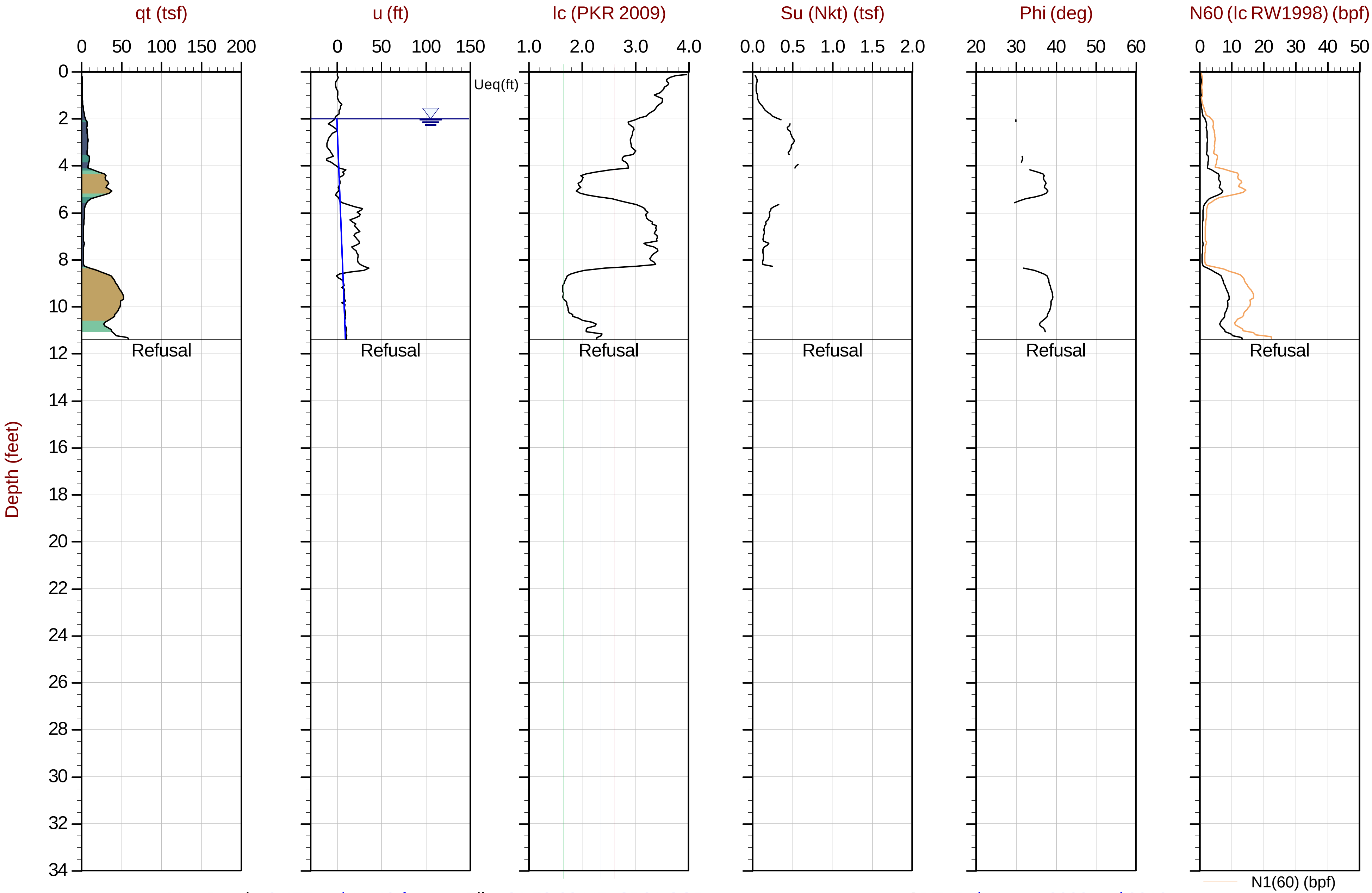
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

ConeTec

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-09 10:35
Site: LDW Phase 3

Sounding: LDW21-GT31-GC
Cone: 681:T375F10U35



Max Depth: 3.475 m / 11.40 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP31.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: N/A Long: N/A

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

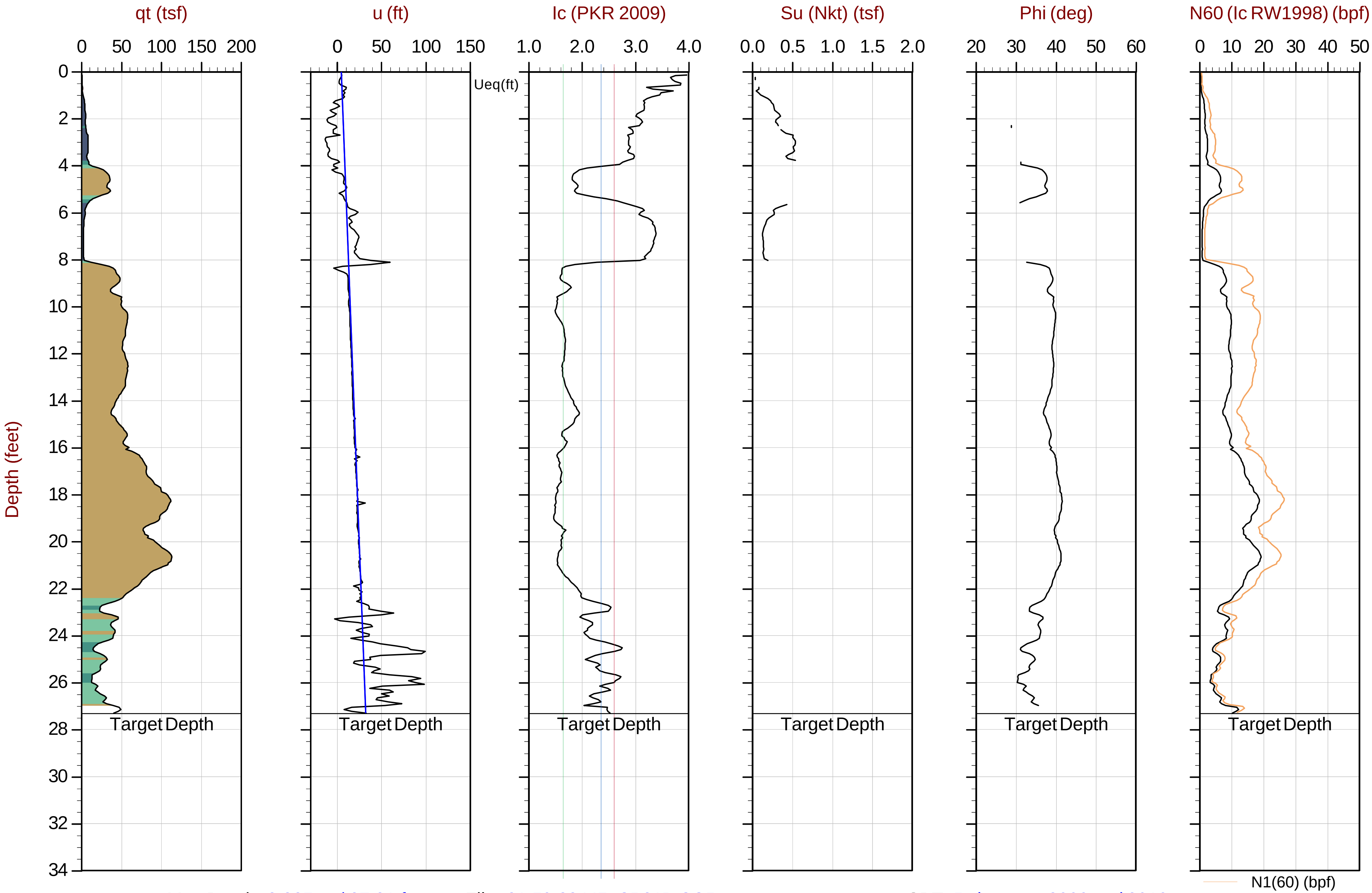
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-13 17:56
Site: LDW Phase 3

Sounding: LDW21-GT31-GC-B
Cone: 681:T375F10U35



Max Depth: 8.325 m / 27.31 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP31B.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

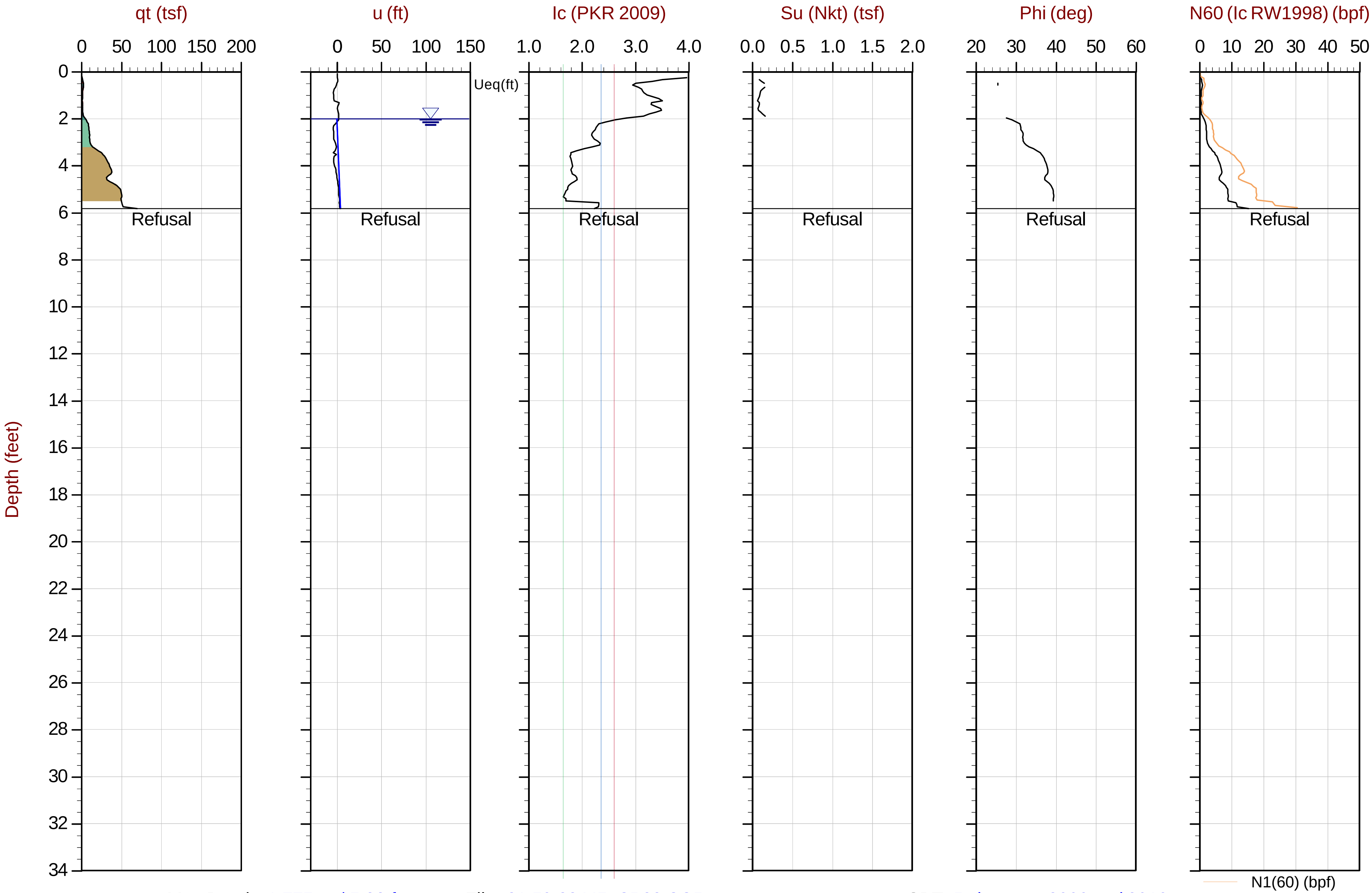
SBT: Robertson, 2009 and 2010
Coords: Lat: N/A Long: N/A

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-09 11:18
Site: LDW Phase 3
Sounding: LDW21-GT32-GC
Cone: 681:T375F10U35



Max Depth: 1.775 m / 5.82 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP32.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.52028 Long: -122.30553

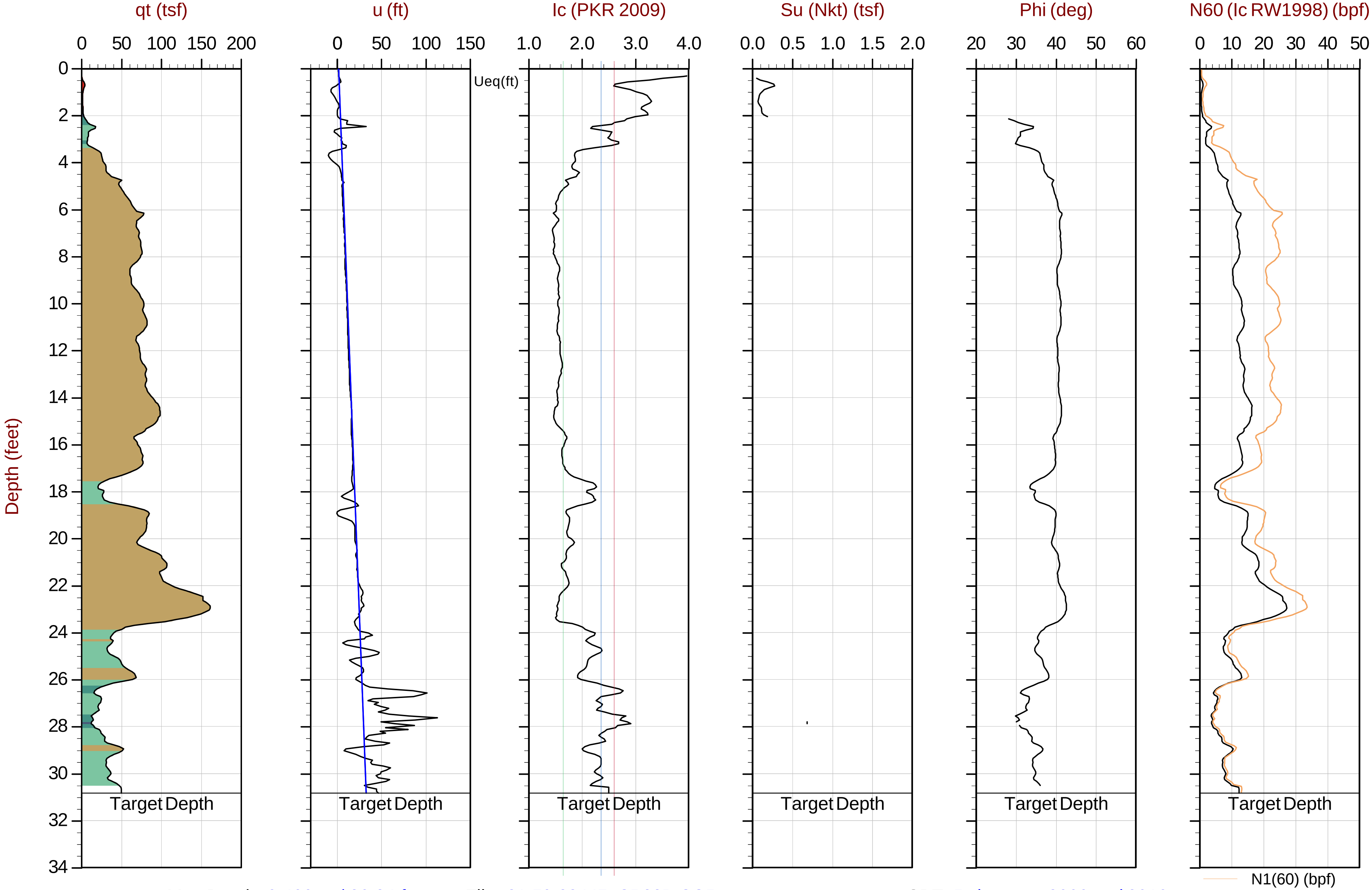
Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

ConeTec

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-21 13:24
Site: LDW Phase 3
Sounding: LDW21-GT32-GC-B
Cone: 681:T375F10U35



Max Depth: 9.400 m / 30.84 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP32B.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.52030 Long: -122.30555

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

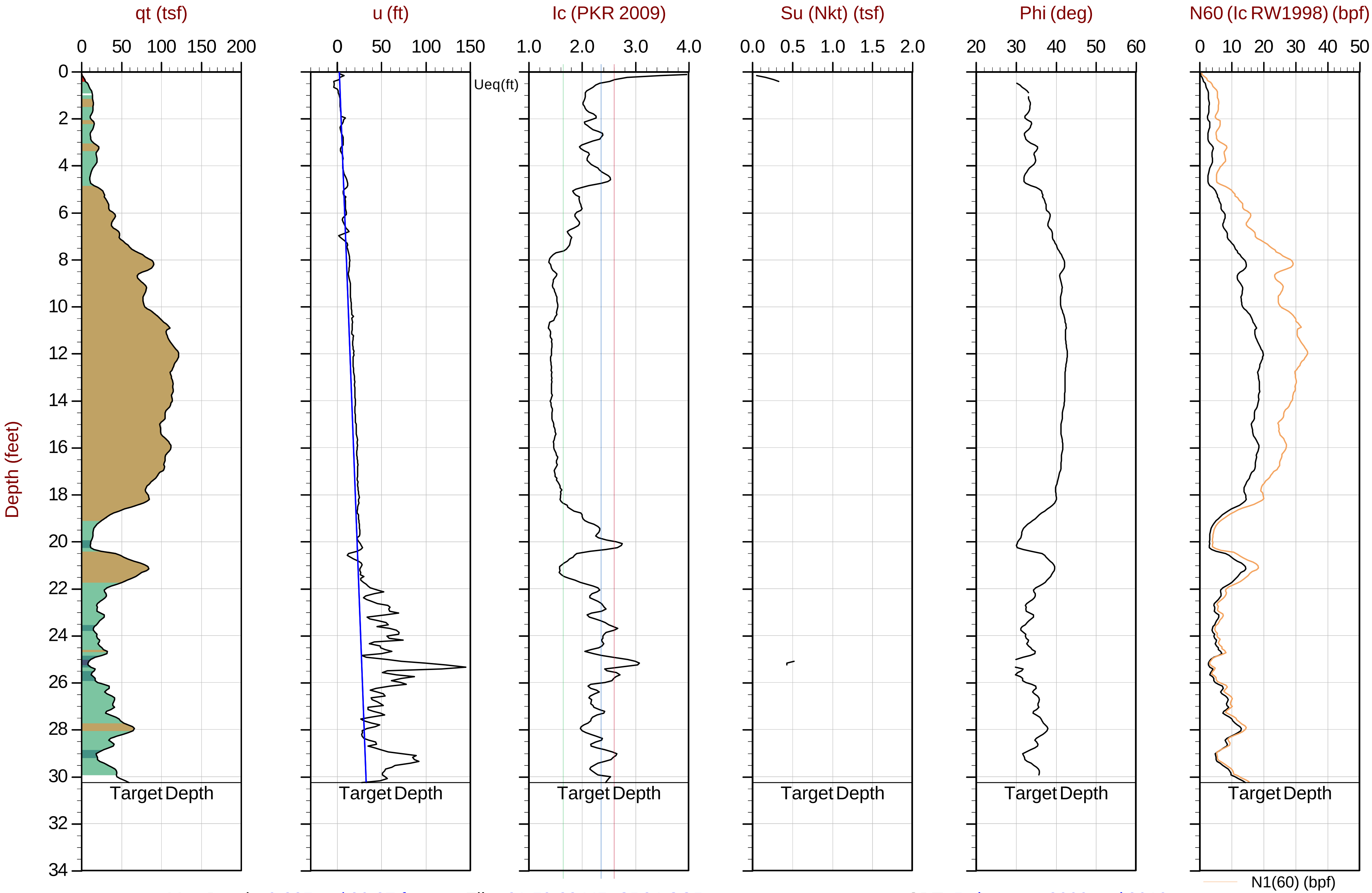
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-21 14:17
Site: LDW Phase 3

Sounding: LDW21-GT34-GC
Cone: 681:T375F10U35



Max Depth: 9.225 m / 30.27 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP34.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51986 Long: -122.30540

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

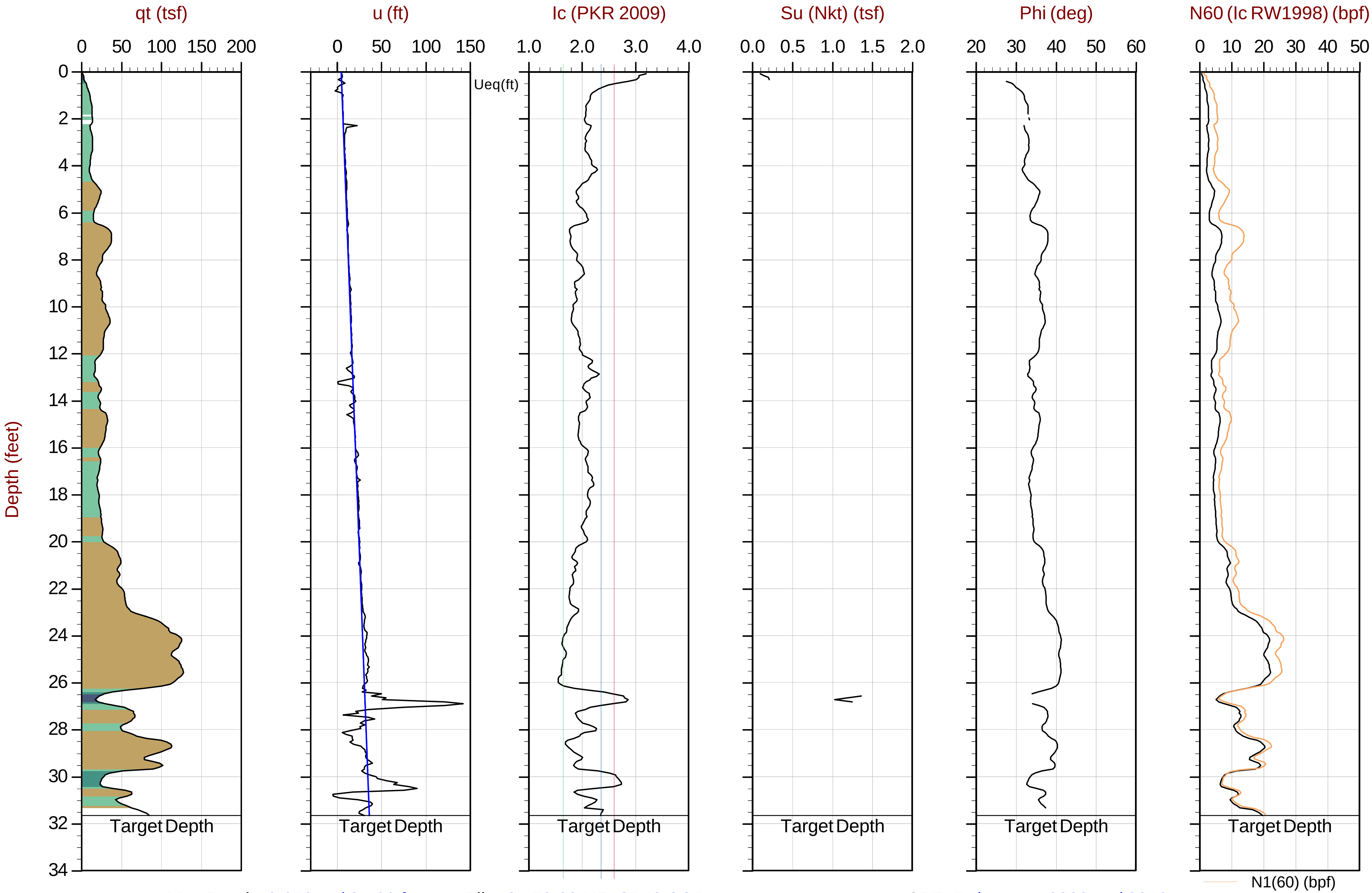
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

ConeTec

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-19 13:58
Site: LDW Phase 3

Sounding: LDW21-GT40-GC
Cone: 681:T375F10U35



Max Depth: 9.650 m / 31.66 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP40.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51155 Long: -122.30247

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

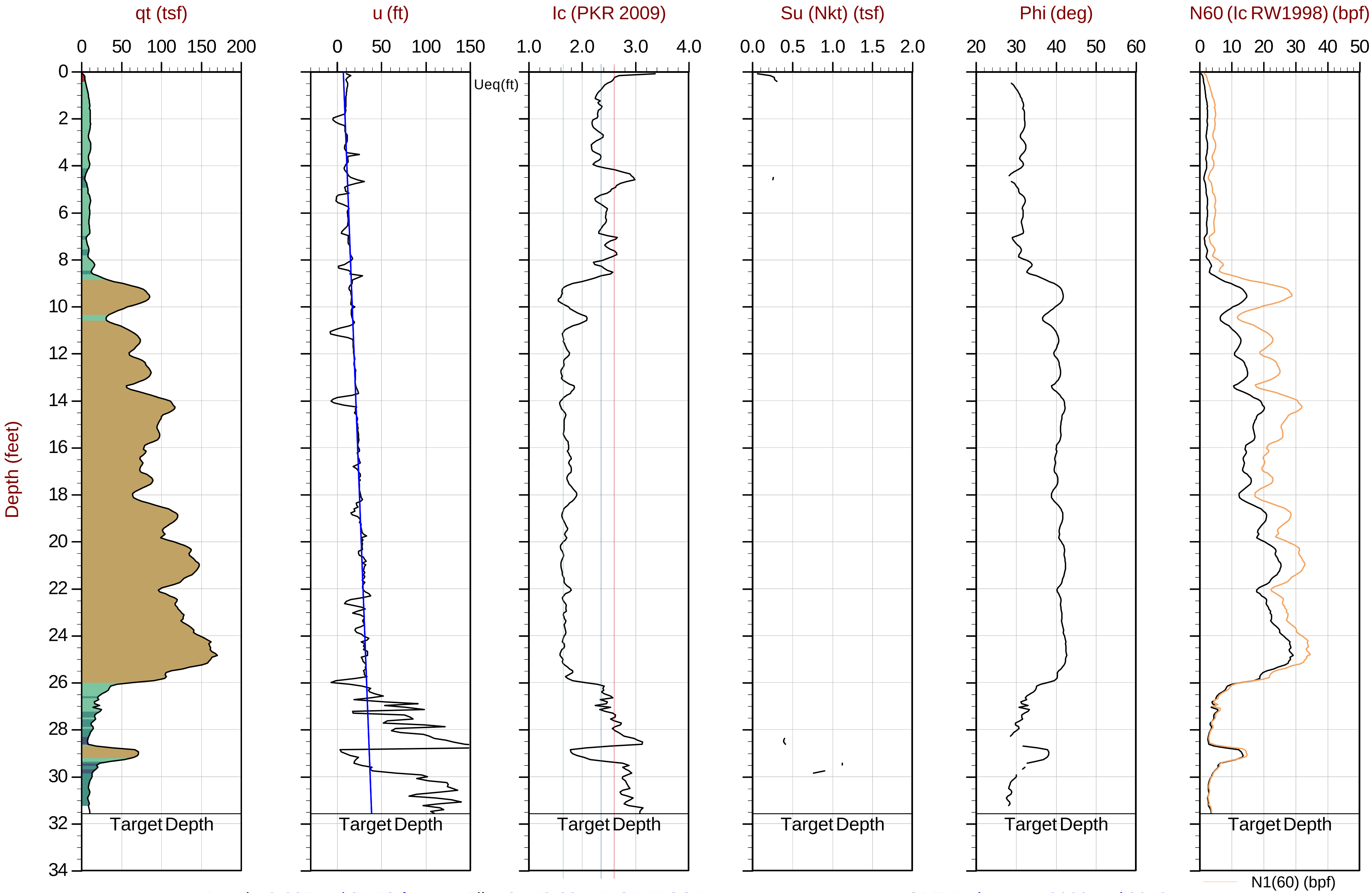
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-28 18:24
Site: LDW Phase 3

Sounding: LDW21-GT45-GC
Cone: 681:T375F10U35



Max Depth: 9.625 m / 31.58 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP45.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51253 Long: -122.29899

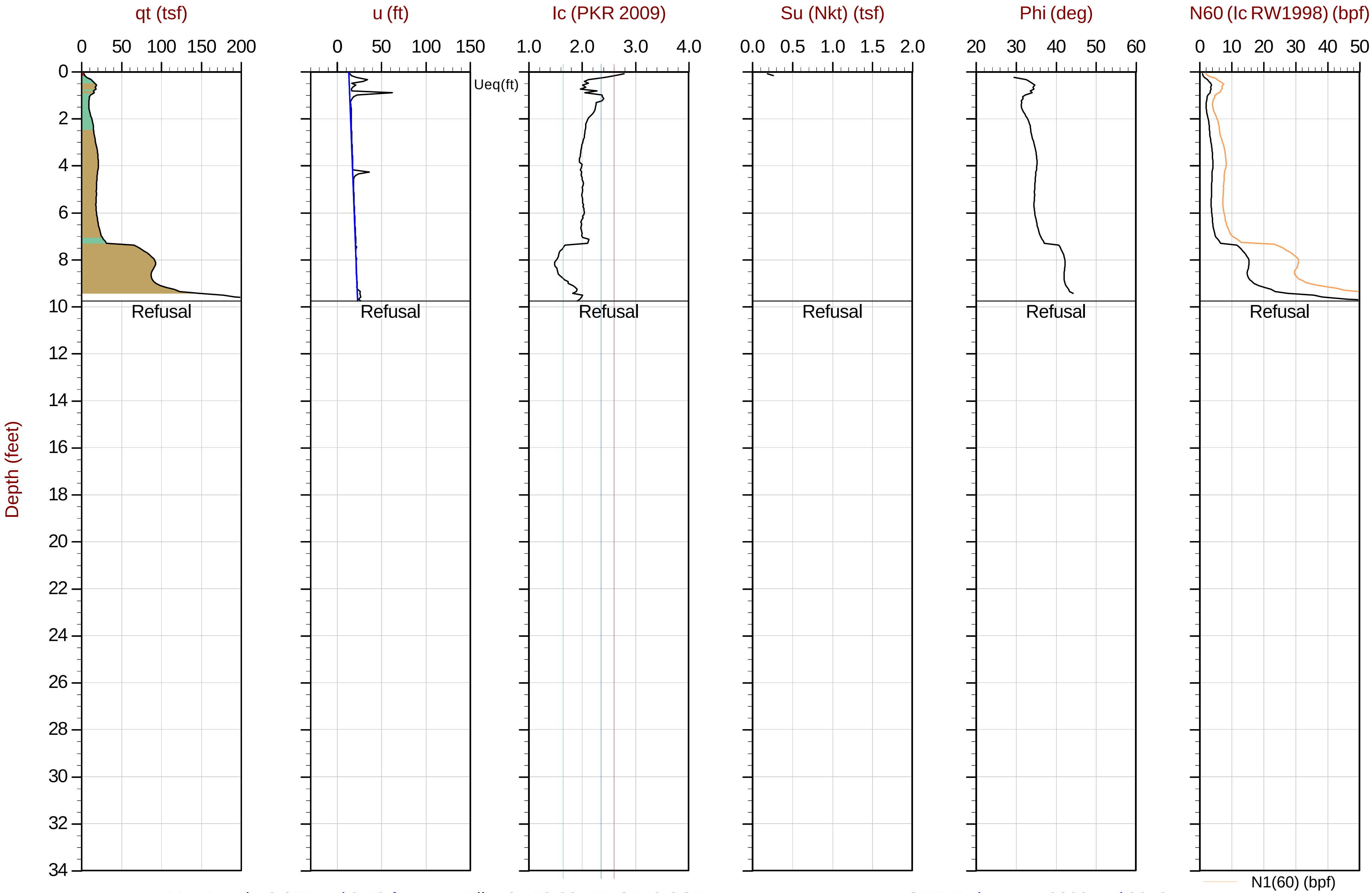
Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-26 09:49
Site: LDW Phase 3
Sounding: LDW21-GT46-GC
Cone: 681:T375F10U35



Max Depth: 2.975 m / 9.76 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP46.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51233 Long: -122.29862

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

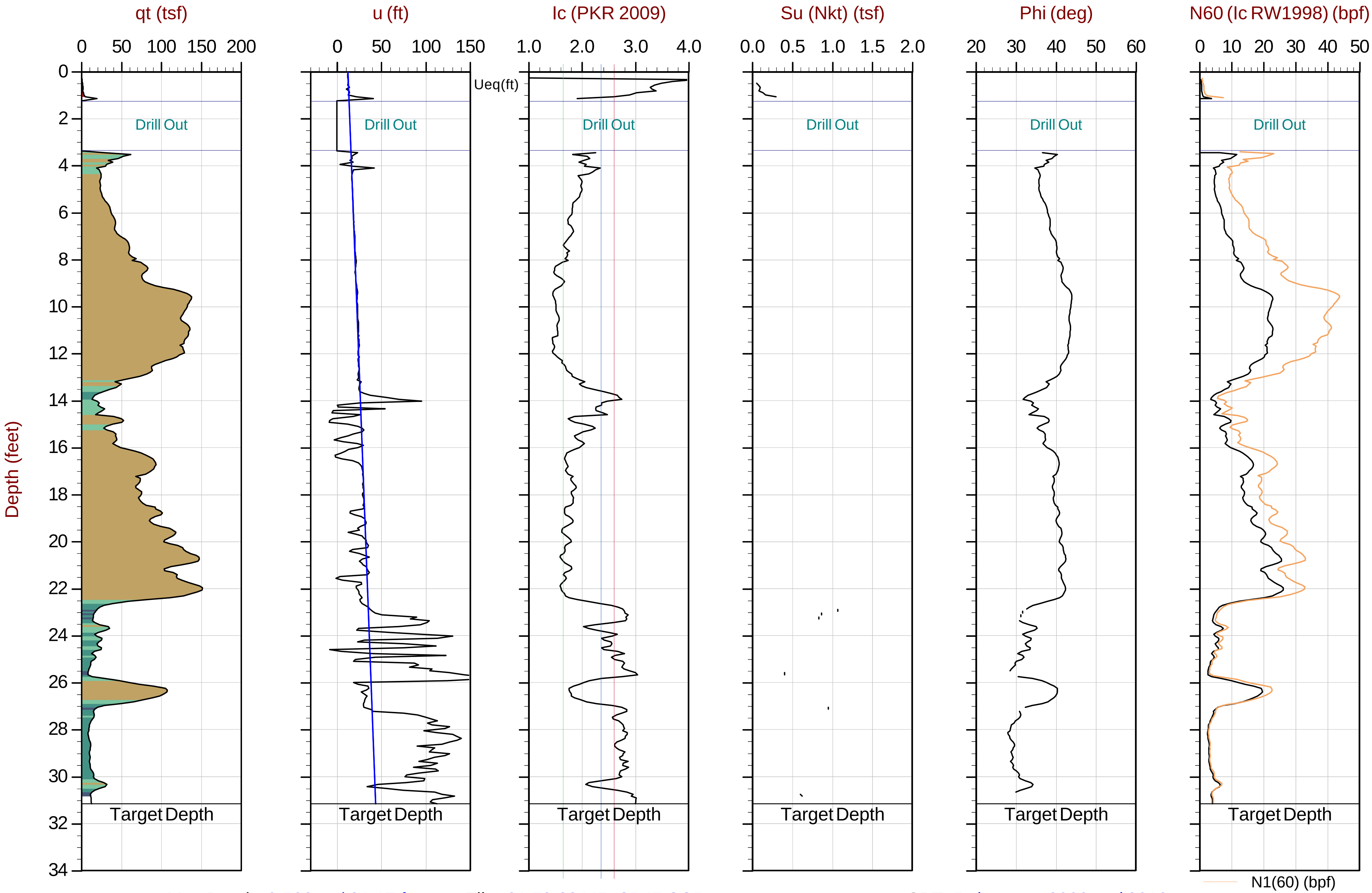
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-27 20:39
Site: LDW Phase 3

Sounding: LDW21-GT47-GC
Cone: 681:T375F10U35



Max Depth: 9.500 m / 31.17 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

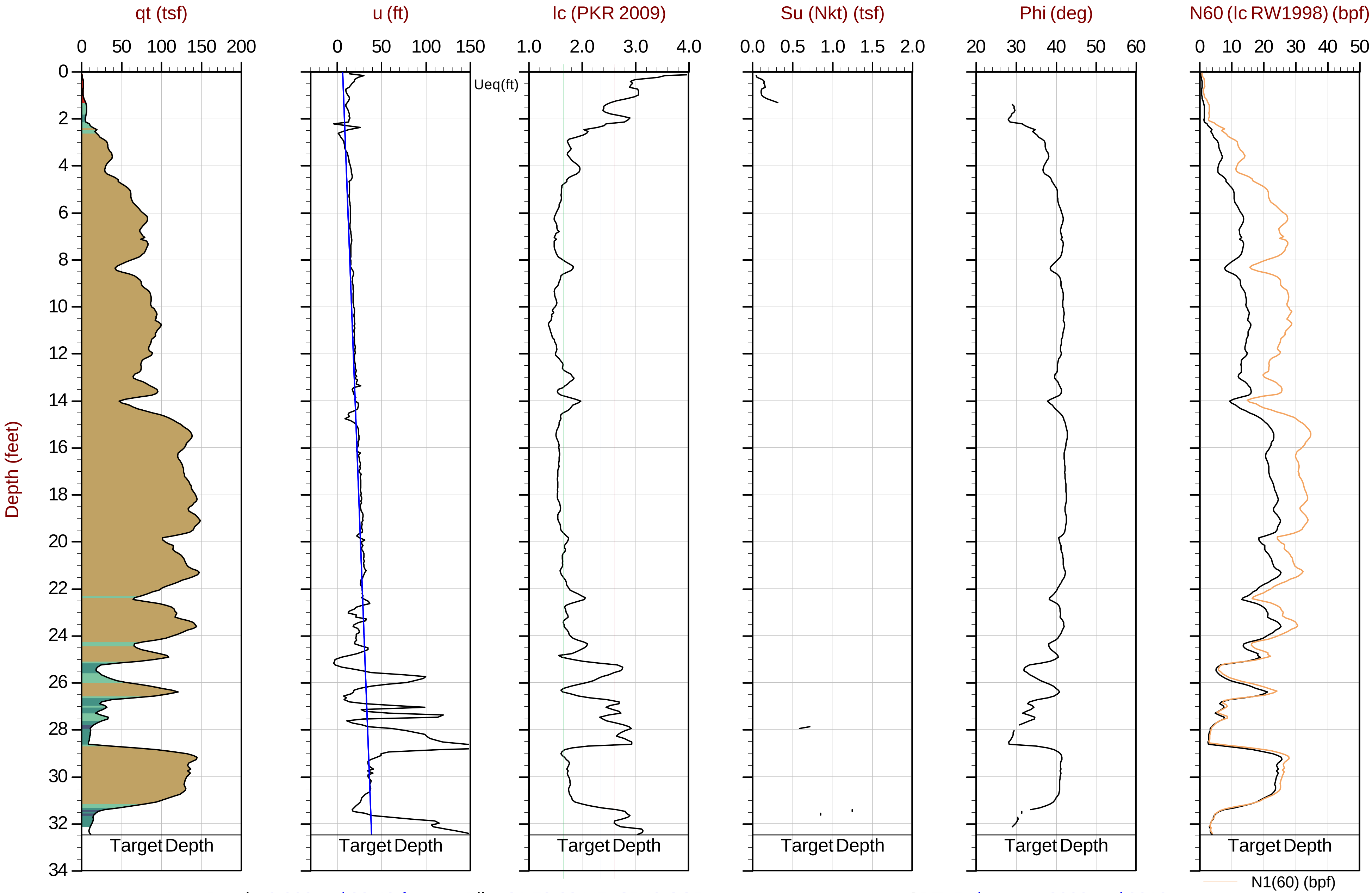
File: 21-59-22445_CP47.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51242 Long: -122.29865

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Job No: 21-59-22445
Date: 2021-07-28 19:27
Site: LDW Phase 3
Sounding: LDW21-GT49-GC
Cone: 681:T375F10U35



Max Depth: 9.900 m / 32.48 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP49.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51235 Long: -122.29820

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

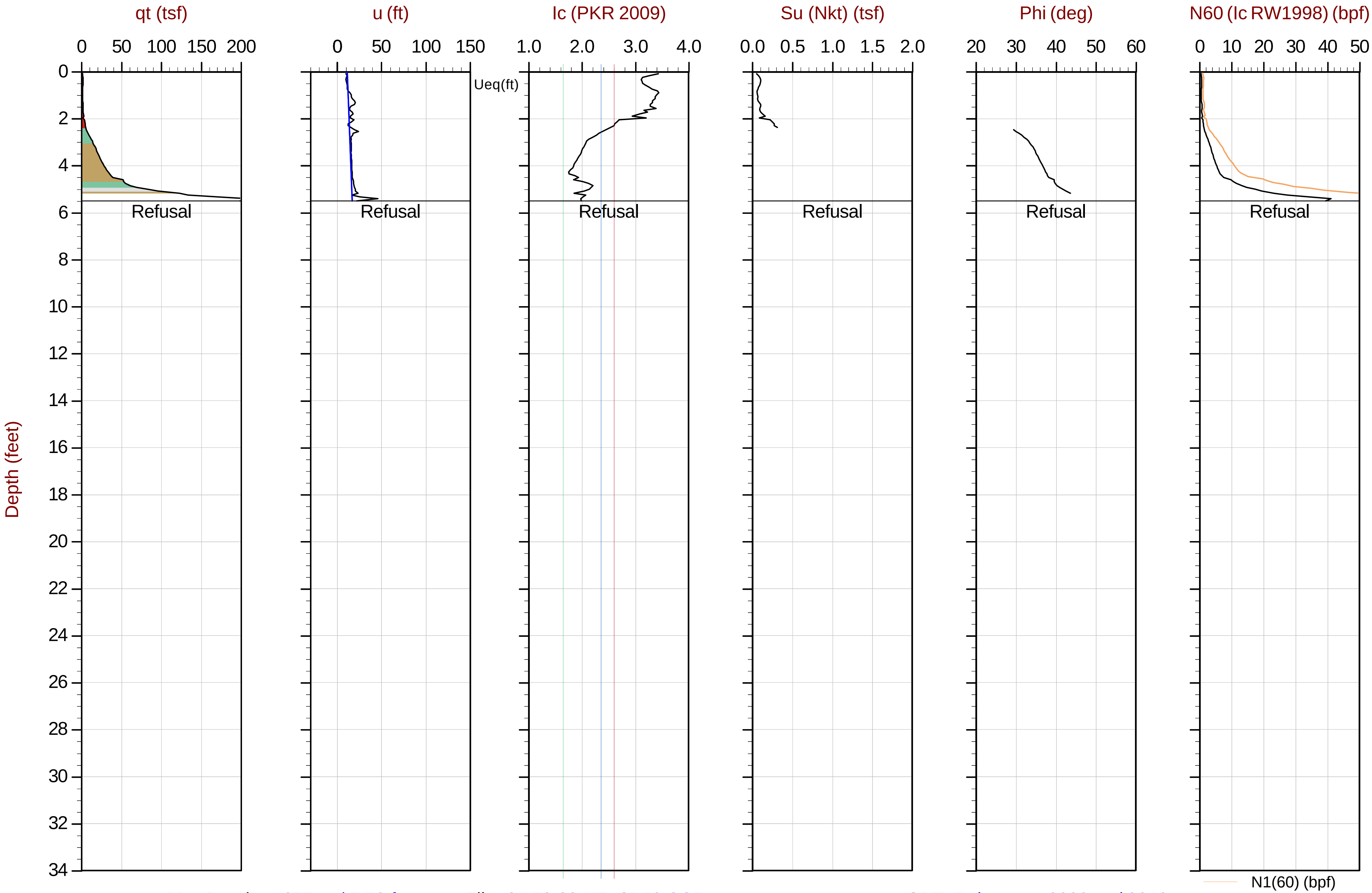
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

ConeTec

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-23 15:21
Site: LDW Phase 3

Sounding: LDW21-GT50-GC
Cone: 681:T375F10U35



Max Depth: 1.675 m / 5.50 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP50.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

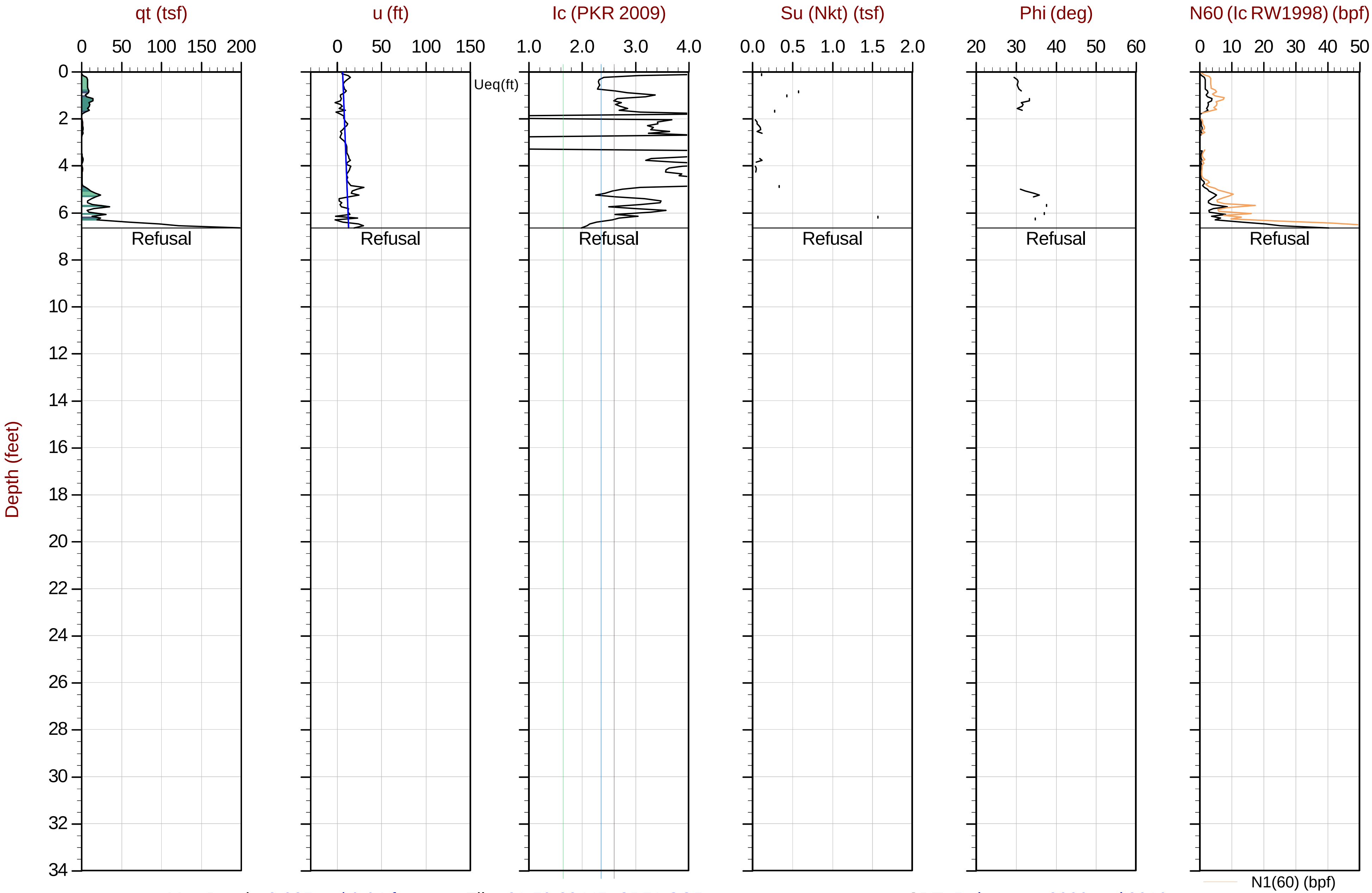
SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51207 Long: -122.29793

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-26 19:23
Site: LDW Phase 3
Sounding: LDW21-GT51-GC
Cone: 681:T375F10U35



Max Depth: 2.025 m / 6.64 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP51.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51218 Long: -122.29794

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

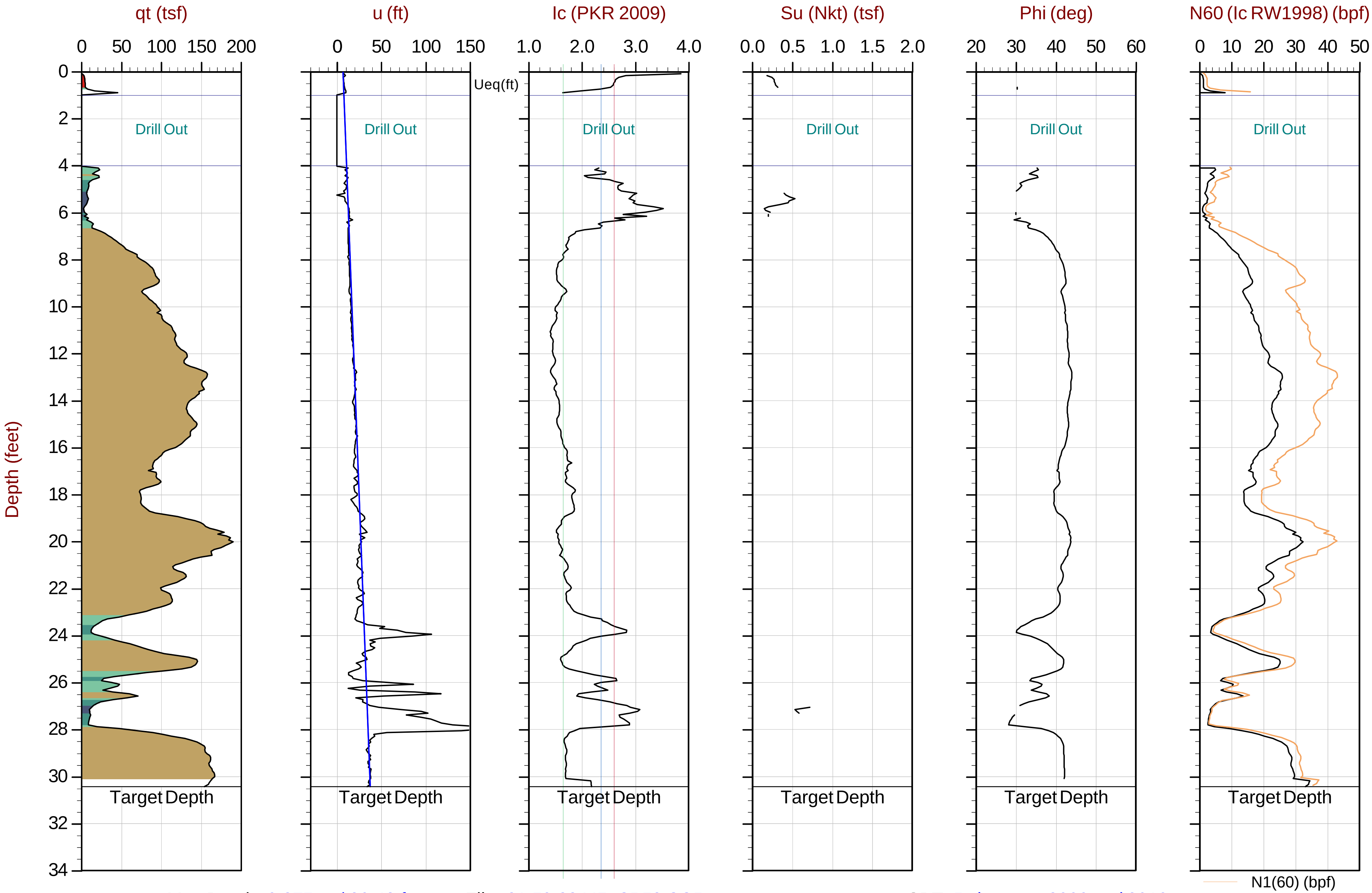
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-27 19:40
Site: LDW Phase 3

Sounding: LDW21-GT52-GC
Cone: 681:T375F10U35



Max Depth: 9.275 m / 30.43 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP52.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51211 Long: -122.29774

Equilibrium Pore Pressure (Ueq) Assumed Ueq Dissipation, Ueq achieved Dissipation, Ueq not achieved Hydrostatic Line

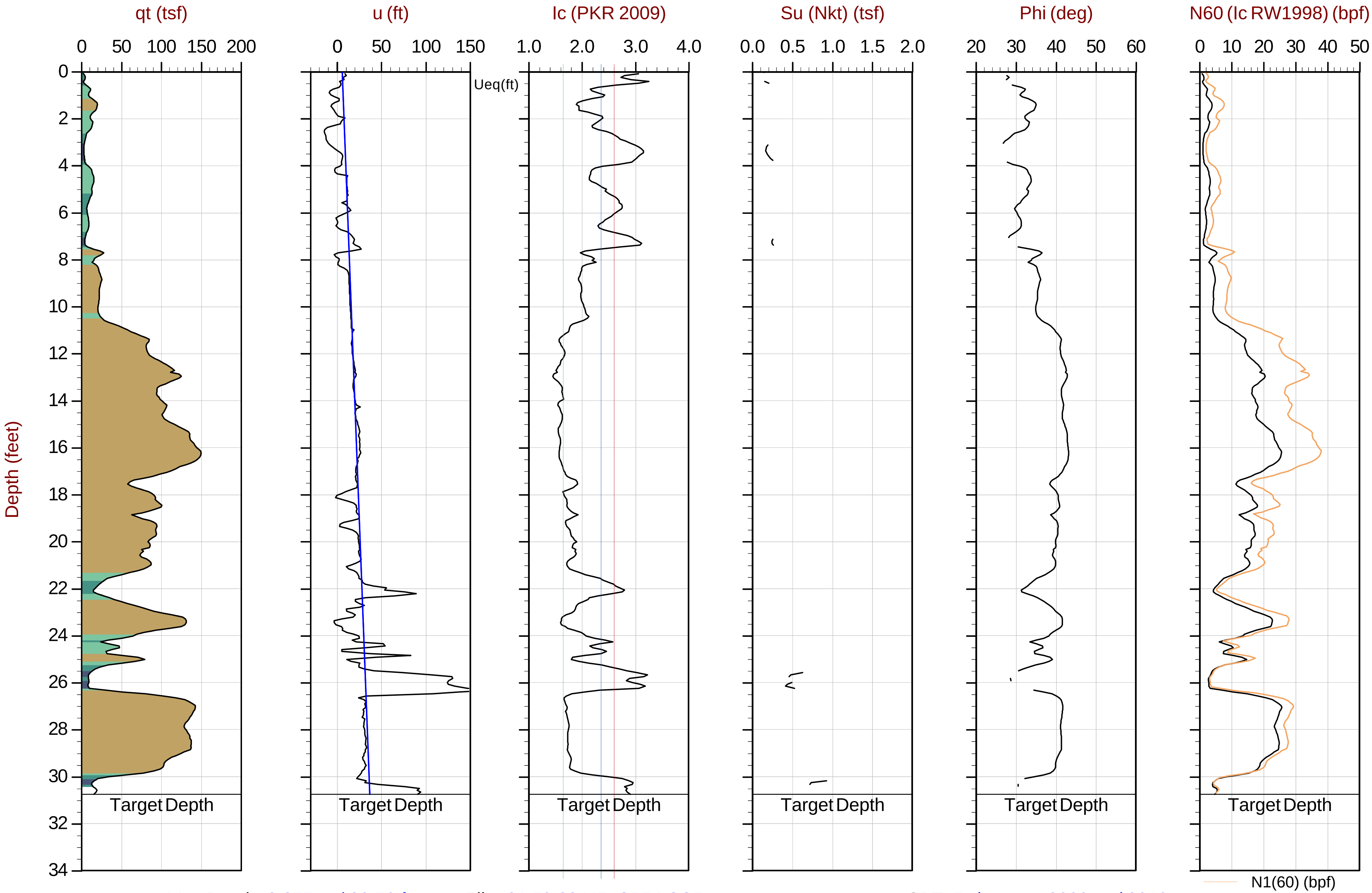
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-27 18:31
Site: LDW Phase 3

Sounding: LDW21-GT54-GC
Cone: 681:T375F10U35



Max Depth: 9.375 m / 30.76 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-22445_CP54.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 47.51197 Long: -122.29758

Equilibrium Pore Pressure (Ueq) · Assumed Ueq · Dissipation, Ueq achieved · Dissipation, Ueq not achieved · Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

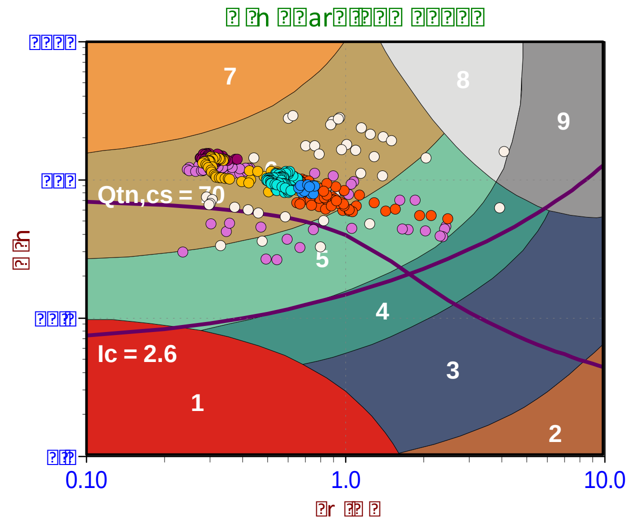
Soil Behavior Type (SBT) Scatter Plots

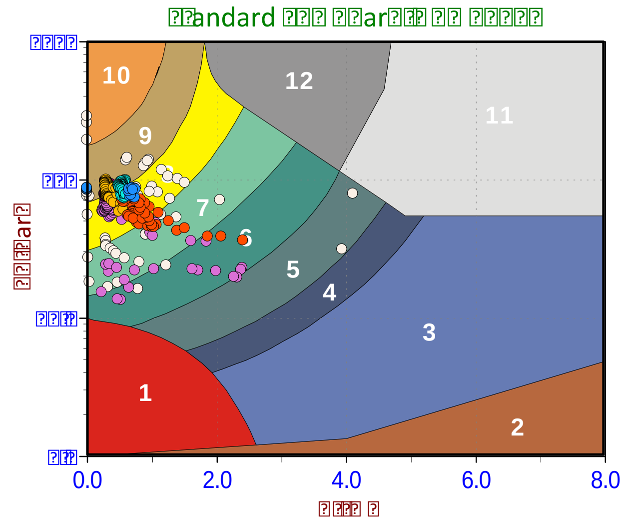
CONETEC

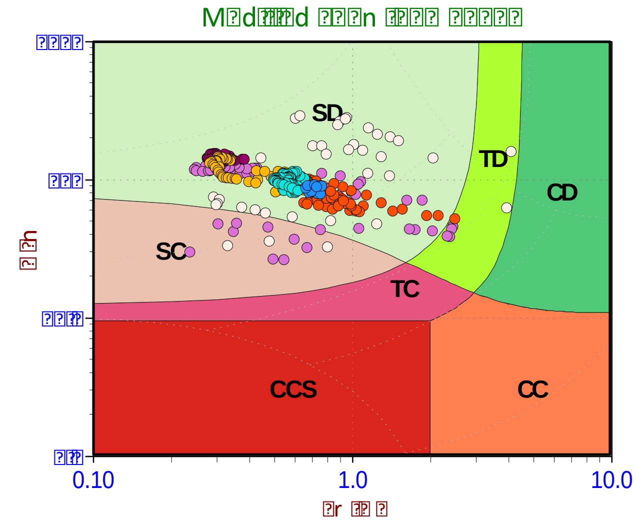
Anchor QEA

Job No: 21-59-22445
Date: 2021-07-22 17:30
Site: LDW Phase 3

Sounding: LDW21-GT06-GC
Cone: 681:T375F10U35







Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

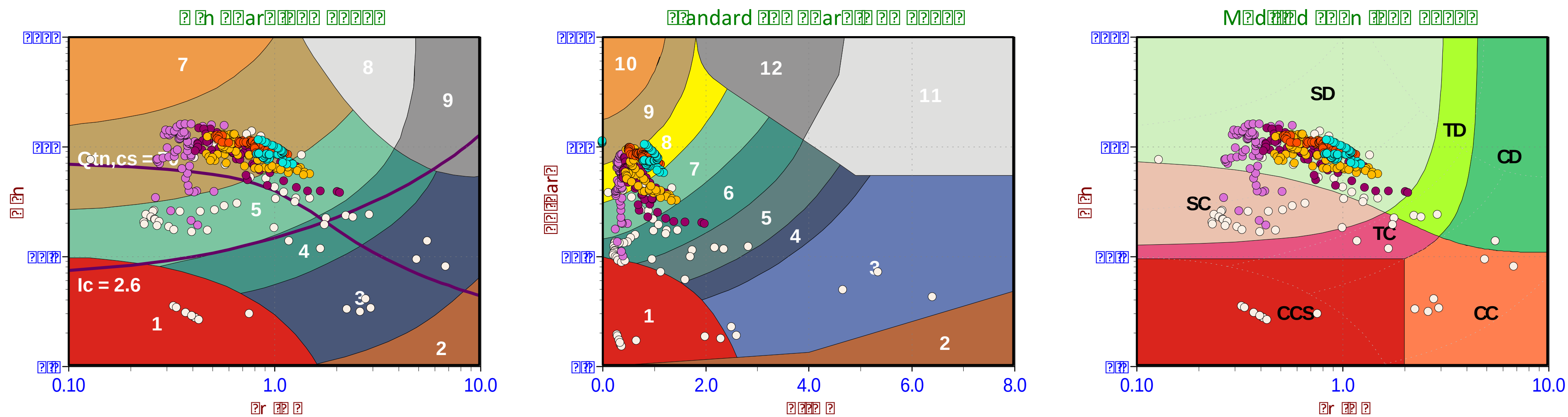
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-08 14:11
Site: LDW Phase 3

Sounding: LDW21-GT14-GC
Cone: 681:T375F10U35



Depth Ranges
- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend
- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend
- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

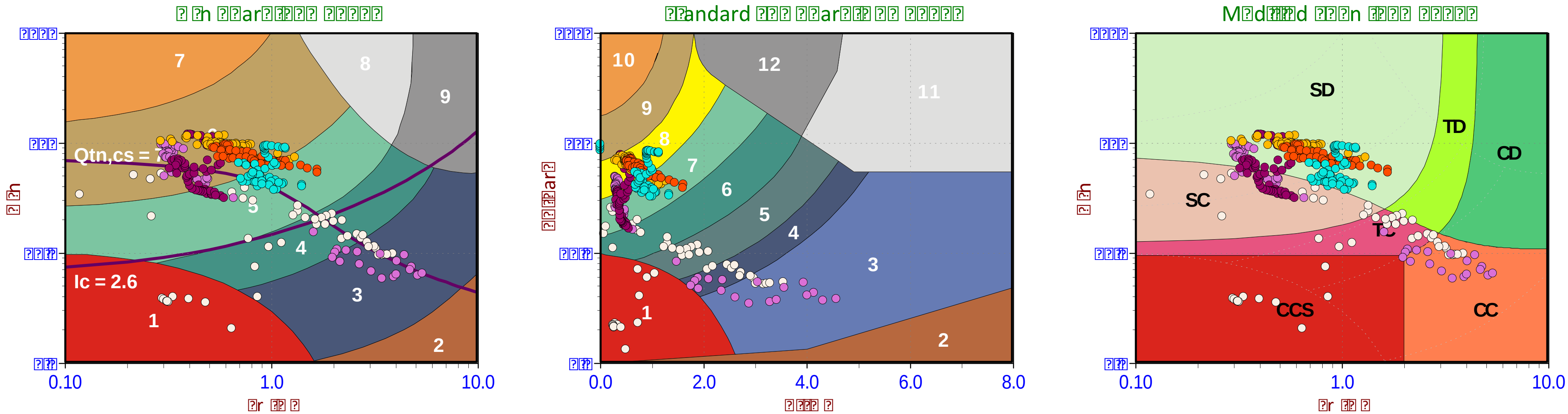
Legend
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-08 16:24
Site: LDW Phase 3

Sounding: LDW21-GT16-GC
Cone: 681:T375F10U35



Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

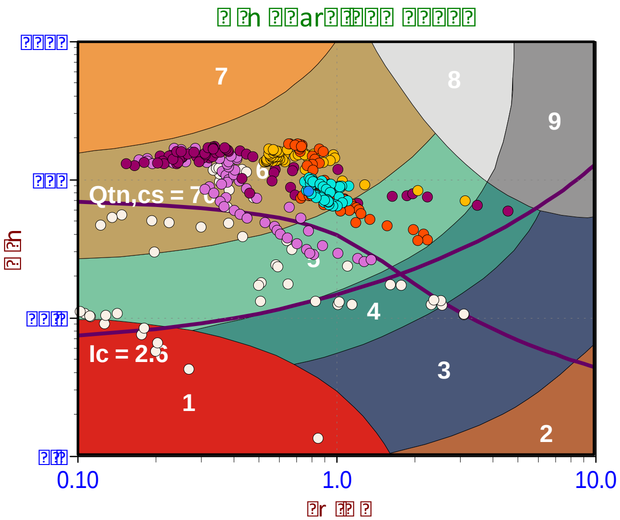
Legend

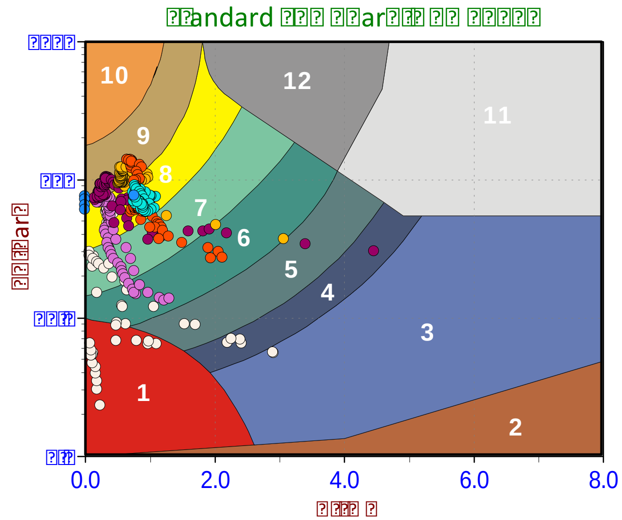
- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

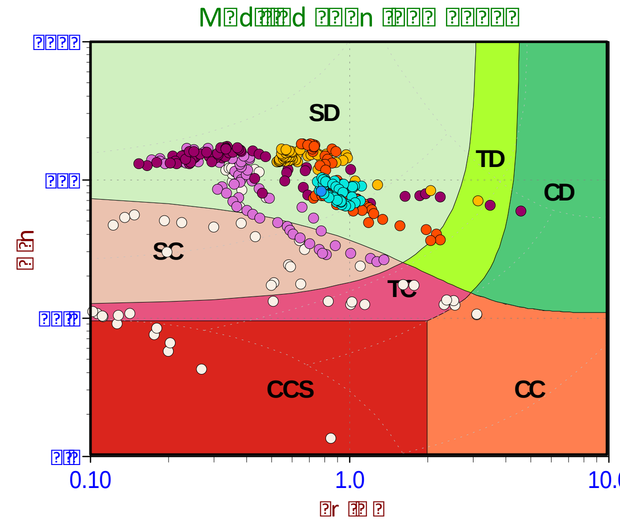
Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Anchor QEA	Job No: 21-59-22445	Sounding: LDW21-GT17-GC	
	Date: 2021-07-12 19:15	Cone: 681:T375F10U35	
	Site: LDW Phase 3		







Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

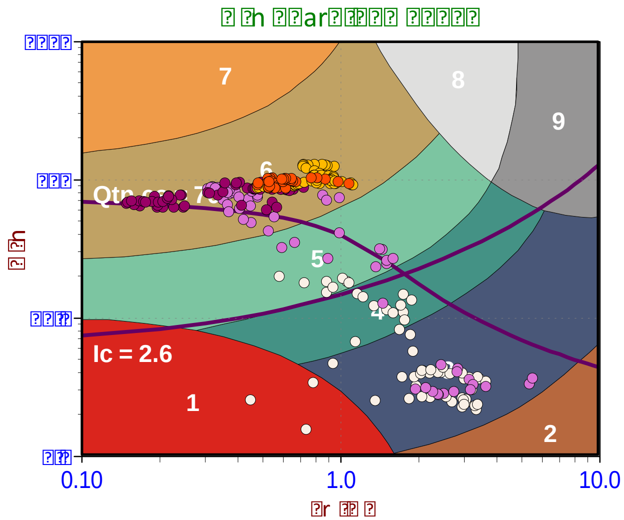
Legend

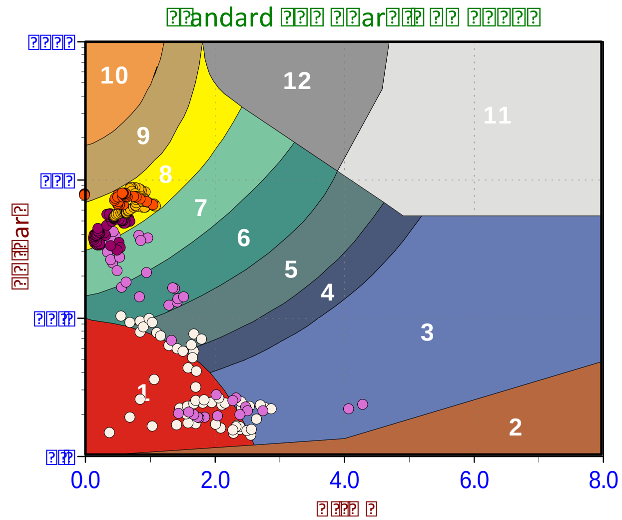
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

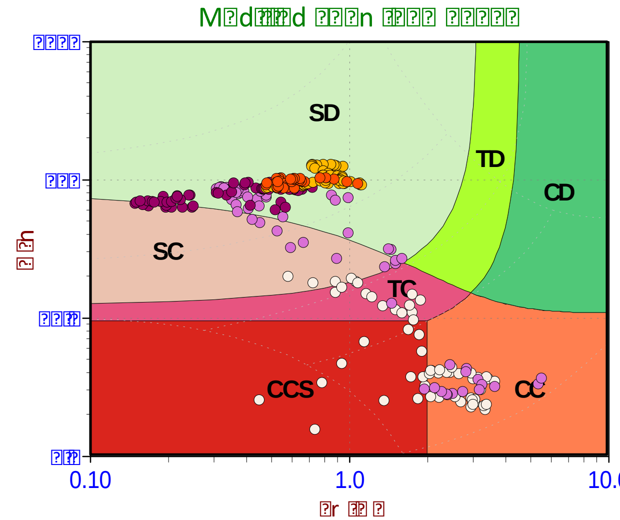
Anchor QEA

Job No: 21-59-22445
Date: 2021-07-16 09:40
Site: LDW Phase 3

Sounding: LDW21-GT20-GC
Cone: 681:T375F10U35







Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

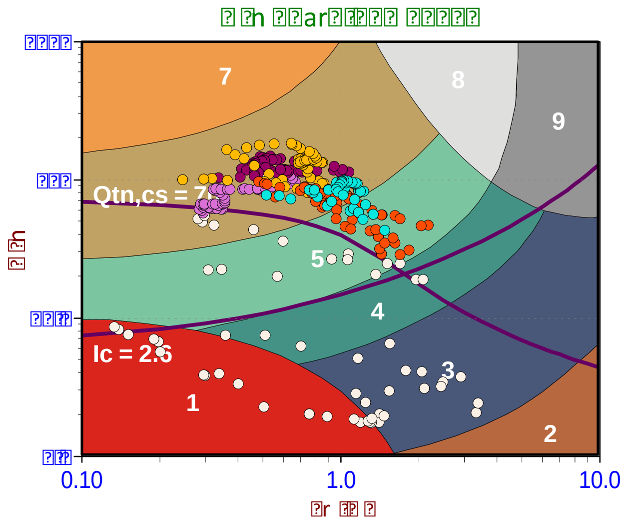
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

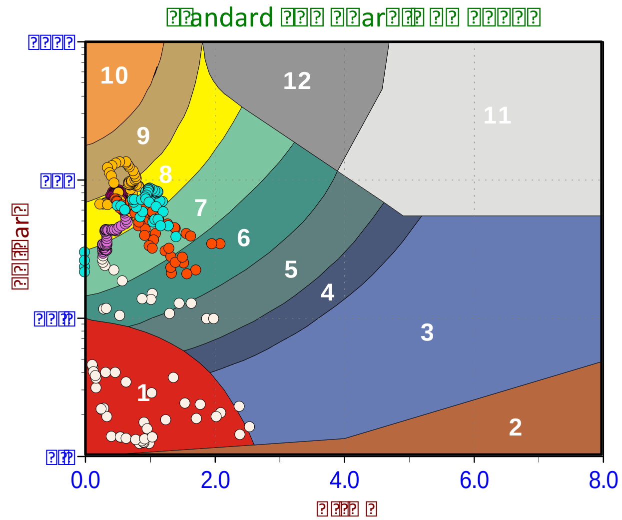
ConeTec

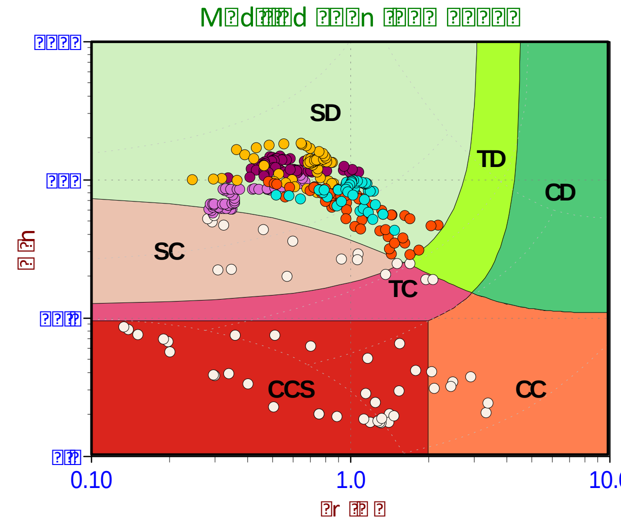
Anchor QEA

Job No: 21-59-22445
Date: 2021-07-13 19:06
Site: LDW Phase 3

Sounding: LDW21-GT22-GC
Cone: 681:T375F10U35







Depth Ranges
- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

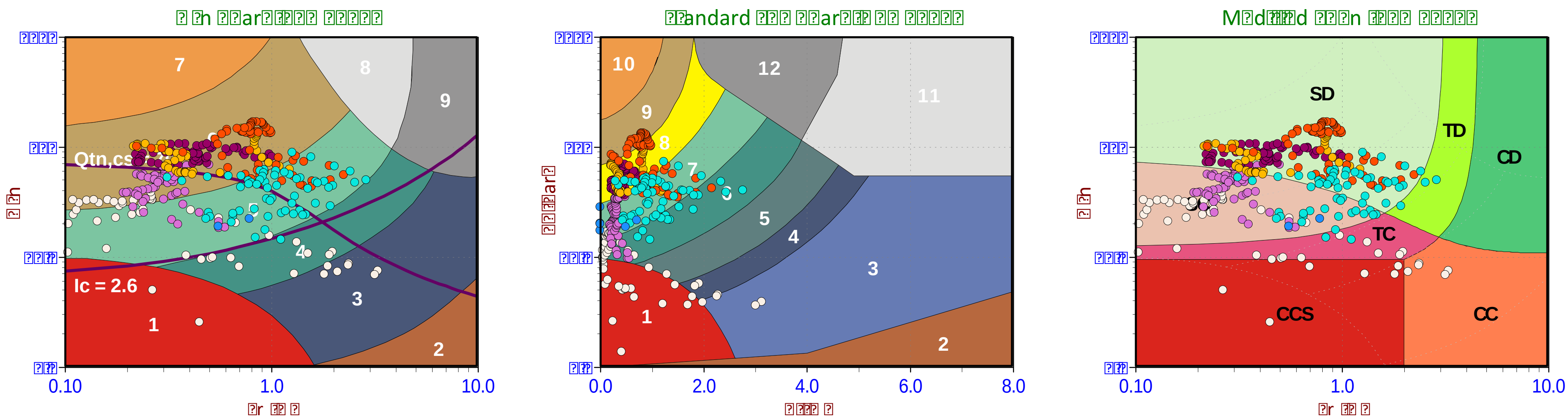
Legend
- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend
- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-16 08:30
Site: LDW Phase 3
Sounding: LDW21-GT27-GC
Cone: 681:T375F10U35



Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

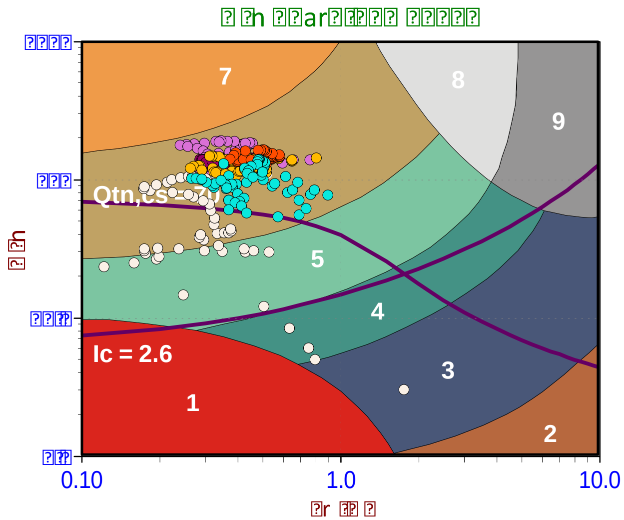
Legend

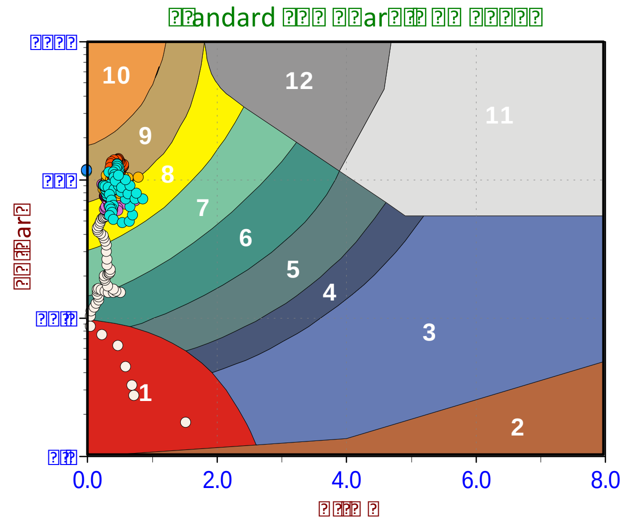
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

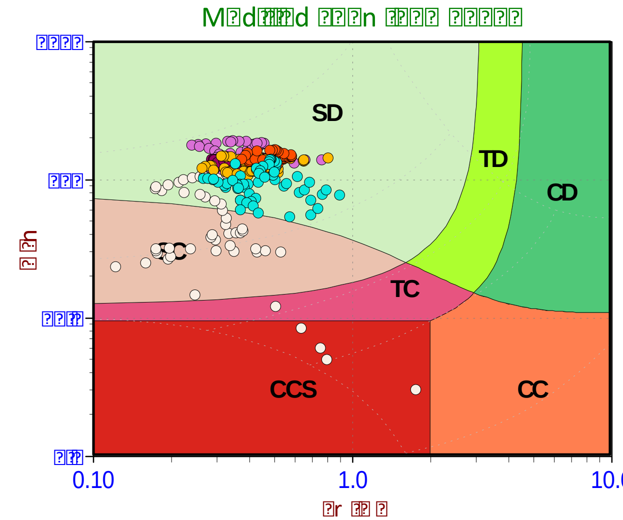
Anchor QEA

Job No: 21-59-22445
Date: 2021-07-21 15:09
Site: LDW Phase 3

Sounding: LDW21-GT30-GC
Cone: 681:T375F10U35







Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

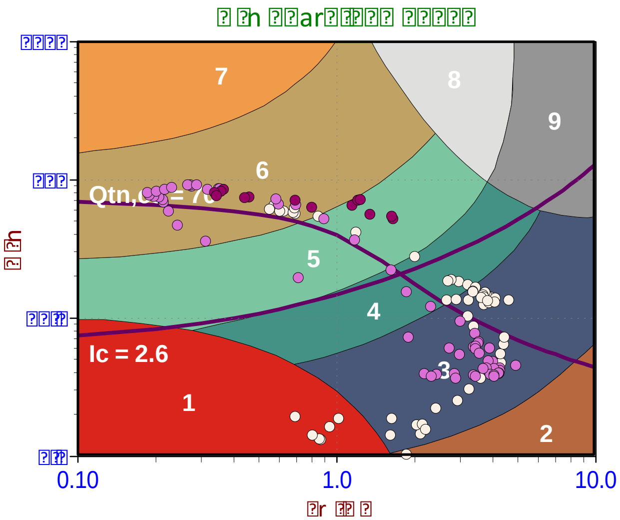
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

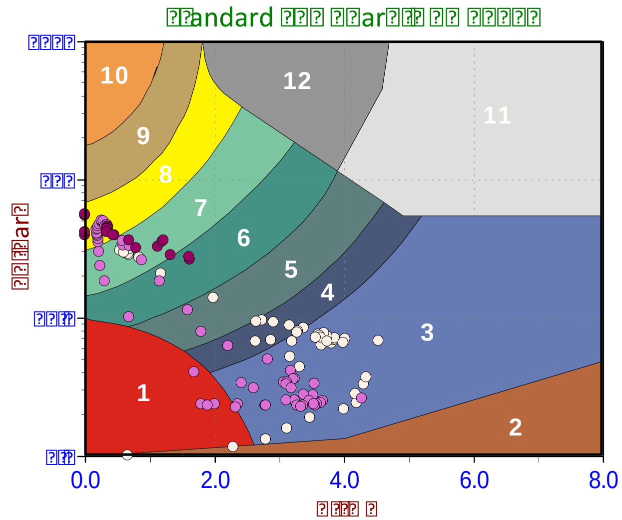
CONETEC

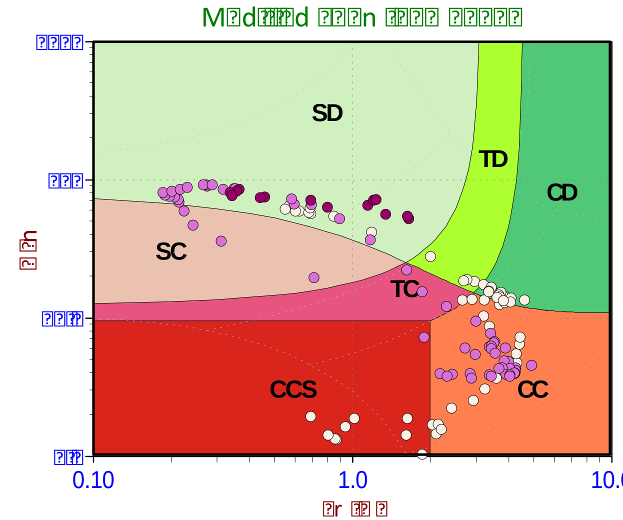
Anchor QEA

Job No: 21-59-22445
Date: 2021-07-09 10:35
Site: LDW Phase 3

Sounding: LDW21-GT31-GC
Cone: 681:T375F10U35







Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

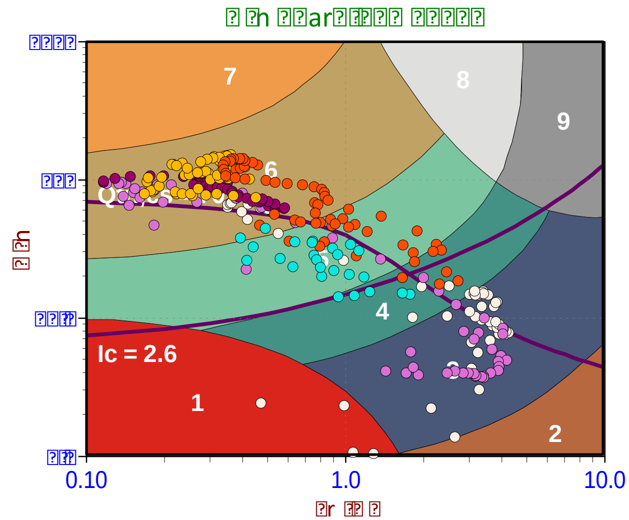
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

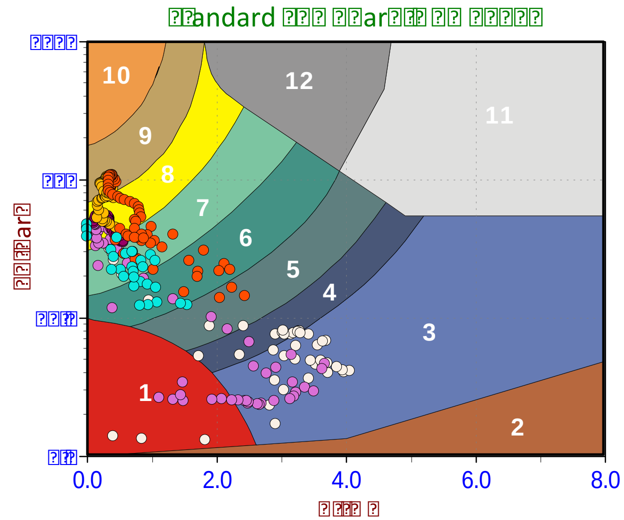
CONETEC

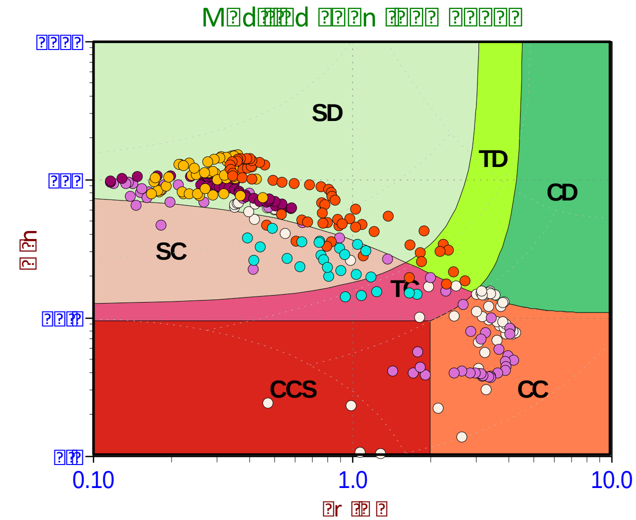
Anchor QEA

Job No: 21-59-22445
Date: 2021-07-13 17:56
Site: LDW Phase 3

Sounding: LDW21-GT31-GC-B
Cone: 681:T375F10U35







Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

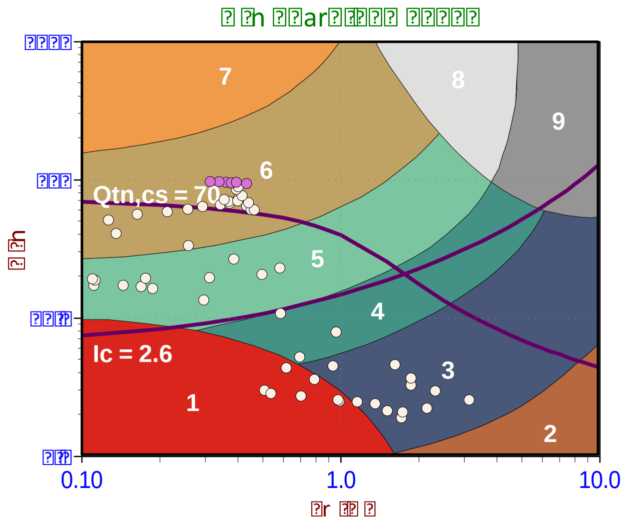
Legend

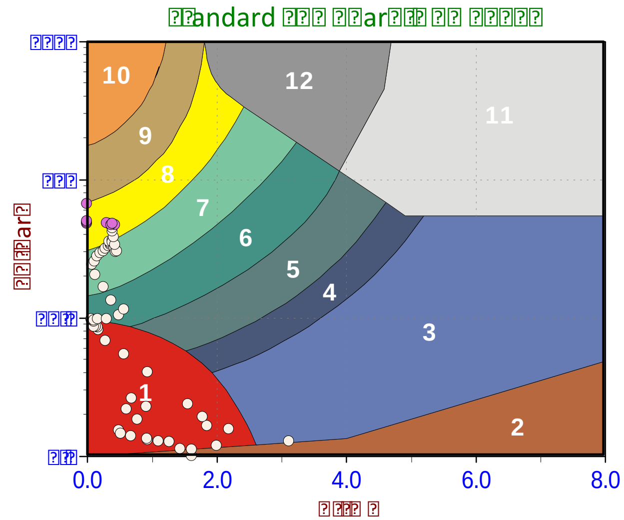
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

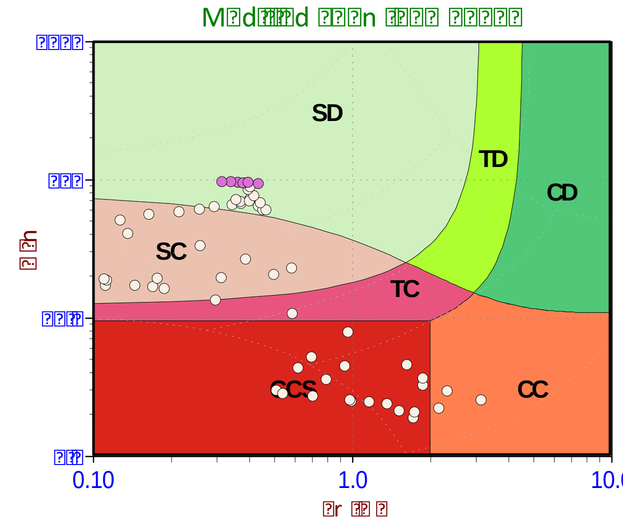
Anchor QEA

Job No: 21-59-22445
Date: 2021-07-09 11:18
Site: LDW Phase 3

Sounding: LDW21-GT32-GC
Cone: 681:T375F10U35







Depth Ranges
- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend
- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

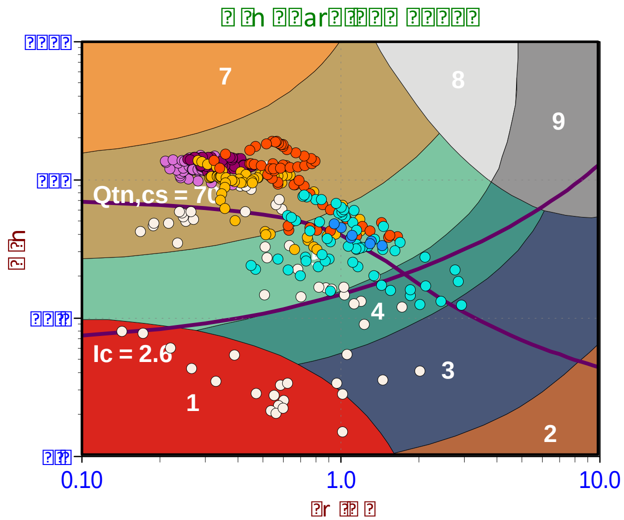
Legend
- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

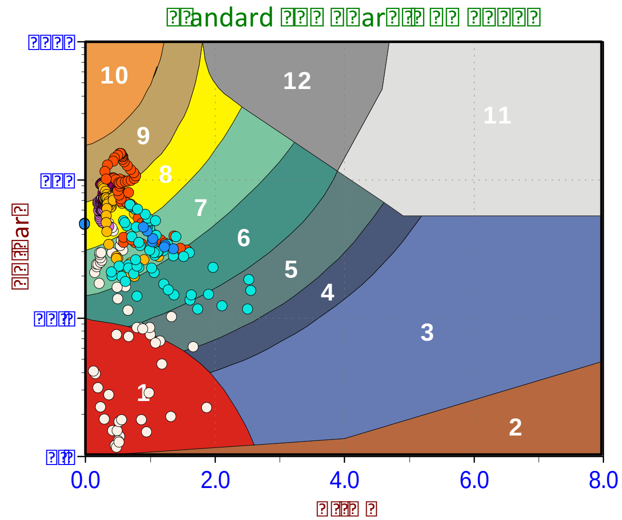
Legend
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

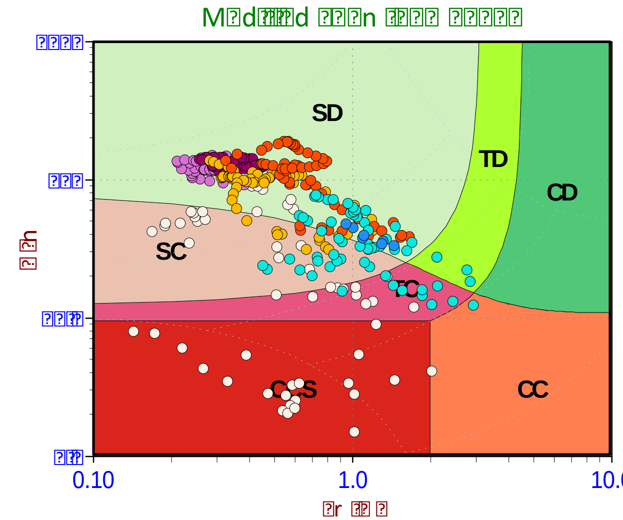
Anchor QEA

Job No: 21-59-22445
Date: 2021-07-21 13:24
Site: LDW Phase 3

Sounding: LDW21-GT32-GC-B
Cone: 681:T375F10U35







Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

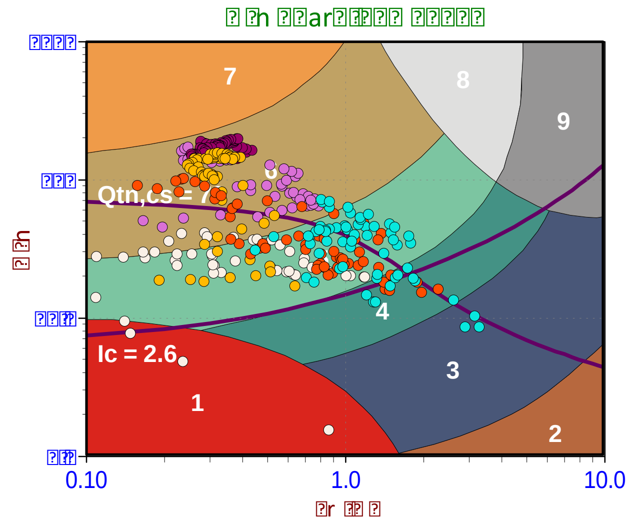
- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

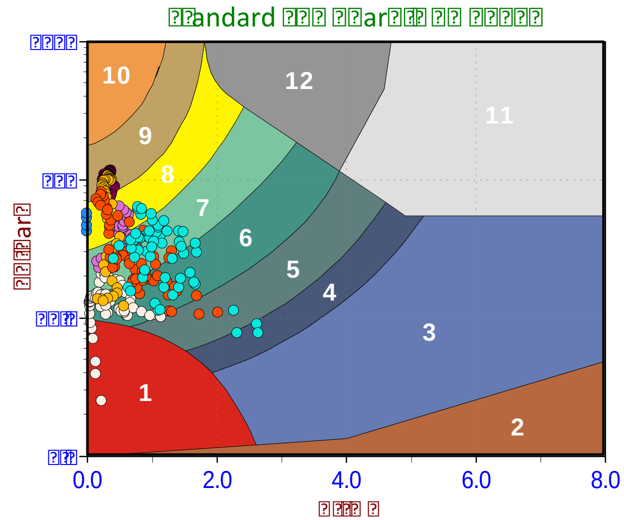
Legend

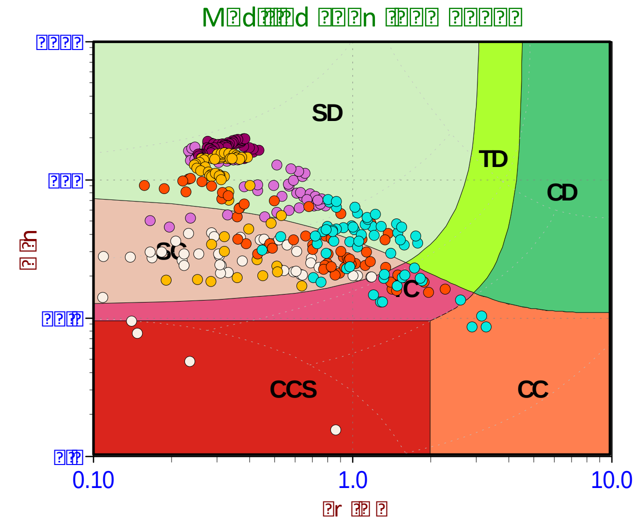
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

ConeTec

Anchor QEA	Job No: 21-59-22445	Sounding: LDW21-GT34-GC
	Date: 2021-07-21 14:17	Cone: 681:T375F10U35
	Site: LDW Phase 3	







Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

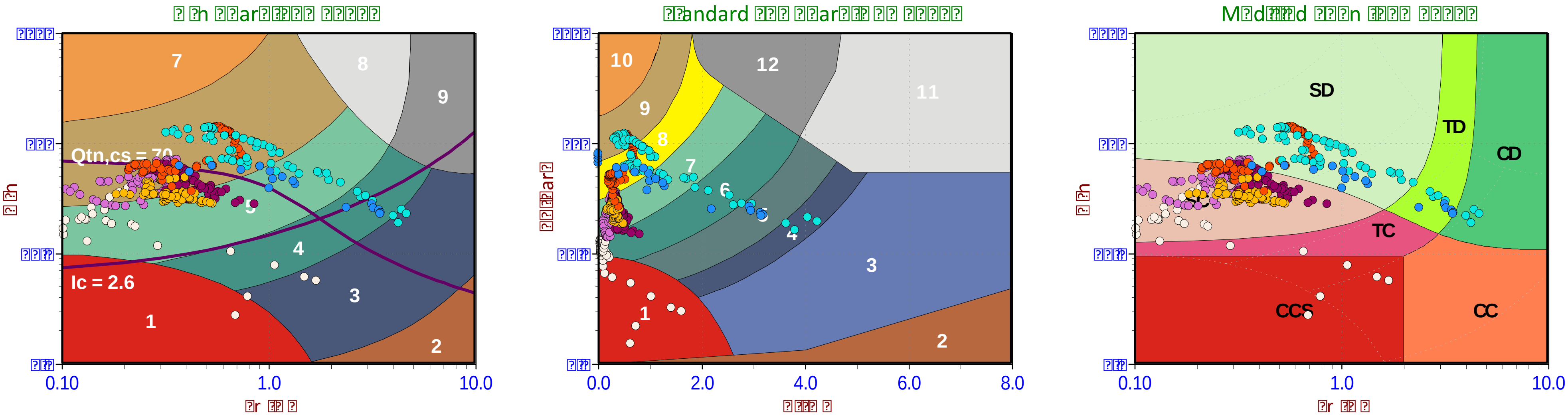
Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-19 13:58
Site: LDW Phase 3

Sounding: LDW21-GT40-GC
Cone: 681:T375F10U35



Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

1. Sensitive, Fine Grained
2. Organic Soils
3. Clays
4. Silt Mixtures
5. Sand Mixtures
6. Sands
7. Gravelly Sand to Sand
8. Stiff Sand to Clayey Sand
9. Very Stiff Fine Grained

Legend

1. Sensitive Fines
2. Organic Soil
3. Clay
4. Silty Clay
5. Clayey Silt
6. Silt
7. Sandy Silt
8. Silty Sand/Sand
9. Sand
10. Gravelly Sand
11. Stiff Fine Grained
12. Cemented Sand

Legend

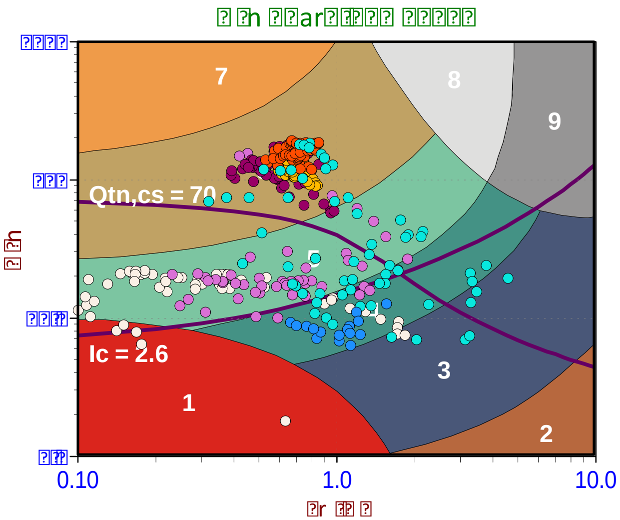
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

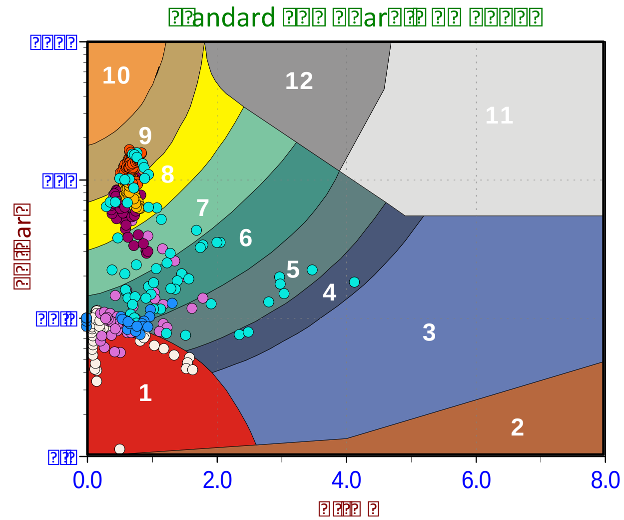
CONETEC

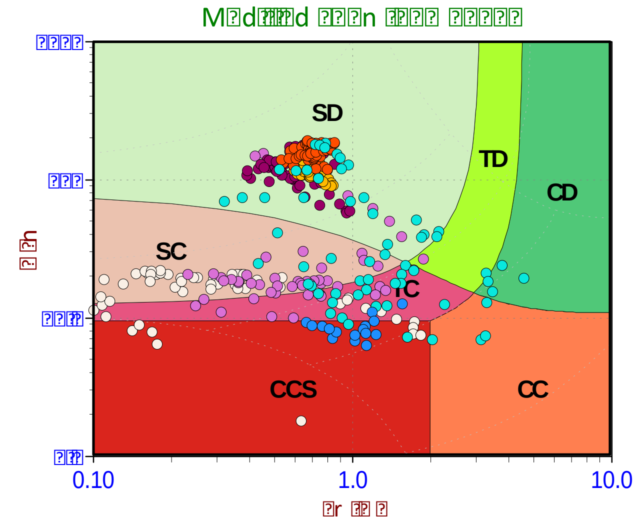
Anchor QEA

Job No: 21-59-22445
Date: 2021-07-28 18:24
Site: LDW Phase 3

Sounding: LDW21-GT45-GC
Cone: 681:T375F10U35







Depth Ranges
- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend
- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend
- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

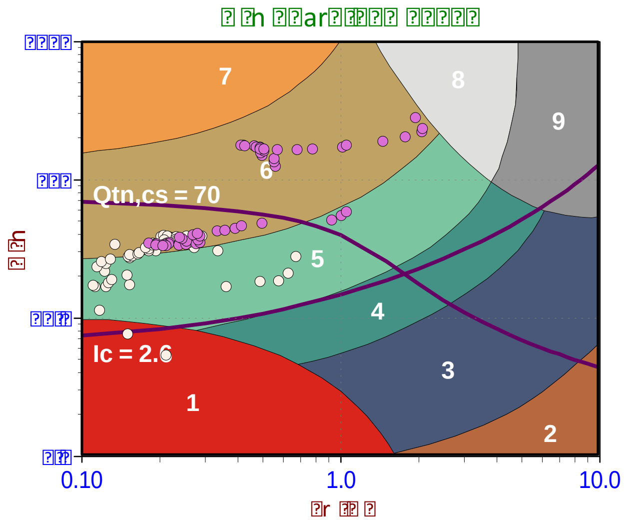
Legend
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

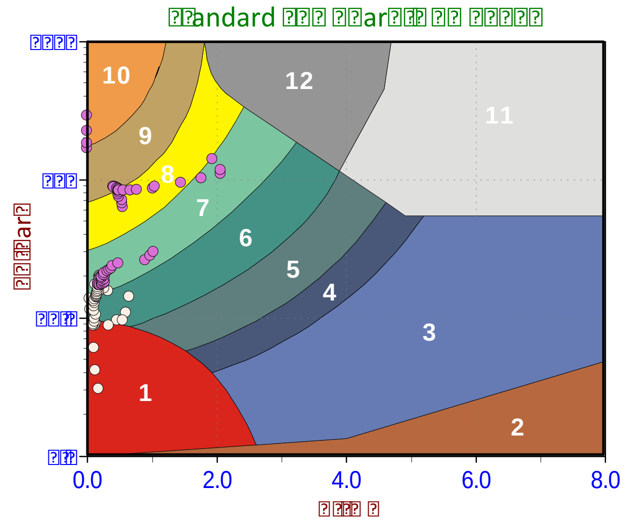
CONETEC

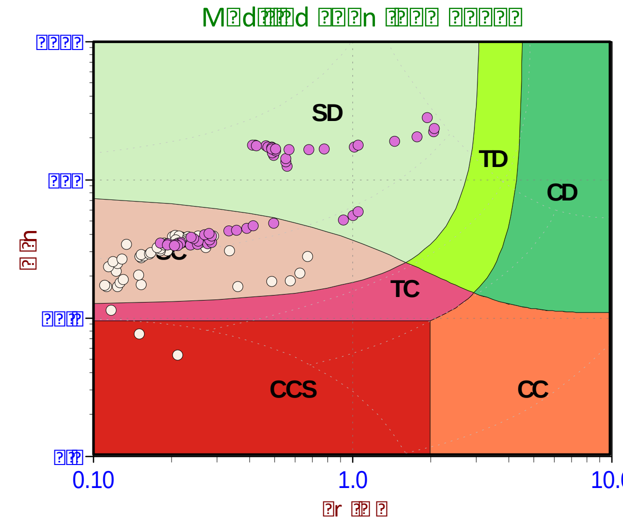
Anchor QEA

Job No: 21-59-22445
Date: 2021-07-26 09:49
Site: LDW Phase 3

Sounding: LDW21-GT46-GC
Cone: 681:T375F10U35







Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

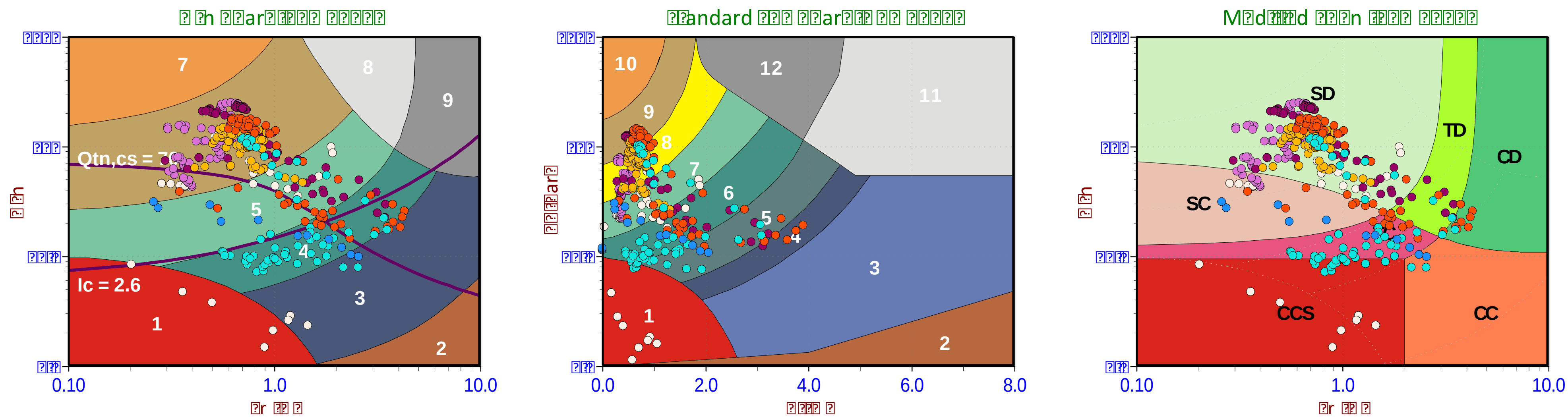
Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-27 20:39
Site: LDW Phase 3
Sounding: LDW21-GT47-GC
Cone: 681:T375F10U35



Depth Ranges
- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend
- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend
- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

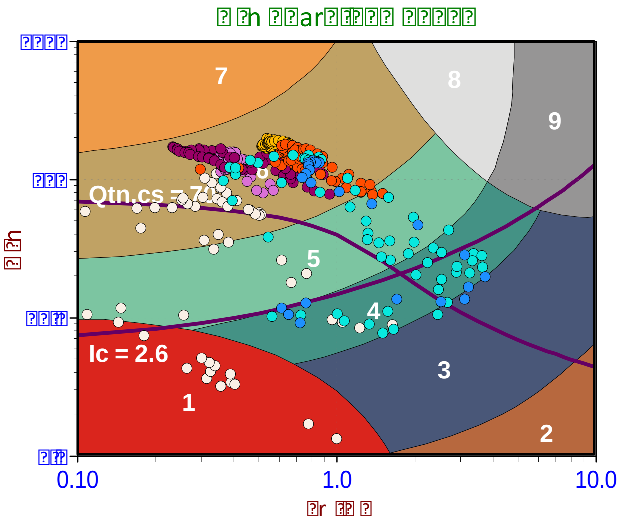
Legend
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

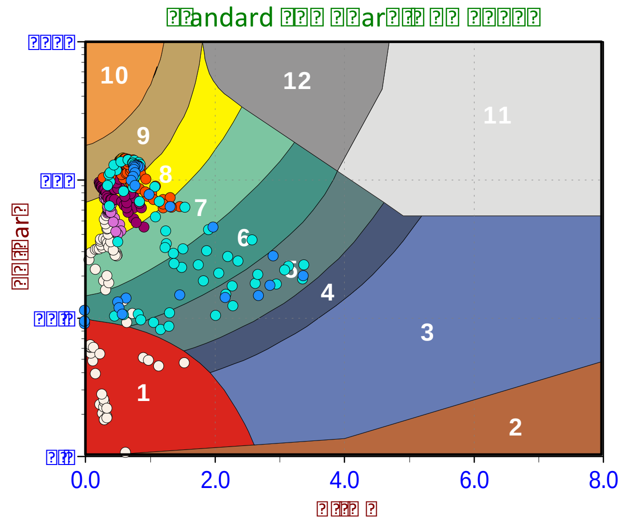
CONETEC

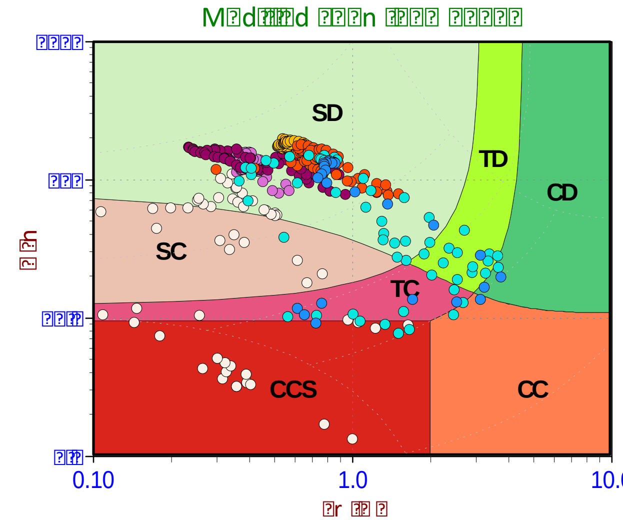
Anchor QEA

Job No: 21-59-22445
Date: 2021-07-28 19:27
Site: LDW Phase 3

Sounding: LDW21-GT49-GC
Cone: 681:T375F10U35







Depth Ranges
- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend
- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend
- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

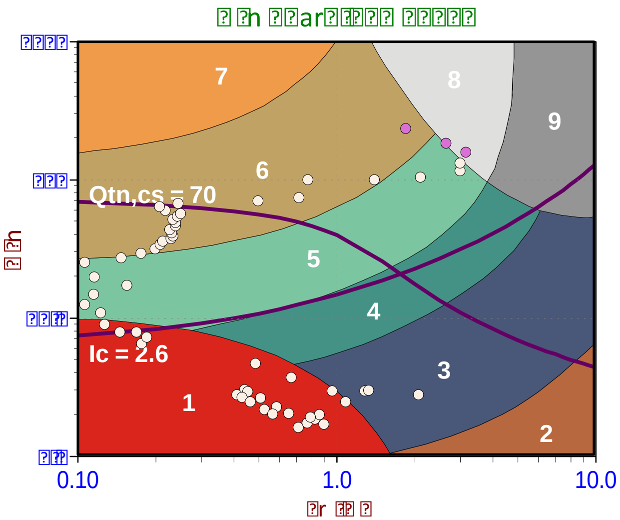
Legend
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

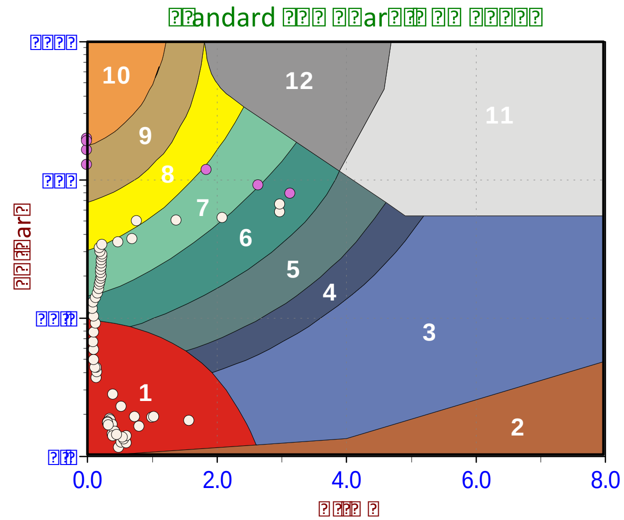
ConeTec

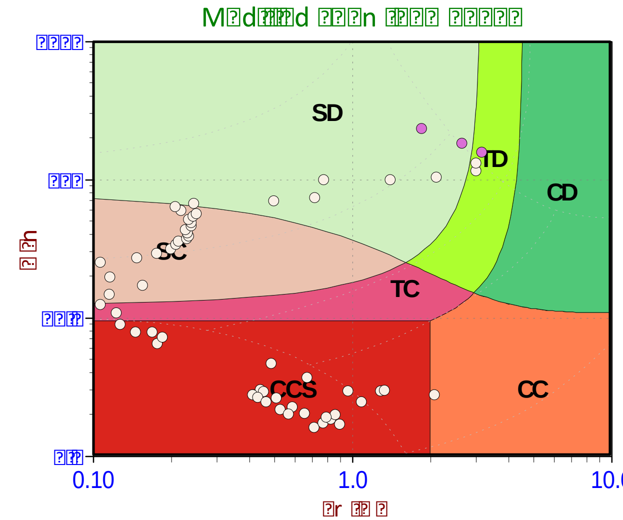
Anchor QEA

Job No: 21-59-22445
Date: 2021-07-23 15:21
Site: LDW Phase 3

Sounding: LDW21-GT50-GC
Cone: 681:T375F10U35







Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

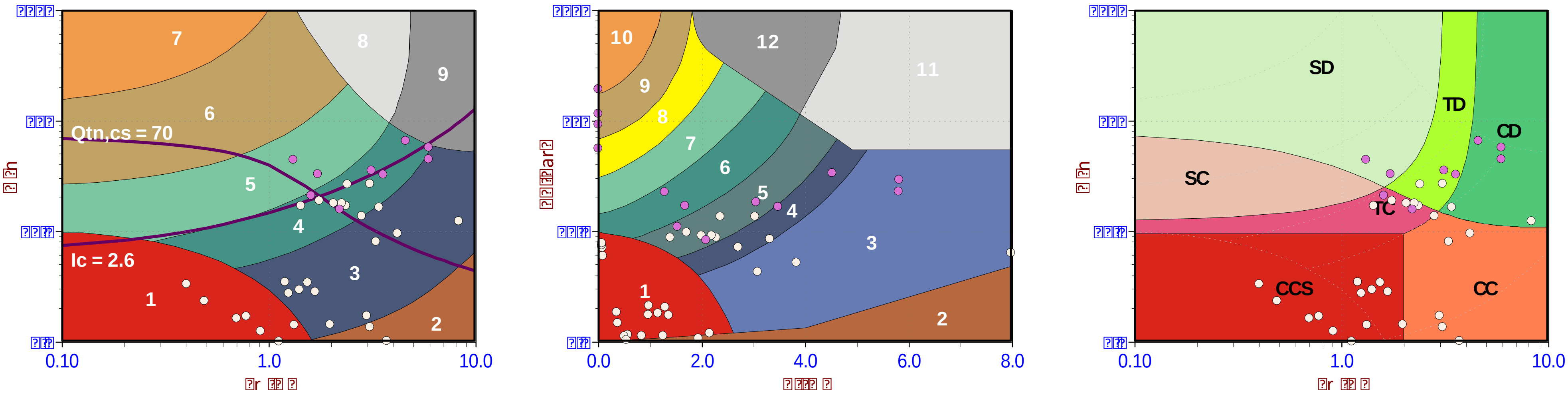
Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

CONETEC

Anchor QEA

Job No: 21-59-22445
Date: 2021-07-26 19:23
Site: LDW Phase 3
Sounding: LDW21-GT51-GC
Cone: 681:T375F10U35



Depth Ranges
- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend
- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

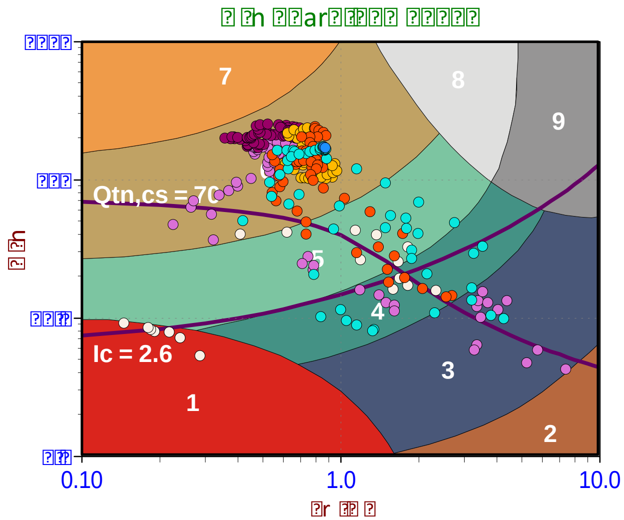
Legend
- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

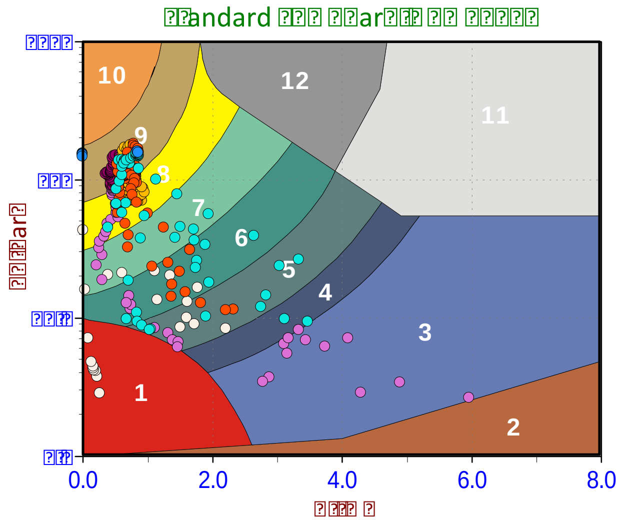
Legend
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

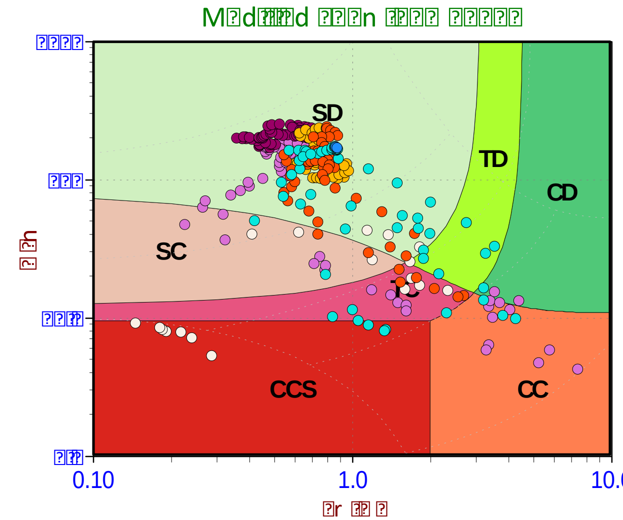
Anchor QEA

Job No: 21-59-22445
Date: 2021-07-27 19:40
Site: LDW Phase 3

Sounding: LDW21-GT52-GC
Cone: 681:T375F10U35







Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

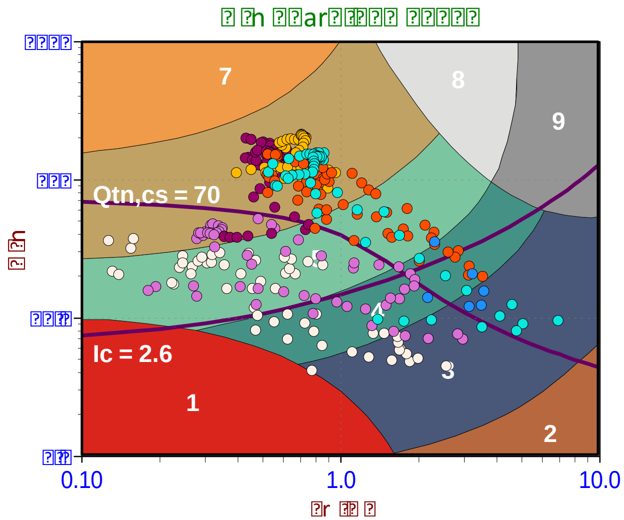
Legend

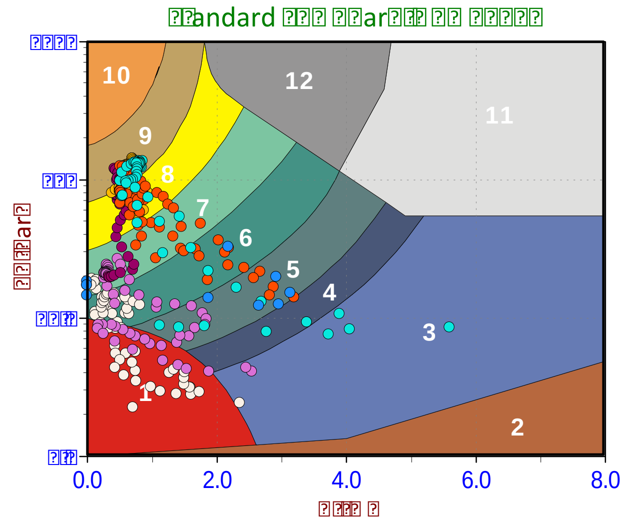
- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

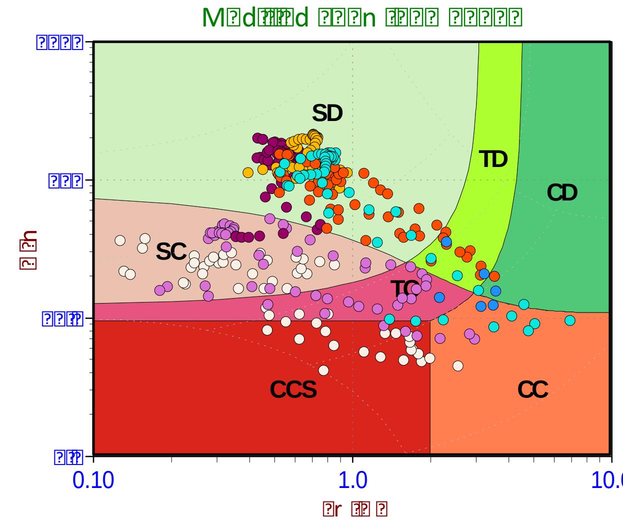
Anchor QEA

Job No: 21-59-22445
Date: 2021-07-27 18:31
Site: LDW Phase 3

Sounding: LDW21-GT54-GC
Cone: 681:T375F10U35







Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Ball Full Flow Cone Penetration Test Summary and Plots

Job No: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Start Date: 06-Jul-2021
End Date: 29-Jul-2021

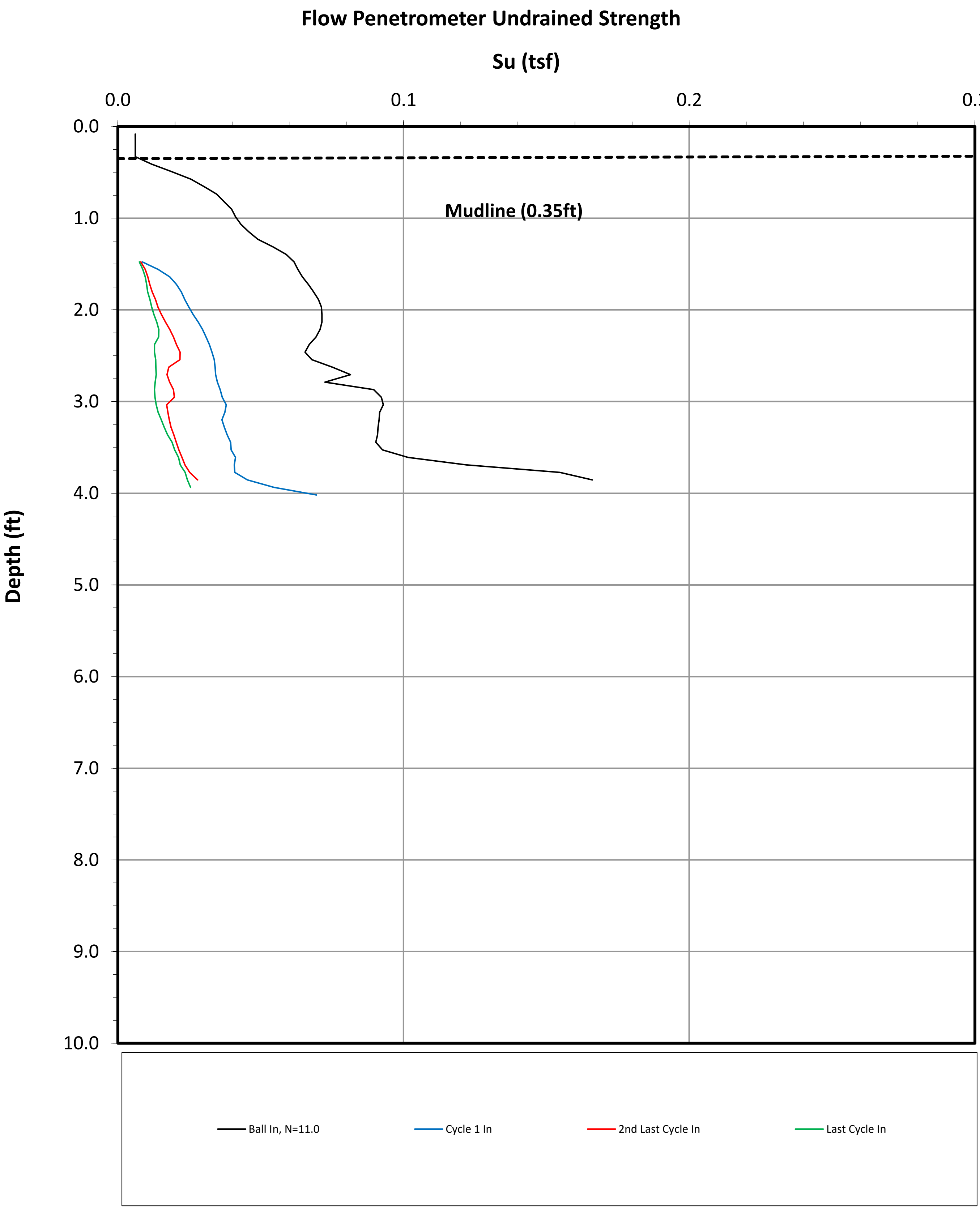
BALL FULL FLOW PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Cone Area (cm^2)	Ball Area (cm^2)	Final Depth (ft)	Cycling Conducted	Latitude[1] (deg)	Longitude[1] (deg)	Refer to Notation Number
LDW21-GT01-FFP	21-59-22445_BP01	14-Jul-2021	681:T375F10U35	15	150	4.0	YES	47.53230	-122.31937	
LDW21-GT03-FFP	21-59-22445_BP03	14-Jul-2021	681:T375F10U35	15	150	5.9	YES	47.52757	-122.31136	
LDW21-GT09-FFP	21-59-22445_BP09	14-Jul-2021	681:T375F10U35	15	150	12.1	YES			2
LDW21-GT11-FFP	21-59-22445_BP11	16-Jul-2021	681:T375F10U35	15	150	9.4	YES	47.52623	-122.30963	
LDW21-GT26-FFP	21-59-22445_BP26	16-Jul-2021	681:T375F10U35	15	150	4.0	YES	47.52150	-122.30687	
LDW21-GT30-31-FFP	21-59-22445_BP30-31	21-Jul-2021	681:T375F10U35	15	150	5.2	YES	47.52051	-122.30581	
LDW21-GT32-34-FFP	21-59-22445_BP32-34	21-Jul-2021	681:T375F10U35	15	150	4.0	YES	47.51999	-122.30585	

1. Coordinates were provided by client
2. Coordinates currently not available. Coordinates will be provided by client at a later date

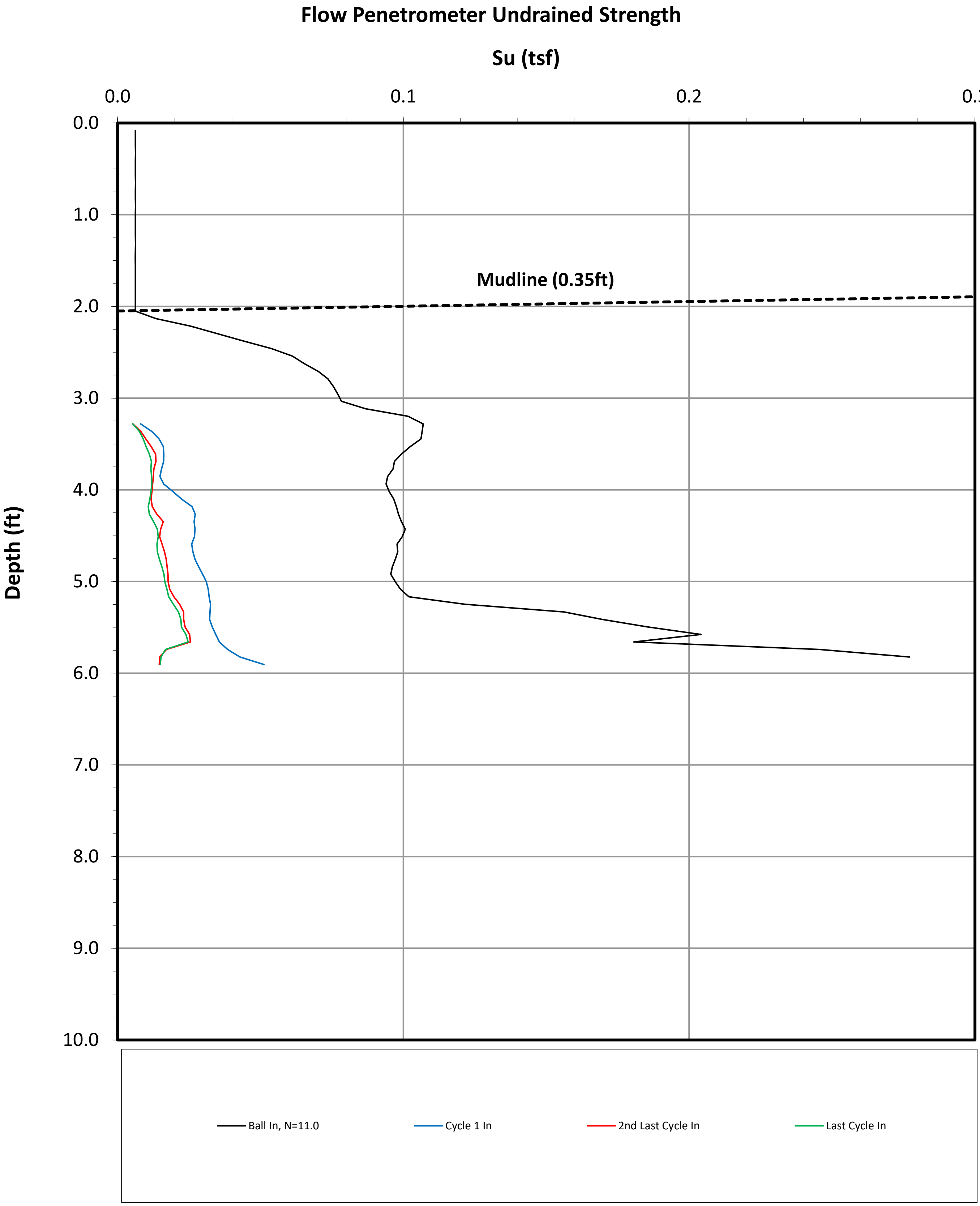
Job No: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding ID: LDW21-GT01-FFP
Sounding Date: July 14, 2021

Coordinate System: WGS 84 Lat/Long
Lat (deg): 47.5322979
Long (deg): -122.3193655



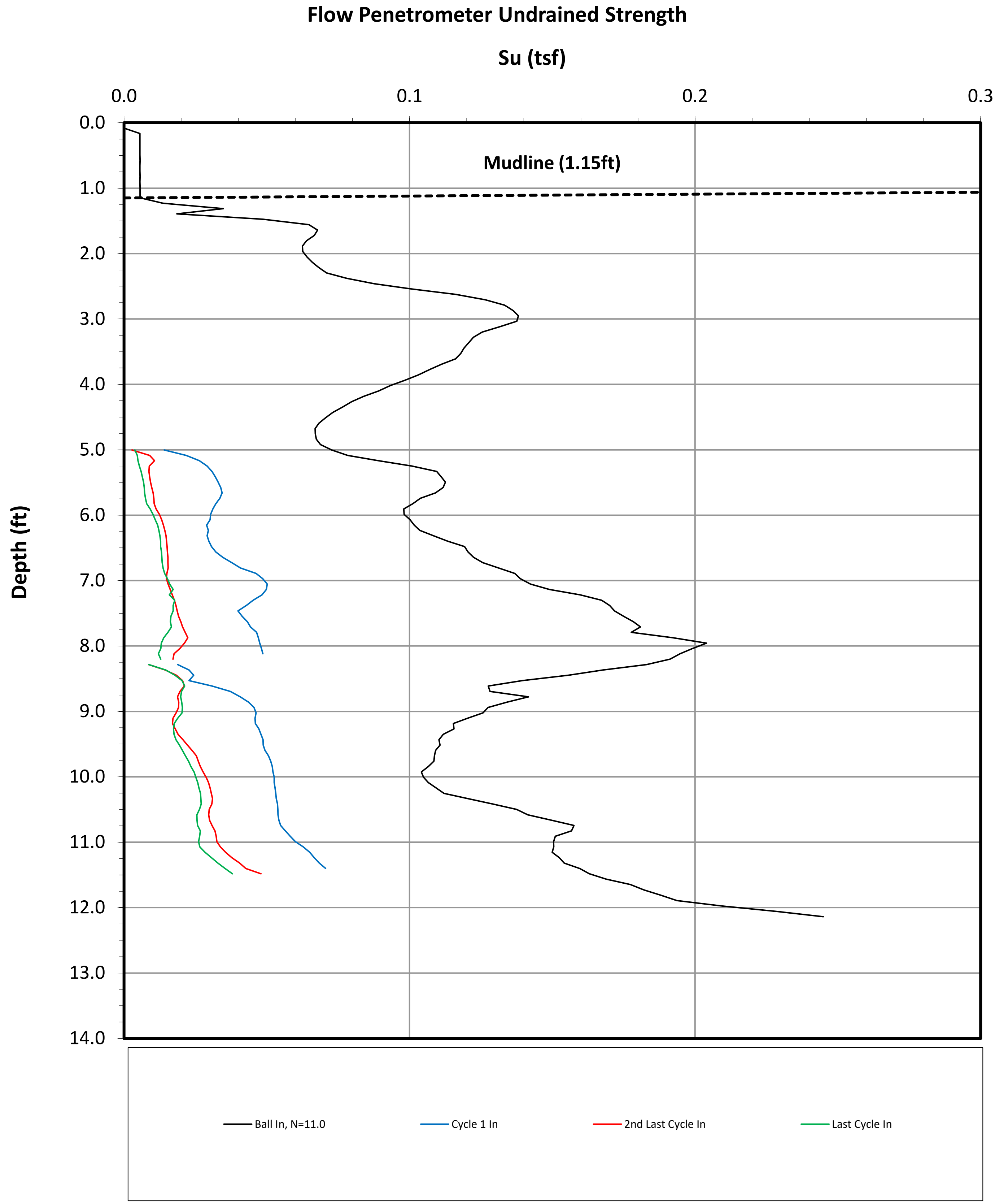
Job No: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding ID: LDW21-GT03-FFP
Sounding Date: July 14, 2021

Coordinate System: WGS 84 Lat/Long
Lat (deg): 47.5275718
Long (deg): -122.3113628



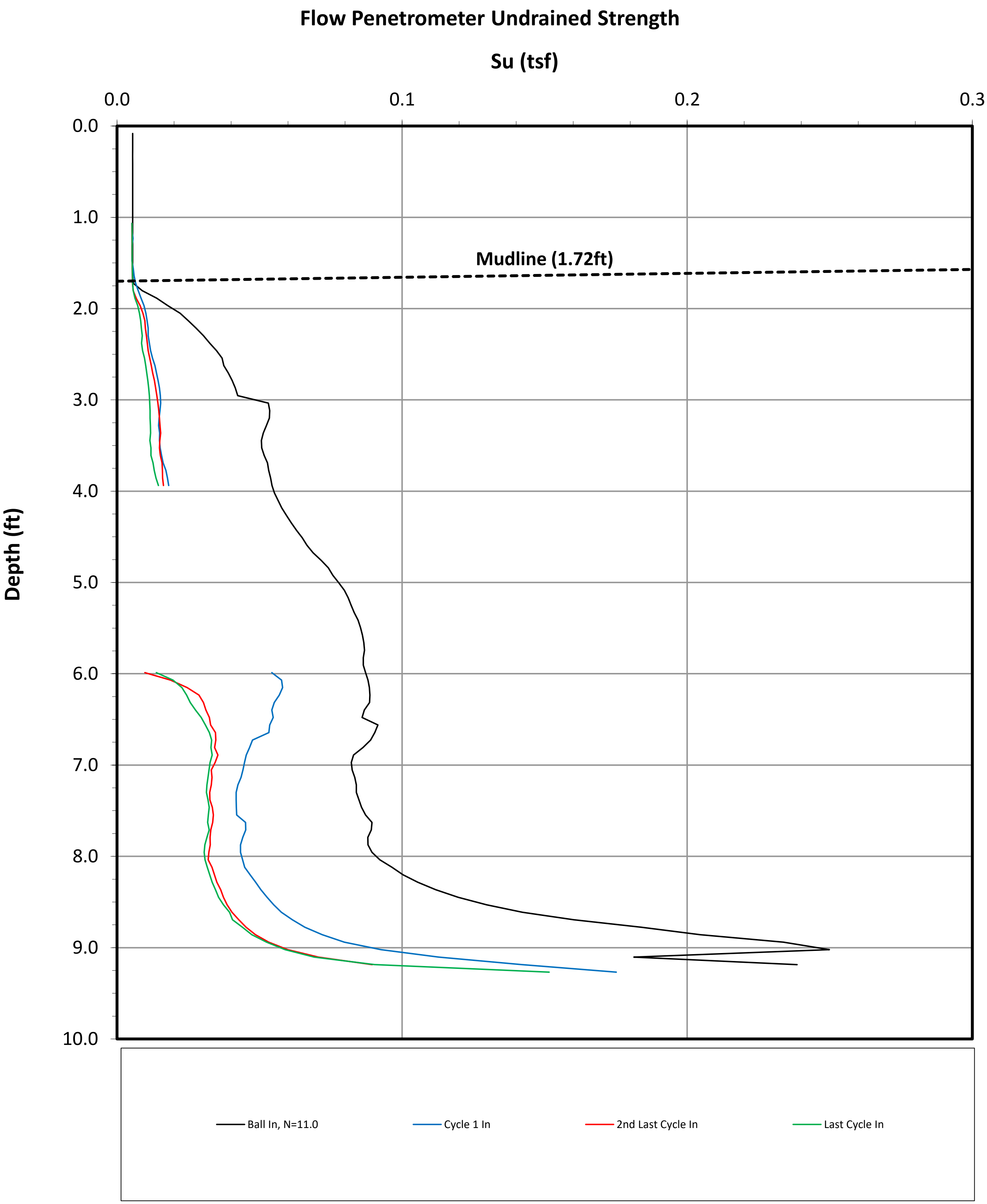
Job No: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding ID: LDW21-GT09-FFP
Sounding Date: July 14, 2021

Coordinate System: WGS 84 Lat/Long
Lat (deg):
Long (deg):



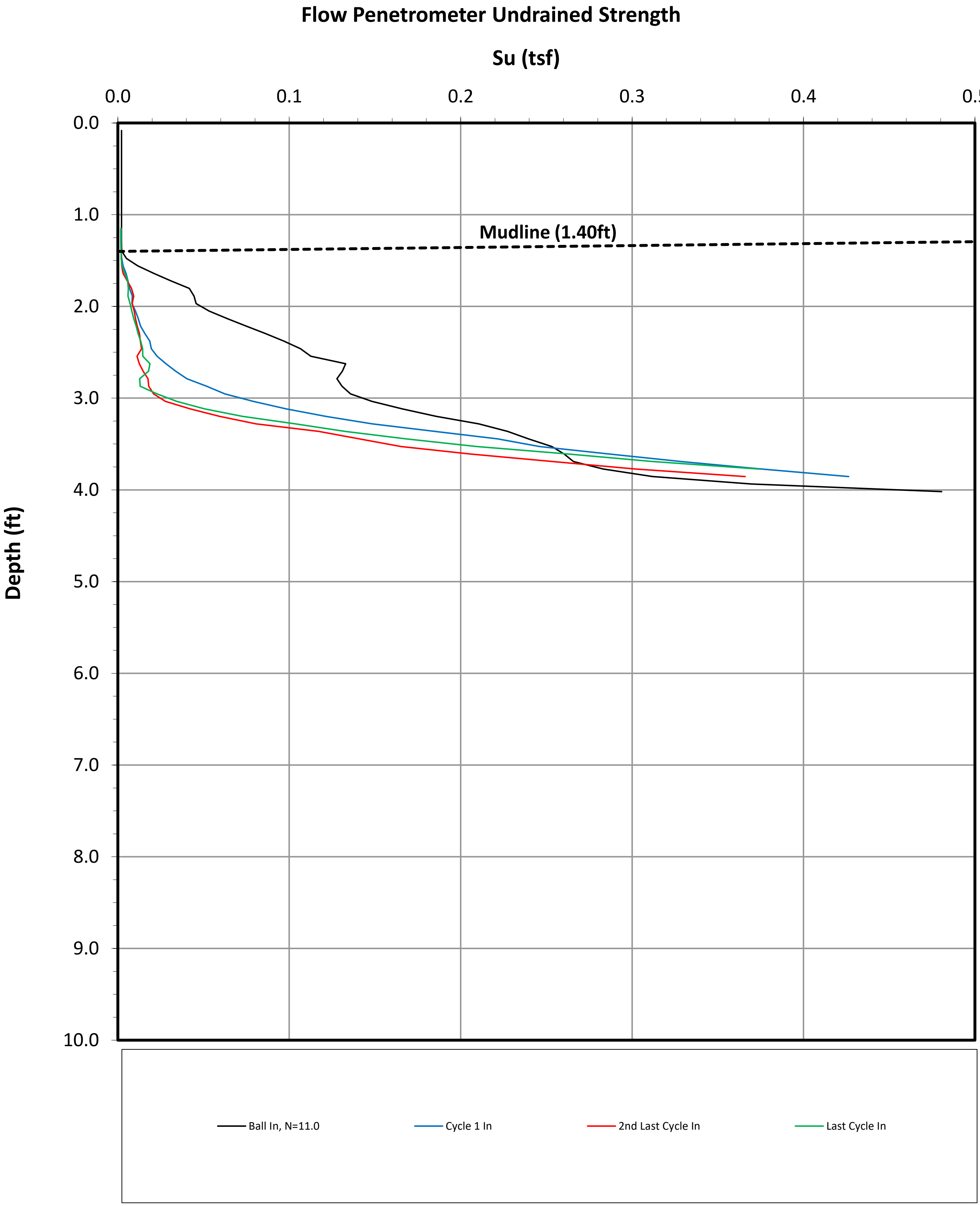
Job No: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding ID: LDW21-GT11-FFP
Sounding Date: July 16, 2021

Coordinate System: WGS 84 Lat/Long
Lat (deg): 47.5262259
Long (deg): -122.3096315



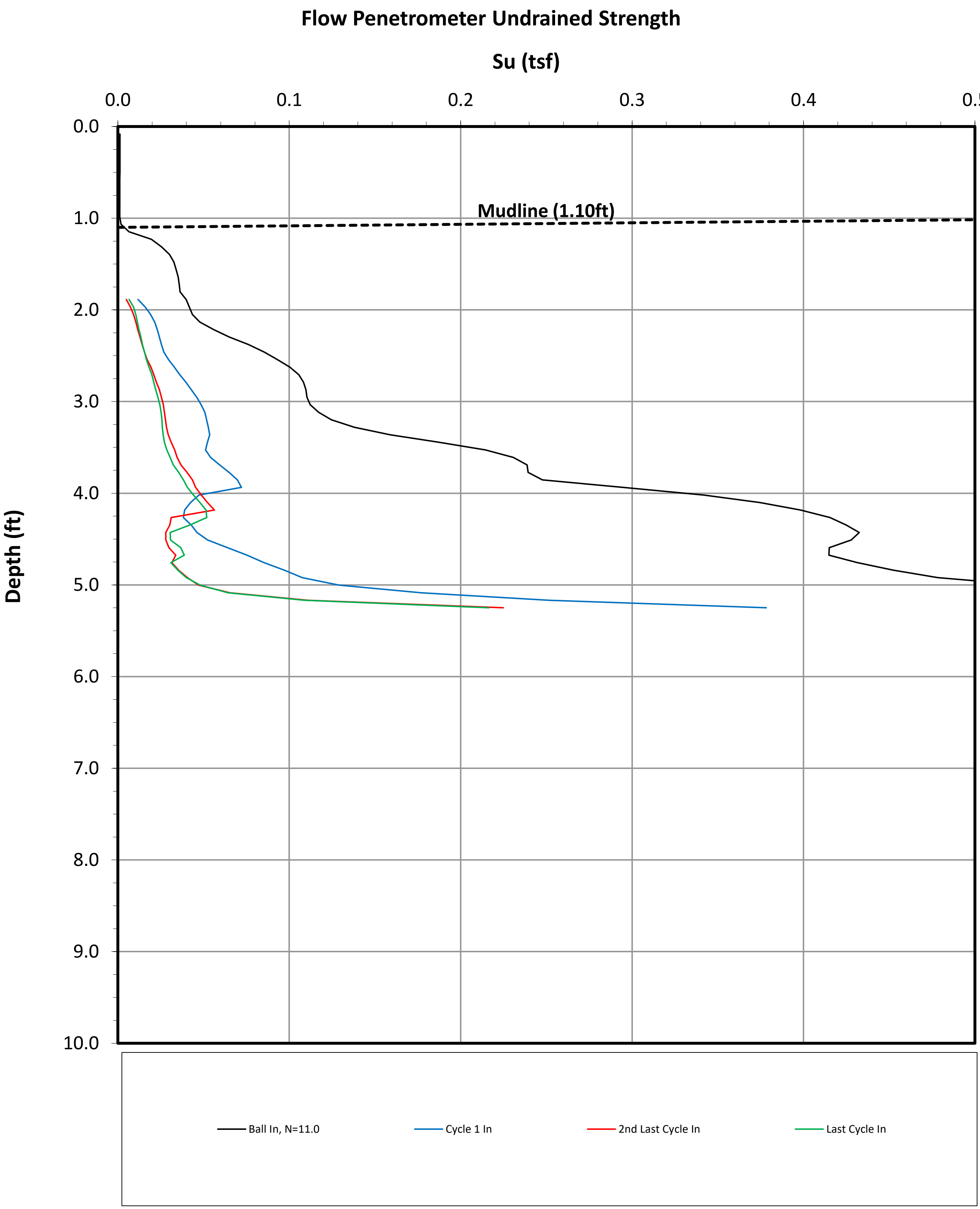
Job No: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding ID: LDW21-GT26-FFP
Sounding Date: July 16, 2021

Coordinate System: WGS 84 Lat/Long
Lat (deg): 47.5215043
Long (deg): -122.3068749



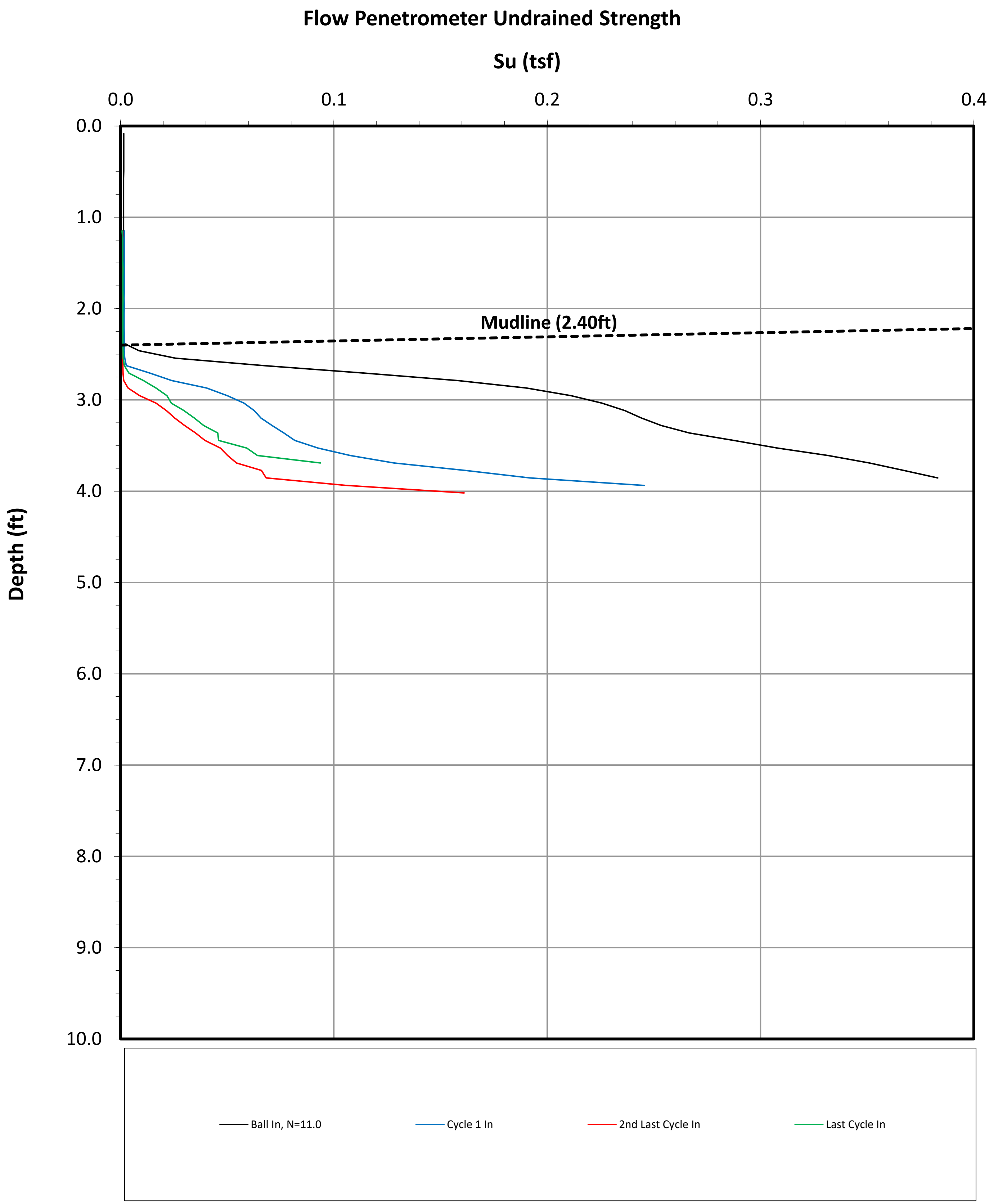
Job No: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding ID: LDW21-GT30-31-FFP
Sounding Date: July 21, 2021

Coordinate System: WGS 84 Lat/Long
Lat (deg): 47.520508
Long (deg): -122.3058147



Job No: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding ID: LDW21-GT32-34-FFP
Sounding Date: July 21, 2021

Coordinate System: WGS 84 Lat/Long
Lat (deg): 47.5199896
Long (deg): -122.3058465



Electronic Field Vane Shear Test Profile Summary and Results

Job Number:	21-59-22445
Client:	Anchor QEA
Project:	LDW Phase 3
Start Date:	06-Jul-2021
End Date:	29-Jul-2021

ELECTRIC FIELD VANE SHEAR TEST SUMMARY

Sounding ID	File Name	Adjacent CPT Sounding ID	Rig	Date From	Date To	Latitude[1]	Longitude[1]	Refer to Notation Number
LDW21-GT04-GV	21-59-22445_VST04	NONE	C05-023	12-Jul-2021	12-Jul-2021			2
LDW21-GT20-GV	21-59-22445_VST20	NONE	C05-023	19-Jul-2021	19-Jul-2021			2
LDW21-GT-26-GV	21-59-22445_VST26	NONE	C05-023	07-Jul-2021	07-Jul-2021	47.521510	-122.306837	
LDW21-GT-26-GV-B	21-59-22445_VST26B	NONE	C05-023	07-Jul-2021	07-Jul-2021	47.521522	-122.306805	
LDW21-GT43-GV	21-59-22445_VST43	NONE	C05-023	22-Jul-2021	22-Jul-2021	47.511105	-122.303294	

1. Coordinates were provided by client
2. Coordinates currently not available. Corrdiantes will be proviced by client at a later date
3. Test depth reference depth below mudline.
4. All vane tests were completed from the floating barge platform. The vane test results were affected by barge movement from local waves, local vessel traffic and river flow. Additionally, the vane results were susceptible to elevation charge from either rising or falling tide. Over the course of a vane test the barge would gain/lose approximately 1”-4” of elevation due to tidal effects.

Job Number: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Start Date: 06-Jul-2021
End Date: 29-Jul-2021

ELECTRIC FIELD VANE SHEAR TEST RESULTS

Sounding ID	File Name	Date	Load Cell Serial Number	Load Cell Location	Casing/Drillout Depth (ft)	Test Depth[1] (ft)	Vane Diameter D (mm)	Vane Height H (mm)	Top Taper Angle i_T (deg)	Bottom Taper Angle i_B (deg)	Vane Factor (kPa/Nm)	Peak Torque (Nm)	Remolded Torque (Nm)	Peak Stress (tsf)	Remolded Stress (tsf)	Peak Frictional Stress (tsf)	Remolded Frictional Stress (tsf)	Su Peak (tsf)	Su Remolded (tsf)	Sensitivity	Refer to Notation Number
LDW21-GT04-GV	21-59-22445_VST04	12-Jul-2021	AVLC009	Surface	N/A	1.50	75	150	45	45	0.6106	10.28		0.07		0.003		0.06			
LDW21-GT04-GV	21-59-22445_VST04	12-Jul-2021	AVLC009	Surface	N/A	2.50	75	150	45	45	0.6106	16.52	2.69	0.11	0.02	0.001	0.002	0.10	0.02	6.83	
LDW21-GT20-GV	21-59-22445_VST20	19-Jul-2021	AVLC009	Surface	N/A	2.50	75	150	45	45	0.6106	67.49	5.27	0.43	0.03	0.003	0.002	0.43	0.03	13.40	
LDW21-GT20-GV	21-59-22445_VST20	19-Jul-2021	AVLC009	Surface	N/A	4.50	75	150	45	45	0.6106	13.50	3.49	0.09	0.02	0.002	0.003	0.08	0.02	4.26	
LDW21-GT-26-GV	21-59-22445_VST26	07-Jul-2021	AVLC013	Surface	N/A	1.17	60	120	45	45	1.1926	3.04	0.47	0.04	0.01	0.004	0.004	0.03	0.00	15.56	
LDW21-GT-26-GV	21-59-22445_VST26	07-Jul-2021	AVLC013	Surface	N/A	3.17	60	120	45	45	1.1926	6.79	2.51	0.08	0.03	0.007	0.008	0.08	0.02	3.36	
LDW21-GT-26-GV	21-59-22445_VST26	07-Jul-2021	AVLC013	Surface	N/A	4.42	60	120	45	45	1.1926	4.23		0.05		0.004		0.05			
LDW21-GT-26-GV-B	21-59-22445_VST26B	07-Jul-2021	AVLC013	Surface	N/A	1.17	75	150	45	45	0.6106	14.96		0.10		0.003		0.09			
LDW21-GT43-GV	21-59-22445_VST43	22-Jul-2021	AVLC009	Surface	N/A	1.08	75	150	45	45	0.6106	43.50	6.22	0.28	0.04	0.003	0.001	0.27	0.04	7.03	
LDW21-GT43-GV	21-59-22445_VST43	22-Jul-2021	AVLC009	Surface	N/A	3.17	75	150	45	45	0.6106	72.29		0.46		0.003		0.46			

1. Test depths are referenced to the middle of the vane.

Job Number: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Start Date: 06-Jul-2021
End Date: 29-Jul-2021

ELECTRIC FIELD VANE SHEAR TEST TIMING

Sounding ID	Date	Test Depth[1] (ft)	Vane Insertion Time (HH:mm)	Peak Test Start Time (HH:mm)	Insertion to Start Interval (min)	Start to Failure Interval (sec)	Peak Test Avg Rate (deg/sec)	Remolding Completion Time (HH:mm)	Remold Test Start Time (HH:mm)	Remolding to Start Interval (min)	Remold Test Avg Rate (deg/sec)	Refer to Notation Number
LDW21-GT04-GV	12-Jul-2021	1.50	17:27	17:27	1	150	0.12					
LDW21-GT04-GV	12-Jul-2021	2.50	18:21	18:23	16	357	0.11	18:32	18:33	27	0.11	
LDW21-GT20-GV	19-Jul-2021	2.50	12:15	12:16	1	686	0.12	12:34	12:35	20	0.11	
LDW21-GT20-GV	19-Jul-2021	4.50	12:49	12:50	36	307	0.11	12:57	12:58	43	0.11	
LDW21-GT-26-GV	07-Jul-2021	1.17	14:08	14:10	2	210	0.08	14:22	14:23	16	0.09	
LDW21-GT-26-GV	07-Jul-2021	3.17	14:33	14:35	28	492	0.08	14:54	14:55	47	0.08	
LDW21-GT-26-GV	07-Jul-2021	4.42	15:08	15:11	63	269	0.08					
LDW21-GT-26-GV-B	07-Jul-2021	1.17	15:57	15:58	1	303	0.10					
LDW21-GT43-GV	22-Jul-2021	1.08	16:06	16:10	4	330	0.12	16:21	16:22	16	0.13	
LDW21-GT43-GV	22-Jul-2021	3.17	16:35	16:36	31	400	0.12					

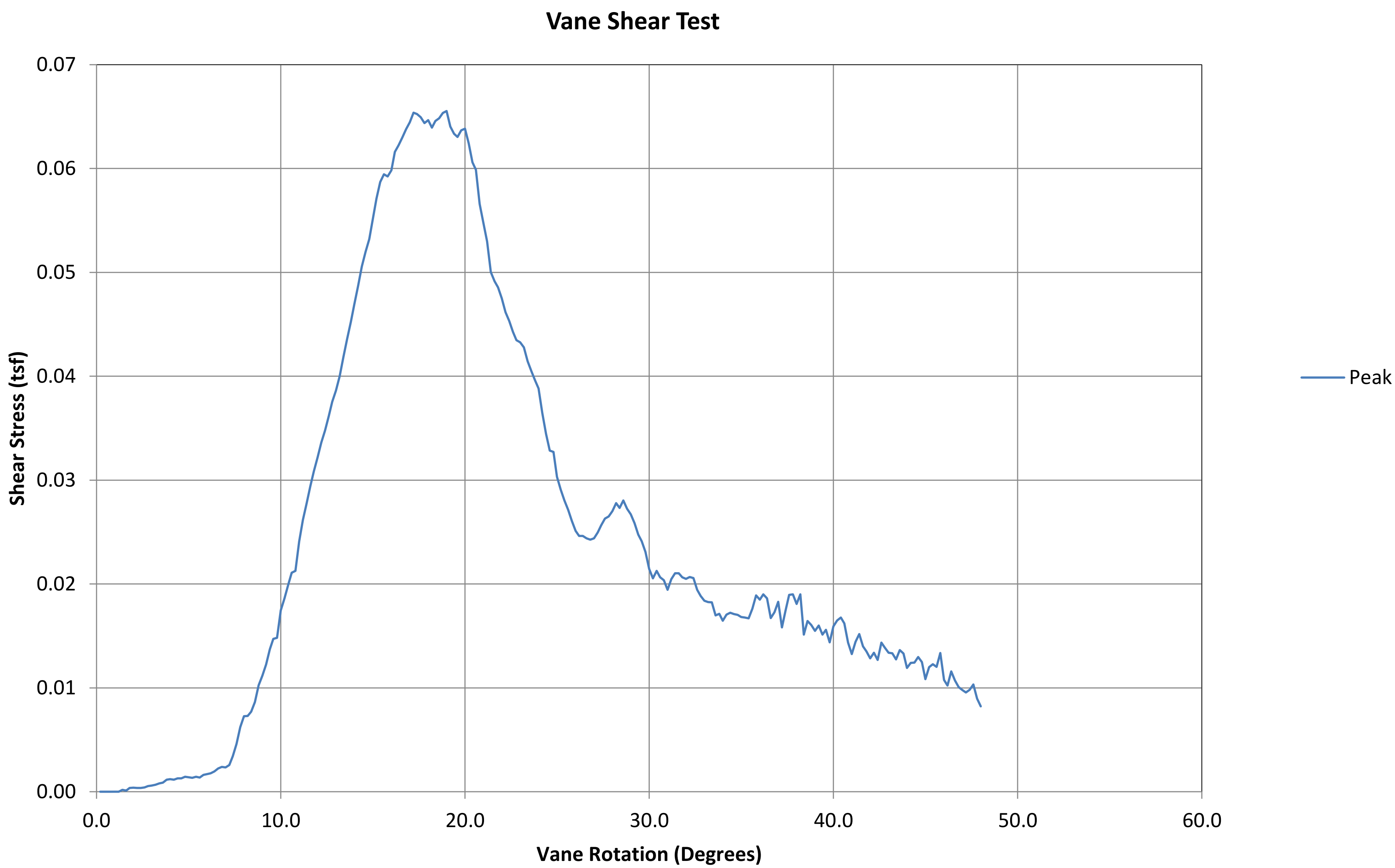
1. Test depths are referenced to the middle of the vane.

Electronic Field Vane Shear Test Plots

Job Number: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding: LDW21-GT04-GV

Test Date: 12-Jul-2021 17:27
Test Depth (ft): 1.50
Vane Type: Adara solid double tapered 75 x 150 mm (45°, 45°)

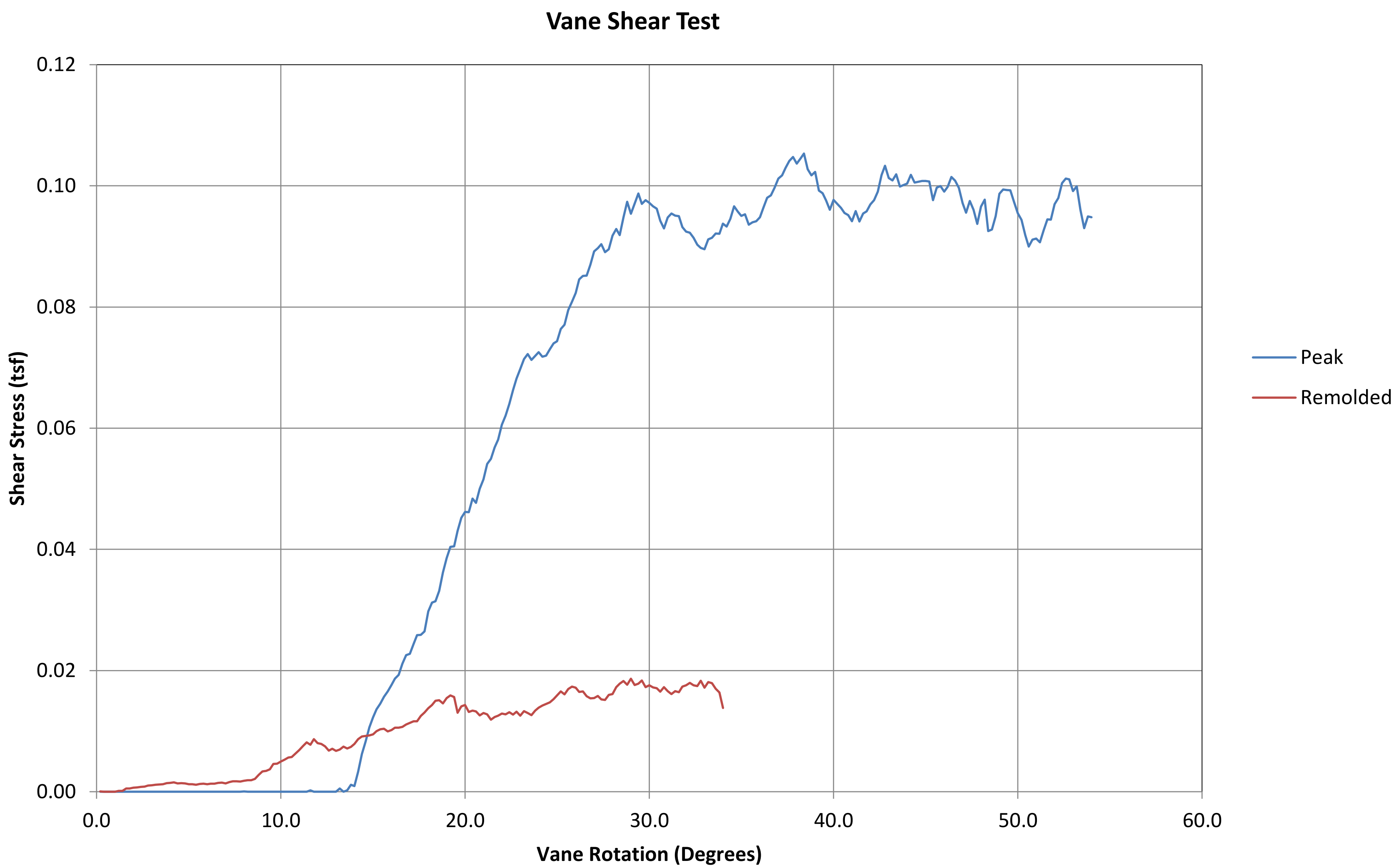
Coordinate System: WGS 84 Lat/Long
Latitude: 0
Longitude: 0



Job Number: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding: LDW21-GT04-GV

Test Date: 12-Jul-2021 18:23
Test Depth (ft): 2.50
Vane Type: Adara solid double tapered 75 x 150 mm (45°, 45°)

Coordinate System: WGS 84 Lat/Long
Latitude: 0
Longitude: 0



Job Number: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding: LDW21-GT20-GV

Test Date: 19-Jul-2021 12:16
Test Depth (ft): 2.50
Vane Type: Adara solid double tapered 75 x 150 mm (45°, 45°)

Coordinate System: WGS 84 Lat/Long
Latitude: 0
Longitude: 0

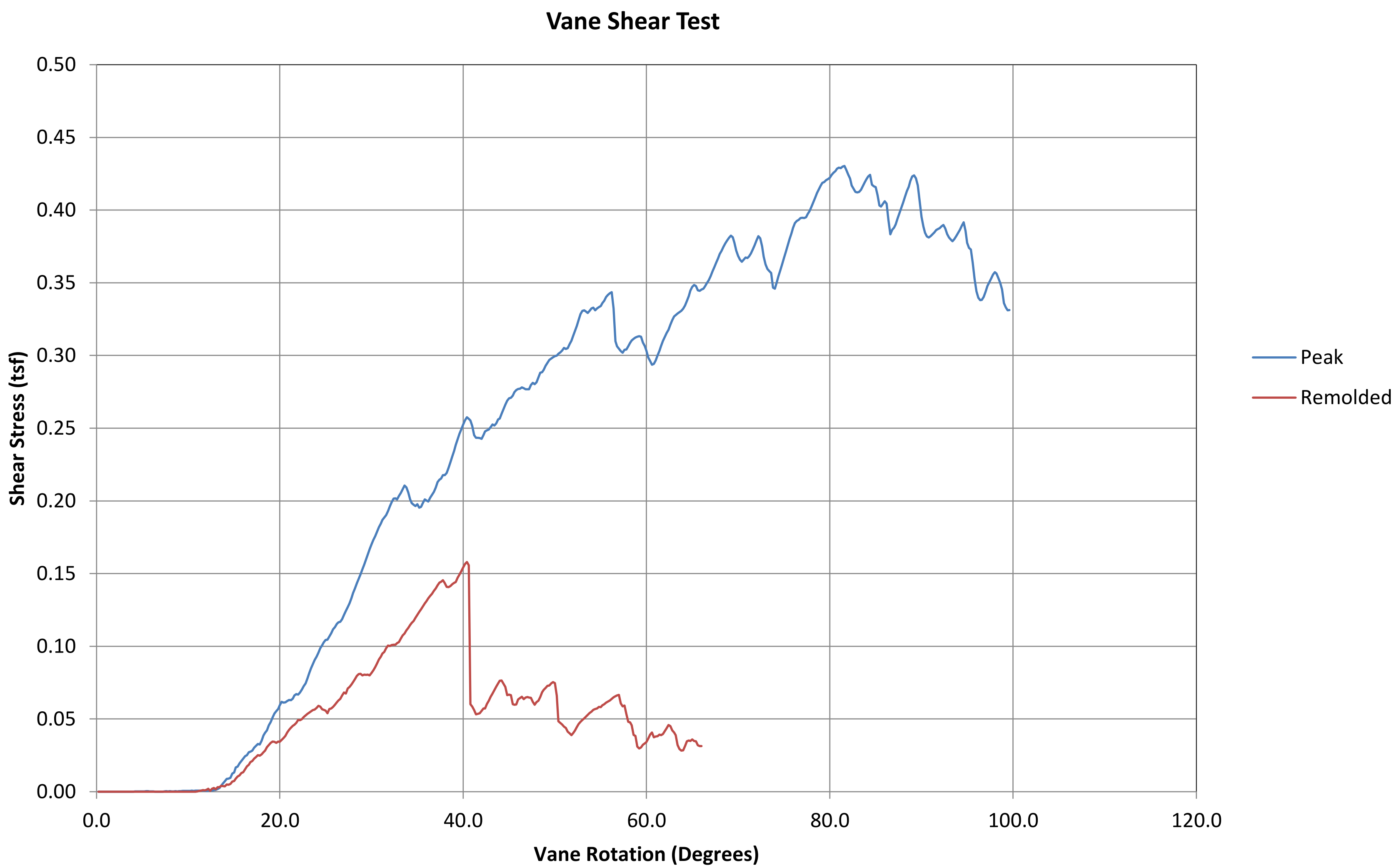


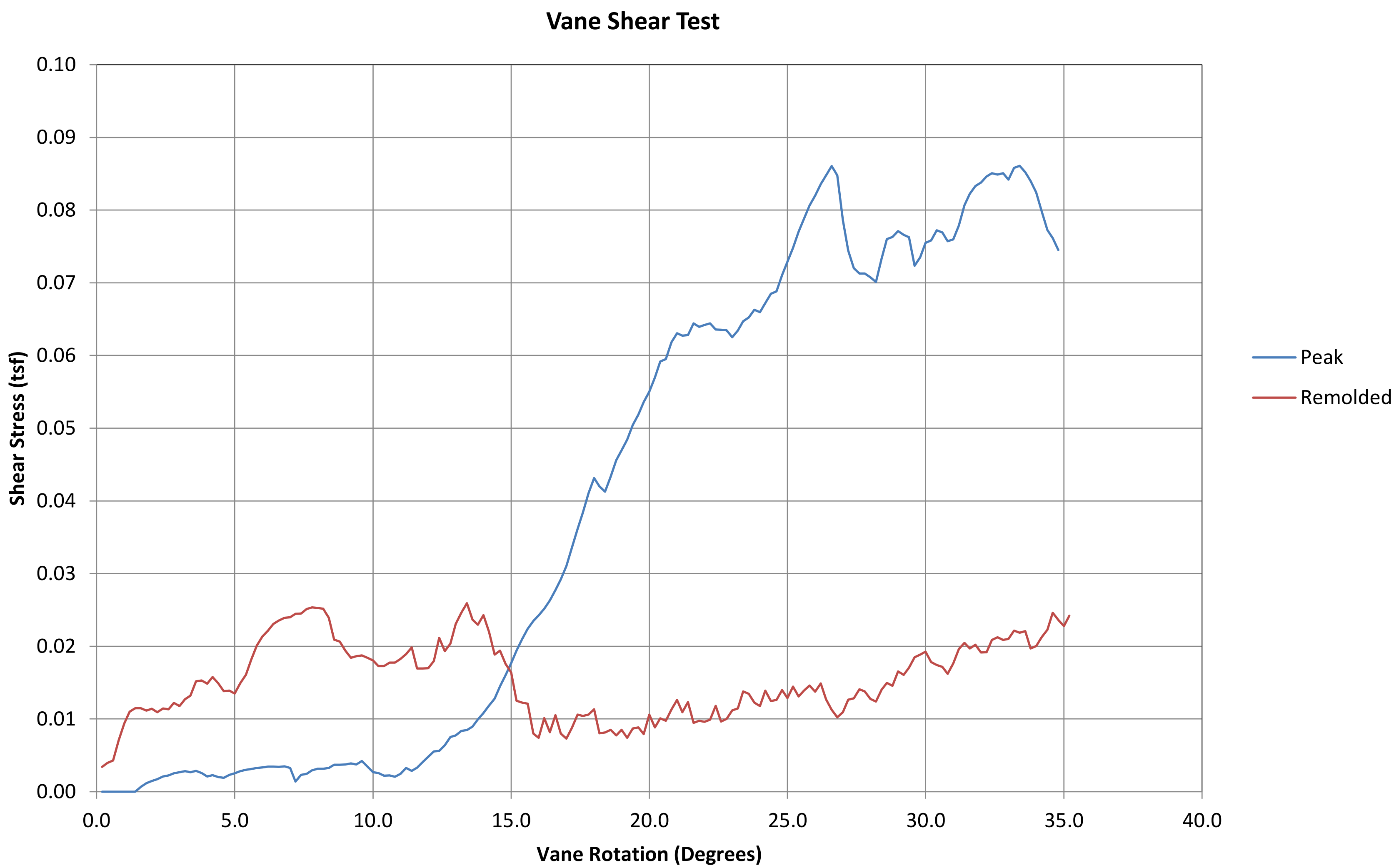
Chart 1 of 2

CONETEC

Job Number: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding: LDW21-GT20-GV

Test Date: 19-Jul-2021 12:50
Test Depth (ft): 4.50
Vane Type: Adara solid double tapered 75 x 150 mm (45°, 45°)

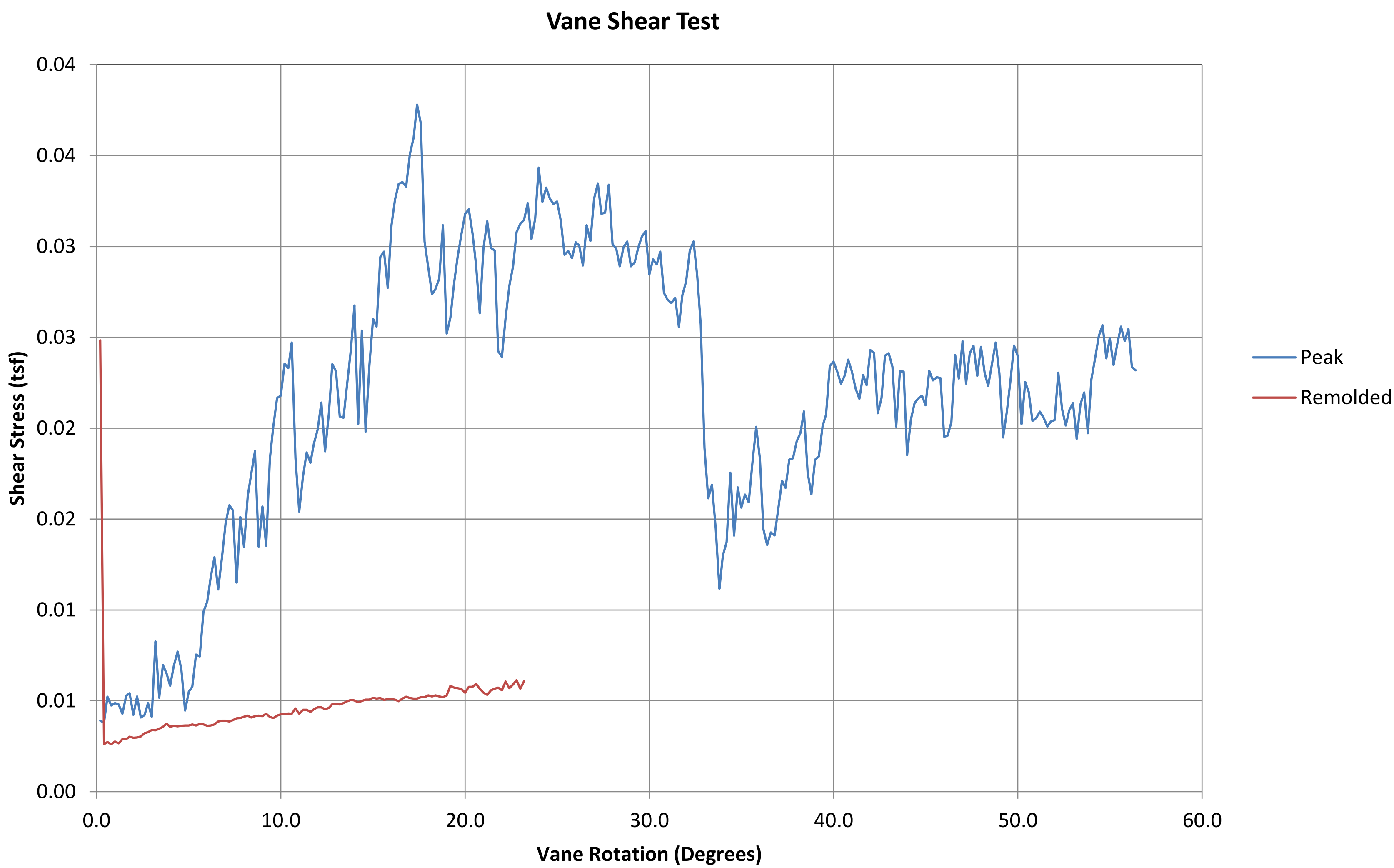
Coordinate System: WGS 84 Lat/Long
Latitude: 0
Longitude: 0



Job Number: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding: LDW21-GT-26-GV

Test Date: 07-Jul-2021 14:10
Test Depth (ft): 1.17
Vane Type: Adara solid double tapered 60 x 120 mm (45°, 45°)

Coordinate System: WGS 84 Lat/Long
Latitude: 47.5215097
Longitude: -122.3068371

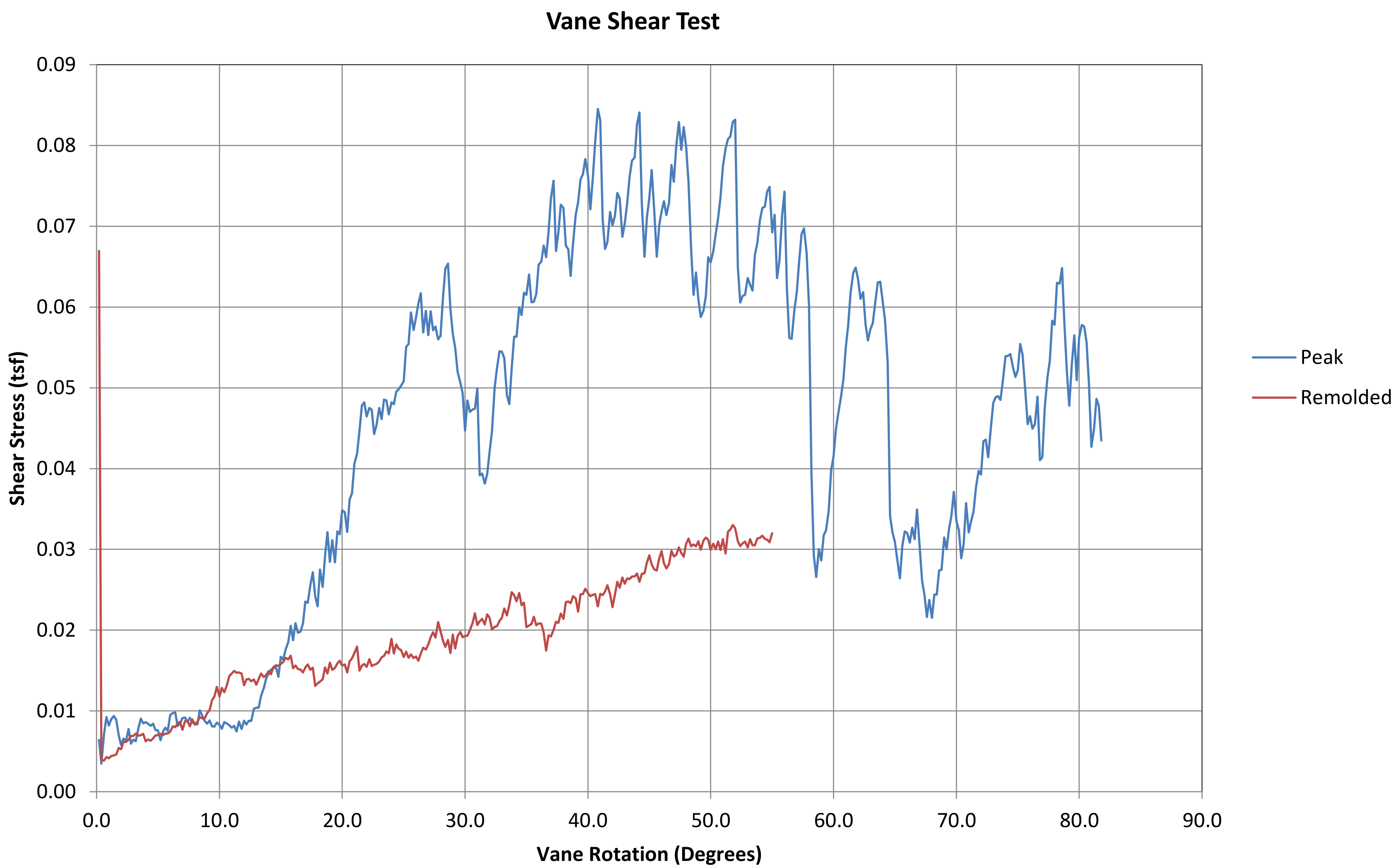


CONETEC

Job Number: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding: LDW21-GT-26-GV

Test Date: 07-Jul-2021 14:35
Test Depth (ft): 3.17
Vane Type: Adara solid double tapered 60 x 120 mm (45°, 45°)

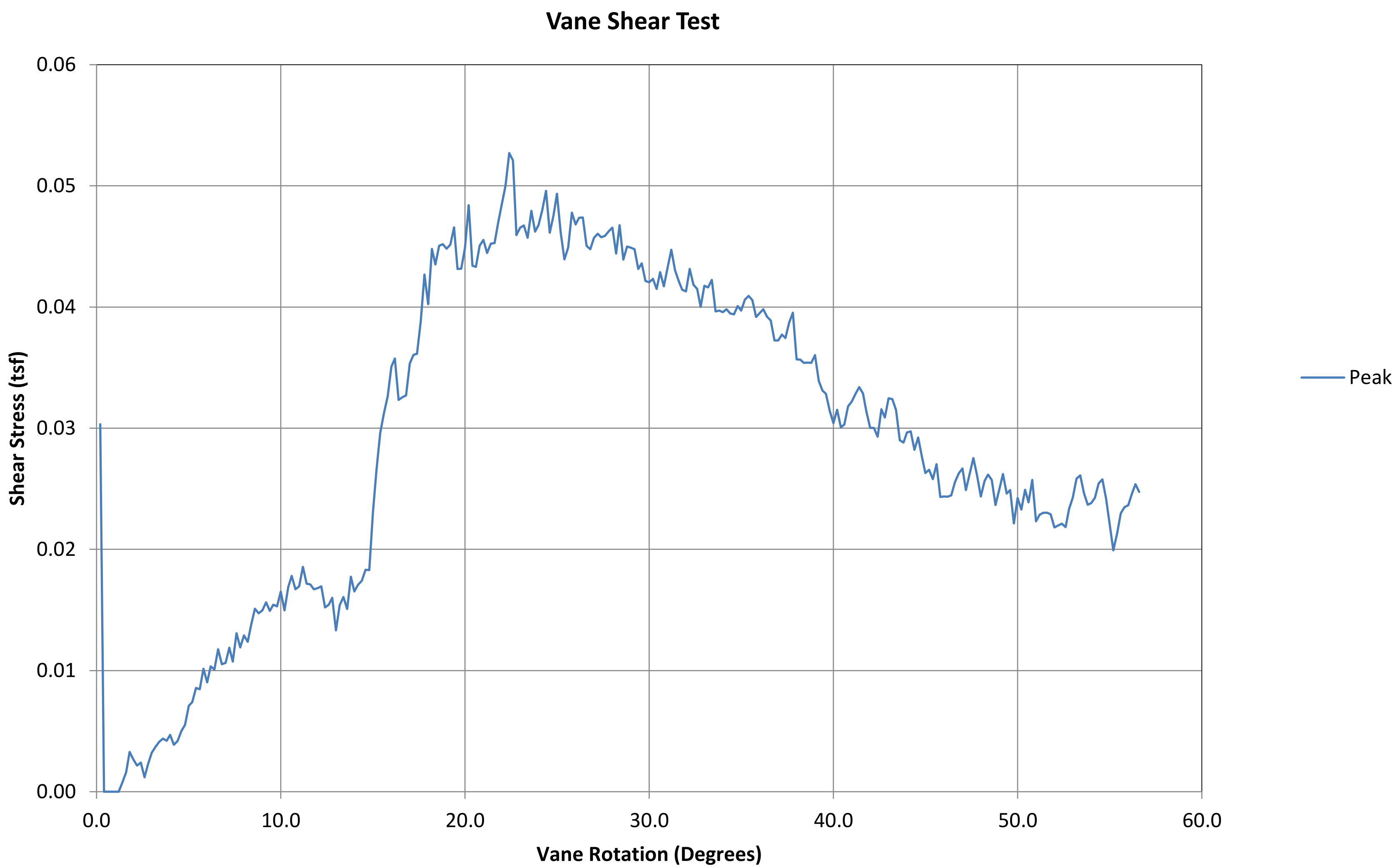
Coordinate System: WGS 84 Lat/Long
Latitude: 47.5215097
Longitude: -122.3068371



Job Number: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding: LDW21-GT-26-GV

Test Date: 07-Jul-2021 15:11
Test Depth (ft): 4.42
Vane Type: Adara solid double tapered 60 x 120 mm (45°, 45°)

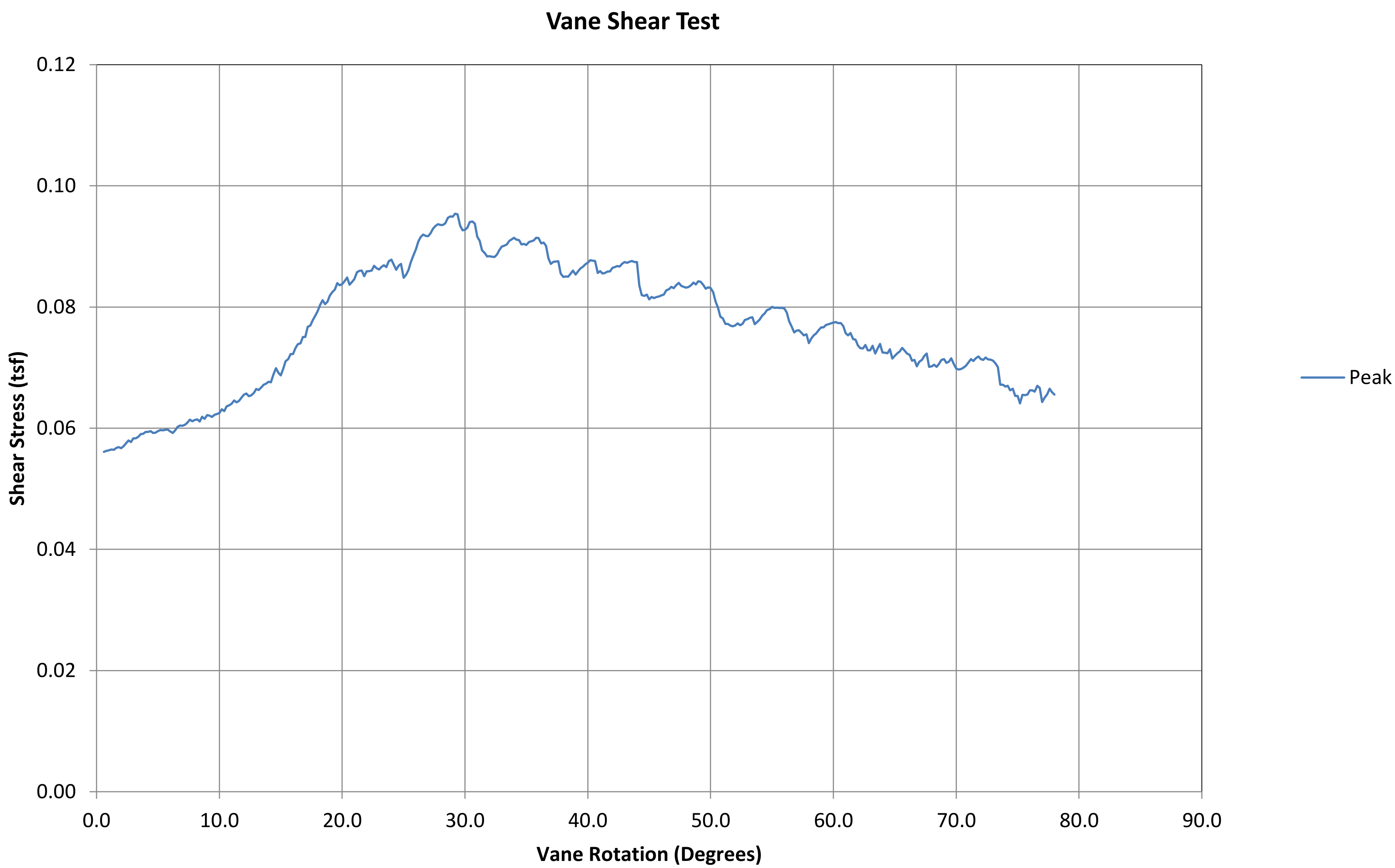
Coordinate System: WGS 84 Lat/Long
Latitude: 47.5215097
Longitude: -122.3068371



Job Number: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding: LDW21-GT-26-GV-B

Test Date: 07-Jul-2021 15:58
Test Depth (ft): 1.17
Vane Type: Adara solid double tapered 75 x 150 mm (45°, 45°)

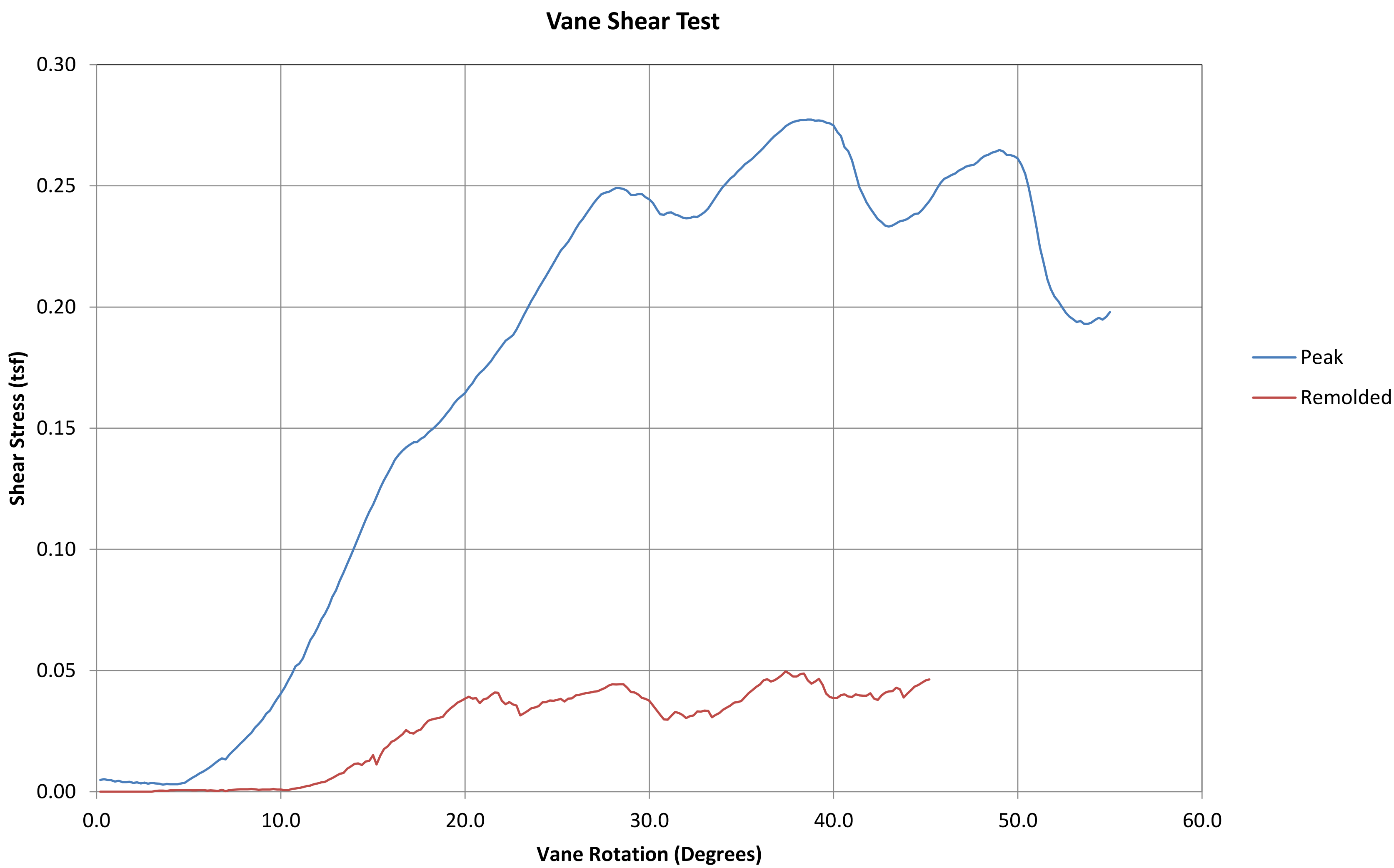
Coordinate System: WGS 84 Lat/Long
Latitude: 47.5215216
Longitude: -122.3068046



Job Number: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding: LDW21-GT43-GV

Test Date: 22-Jul-2021 16:10
Test Depth (ft): 1.08
Vane Type: Adara solid double tapered 75 x 150 mm (45°, 45°)

Coordinate System: WGS 84 Lat/Long
Latitude: 47.5111048
Longitude: -122.3032936

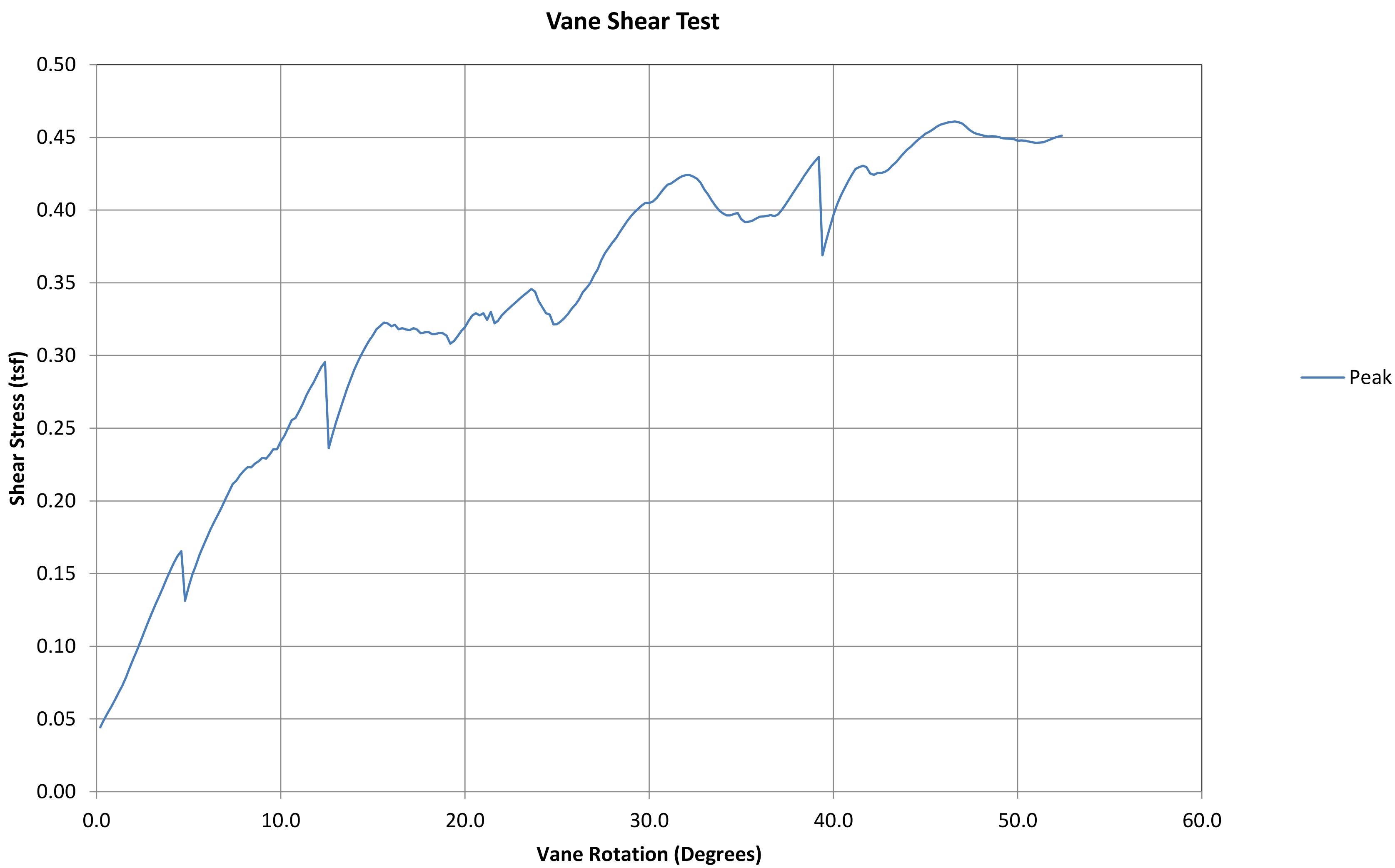


CONETEC

Job Number: 21-59-22445
Client: Anchor QEA
Project: LDW Phase 3
Sounding: LDW21-GT43-GV

Test Date: 22-Jul-2021 16:36
Test Depth (ft): 3.17
Vane Type: Adara solid double tapered 75 x 150 mm (45°, 45°)

Coordinate System: WGS 84 Lat/Long
Latitude: 47.5111048
Longitude: -122.3032936



Location ID:	LDW21-GT8-GD	Surface Elevation:	-2.8 MLLW
Performed By:	A. Barrett, G. Timm	Groundwater Depth:	NA
Vert. Datum:	NAD83	Hammer Weight:	35 lbs.
Horiz. Datum:	WA St. Plane N.	Cone Area:	10 sq. cm
Easting:	1275111.124	Start Date	8/4/21
Northing:	195841.496	End Date	8/5/21

Depth	Blows per 10 cm	Resistance (kg/cm²)	Dynamic Cone Resistance (kg/cm^2) 0 50 100 150	Correlated SPT N-Value	Density/Consistency Cohesionless	Cohesive
-	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
- 1 ft	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
- 2 ft	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
- 3 ft	0	0.0		0	V. Loose	V. Soft
- 1 m	0	0.0	Mudline	0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
- 4 ft	0	0.0	Weight of Rods	0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
- 5 ft	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
- 6 ft	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
- 2 m	0	0.0	Weight of Hammer	0	V. Loose	V. Soft
- 7 ft	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
- 8 ft	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
- 9 ft	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
- 3 m 10 ft	0	0.0	Weight of Hammer	0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
- 11 ft	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
- 12 ft	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
- 4 m 13 ft	0	0.0	Weight of Hammer	0	V. Loose	V. Soft

Location ID: LDW21-GT8-GD
Performed By: A. Barrett, G. Timm

Surface Elevation:
Groundwater Depth: NA

Depth	Blows per 10 cm	Resistance (kg/cm²)	Dynamic Cone Resistance (kg/cm^2) 0 50 100 150	Correlated SPT N-Value	Density/Consistency Cohesionless	Density/Consistency Cohesive
-	0	0.0		0	V. Loose	V. Soft
-	0	0.0		0	V. Loose	V. Soft
- 14 ft	4	11.1	••	3	V. Loose	Soft
-	5	13.9	•••	3	V. Loose	Soft
-	7	19.4	•••••	5	Loose	M. Stiff
- 15 ft	13	36.0	•••••••••	10	Loose	Stiff
-	24	66.5	•••••••••••••••••	18	M. Dense	V. Stiff
-	41	113.6	•••••••••••••••••••••••••••••	25+	Dense	Hard
- 16 ft	10	27.7	•••••••	7	Loose	M. Stiff
- 5 m	11	30.5	••••••••	8	Loose	M. Stiff
-						
- 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						
-						
-						

Dynamic Cone Penetrometer

Exploration Log

180067-02.03
Lower Duwamish Waterway Upper Reach
Boeing Development Center

Location ID:	GT38-A	Surface Elevation:	0.0
Performed By:	A. Barrett, G. Timm	Groundwater Depth:	NA
Vert. Datum:	NAD83	Hammer Weight:	35 lbs.
Horiz. Datum:	WA St. Plane N.	Cone Area:	10 sq. cm
Easting:	1277389.19	Start Date	8/4/21
Northing:	1906166.48	End Date	8/5/21

Depth	Blows per 10 cm	Resistance (kg/cm²)	Dynamic Cone Resistance (kg/cm²) 0 50 100 150	Correlated SPT N-Value	Density/Consistency Cohesionless	Density/Consistency Cohesive
-	1	4.4	•	1	V. Loose	V. Soft
-	2	8.9	••	2	V. Loose	Soft
- 1 ft	3	13.3	•••	3	V. Loose	Soft
-	4	17.8	••••	5	Loose	M. Stiff
-	3	13.3	•••	3	V. Loose	Soft
- 2 ft	2	8.9	••	2	V. Loose	Soft
-	1	4.4	•	1	V. Loose	V. Soft
-	4	17.8	••••	5	Loose	M. Stiff
- 3 ft	4	17.8	••••	5	Loose	M. Stiff
- 1 m	3	13.3	•••	3	V. Loose	Soft
-	3	11.6	•••	3	V. Loose	Soft
- 4 ft	2	7.7	••	2	V. Loose	Soft
-	3	11.6	•••	3	V. Loose	Soft
-	3	11.6	•••	3	V. Loose	Soft
- 5 ft	4	15.4	••••	4	V. Loose	Soft
-	3	11.6	•••	3	V. Loose	Soft
-	3	11.6	•••	3	V. Loose	Soft
- 6 ft	3	11.6	•••	3	V. Loose	Soft
-	5	19.3	•••••	5	Loose	M. Stiff
- 2 m	7	27.0	•••••••	7	Loose	M. Stiff
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

Dynamic Cone Penetrometer

Exploration Log

Lower Duwamish Waterway Upper Reach
Boeing Development Center

Location ID: GT38-B
Performed By: A. Barrett, G. Timm
Vert. Datum: NAD83
Horiz. Datum: WA St. Plane N.
Easting: 1277392.36
Northing: 190614.83

Surface Elevation: 0.0
Groundwater Depth: NA
Hammer Weight: 35 lbs.
Cone Area: 10 sq. cm
Start Date 8/4/21
End Date 8/5/21

Depth	Blows per 10 cm	Resistance (kg/cm²)	Dynamic Cone Resistance (kg/cm^2) 0 50 100 150	Correlated SPT N-Value	Density/Consistency Cohesionless	Cohesive
-	3	13.3	•••	3	V. Loose	Soft
-	2	8.9	••	2	V. Loose	Soft
- 1 ft	1	4.4	•	1	V. Loose	V. Soft
-	2	8.9	••	2	V. Loose	Soft
-	2	8.9	••	2	V. Loose	Soft
- 2 ft	3	13.3	•••	3	V. Loose	Soft
-	2	8.9	••	2	V. Loose	Soft
-	1	4.4	•	1	V. Loose	V. Soft
- 3 ft	4	17.8	••••	5	Loose	M. Stiff
- 1 m	4	17.8	••••	5	Loose	M. Stiff
-	2	7.7	••	2	V. Loose	Soft
- 4 ft	3	11.6	•••	3	V. Loose	Soft
-	3	11.6	•••	3	V. Loose	Soft
-	3	11.6	•••	3	V. Loose	Soft
- 5 ft	4	15.4	••••	4	V. Loose	Soft
-	3	11.6	•••	3	V. Loose	Soft
-	3	11.6	•••	3	V. Loose	Soft
- 6 ft	3	11.6	•••	3	V. Loose	Soft
-	7	27.0	•••••••	7	Loose	M. Stiff
- 2 m	4	15.4	••••	4	V. Loose	Soft
- 7 ft	3	10.3	••	2	V. Loose	Soft
-	9	30.8	••••••••	8	Loose	M. Stiff
-	5	17.1	••••	4	V. Loose	Soft
- 8 ft	8	27.4	•••••••	7	Loose	M. Stiff
-	7	23.9	••••••	6	Loose	M. Stiff
-	14	47.9	••••••••••••	13	M. Dense	Stiff
- 9 ft	15	51.3	•••••••••••••	14	M. Dense	Stiff
-	16	54.7	••••••••••••••	15	M. Dense	Stiff
-	19	65.0	•••••••••••••••••	18	M. Dense	V. Stiff
- 3 m 10 ft	19	65.0	•••••••••••••••••	18	M. Dense	V. Stiff
-	19	58.1	•••••••••••••••	16	M. Dense	V. Stiff
-	20	61.2	••••••••••••••••	17	M. Dense	V. Stiff
-	21	64.3	••••••••••••••••	18	M. Dense	V. Stiff
- 11 ft	28	85.7	••••••••••••••••••••••	24	M. Dense	V. Stiff
-	23	70.4	••••••••••••••••••	20	M. Dense	V. Stiff
-	18	55.1	••••••••••••••	15	M. Dense	Stiff
- 12 ft	18	55.1	••••••••••••••	15	M. Dense	Stiff
-	18	55.1	••••••••••••••	15	M. Dense	Stiff
-	17	52.0	•••••••••••••	14	M. Dense	Stiff
- 4 m 13 ft	24	73.4	•••••••••••••••••••	20	M. Dense	V. Stiff

Anchor QEA, LLC
1201 3rd Ave Suite 2600
Seattle, WA 98101

Location ID: GT38-B

Performed By: A. Barrett, G. Timm

Surface Elevation:

Groundwater Depth: NA

Depth	Blows per 10 cm	Resistance (kg/cm²)	Dynamic Cone Resistance (kg/cm^2) 0 50 100 150	Correlated SPT N-Value	Density/Consistency Cohesionless	Density/Consistency Cohesive
-	29	80.3	••••••••••••••••••••	22	M. Dense	V. Stiff
-	25	69.3	•••••••••••••••••	19	M. Dense	V. Stiff
- 14 ft	20	55.4	••••••••••••••	15	M. Dense	Stiff
-	13	36.0	•••••••••	10	Loose	Stiff
-	13	36.0	•••••••••	10	Loose	Stiff
- 15 ft	10	27.7	•••••••	7	Loose	M. Stiff
-	8	22.2	•••••	6	Loose	M. Stiff
-	5	13.9	•••	3	V. Loose	Soft
- 16 ft	7	19.4	•••••	5	Loose	M. Stiff
- 5 m	8	22.2	•••••	6	Loose	M. Stiff
-						
- 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						
-						

Attachment G.2

Geotechnical Laboratory Testing

July 19, 2022

Anchor QEA, LLC.
1201 3rd Avenue, Suite 2600
Seattle, WA 98101

To Whom It May Concern,

MTC approves and authorizes the release and publication of statements, conclusions, and extracts from or regarding our reports to Anchor QEA, LLC.

If you have any other questions, feel free to call us at (360) 755-1990, or email me at alex.eifrig@mtc-inc.net.

Thank you,

Alex Eifrig

MATERIALS TESTING & CONSULTING, INC.
Alex Eifrig
NW Region Laboratory Manager
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Client:	Anchor QEA	**Date:**	September 23, 2021
Address:	21328 2nd Drive SE	**Project:**	Q.C. - Lower Duwamish Waterway
	Bothell, WA 98021	**Project #:**	21B233
Attn:	Garrett Timm	**Sample #:**	B21-1427 - 1446
Revised on:		**Date sampled:**	7-7-21 & 7-8-21

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	Please See Attached Reports		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count			LA Abrasion	
X	Moisture Content	Please See Attached Report	X	Direct Shear	Please See Attached Reports
	Specific Gravity, Coarse		X	Specific Gravity, Soils	Please See Attached Reports
	Specific Gravity, Fine				
X	Hydrometer Analysis	Please See Attached Reports			
X	Atterberg Limits	Please See Attached Reports			

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Respectfully Submitted,
Meghan Blodgett-Carrillo
WABO Supervising Laboratory Technician

Moisture Content - ASTM C566, ASTM D2216

Project: Q.C. - Lower Duwamish Waterway
Client: Anchor QEA
Project #: 21B233
Date Received: July 29, 2021
Sampled by: Client
Date Tested: August 23, 2021
Tested by: A. Eifrig

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B21-1427	LDW21-GT10-GB-0-1.5 ft	233.1	600.7	434.9	165.8	201.8	82.2%
B21-1428	LDW21-GT10-GB-0-9 ft	233.1	804.9	583.3	221.6	350.2	63.3%
B21-1429	LDW21-GT10-GB-9-14 ft	221.7	1019.4	669.5	349.9	447.8	78.1%
B21-1430	LDW21-GT10-GB-14-19 ft	224.1	475.2	368.0	107.2	143.9	74.5%
B21-1431	LDW21-GT10-GB-19-24 ft	217.2	895.4	719.1	176.3	501.9	35.1%
B21-1432	LDW21-GT10-GB-24-25.5 ft	233.7	639.9	567.2	72.7	333.5	21.8%
B21-1433	LDW21-GT28-GB-0-1.5 ft	208.6	1012.3	678.5	333.8	469.9	71.0%
B21-1434	LDW21-GT28-GB-0-10 ft	222.9	1087.3	729.8	357.5	506.9	70.5%
B21-1435	LDW21-GT28-GB-10-11.5 ft	302.0	1045.9	721.9	324.0	419.9	77.2%
B21-1436	LDW21-GT28-GB-10-15 ft	303.4	1236.5	827.0	409.5	523.6	78.2%
B21-1437	LDW21-GT28-GB-15-16.8 ft	311.0	880.9	647.2	233.7	336.2	69.5%
B21-1438	LDW21-GT28-GB-16.8-20 ft	223.0	1069.1	875.2	193.9	652.2	29.7%
B21-1439	LDW21-GT28-GB-20-21.5 ft	221.8	951.4	801.9	149.5	580.1	25.8%
B21-1440	LDW21-GT21-GB-0-1.5 ft	222.7	653.9	446.8	207.1	224.1	92.4%
B21-1441	LDW21-GT21-GB-0-13 ft	234.6	1463.8	860.0	603.8	625.4	96.5%
B21-1442	LDW21-GT21-GB-13-16 ft	225.2	1059.7	808.7	251.0	583.5	43.0%
B21-1443	LDW21-GT21-GB-16-17.5 ft	233.1	805.2	661.3	143.9	428.2	33.6%
B21-1444	LDW21-GT21-GB-16-21 ft	215.7	1239.6	953.1	286.5	737.4	38.9%
B21-1445	LDW21-GT21-GB-21-25.7 ft	225.1	772.5	628.4	144.1	403.3	35.7%
B21-1446	LDW21-GT21-GB-26-31 ft	108.4	1248.4	956.1	292.3	847.7	34.5%

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM D854

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: August 25, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B21-1428	LDW21-GT10-GB-0-9 ft	584.04	660.85	76.8	TSA-011	190.3	499.5	0.99754	734.30	688.64	23.0	2.465721	0.99933	2.464069
B21-1431	LDW21-GT10-GB-19-24 ft	501.90	602.67	100.8	TSA-021	183.4	499.4	0.99754	742.98	681.60	23.0	2.5581693	0.99933	2.5564553
B21-1442	LDW21-GT21-GB-13-16 ft	510.13	611.47	101.3	TSA-020	195.0	499.5	0.99754	755.39	693.29	23.0	2.5824927	0.99933	2.5807624
B21-1445	LDW21-GT21-GB-21-25.7 ft	500.61	577.32	76.7	TSA-022	198.0	499.5	0.99754	742.91	696.21	23.0	2.5560327	0.99933	2.5543202

Reviewed by:
Meghan Blodgett-Carrillo

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21	**Visual Identification**
Project #:	21B233	**Sampled By:**	Client	Silt with Clay
Client:	Anchor QEA	**Date Tested:**	23-Aug-21	**Sample Color**
Source:	LDW21-GT10-GB-0-9 ft	**Tested By:**	A. Eifrig	brown
Sample #:	B21-1428			

Liquid Limit Determination

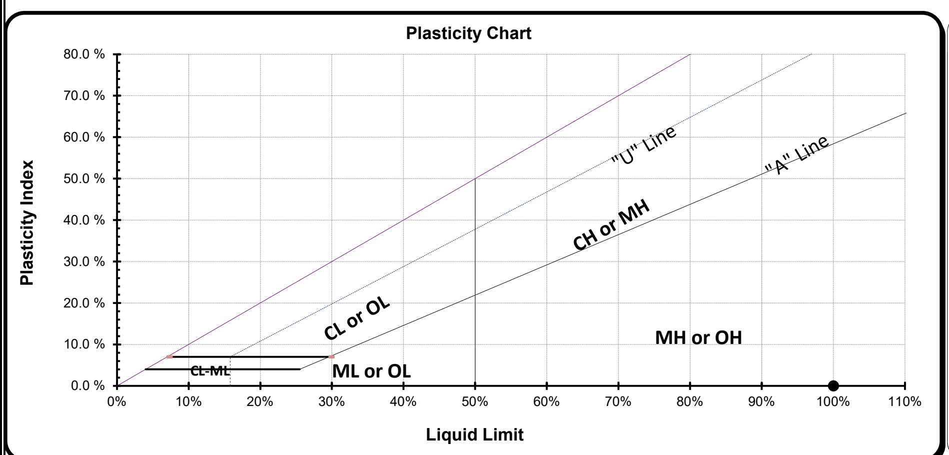
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

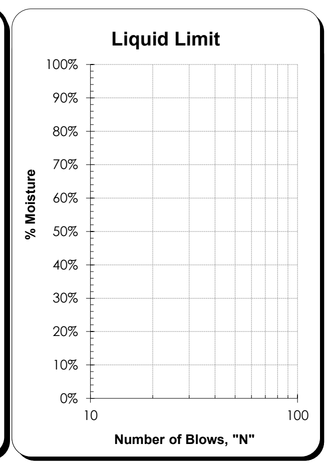
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the liquid limit cup without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT10-GB-9-14 ft
Sample #: B21-1429

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 23-Aug-21
Tested By: A. Eifrig

Visual Identification
Silt with Clay
Sample Color
brown

Liquid Limit Determination

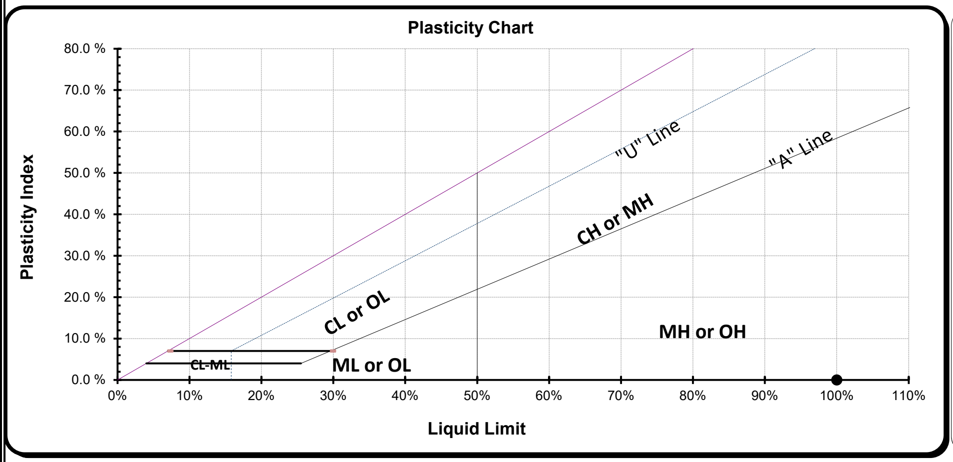
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	40.29	42.71	29.23			
Weight of Dry Soils + Pan:	37.17	38.71	25.20			
Weight of Pan:	28.61	28.25	15.04			
Weight of Dry Soils:	8.56	10.46	10.16			
Weight of Moisture:	3.12	4.00	4.03			
% Moisture:	36.5 %	38.2 %	39.7 %			
Number of Blows:	27	16	11			

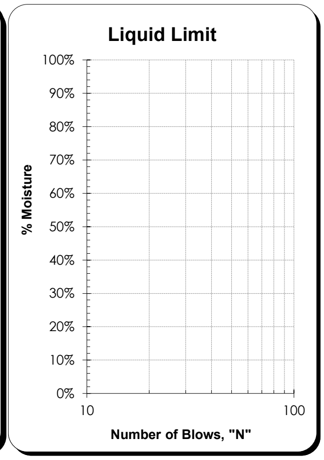
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows: 37 %
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by:

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	23-Aug-21
Source:	LDW21-GT10-GB-14-19 ft	**Tested By:**	A. Eifrig
Sample#:	B21-1430		

Visual Identification
Clayey Silt
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

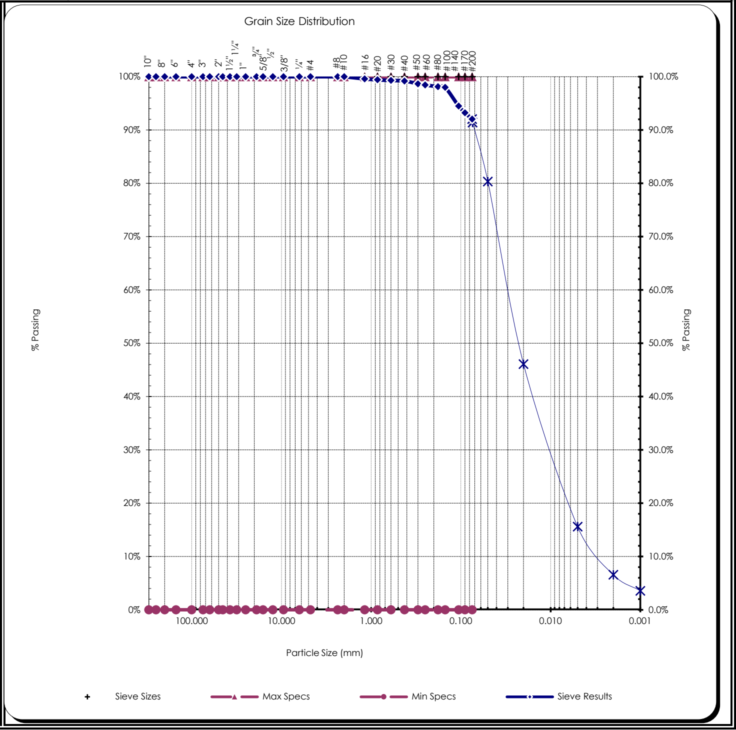
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.001 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 0.79
$D_{(10)}$ = 0.003 mm	% Sand = 8.0%	Coeff. of Uniformity, C_U = 9.14
$D_{(15)}$ = 0.005 mm	% Silt & Clay = 92.0%	Fineness Modulus = 0.04
$D_{(30)}$ = 0.009 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.024 mm	Plasticity Index = n/a	Moisture %, as sampled = 74.5%
$D_{(60)}$ = 0.031 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.072 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 90/97	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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%	100.0%	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%	100.0%	0.0%
3/4"	19.00		100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50		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	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		99%	100.0%	0.0%
#60	0.250		98%	100.0%	0.0%
#80	0.180		98%	100.0%	0.0%
#100	0.150	98%	98%	100.0%	0.0%
#140	0.106		95%	100.0%	0.0%
#170	0.090		93%	100.0%	0.0%
#200	0.075	92.0%	92.0%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project: Q.C. - Lower Duwamish Waterway	**Date Received:** 29-Jul-21	**Visual Identification**		
Project #: 21B233	**Sampled By:** Client	Clayey Silt		
Client : Anchor QEA	**Date Tested:** 23-Aug-21	**Sample Color**		
Source: LDW21-GT10-GB-14-19 ft	**Tested By:** A. Eifrig	brown		
Sample#: B21-1430				

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.30	grams
Hydroscopic Moist.:	3.78%	
Adj. Sample Wgt :	48.47	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	35	72.2%	0.0444 mm
2	30.5	62.9%	0.0326 mm
4	24.5	50.5%	0.0240 mm
15	18.5	38.2%	0.0129 mm
30	15	30.9%	0.0093 mm
60	10.5	21.7%	0.0068 mm
240	5	10.3%	0.0035 mm
1440	2.5	5.2%	0.0014 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	8.0%	**Plastic Limit:**	n/a
% Silt:	76.4%	**Plasticity Index:**	n/a
% Clay:	15.6%		

ASTM D6913

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	100%	4.750 mm
	#10	100%	2.000 mm
	#20	99%	0.850 mm
	#40	99%	0.425 mm
	#100	98%	0.150 mm
	#200	92.0%	0.075 mm
Silts		91.4%	0.074 mm
		80.4%	0.050 mm
		46.1%	0.020 mm
Clays		15.6%	0.005 mm
		6.6%	0.002 mm
Colloids		3.6%	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

Silt Loam

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

MATERIALS TESTING & CONSULTING, INC.

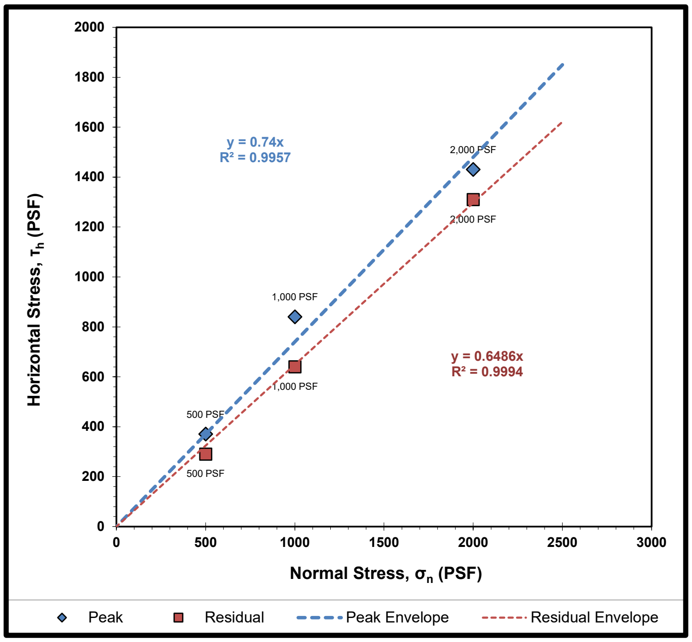
Project: Q.C. - Lower Duwamish Waterway

Project Number:	21B233	**Sample Source:**	LDW21-GT10-GB-14-19 ft
Laboratory Sample ID:	B21-1430	**Visual Soil Description:**	brown clayey silt
Sample Date:	7/7/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	9/20/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0042
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:	σ_n=500 PSF	
Initial Moisture Content (%):	45.3	
	Initial	**Post-Consolidation**
Dry Density (PCF):	91.7	95.2
Void Ratio:	0.837	0.770
Porosity (%):	45.6	43.5
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:	σ_n=1000 PSF	
Initial Moisture Content (%):	40.4	
	Initial	**Post-Consolidation**
Dry Density (PCF):	95.4	102.4
Void Ratio:	0.765	0.646
Porosity (%):	43.4	39.3
Degree of Saturation (%):	saturated	saturated

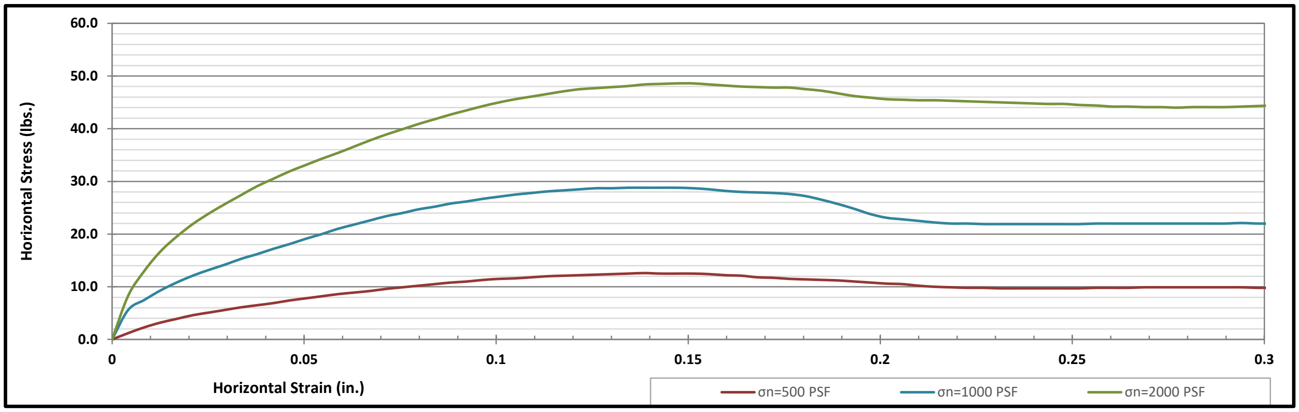
Summary of Sample Data:	σ_n=2000 PSF	
Initial Moisture Content (%):	37.0	
	Initial	**Post-Consolidation**
Dry Density (PCF):	97.7	106.6
Void Ratio:	0.725	0.581
Porosity (%):	42.0	36.7
Degree of Saturation (%):	saturated	saturated

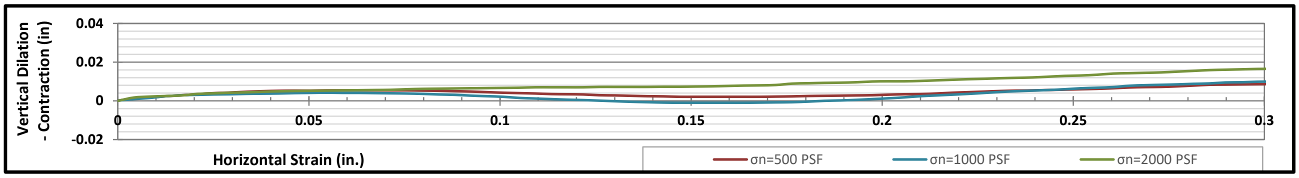


ESTIMATED STRENGTH PARAMETERS

	PEAK	RESIDUAL
Angle of Internal Friction, ϕ (°):	37	33
Cohesion (PSF):	0	0

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	370	840	1430
Residual Horizontal Stress, τ_h (PSF):	290	640	1310





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT10-GB-19-24 ft
Sample#: B21-1431

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 23-Aug-21
Tested By: A. Eifrig

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color:
grayish-brown

ACCREDITED
Certificate #: 1366.01

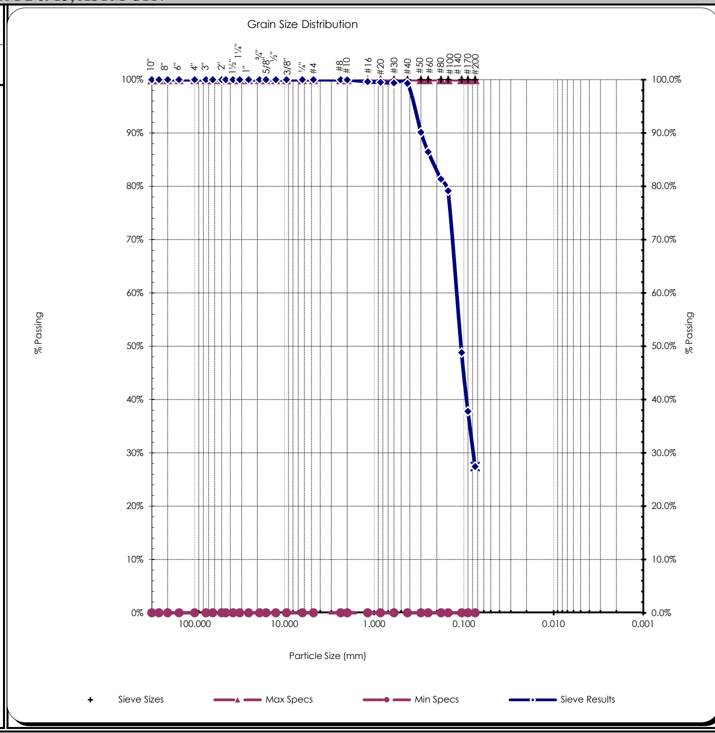
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.014 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.85
$D_{(10)}$ = 0.027 mm	% Sand = 72.5%	Coeff. of Uniformity, C_U = 4.47
$D_{(15)}$ = 0.041 mm	% Silt & Clay = 27.5%	Fineness Modulus = 0.32
$D_{(30)}$ = 0.079 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.108 mm	Plasticity Index = n/a	Moisture %, as sampled = 35.1%
$D_{(60)}$ = 0.122 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.298 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 13/47	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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%	100.0%	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	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		90%	100.0%	0.0%
#60	0.250		86%	100.0%	0.0%
#80	0.180		81%	100.0%	0.0%
#100	0.150	79%	79%	100.0%	0.0%
#140	0.106		49%	100.0%	0.0%
#170	0.090		38%	100.0%	0.0%
#200	0.075	27.5%	27.5%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT28-GB-0-10 ft
Sample #: B21-1434

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Aug-21
Tested By: A. Eifrig

Visual Identification
Clay with Silt
Sample Color
dark brown

Liquid Limit Determination

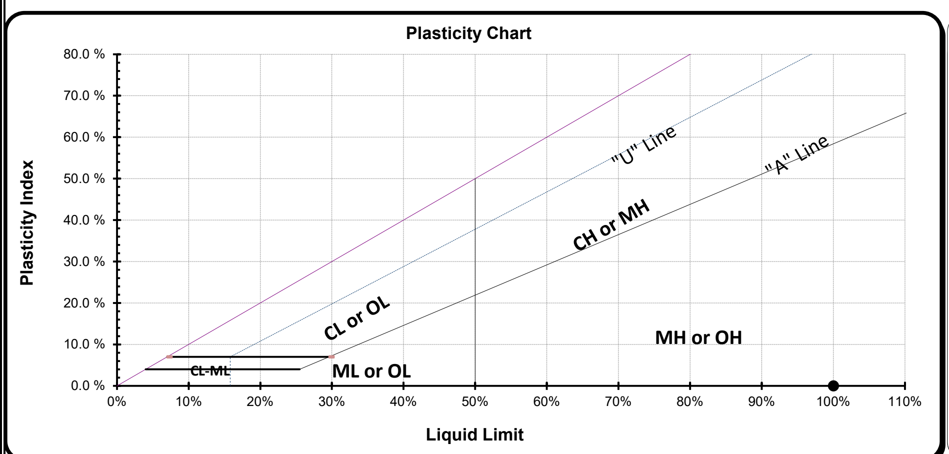
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	33.52	24.84	28.54			
Weight of Dry Soils + Pan:	28.91	21.54	25.61			
Weight of Pan:	19.45	14.96	19.90			
Weight of Dry Soils:	9.46	6.58	5.71			
Weight of Moisture:	4.61	3.30	2.93			
% Moisture:	48.7 %	50.2 %	51.3 %			
Number of Blows:	34	22	19			

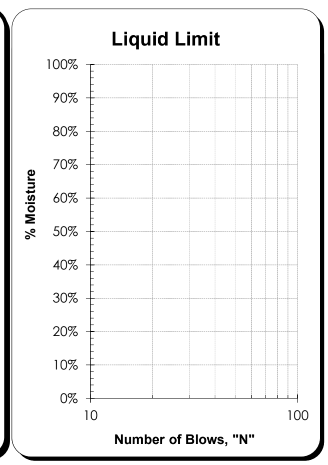
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows:	50 %
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Plastic Limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT28-GB-10-15 ft
Sample #: B21-1436

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Aug-21
Tested By: A. Eifrig

Visual Identification
Silty Clay
Sample Color
dark brown

Liquid Limit Determination

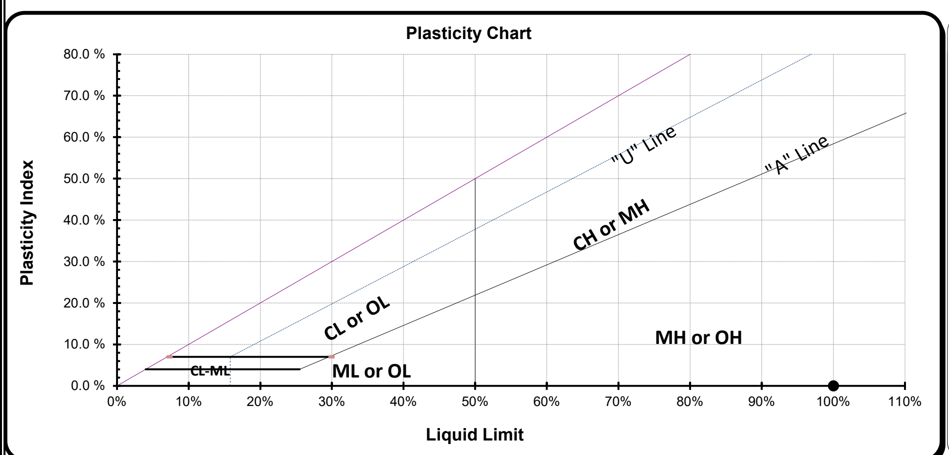
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	30.19	31.68	32.21			
Weight of Dry Soils + Pan:	26.52	27.44	27.75			
Weight of Pan:	19.62	19.54	19.84			
Weight of Dry Soils:	6.90	7.90	7.91			
Weight of Moisture:	3.67	4.24	4.46			
% Moisture:	53.2 %	53.7 %	56.4 %			
Number of Blows:	25	21	12			

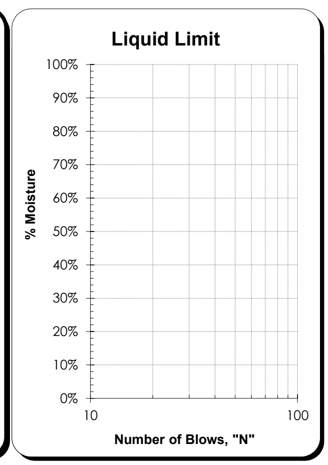
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows: 53 %
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Plastic Limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT28-GB-15-16.8 ft
Sample #: B21-1437

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Aug-21
Tested By: A. Eifrig

Visual Identification
Clay and Silt
Sample Color
dark brown

Liquid Limit Determination

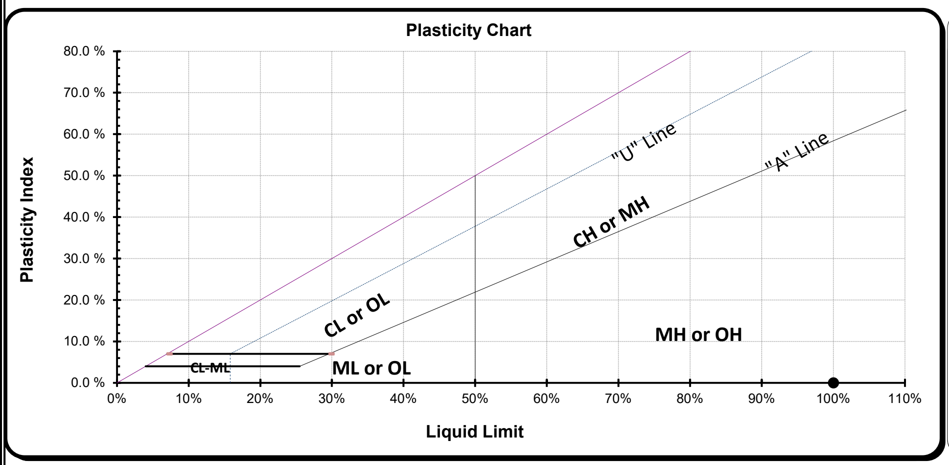
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	31.73	40.08	39.56			
Weight of Dry Soils + Pan:	28.13	36.32	36.04			
Weight of Pan:	19.86	28.17	28.53			
Weight of Dry Soils:	8.27	8.15	7.51			
Weight of Moisture:	3.60	3.76	3.52			
% Moisture:	43.5 %	46.1 %	46.9 %			
Number of Blows:	27	15	12			

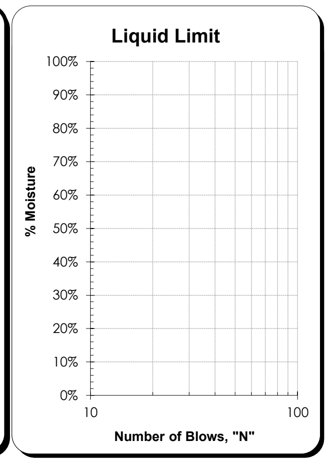
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows:	44 %
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Plastic Limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	23-Aug-21
Source:	LDW21-GT28-GB-16.8-20 ft	**Tested By:**	A. Eifrig
Sample#:	B21-1438		

Unified Soils Classification System, ASTM D-2487
SP, Poorly graded Sand
Sample Color:
gray

ACCREDITED
Certificate #: 1366.01

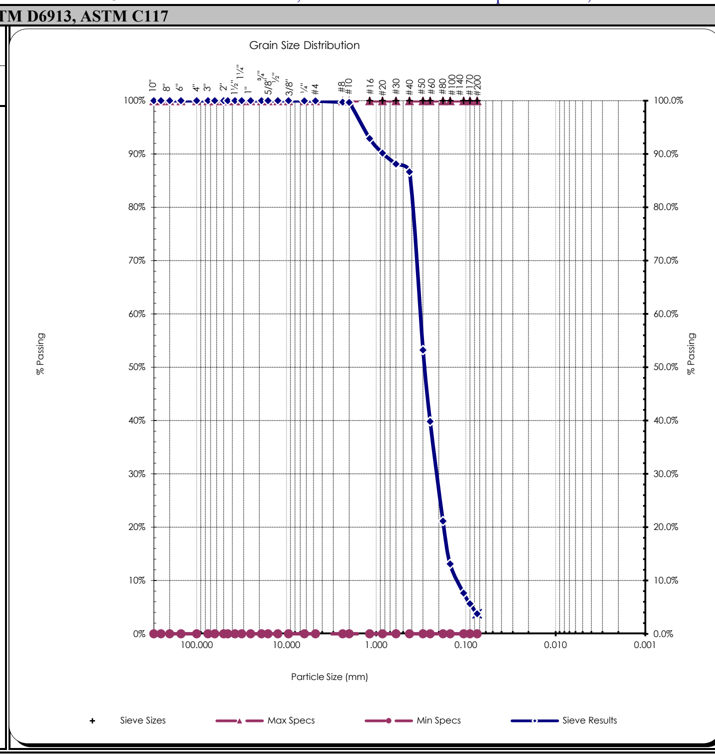
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.085	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C =	1.12
$D_{(10)}$ =	0.125	mm	% Sand =	96.2%	Coeff. of Uniformity, C_U =	2.60
$D_{(15)}$ =	0.157	mm	% Silt & Clay =	3.8%	Fineness Modulus =	1.53
$D_{(30)}$ =	0.213	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.288	mm	Plasticity Index =	n/a	Moisture %, as sampled =	29.7%
$D_{(60)}$ =	0.325	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	0.827	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	1/23		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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%	100.0%	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	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		93%	100.0%	0.0%
#20	0.850		90%	100.0%	0.0%
#30	0.600		88%	100.0%	0.0%
#40	0.425	87%	87%	100.0%	0.0%
#50	0.300		53%	100.0%	0.0%
#60	0.250		40%	100.0%	0.0%
#80	0.180		21%	100.0%	0.0%
#100	0.150	13%	13%	100.0%	0.0%
#140	0.106		8%	100.0%	0.0%
#170	0.090		6%	100.0%	0.0%
#200	0.075	3.8%	3.8%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

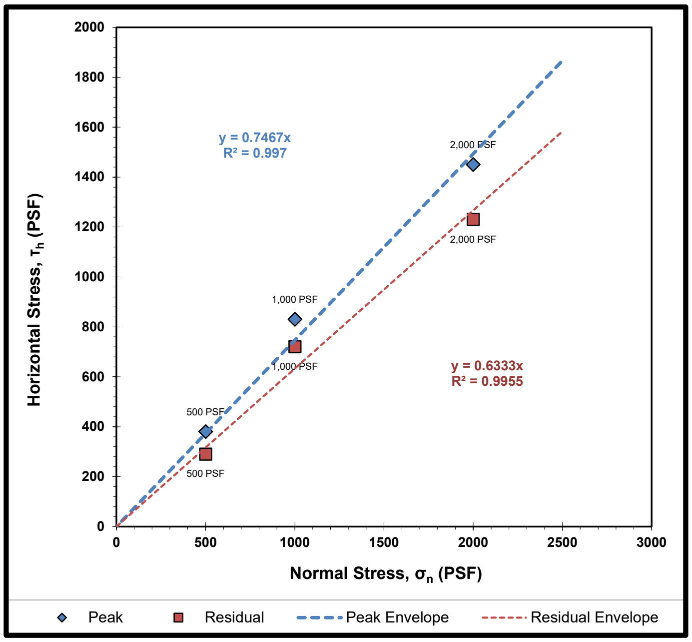
MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway
Project Number:	21B233
Laboratory Sample ID:	B21-1438
Sample Date:	7/7/2021
Test Date:	8/25/2021
Technician:	M. Carrillo
Sample Source:	LDW21-GT28-GB-16.8-20 ft
Visual Soil Description:	gray sand
Type of Specimen:	Remolded Cylindrical Shear Box
Specimen Diameter (in):	2.5
Specimen Height (in):	1
Rate of Strain (in/min):	0.0208
Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	31.3	
	Initial	**Post-Consolidation**
Dry Density (PCF):	105.4	106.7
Void Ratio:	0.598	0.579
Porosity (%):	37.4	36.7
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	31.0	
	Initial	**Post-Consolidation**
Dry Density (PCF):	105.6	107.2
Void Ratio:	0.595	0.572
Porosity (%):	37.3	36.4
Degree of Saturation (%):	saturated	saturated

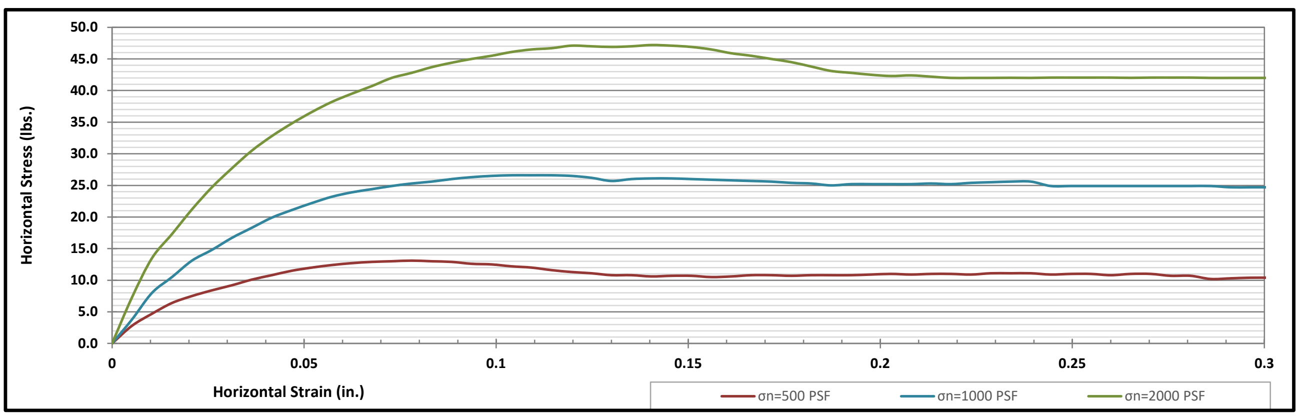
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	32.9	
	Initial	**Post-Consolidation**
Dry Density (PCF):	104.0	107.8
Void Ratio:	0.619	0.562
Porosity (%):	38.2	36.0
Degree of Saturation (%):	saturated	saturated

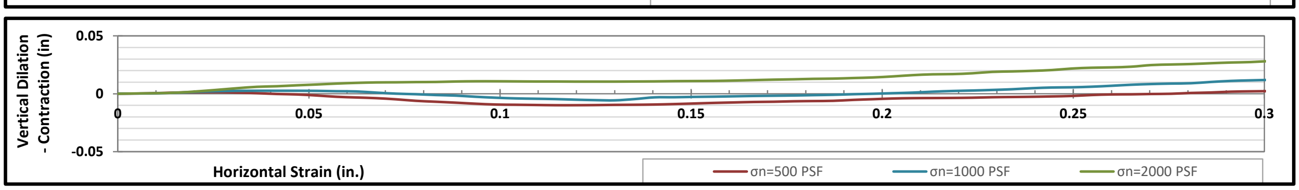


ESTIMATED STRENGTH PARAMETERS

	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	**37**	**32**
Cohesion (PSF):	**0**	**0**

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	380	830	1450
Residual Horizontal Stress, τ_h (PSF):	290	720	1230





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT21-GB-0-13 ft
Sample #: B21-1441

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Aug-21
Tested By: A. Eifrig

Visual Identification
Silty Clay
Sample Color
dark brown

Liquid Limit Determination

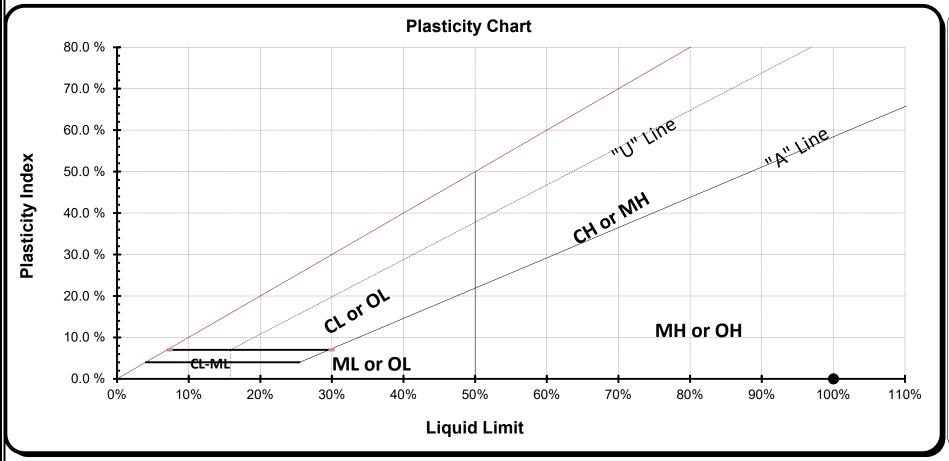
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	28.39	31.98	25.34			
Weight of Dry Soils + Pan:	23.97	27.63	21.68			
Weight of Pan:	15.01	19.45	14.80			
Weight of Dry Soils:	8.96	8.18	6.88			
Weight of Moisture:	4.42	4.35	3.66			
% Moisture:	49.3 %	53.2 %	53.2 %			
Number of Blows:	35	17	19			

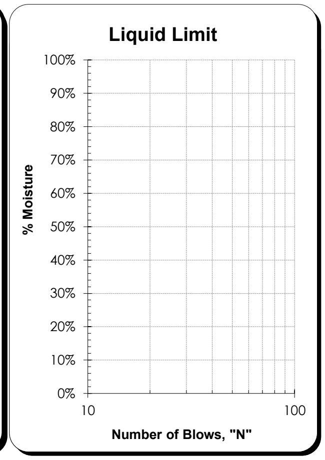
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows:	52 %
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Plastic Limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT21-GB-13-16 ft
Sample#: B21-1442

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 23-Aug-21
Tested By: A. Eifrig

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

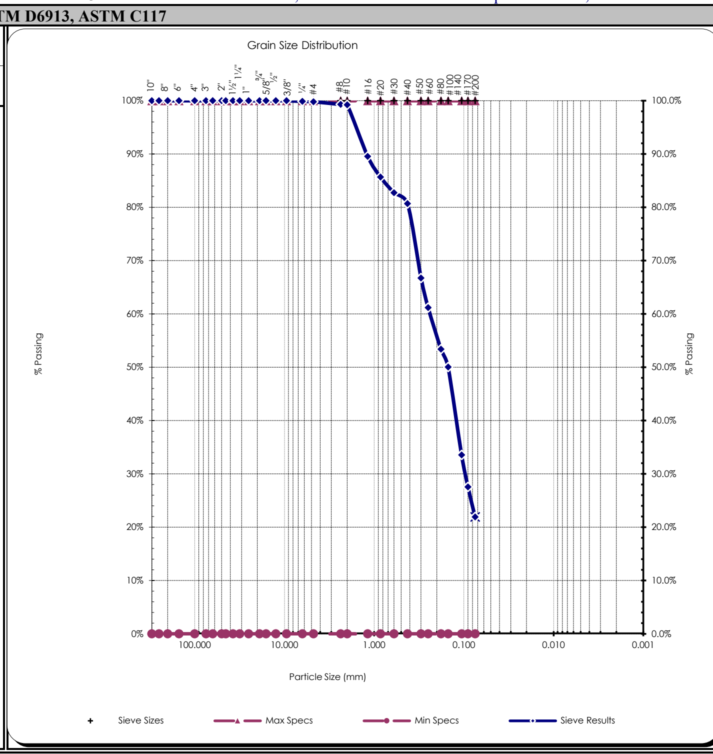
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.017 mm	% Gravel = 0.2%	Coeff. of Curvature, C_C = 1.14
$D_{(10)}$ = 0.034 mm	% Sand = 77.9%	Coeff. of Uniformity, C_U = 7.00
$D_{(15)}$ = 0.051 mm	% Silt & Clay = 22.0%	Fineness Modulus = 1.12
$D_{(30)}$ = 0.096 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.150 mm	Plasticity Index = n/a	Moisture %, as sampled = 96.5%
$D_{(60)}$ = 0.239 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.216 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 3/11	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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%	100.0%	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	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		90%	100.0%	0.0%
#20	0.850		86%	100.0%	0.0%
#30	0.600		83%	100.0%	0.0%
#40	0.425	81%	81%	100.0%	0.0%
#50	0.300		67%	100.0%	0.0%
#60	0.250		61%	100.0%	0.0%
#80	0.180		53%	100.0%	0.0%
#100	0.150	50%	50%	100.0%	0.0%
#140	0.106		34%	100.0%	0.0%
#170	0.090		28%	100.0%	0.0%
#200	0.075	22.0%	22.0%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	23-Aug-21
Source:	LDW21-GT21-GB-16-21 ft	**Tested By:**	A. Eifrig
Sample#:	B21-1444		

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color:
dark gray

ACCREDITED
Certificate #: 1366.01

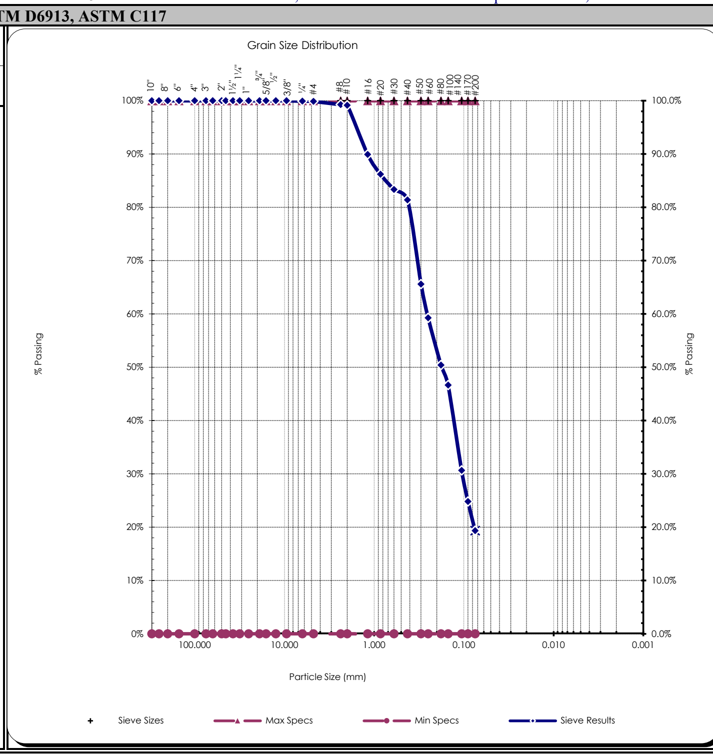
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.019 mm	% Gravel = 0.1%	Coeff. of Curvature, C_C = 1.10
$D_{(10)}$ = 0.039 mm	% Sand = 80.5%	Coeff. of Uniformity, C_U = 6.61
$D_{(15)}$ = 0.058 mm	% Silt & Clay = 19.4%	Fineness Modulus = 1.15
$D_{(30)}$ = 0.104 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.177 mm	Plasticity Index = n/a	Moisture %, as sampled = 38.7%
$D_{(60)}$ = 0.256 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.188 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 5/21	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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%	100.0%	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	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		90%	100.0%	0.0%
#20	0.850		86%	100.0%	0.0%
#30	0.600		83%	100.0%	0.0%
#40	0.425	81%	81%	100.0%	0.0%
#50	0.300		66%	100.0%	0.0%
#60	0.250		59%	100.0%	0.0%
#80	0.180		50%	100.0%	0.0%
#100	0.150	47%	47%	100.0%	0.0%
#140	0.106		31%	100.0%	0.0%
#170	0.090		25%	100.0%	0.0%
#200	0.075	19.4%	19.4%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

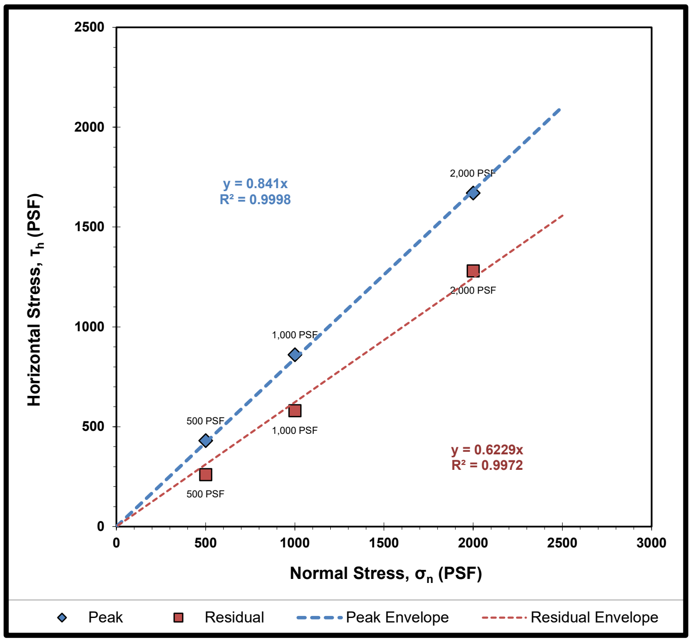
MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway		
Project Number:	21B233	**Sample Source:**	LDW21-GT21-GB-16-21 ft
Laboratory Sample ID:	B21-1444	**Visual Soil Description:**	dark gray sand
Sample Date:	7/8/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	9/13/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		**σ_n=500 PSF**
Initial Moisture Content (%):	26.8	
	Initial	**Post-Consolidation**
Dry Density (PCF):	107.5	109.1
Void Ratio:	0.568	0.545
Porosity (%):	36.2	35.3
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		**σ_n=1000 PSF**
Initial Moisture Content (%):	26.2	
	Initial	**Post-Consolidation**
Dry Density (PCF):	107.6	110.8
Void Ratio:	0.566	0.521
Porosity (%):	36.1	34.3
Degree of Saturation (%):	saturated	saturated

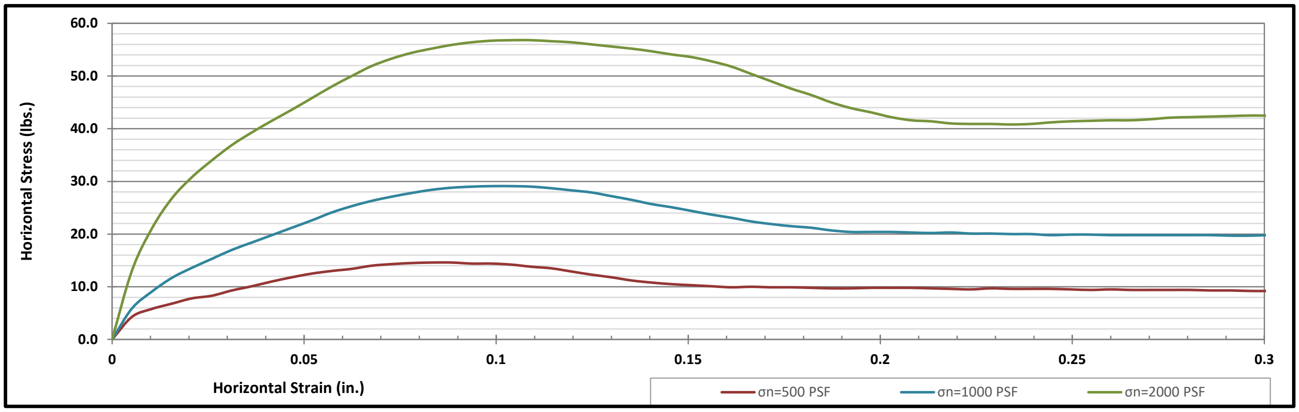
Summary of Sample Data:		**σ_n=2000 PSF**
Initial Moisture Content (%):	24.9	
	Initial	**Post-Consolidation**
Dry Density (PCF):	108.8	113.7
Void Ratio:	0.549	0.481
Porosity (%):	35.4	32.5
Degree of Saturation (%):	saturated	saturated

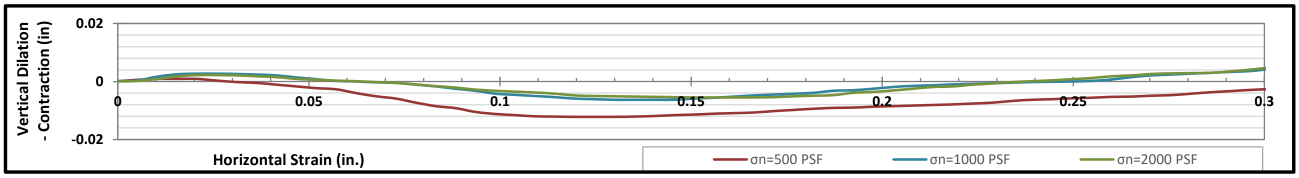


ESTIMATED STRENGTH PARAMETERS

	PEAK	**RESIDUAL**
Angle of Internal Friction, φ (°):	**40**	**32**
Cohesion (PSF):	**0**	**0**

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	430	860	1670
Residual Horizontal Stress, τ_h (PSF):	260	580	1280





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	23-Aug-21
Source:	LDW21-GT21-GB-21-25.7 ft	**Tested By:**	A. Eifrig
Sample#:	B21-1445		

Visual Identification
Sandy Silt
Sample Color:
grayish-brown

ACCREDITED
Certificate #: 1366.01

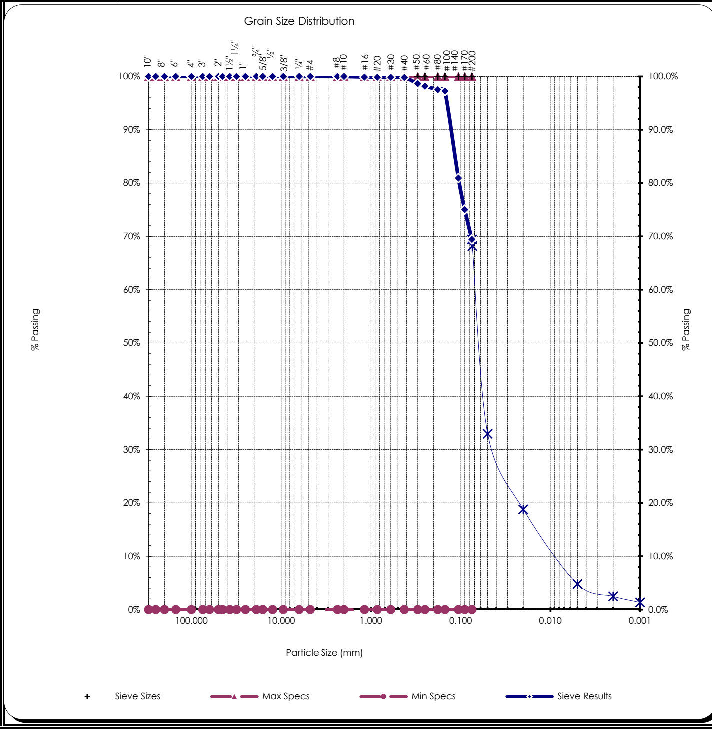
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.005 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 2.30
$D_{(10)}$ = 0.010 mm	% Sand = 30.5%	Coeff. of Uniformity, C_U = 6.70
$D_{(15)}$ = 0.015 mm	% Silt & Clay = 69.5%	Fineness Modulus = 0.04
$D_{(30)}$ = 0.040 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.060 mm	Plasticity Index = n/a	Moisture %, as sampled = 35.7%
$D_{(60)}$ = 0.068 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.130 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 16/23	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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%	100.0%	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%	100.0%	0.0%
3/4"	19.00		100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50		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	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		100%	100.0%	0.0%
#30	0.600		100%	100.0%	0.0%
#40	0.425	100%	100%	100.0%	0.0%
#50	0.300		99%	100.0%	0.0%
#60	0.250		98%	100.0%	0.0%
#80	0.180		98%	100.0%	0.0%
#100	0.150	97%	97%	100.0%	0.0%
#140	0.106		81%	100.0%	0.0%
#170	0.090		75%	100.0%	0.0%
#200	0.075	69.5%	69.5%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Hydrometer Report

Project: Q.C. - Lower Duwamish Waterway	**Date Received:** 29-Jul-21		**Visual Identification**	
Project #: 21B233	**Sampled By:** Client		Sandy Silt	
Client : Anchor QEA	**Date Tested:** 23-Aug-21		**Sample Color**	
Source: LDW21-GT21-GB-21-25.7 ft	**Tested By:** A. Eifrig		grayish-brown	
Sample#: B21-1445				

ASTM D7928, HYDROMETER ANALYSIS

Sp Gr :	2.55	
Sample Weight:	51.07	grams
Hydroscopic Moist.:	0.72%	
Adj. Sample Wgt :	50.70	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	19.5	39.2%	0.0512 mm
2	14	28.2%	0.0373 mm
4	12	24.1%	0.0266 mm
15	7	14.1%	0.0142 mm
30	5	10.1%	0.0101 mm
60	3	6.0%	0.0072 mm
240	2	4.0%	0.0036 mm
1440	1	2.0%	0.0015 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	30.5%	**Plastic Limit:**	n/a
% Silt:	64.7%	**Plasticity Index:**	n/a
% Clay:	4.8%		

ASTM D6913

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	100%	4.750 mm
#10	100%	2.000 mm
#20	100%	0.850 mm
#40	100%	0.425 mm
#100	97%	0.150 mm
#200	69.5%	0.075 mm
Silts	68.2%	0.074 mm
	33.0%	0.050 mm
	18.8%	0.020 mm
Clays	4.8%	0.005 mm
	2.5%	0.002 mm
Colloids	1.4%	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: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	23-Aug-21
Source:	LDW21-GT21-GB-26-31 ft	**Tested By:**	A. Eifrig
Sample#:	B21-1446		

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color:
gray

ACCREDITED
Certificate #: 1366.01

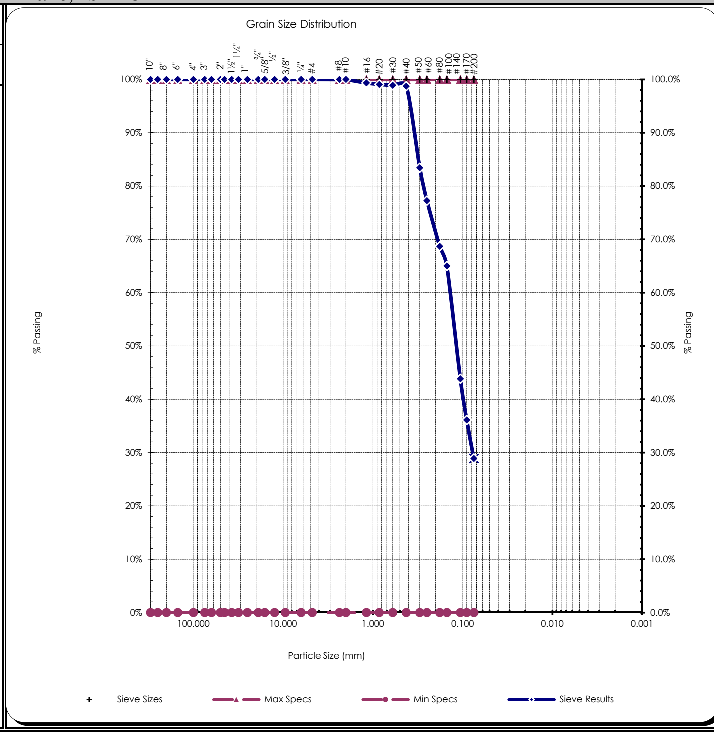
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.013 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.65
$D_{(10)}$ = 0.026 mm	% Sand = 71.1%	Coeff. of Uniformity, C_U = 5.38
$D_{(15)}$ = 0.039 mm	% Silt & Clay = 28.9%	Fineness Modulus = 0.53
$D_{(30)}$ = 0.077 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.119 mm	Plasticity Index = n/a	Moisture %, as sampled = 34.2%
$D_{(60)}$ = 0.140 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.354 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 12/41	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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%	100.0%	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	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		83%	100.0%	0.0%
#60	0.250		77%	100.0%	0.0%
#80	0.180		69%	100.0%	0.0%
#100	0.150	65%	65%	100.0%	0.0%
#140	0.106		44%	100.0%	0.0%
#170	0.090		36%	100.0%	0.0%
#200	0.075	28.9%	28.9%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Client:	Anchor QEA	**Date:**	September 28, 2021
Address:	21328 2nd Drive SE	**Project:**	Q.C. - Lower Duwamish Waterway
	Bothell, WA 98021	**Project #:**	21B233
Attn:	Garrett Timm	**Sample #:**	B21-1321 - 1335
Revised on:		**Date sampled:**	7-26-21 & 7-27-21

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	Please See Attached Reports		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count			LA Abrasion	
X	Moisture Content	Please See Attached Report	X	Direct Shear	Please See Attached Reports
	Specific Gravity, Coarse		X	Specific Gravity, Soils	Please See Attached Reports
	Specific Gravity, Fine				
X	Hydrometer Analysis	Please See Attached Reports			
X	Atterberg Limits	Please See Attached Reports			

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Meghan Blodgett-Carrillo

Respectfully Submitted,
Meghan Blodgett-Carrillo
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM C566, ASTM D2216

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: August 24, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B21-1321	LDW21-GT24-0-5 ft	233.2	648.4	595.4	53.0	362.2	14.6%
B21-1322	LDW21-GT24-5-13.6ft	234.1	1046.2	877.7	168.5	643.6	26.2%
B21-1323	LDW21-GT24-13.6-29 ft	232.6	1197.1	1046.9	150.2	814.3	18.4%
B21-1324	LDW21-GT24-33-35 ft	229.5	540.4	454.5	85.9	225.0	38.2%
B21-1325	LDW21-GT24-35-43 ft	233.3	1203.4	995.3	208.1	762.0	27.3%
B21-1326	LDW21-GT24-43-50 ft	223.9	840.4	682.9	157.5	459.0	34.3%
B21-1327	LDW21-GT24-53.3-59 ft	234.6	1087.0	874.9	212.1	640.3	33.1%
B21-1328	LDW21-GT36-0-3.6 ft	215.2	760.8	729.9	30.9	514.7	6.0%
B21-1329	LDW21-GT36-3.6-6.2 ft	217.1	499.1	461.2	37.9	244.1	15.5%
B21-1330	LDW21-GT36-6.2-9.5 ft	91.9	740.7	600.6	140.1	508.7	27.5%
B21-1331	LDW21-GT36-9.5-11.7 ft	221.2	864.4	682.7	181.7	461.5	39.4%
B21-1332	LDW21-GT36-11.7-32 ft	215.5	1106.1	985.3	120.8	769.8	15.7%
B21-1333	LDW21-GT36-32-34.7 ft	223.9	674.7	563.9	110.8	340.0	32.6%
B21-1334	LDW21-GT36-34.7-50 ft	759.4	1828.1	1623.0	205.1	863.6	23.7%
B21-1335	LDW21-GT36-50.5-61.5 ft	233.5	678.3	545.8	132.5	312.3	42.4%

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Moisture Content - ASTM D854

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: August 26, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B21-1323	LDW21-GT24-13.6-29 ft	601.52	701.51	100.0	TSA-010	180.3	499.5	0.99754	742.00	678.62	23.0	2.7311347	0.99933	2.7293049
B21-1326	LDW21-GT24-43-50 ft	497.42	571.51	74.1	TSA-017	187.9	499.4	0.99754	731.68	686.06	23.0	2.6022626	0.99933	2.600519
B21-1332	LDW21-GT36-11.7-32 ft	497.79	598.00	100.2	TSA-015	187.6	499.5	0.99754	748.84	685.87	23.0	2.6908295	0.99933	2.6890267
B21-1335	LDW21-GT36-50.5-61.5 ft	600.15	650.57	50.4	TSA-016	197.2	499.5	0.99754	726.46	695.45	23.0	2.5974523	0.99933	2.595712

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	24-Aug-21
Source:	LDW-GT24-5-13.6 ft	**Tested By:**	A. Eifrig
Sample#:	B21-1322		

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

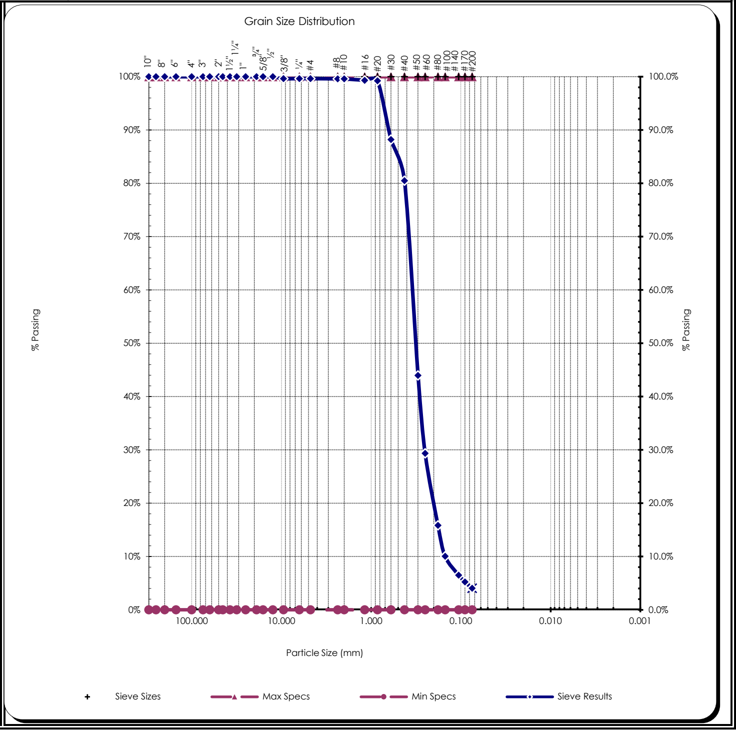
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.087	mm	% Gravel =	0.4%	Coeff. of Curvature, C_C =	1.20
$D_{(10)}$ = 0.149	mm	% Sand =	95.6%	Coeff. of Uniformity, C_U =	2.38
$D_{(15)}$ = 0.176	mm	% Silt & Clay =	4.0%	Fineness Modulus =	1.60
$D_{(30)}$ = 0.252	mm	Liquid Limit =	0.0%	Plastic Limit =	0.0%
$D_{(50)}$ = 0.321	mm	Plasticity Index =	0.0%	Moisture %, as sampled =	26.2%
$D_{(60)}$ = 0.355	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ = 0.640	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio = 1/20		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850	99%	99%	100.0%	0.0%
#30	0.600		88%	100.0%	0.0%
#40	0.425	81%	81%	100.0%	0.0%
#50	0.300		44%	100.0%	0.0%
#60	0.250	29%	29%	100.0%	0.0%
#80	0.180		16%	100.0%	0.0%
#100	0.150	10%	10%	100.0%	0.0%
#140	0.106		7%	100.0%	0.0%
#170	0.090		5%	100.0%	0.0%
#200	0.075	4.0%	4.0%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway
Project Number:	21B233
Laboratory Sample ID:	B21-1322
Sample Date:	7/26/2021
Test Date:	8/24/2021
Technician:	M. Carrillo
Sample Source:	LDW-GT24-5-13.6 ft
Visual Soil Description:	brown sand with silt
Type of Specimen:	Remolded Cylindrical Shear Box
Specimen Diameter (in):	2.5
Specimen Height (in):	1
Rate of Strain (in/min):	0.0208
Estimated Specific Gravity of Solids:	2.65

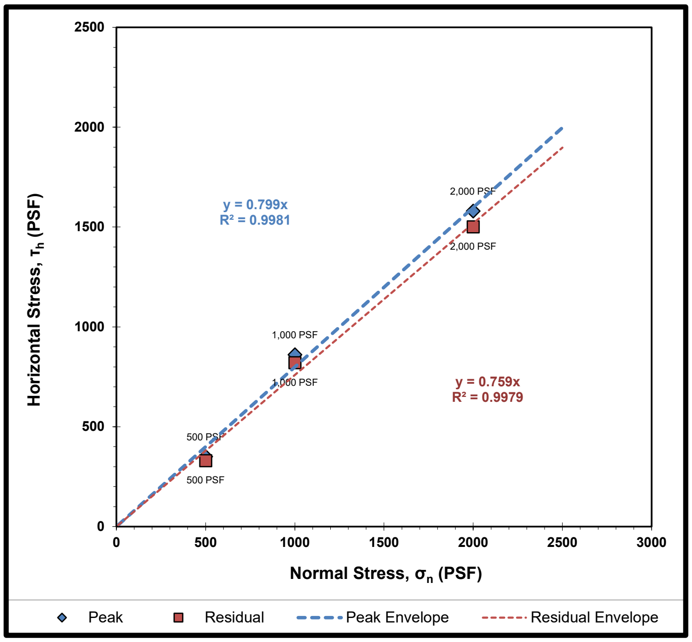
Summary of Sample Data:		**σ_n=500 PSF**
Initial Moisture Content (%):	26.4	
	Initial	**Post-Consolidation**
Dry Density (PCF):	108.1	108.3
Void Ratio:	0.559	0.556
Porosity (%):	35.9	35.7
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		**σ_n=1000 PSF**
Initial Moisture Content (%):	27.1	
	Initial	**Post-Consolidation**
Dry Density (PCF):	107.4	109.3
Void Ratio:	0.569	0.541
Porosity (%):	36.3	35.1
Degree of Saturation (%):	saturated	saturated

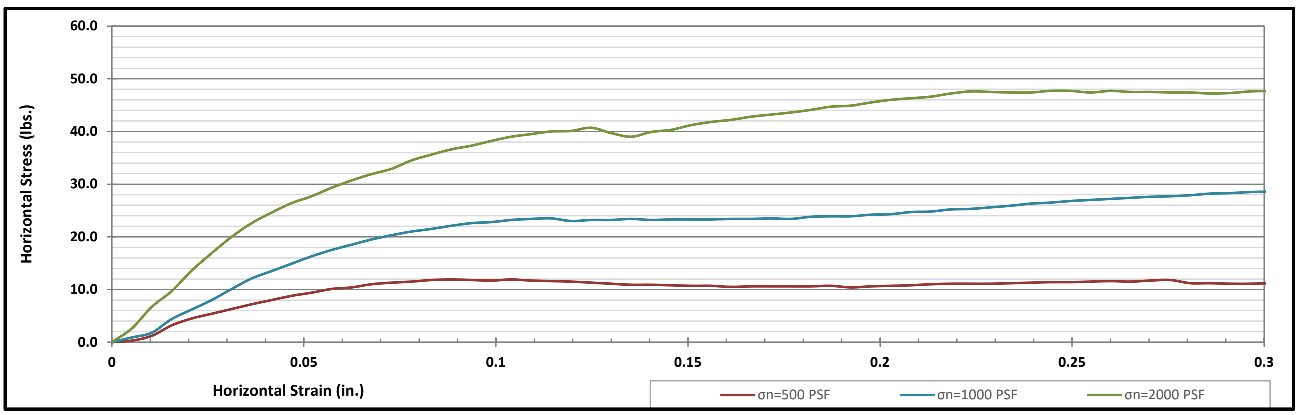
Summary of Sample Data:		**σ_n=2000 PSF**
Initial Moisture Content (%):	29.0	
	Initial	**Post-Consolidation**
Dry Density (PCF):	105.6	108.6
Void Ratio:	0.595	0.551
Porosity (%):	37.3	35.5
Degree of Saturation (%):	saturated	saturated

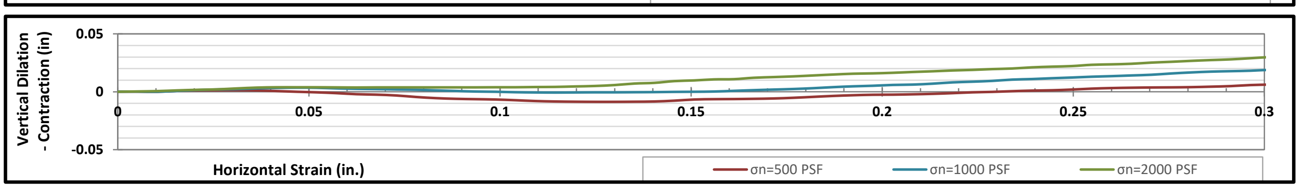
ESTIMATED STRENGTH PARAMETERS

	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	**39**	**37**
Cohesion (PSF):	**0**	**0**



Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	350	860	1580
Residual Horizontal Stress, τ_h (PSF):	330	820	1500





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW-GT24-13.6-29 ft
Sample#: B21-1323

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 24-Aug-21
Tested By: A. Eifrig

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

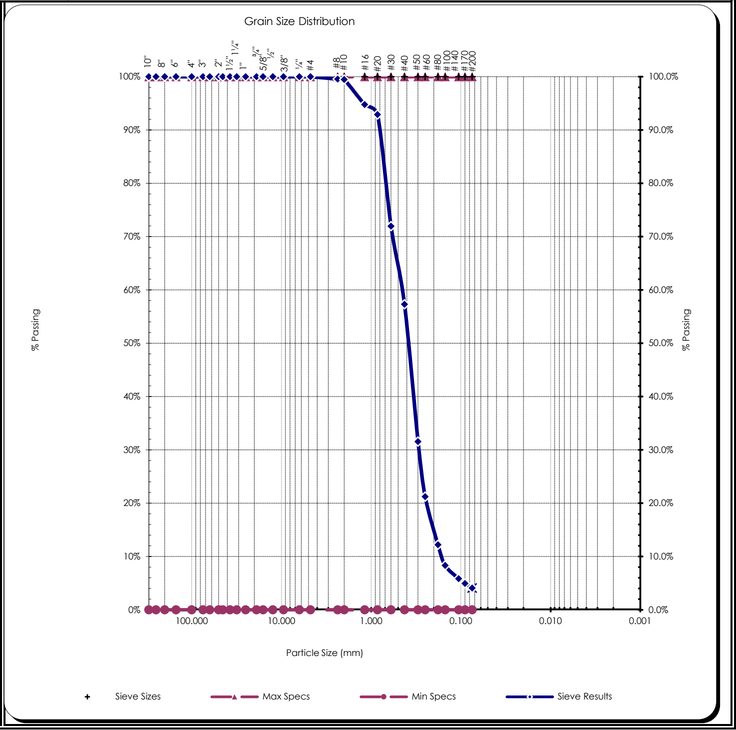
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.091 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.15
$D_{(10)}$ = 0.163 mm	% Sand = 95.9%	Coeff. of Uniformity, C_U = 2.81
$D_{(15)}$ = 0.201 mm	% Silt & Clay = 4.1%	Fineness Modulus = 1.94
$D_{(30)}$ = 0.292 mm	Liquid Limit = 0.0%	Plastic Limit = 0.0%
$D_{(50)}$ = 0.389 mm	Plasticity Index = 0.0%	Moisture %, as sampled = 18.4%
$D_{(60)}$ = 0.457 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.815 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 1/14	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		95%	100.0%	0.0%
#20	0.850	93%	93%	100.0%	0.0%
#30	0.600		72%	100.0%	0.0%
#40	0.425	57%	57%	100.0%	0.0%
#50	0.300		32%	100.0%	0.0%
#60	0.250	21%	21%	100.0%	0.0%
#80	0.180		12%	100.0%	0.0%
#100	0.150	8%	8%	100.0%	0.0%
#140	0.106		6%	100.0%	0.0%
#170	0.090		5%	100.0%	0.0%
#200	0.075	4.1%	4.1%	100.0%	0.0%



Comments:

Reviewed by:
Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.
Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW-GT24-33-35 ft
Sample #: B21-1324

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Aug-21
Tested By: C. Kriss

Visual Identification
Sandy Silt
Sample Color
brown

Liquid Limit Determination

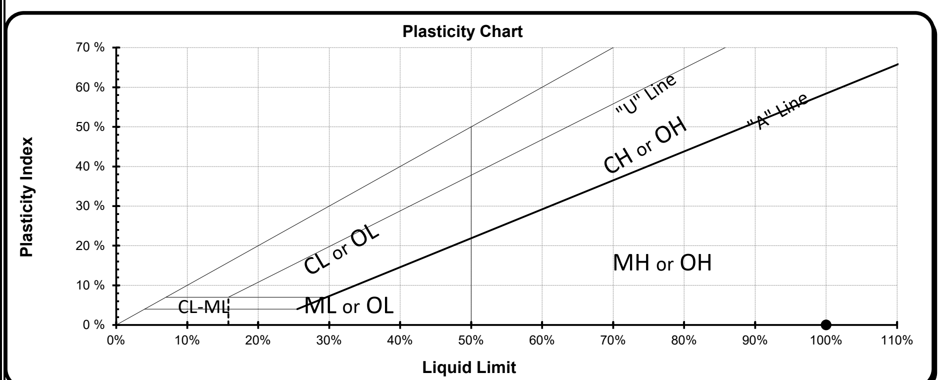
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:	Liquid Limit cannot be established					
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

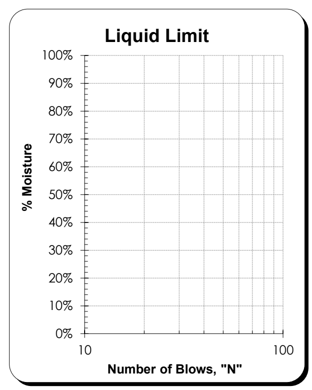
Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:	Plastic Limit cannot be determined					
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

Corporate ~ 777 Chrysler Drive • Burlington, WA 98233 • Phone (360) 755-1990 • Fax (360) 755-1980
Regional Offices: Olympia ~ 360.534.9777 Bellingham ~ 360.647.6111 Silverdale ~ 360.698.6787 Tukwila ~ 206.241.1974
Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	24-Aug-21
Source:	LDW-GT24-35-43 ft	**Tested By:**	A. Eifrig
Sample#:	B21-1325		

Unified Soil Classification System, ASTM-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
gray

ACCREDITED
Certificate #: 1366.01

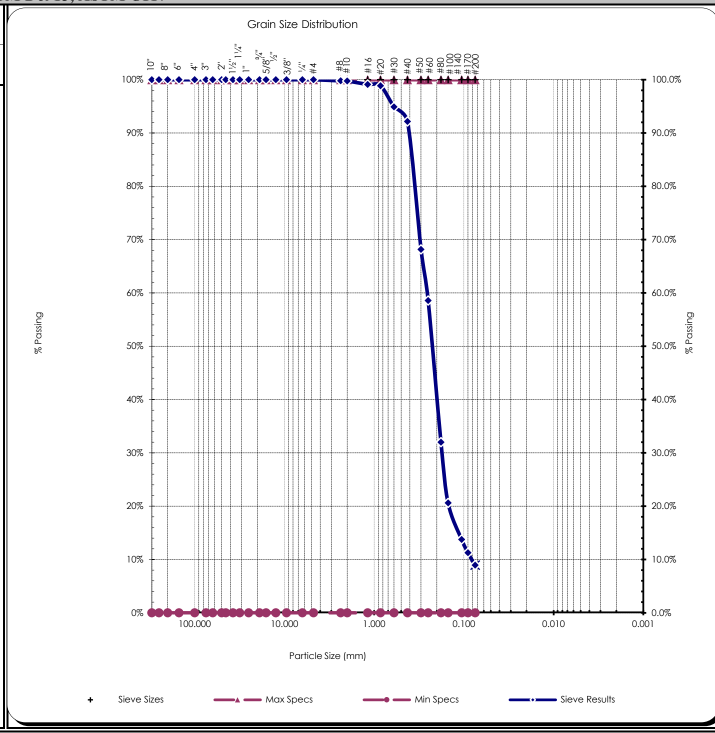
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.042 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.45
$D_{(10)}$ = 0.082 mm	% Sand = 91.1%	Coeff. of Uniformity, C_U = 3.14
$D_{(15)}$ = 0.114 mm	% Silt & Clay = 8.9%	Fineness Modulus = 1.17
$D_{(30)}$ = 0.175 mm	Liquid Limit = 0.0%	Plastic Limit = 0.0%
$D_{(50)}$ = 0.227 mm	Plasticity Index = 0.0%	Moisture %, as sampled = 27.3%
$D_{(60)}$ = 0.257 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.414 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 3/31	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850	99%	99%	100.0%	0.0%
#30	0.600		95%	100.0%	0.0%
#40	0.425	92%	92%	100.0%	0.0%
#50	0.300		68%	100.0%	0.0%
#60	0.250	59%	59%	100.0%	0.0%
#80	0.180		32%	100.0%	0.0%
#100	0.150	21%	21%	100.0%	0.0%
#140	0.106		14%	100.0%	0.0%
#170	0.090		11%	100.0%	0.0%
#200	0.075	8.9%	8.9%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	25-Aug-21
Source:	LDW-GT24-43-50 ft	**Tested By:**	C. Kriss
Sample #:	B21-1326		

Visual Identification
Silty Sand

Sample Color
dark brown

Liquid Limit Determination

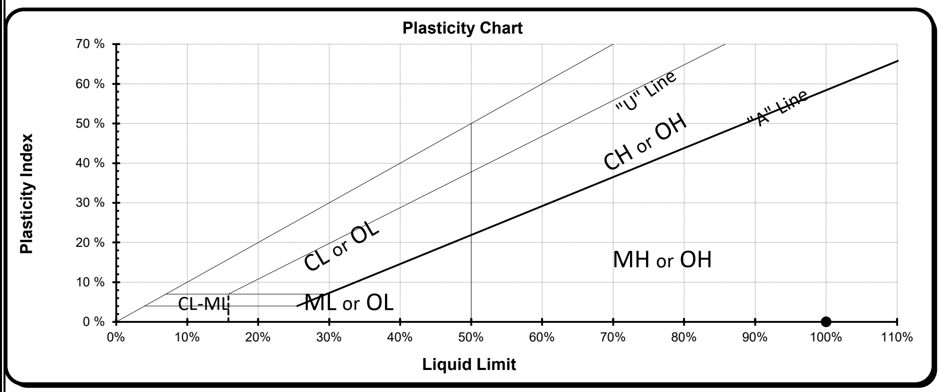
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid Limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

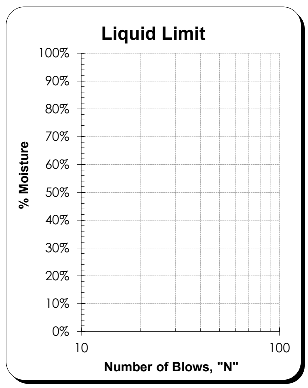
Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic Limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Corporate ~ 777 Chrysler Drive • Burlington, WA 98233 • Phone (360) 755-1990 • Fax (360) 755-1980

Regional Offices: Olympia ~ 360.534.9777 Bellingham ~ 360.647.6111 Silverdale ~ 360.698.6787 Tukwila ~ 206.241.1974

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW-GT24-53.3-59 ft
Sample#: B21-1327

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 24-Aug-21
Tested By: A. Eifrig

Visual Identification
Sandy Silt
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

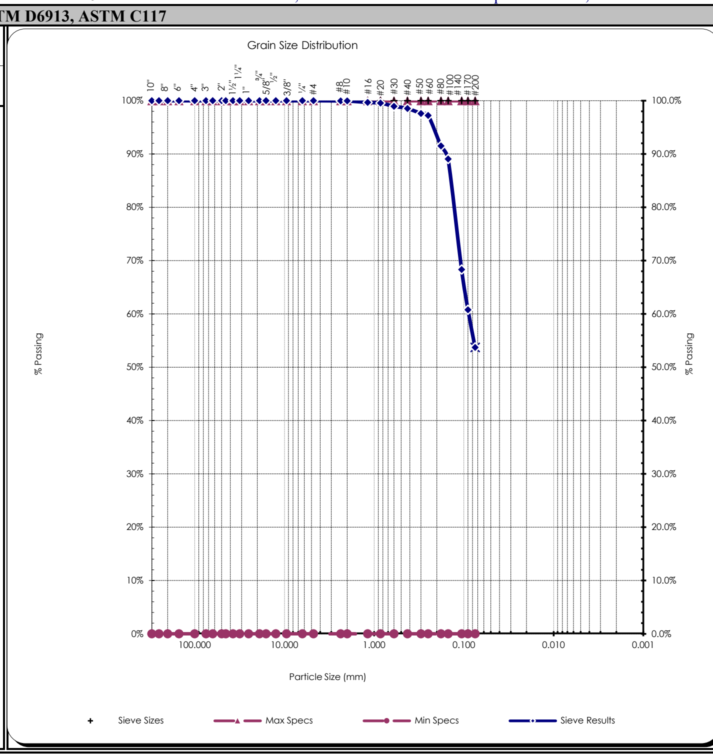
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.007 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.42
$D_{(10)}$ = 0.014 mm	% Sand = 46.3%	Coeff. of Uniformity, C_U = 6.33
$D_{(15)}$ = 0.021 mm	% Silt & Clay = 53.7%	Fineness Modulus = 0.15
$D_{(30)}$ = 0.042 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.070 mm	Plasticity Index = n/a	Moisture %, as sampled = 33.1%
$D_{(60)}$ = 0.088 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.161 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 6/11	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850	100%	100%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		98%	100.0%	0.0%
#60	0.250	97%	97%	100.0%	0.0%
#80	0.180		92%	100.0%	0.0%
#100	0.150	89%	89%	100.0%	0.0%
#140	0.106		68%	100.0%	0.0%
#170	0.090		61%	100.0%	0.0%
#200	0.075	53.7%	53.7%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW-GT36-3.6-6.2 ft
Sample#: B21-1329

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 24-Aug-21
Tested By: A. Eifrig

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

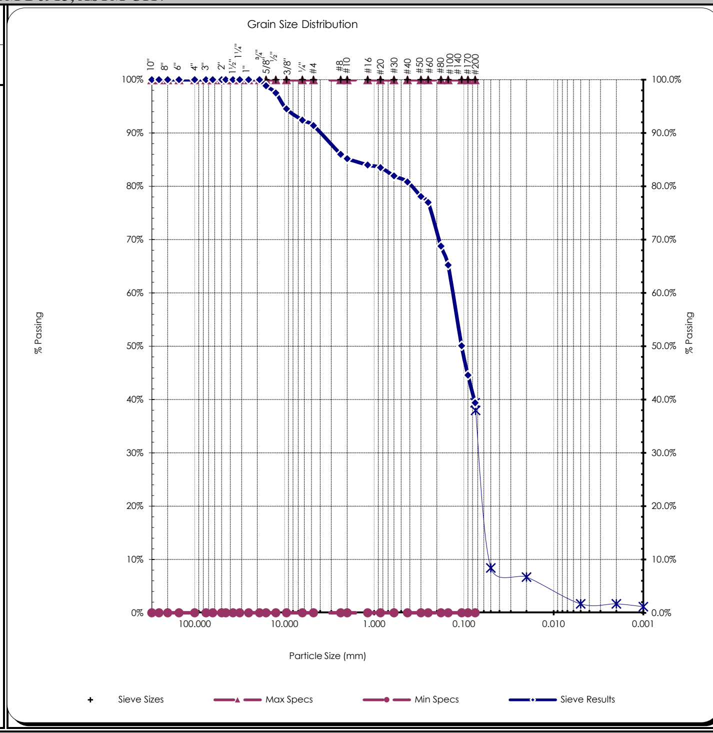
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.016 mm	% Gravel = 8.6%	Coeff. of Curvature, C_C = 0.64
$D_{(10)}$ = 0.055 mm	% Sand = 52.0%	Coeff. of Uniformity, C_U = 2.46
$D_{(15)}$ = 0.058 mm	% Silt & Clay = 39.4%	Fineness Modulus = 1.19
$D_{(30)}$ = 0.069 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.106 mm	Plasticity Index = n/a	Moisture %, as sampled = 15.5%
$D_{(60)}$ = 0.135 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 4.129 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 39/80	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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		99%	100.0%	0.0%
1/2"	12.50	98%	98%	100.0%	0.0%
3/8"	9.50	95%	95%	100.0%	0.0%
1/4"	6.30		92%	100.0%	0.0%
#4	4.75	91%	91%	100.0%	0.0%
#8	2.36		86%	100.0%	0.0%
#10	2.00	85%	85%	100.0%	0.0%
#16	1.18		84%	100.0%	0.0%
#20	0.850	84%	84%	100.0%	0.0%
#30	0.600		82%	100.0%	0.0%
#40	0.425	81%	81%	100.0%	0.0%
#50	0.300		78%	100.0%	0.0%
#60	0.250	77%	77%	100.0%	0.0%
#80	0.180		69%	100.0%	0.0%
#100	0.150	65%	65%	100.0%	0.0%
#140	0.106		50%	100.0%	0.0%
#170	0.090		45%	100.0%	0.0%
#200	0.075	39.4%	39.4%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	24-Aug-21
Source:	LDW-GT36-3.6-6.2 ft	**Tested By:**	A. Eifrig
Sample#:	B21-1329		

Unified Soils Classification System, ASTM D-2487

SM, Silty Sand

Sample Color

brown

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	50.78	grams
Hydroscopic Moist.:	0.57%	
Adj. Sample Wgt :	50.49	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	5	8.4%	0.0537 mm
2	5	8.4%	0.0380 mm
5	5	8.4%	0.0240 mm
15	2.5	4.2%	0.0141 mm
30	1	1.7%	0.0100 mm
60	1	1.7%	0.0071 mm
240	1	1.7%	0.0035 mm
1440	1	1.7%	0.0014 mm

% Gravel:	8.6%	**Liquid Limit:**	n/a
% Sand:	52.0%	**Plastic Limit:**	n/a
% Silt:	37.7%	**Plasticity Index:**	n/a
% Clay:	1.7%		

ASTM D6913

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"	99%	16.000 mm
1/2"	98%	12.500 mm
3/8"	95%	9.500 mm
1/4"	92%	6.300 mm
#4	91%	4.750 mm
#10	85%	2.000 mm
#20	84%	0.850 mm
#40	81%	0.425 mm
#100	65%	0.150 mm
#200	39.4%	0.075 mm
Silts	38.0%	0.074 mm
	8.4%	0.050 mm
	6.7%	0.020 mm
Clays	1.7%	0.005 mm
	1.7%	0.002 mm
Colloids	1.2%	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

Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

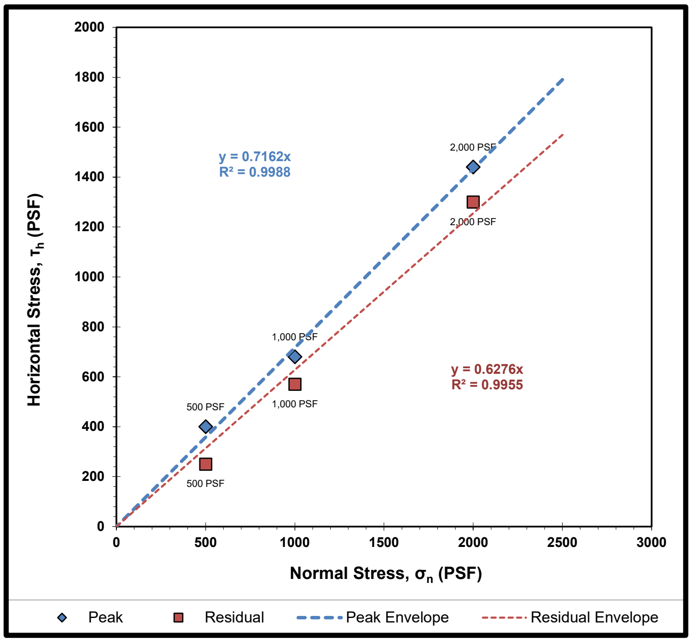
MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway		
Project Number:	21B233	**Sample Source:**	LDW-GT36-3.6-6.2 ft
Laboratory Sample ID:	B21-1329	**Visual Soil Description:**	brown silty sand
Sample Date:	7/26/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	8/26/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		**σ_n=500 PSF**
Initial Moisture Content (%):	19.8	
	Initial	**Post-Consolidation**
Dry Density (PCF):	114.5	115.4
Void Ratio:	0.472	0.460
Porosity (%):	32.1	31.5
Degree of Saturation (%):	saturated	saturated

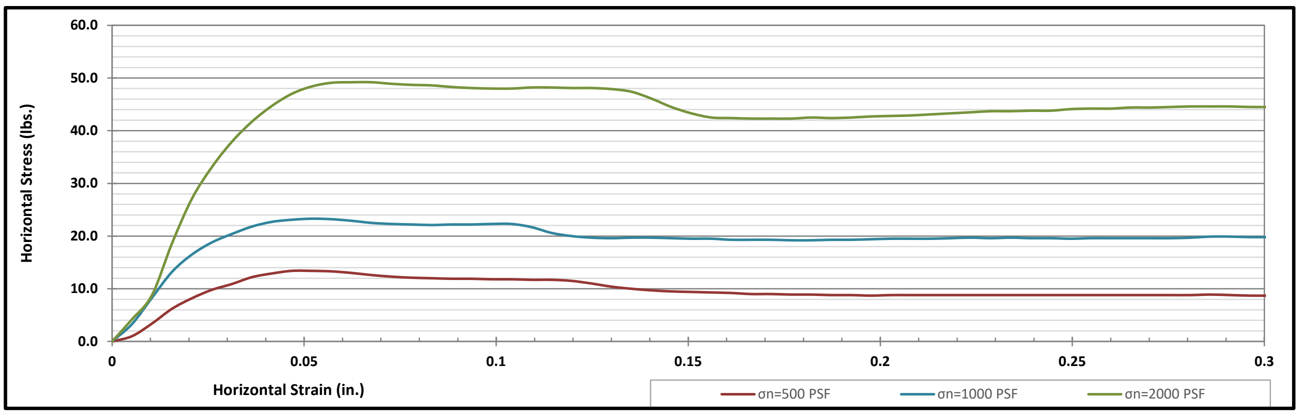
Summary of Sample Data:		**σ_n=1000 PSF**
Initial Moisture Content (%):	20.2	
	Initial	**Post-Consolidation**
Dry Density (PCF):	115.0	117.1
Void Ratio:	0.465	0.439
Porosity (%):	31.7	30.5
Degree of Saturation (%):	saturated	saturated

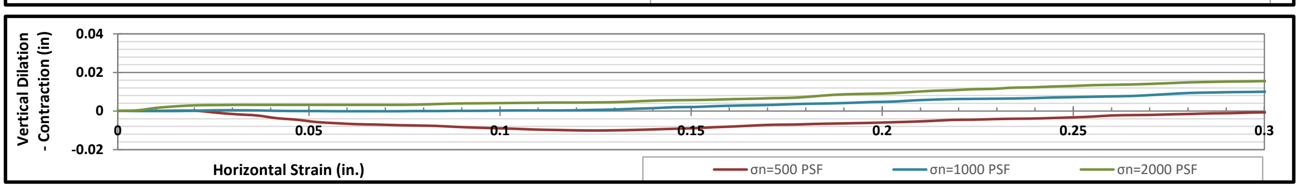
Summary of Sample Data:		**σ_n=2000 PSF**
Initial Moisture Content (%):	19.0	
	Initial	**Post-Consolidation**
Dry Density (PCF):	115.4	120.1
Void Ratio:	0.460	0.403
Porosity (%):	31.5	28.7
Degree of Saturation (%):	saturated	saturated



ESTIMATED STRENGTH PARAMETERS		
	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	**36**	**32**
Cohesion (PSF):	**0**	**0**

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	400	680	1440
Residual Horizontal Stress, τ_h (PSF):	250	570	1300





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	24-Aug-21
Source:	LDW-GT36-6.2-9.5 ft	**Tested By:**	A. Eifrig
Sample#:	B21-1330		

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

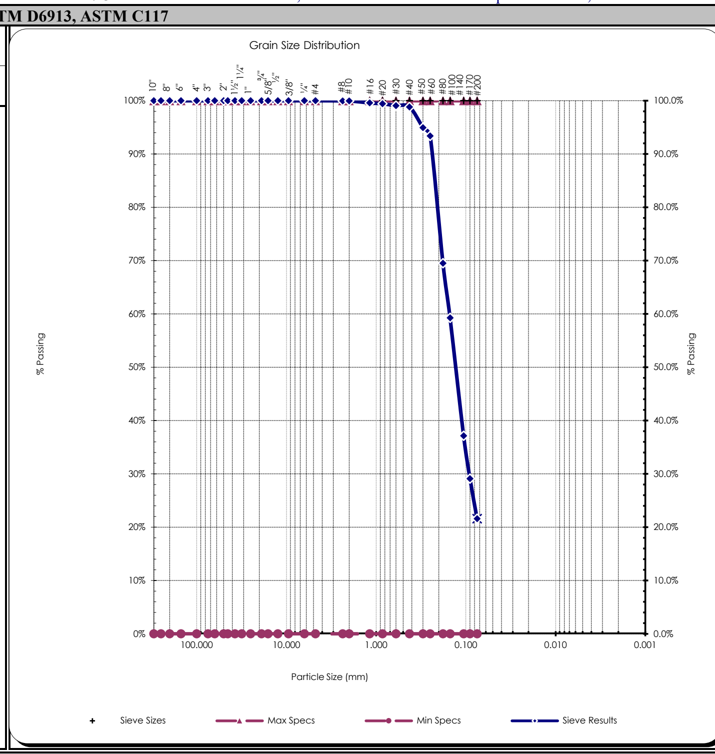
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.017 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.59
$D_{(10)}$ = 0.035 mm	% Sand = 78.4%	Coeff. of Uniformity, C_U = 4.38
$D_{(15)}$ = 0.052 mm	% Silt & Clay = 21.6%	Fineness Modulus = 0.47
$D_{(30)}$ = 0.092 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.132 mm	Plasticity Index = n/a	Moisture %, as sampled = 27.5%
$D_{(60)}$ = 0.152 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.240 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 7/32	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850	99%	99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		95%	100.0%	0.0%
#60	0.250	93%	93%	100.0%	0.0%
#80	0.180		70%	100.0%	0.0%
#100	0.150	59%	59%	100.0%	0.0%
#140	0.106		37%	100.0%	0.0%
#170	0.090		29%	100.0%	0.0%
#200	0.075	21.6%	21.6%	100.0%	0.0%



Comments:

Reviewed by:

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW-GT36-11.7-32 ft
Sample#: B21-1332

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 24-Aug-21
Tested By: A. Eifrig

Unified Soils Classification System, ASTM D-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

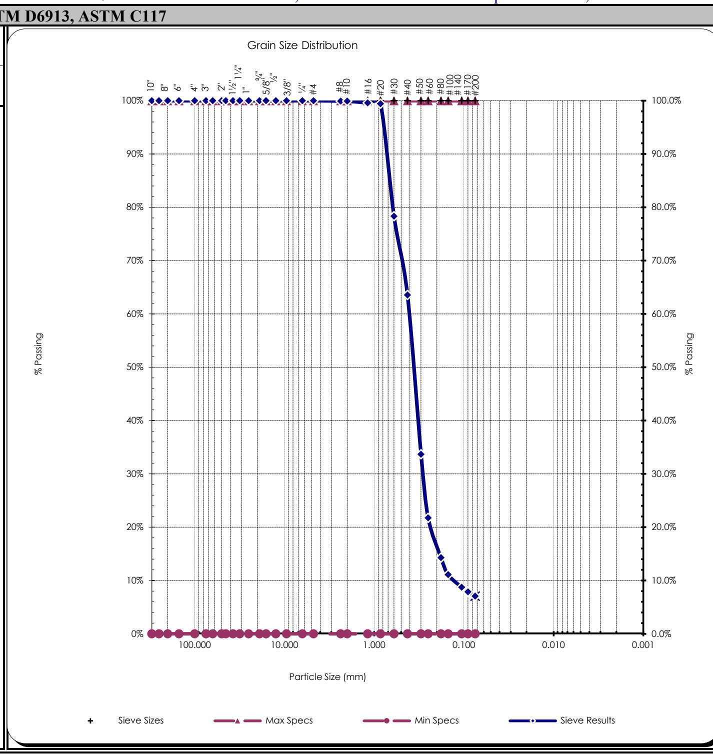
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.053 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.53
$D_{(10)}$ = 0.129 mm	% Sand = 92.9%	Coeff. of Uniformity, C_U = 3.18
$D_{(15)}$ = 0.186 mm	% Silt & Clay = 7.1%	Fineness Modulus = 1.77
$D_{(30)}$ = 0.285 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.368 mm	Plasticity Index = n/a	Moisture %, as sampled = 15.7%
$D_{(60)}$ = 0.410 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.738 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 1/9	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850	99%	99%	100.0%	0.0%
#30	0.600		78%	100.0%	0.0%
#40	0.425	64%	64%	100.0%	0.0%
#50	0.300		34%	100.0%	0.0%
#60	0.250	22%	22%	100.0%	0.0%
#80	0.180		14%	100.0%	0.0%
#100	0.150	11%	11%	100.0%	0.0%
#140	0.106		9%	100.0%	0.0%
#170	0.090		8%	100.0%	0.0%
#200	0.075	7.1%	7.1%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW-GT36-32-34.7 ft
Sample #: B21-1333

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Aug-21
Tested By: C. Kriss

Visual Identification
Sand with Silt
Sample Color
brown

Liquid Limit Determination

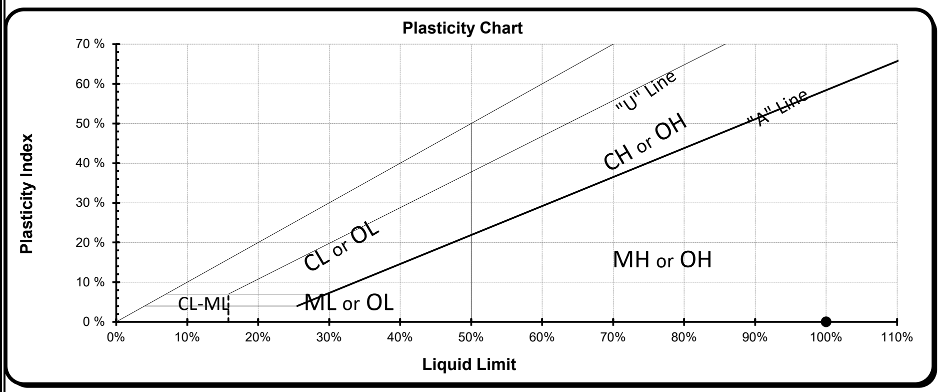
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid Limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

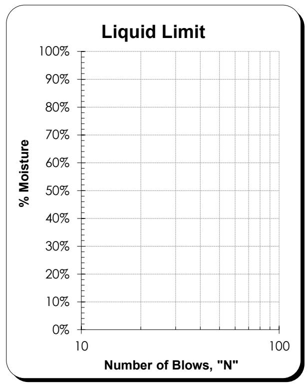
Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic Limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	24-Aug-21
Source:	LDW-GT36-34.7-50 ft	**Tested By:**	A. Eifrig
Sample#:	B21-1334		

Unified Soils Classification System, ASTM D-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
grayish-brown

ACCREDITED
Certificate #: 1366.01

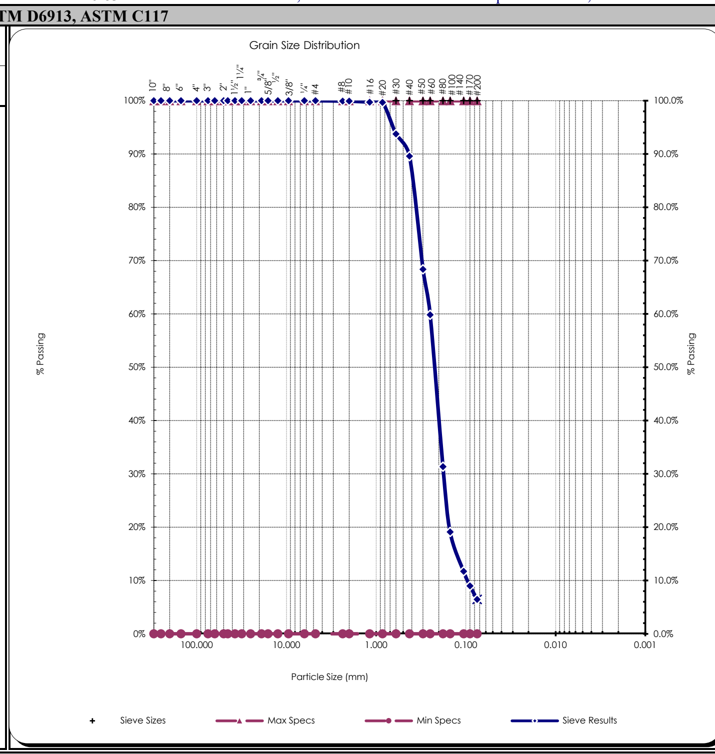
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.058 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.30
$D_{(10)}$ = 0.096 mm	% Sand = 93.5%	Coeff. of Uniformity, C_U = 2.62
$D_{(15)}$ = 0.126 mm	% Silt & Clay = 6.5%	Fineness Modulus = 1.19
$D_{(30)}$ = 0.177 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.226 mm	Plasticity Index = n/a	Moisture %, as sampled = 23.7%
$D_{(60)}$ = 0.251 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.441 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 6/83	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850	100%	100%	100.0%	0.0%
#30	0.600		94%	100.0%	0.0%
#40	0.425	90%	90%	100.0%	0.0%
#50	0.300		68%	100.0%	0.0%
#60	0.250	60%	60%	100.0%	0.0%
#80	0.180		31%	100.0%	0.0%
#100	0.150	19%	19%	100.0%	0.0%
#140	0.106		12%	100.0%	0.0%
#170	0.090		9%	100.0%	0.0%
#200	0.075	6.5%	6.5%	100.0%	0.0%



Comments:

Reviewed by:

Meghan Blodgett-Carrillo

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW-GT-36-50.5-61.5 ft
Sample #: B21-1335

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Aug-21
Tested By: C. Kriss

Visual Identification
Silty Clay
Sample Color
brown

Liquid Limit Determination

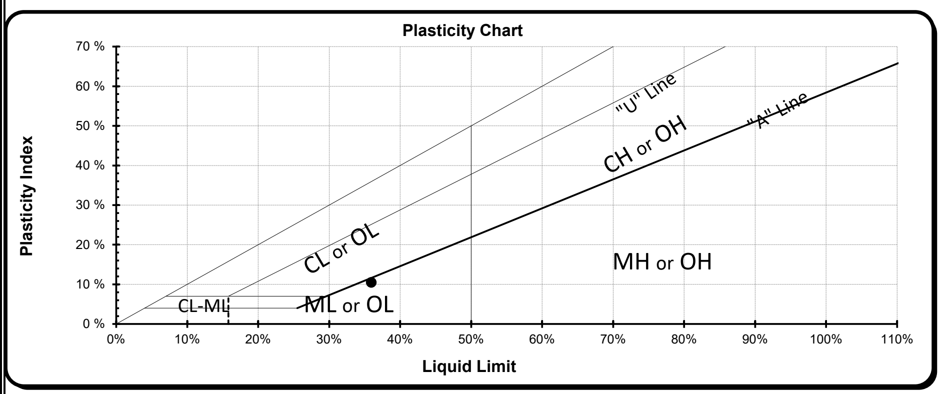
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.50	30.28	27.77			
Weight of Dry Soils + Pan:	26.95	27.50	24.20			
Weight of Pan:	19.61	19.98	14.98			
Weight of Dry Soils:	7.34	7.52	9.22			
Weight of Moisture:	2.55	2.78	3.57			
% Moisture:	34.7 %	37.0 %	38.7 %			
Number of Blows:	30	21	11			

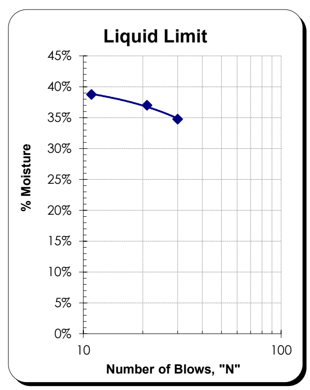
Liquid Limit @ 25 Blows: 36 %
Plastic Limit: 25 %
Plasticity Index, I_P: 11 %

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	34.74	35.86				
Weight of Dry Soils + Pan:	33.48	34.32				
Weight of Pan:	28.53	28.24				
Weight of Dry Soils:	4.95	6.08				
Weight of Moisture:	1.26	1.54				
% Moisture:	25.5 %	25.3 %				

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Client:	Anchor QEA	**Date:**	September 29, 2021
Address:	21328 2nd Drive SE	**Project:**	Q.C. - Lower Duwamish Waterway
	Bothell, WA 98021	**Project #:**	21B233
Attn:	Garrett Timm	**Sample #:**	B21-1447 - 1466
Revised on:		**Date sampled:**	7-8-21 & 7-9-21

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	Please See Attached Reports		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count			LA Abrasion	
X	Moisture Content	Please See Attached Report	X	Direct Shear	Please See Attached Reports
	Specific Gravity, Coarse		X	Specific Gravity, Soils	Please See Attached Reports
	Specific Gravity, Fine				
X	Hydrometer Analysis	Please See Attached Reports			
X	Atterberg Limits	Please See Attached Reports			

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Respectfully Submitted,
Meghan Blodgett-Carrillo
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM C566, ASTM D2216

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: August 31, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B21-1447	LDW21-GT21-GB-31-32.5 ft	222.3	700.9	590.1	110.8	367.8	30.1%
B21-1448	LDW21-GT12-GB-0-1.5 ft	208.8	636.4	466.8	169.6	258.0	65.7%
B21-1449	LDW21-GT12-GB-0-12 ft	224.0	851.3	609.9	241.4	385.9	62.6%
B21-1450	LDW21-GT12-GB-12-13.5 ft	233.8	567.3	458.5	108.8	224.7	48.4%
B21-1451	LDW21-GT12-GB-18-22 ft	222.9	780.0	643.4	136.6	420.5	32.5%
B21-1452	LDW21-GT12-GB-22-23.5 ft	229.4	723.2	606.3	116.9	376.9	31.0%
B21-1453	LDW21-GT11-GB-0-1.5 ft	221.8	617.6	440.0	177.6	218.2	81.4%
B21-1454	LDW21-GT11-GB-0-8.5 ft	233.8	686.2	473.2	213.0	239.4	89.0%
B21-1455	LDW21-GT11-GB-8.5-10 ft	224.8	616.6	455.4	161.2	230.6	69.9%
B21-1456	LDW21-GT11-GB-8.5-16.7 ft	182.3	495.3	374.9	120.4	192.6	62.5%
B21-1457	LDW21-GT11-GB-16.7-18.5 ft	186.7	993.2	821.5	171.7	634.8	27.0%
B21-1458	LDW21-GT11-GB-18.5-20 ft	220.1	643.5	566.8	76.7	346.7	22.1%
B21-1459	LDW21-GT9-GB-0-1.5 ft	221.4	388.1	331.3	56.8	109.9	51.7%
B21-1460	LDW21-GT9-GB-10-11.5 ft	225.6	534.4	429.8	104.6	204.2	51.2%
B21-1461	LDW21-GT9-GB-~~16-20 ft~~	225.7	665.4	521.2	144.2	295.5	48.8%
B21-1462	LDW21-GT9-GB-20-21.5 ft	235.5	299.4	285.9	13.5	50.4	26.8%
B21-1463	LDW21-GT7-GB-0-1.5 ft	301.1	545.2	480.4	64.8	179.3	36.1%
B21-1464	LDW21-GT7-GB-0-5.7 ft	182.9	988.2	806.6	181.6	623.7	29.1%
B21-1465	LDW21-GT7-GB-8.5-10 ft	217.2	591.3	504.5	86.8	287.3	30.2%
B21-1466	LDW21-GT7-GB-8.5-18.5 ft	233.4	693.2	578.2	115.0	344.8	33.4%

Name correction:
LDW21-GT9-GB-10-20

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM D854

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: August 31, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B21-1449	LDW21-GT12-GB-0-12 ft	493.02	545.53	52.5	TSA-012	180.4	499.5	0.99749	742.00	709.46	23.2	2.6294442	0.99929	2.6275773
B21-1451	LDW21-GT12-GB-18-22 ft	497.56	597.70	100.1	TSA-023	163.9	498.7	0.99749	723.96	661.41	23.2	2.6641366	0.99929	2.6622451
B21-1459	LDW21-GT9-GB-0-1.5 ft	601.92	676.89	75.0	TSA-015	187.6	499.5	0.99749	732.66	685.85	23.2	2.6626339	0.99929	2.6607434
B21-1461	LDW21-GT7-GB-0-5.7 ft	502.15	601.95	99.8	TSA-021	183.4	499.4	0.99749	744.55	681.58	23.2	2.7100064	0.99929	2.7080823

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	31-Aug-21
Source:	LDW21-GT12-GB-0-12 ft	**Tested By:**	C. Kriss
Sample #:	B21-1449		

Visual Identification
Clayey Silt with Sand
Sample Color
brown

Liquid Limit Determination

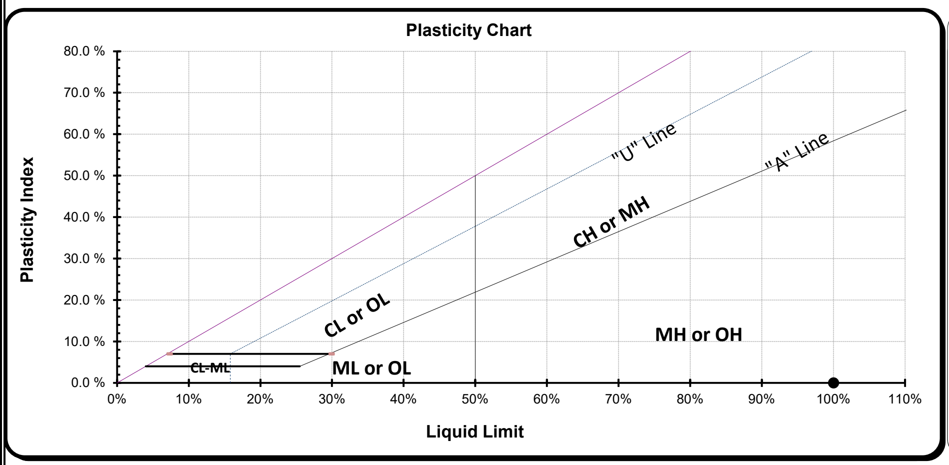
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

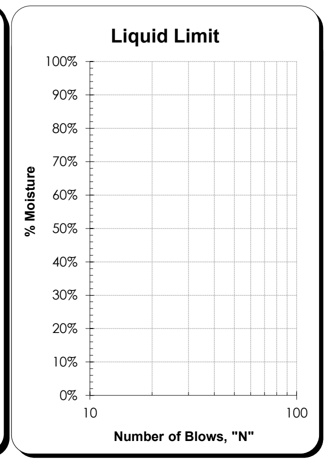
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the cup without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT12-GB-18-22 ft
Sample#: B21-1451

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 31-Aug-21
Tested By: C. Kriss

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

ACCREDITED
Certificate #: 1366.01

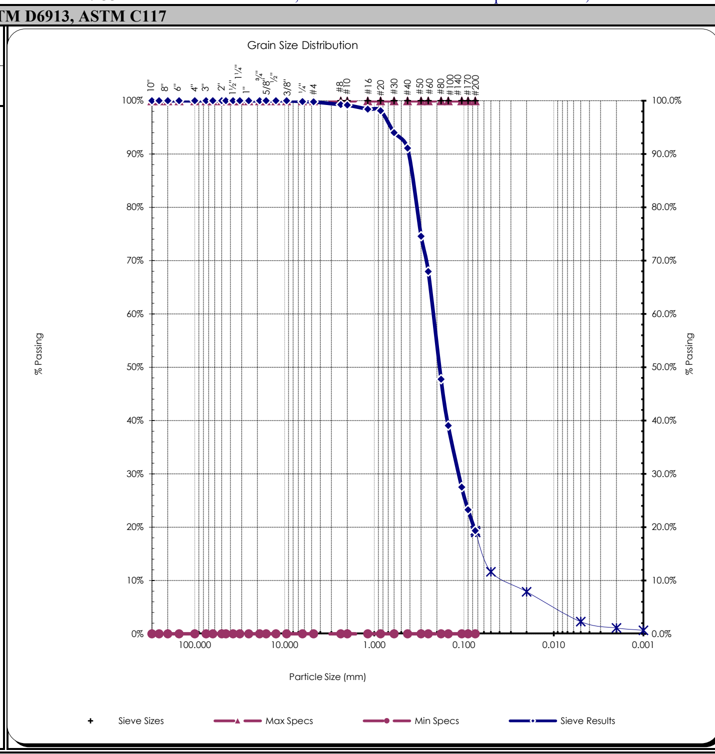
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.010	mm	% Gravel =	0.2%	Coeff. of Curvature, C_C =	1.73
$D_{(10)}$ = 0.035	mm	% Sand =	80.4%	Coeff. of Uniformity, C_U =	6.41
$D_{(15)}$ = 0.062	mm	% Silt & Clay =	19.3%	Fineness Modulus =	0.95
$D_{(30)}$ = 0.115	mm	Liquid Limit =	0.0%	Plastic Limit =	0.0%
$D_{(50)}$ = 0.188	mm	Plasticity Index =	0.0%	Moisture %, as sampled =	32.5%
$D_{(60)}$ = 0.222	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ = 0.417	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio = 7/33		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		98%	100.0%	0.0%
#20	0.850	98%	98%	100.0%	0.0%
#30	0.600		94%	100.0%	0.0%
#40	0.425	91%	91%	100.0%	0.0%
#50	0.300		75%	100.0%	0.0%
#60	0.250	68%	68%	100.0%	0.0%
#80	0.180		48%	100.0%	0.0%
#100	0.150	39%	39%	100.0%	0.0%
#140	0.106		28%	100.0%	0.0%
#170	0.090		23%	100.0%	0.0%
#200	0.075	19.3%	19.3%	100.0%	0.0%



Comments:

Reviewed by: Megh Blodgett Carrillo
Meghan Blodgett-Carrillo

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21	**Unified Soil Classification System, ASTM-2487**
Project #:	21B233	**Sampled By:**	Client	SM, Silty Sand
Client :	Anchor QEA	**Date Tested:**	31-Aug-21	**Sample Color**
Source:	LDW21-GT12-GB-18-22 ft	**Tested By:**	C. Kriss	brown
Sample#:	B21-1451			

ASTM D7928, HYDROMETER ANALYSIS

Sp Gr :	2.66	
Sample Weight:	102.98	grams
Hydroscopic Moist.:	1.38%	
Adj. Sample Wgt :	101.58	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	12	11.7%	0.0516 mm
2	10.5	10.3%	0.0370 mm
5	9	8.8%	0.0235 mm
15	6.5	6.3%	0.0138 mm
30	5	4.9%	0.0098 mm
60	3.5	3.4%	0.0070 mm
240	1.5	1.5%	0.0035 mm
1440	1	1.0%	0.0014 mm

% Gravel:	0.2%	**Liquid Limit:**	0.0 %
% Sand:	80.4%	**Plastic Limit:**	0.0 %
% Silt:	17.1%	**Plasticity Index:**	0.0 %
% Clay:	2.3%		

ASTM D6913

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	100%	4.750 mm
#10	99%	2.000 mm
#20	98%	0.850 mm
#40	91%	0.425 mm
#100	39%	0.150 mm
#200	19.3%	0.075 mm
Silts	19.0%	0.074 mm
	11.7%	0.050 mm
	7.9%	0.020 mm
Clays	2.3%	0.005 mm
	1.1%	0.002 mm
Colloids	0.7%	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
Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

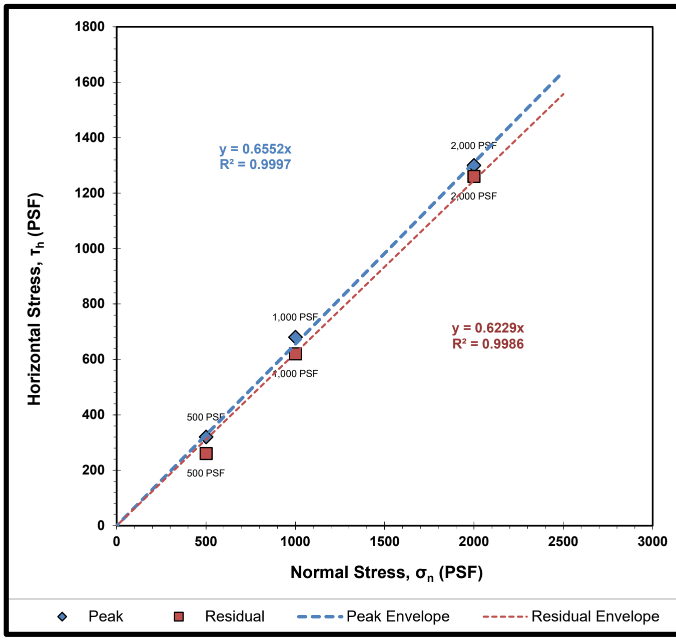
MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway		
Project Number:	21B233	**Sample Source:**	LDW21-GT12-GB-18-22 ft
Laboratory Sample ID:	B21-1451	**Visual Soil Description:**	brown clayey silt
Sample Date:	7/8/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	8/23/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	34.3	
	Initial	**Post-Consolidation**
Dry Density (PCF):	104.7	112.4
Void Ratio:	0.609	0.499
Porosity (%):	37.9	33.3
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	32.5	
	Initial	**Post-Consolidation**
Dry Density (PCF):	106.6	117.5
Void Ratio:	0.580	0.433
Porosity (%):	36.7	30.2
Degree of Saturation (%):	saturated	saturated

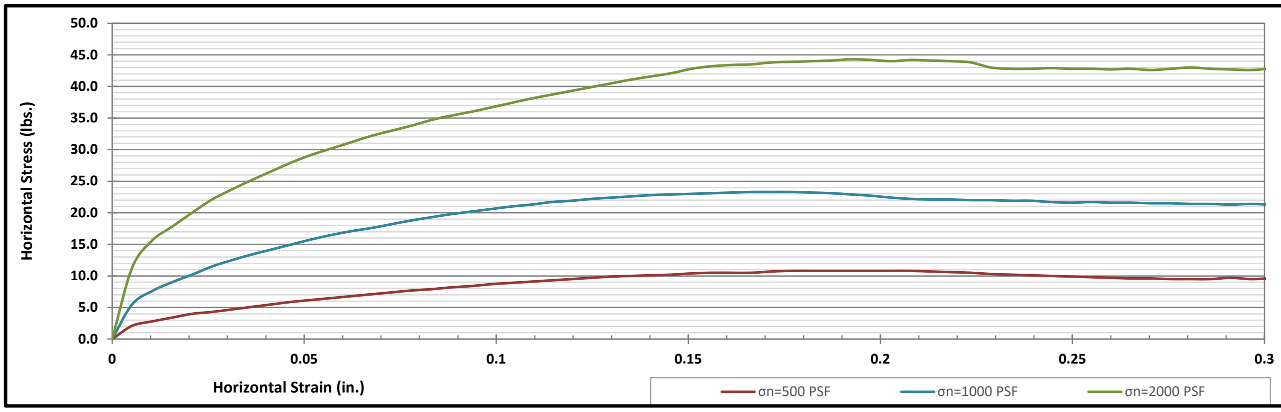
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	34.7	
	Initial	**Post-Consolidation**
Dry Density (PCF):	104.7	119.6
Void Ratio:	0.609	0.409
Porosity (%):	37.8	29.0
Degree of Saturation (%):	saturated	saturated

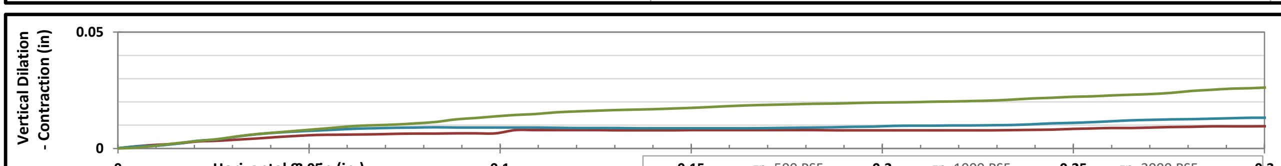


ESTIMATED STRENGTH PARAMETERS

	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	**33**	**32**
Cohesion (PSF):	**0**	**0**

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	320	680	1300
Residual Horizontal Stress, τ_h (PSF):	260	620	1260





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	31-Aug-21
Source:	LDW21-GT11-GB-0-8.5 ft	**Tested By:**	C. Kriss
Sample#:	B21-1454		

Unified Soil Classification System, ASTM-2487
ML, Sandy Silt
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

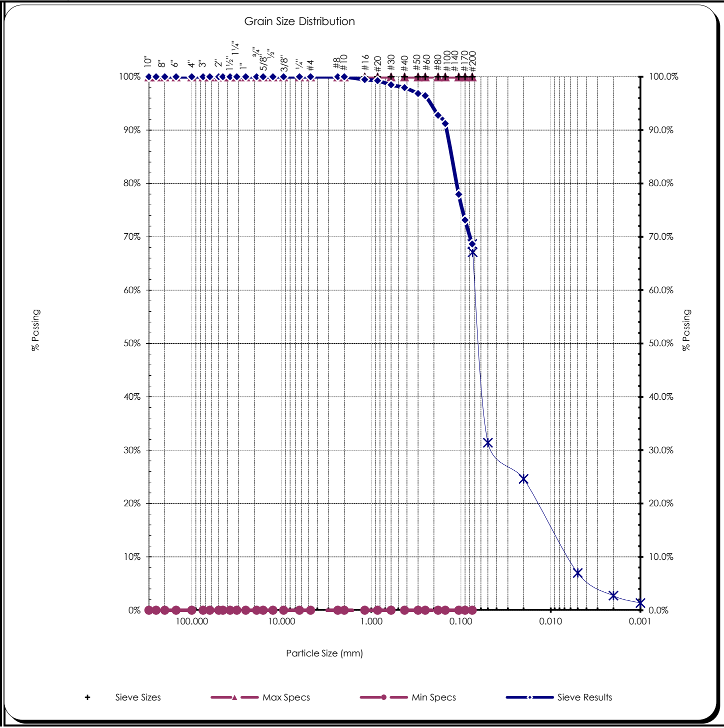
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.004 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 3.47
$D_{(10)}$ = 0.007 mm	% Sand = 31.3%	Coeff. of Uniformity, C_U = 9.80
$D_{(15)}$ = 0.010 mm	% Silt & Clay = 68.7%	Fineness Modulus = 0.14
$D_{(30)}$ = 0.041 mm	Liquid Limit = 40.6%	Plastic Limit = 0.0%
$D_{(50)}$ = 0.063 mm	Plasticity Index = 0.0%	Moisture %, as sampled = 89.0%
$D_{(60)}$ = 0.069 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.146 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 68/97	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850	99%	99%	100.0%	0.0%
#30	0.600		98%	100.0%	0.0%
#40	0.425	98%	98%	100.0%	0.0%
#50	0.300		97%	100.0%	0.0%
#60	0.250	96%	96%	100.0%	0.0%
#80	0.180		93%	100.0%	0.0%
#100	0.150	91%	91%	100.0%	0.0%
#140	0.106		78%	100.0%	0.0%
#170	0.090		73%	100.0%	0.0%
#200	0.075	68.7%	68.7%	100.0%	0.0%



Comments:

Reviewed by:

Meghan Blodgett-Carrillo

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	31-Aug-21
Source:	LDW21-GT11-GB-0-8.5 ft	**Tested By:**	C. Kriss
Sample#:	B21-1454		

Unified Soil Classification System, ASTM-2487
ML, Sandy Silt
Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	53.60	grams
Hydroscopic Moist.:	4.63%	
Adj. Sample Wgt :	51.23	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	16	31.2%	0.0505 mm
2	15	29.3%	0.0359 mm
5	14	27.3%	0.0228 mm
15	9.5	18.5%	0.0136 mm
30	7.5	14.6%	0.0097 mm
60	5	9.8%	0.0069 mm
240	2.5	4.9%	0.0035 mm
1440	1	2.0%	0.0014 mm

% Gravel:	0.0%	**Liquid Limit:**	40.6 %
% Sand:	31.3%	**Plastic Limit:**	0.0 %
% Silt:	61.7%	**Plasticity Index:**	0.0 %
% Clay:	7.0%		

ASTM D6913

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	100%	4.750 mm
#10	100%	2.000 mm
#20	99%	0.850 mm
#40	98%	0.425 mm
#100	91%	0.150 mm
#200	68.7%	0.075 mm
Silts	67.1%	0.074 mm
	31.4%	0.050 mm
	24.6%	0.020 mm
Clays	7.0%	0.005 mm
	2.7%	0.002 mm
Colloids	1.4%	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: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT11-GB-0-8.5 ft
Sample #: B21-1454

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 31-Aug-21
Tested By: C. Kriss

Unified Soils Classification System, ASTM D-2487
ML, Sandy Silt
Sample Color
brown

Liquid Limit Determination

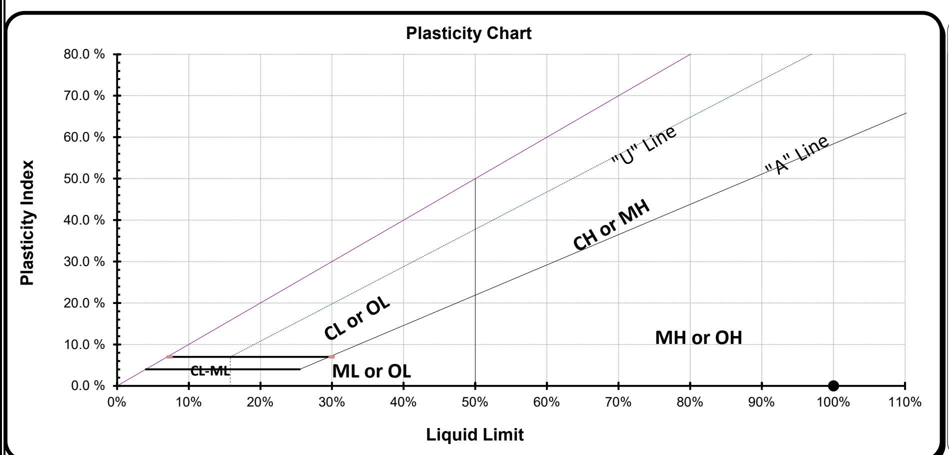
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	32.18	28.53	30.48			
Weight of Dry Soils + Pan:	28.57	24.52	27.32			
Weight of Pan:	19.55	15.03	19.88			
Weight of Dry Soils:	9.02	9.49	7.44			
Weight of Moisture:	3.61	4.01	3.16			
% Moisture:	40.0 %	42.3 %	42.5 %			
Number of Blows:	28	17	15			

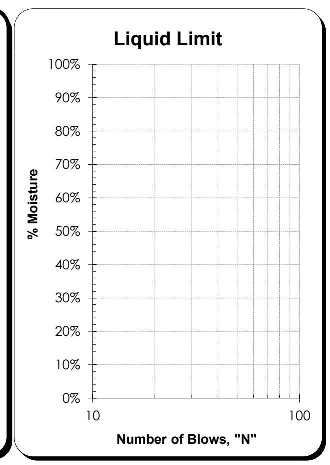
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows: 41 %
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

MATERIALS TESTING & CONSULTING, INC.

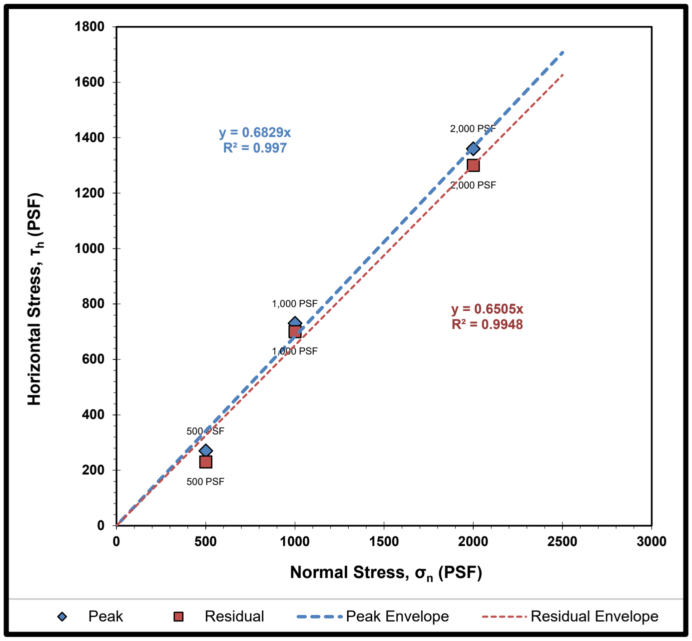
Project: Q.C. - Lower Duwamish Waterway

Project Number:	21B233	**Sample Source:**	LDW21-GT11-GB-0-8.5 ft
Laboratory Sample ID:	B21-1454	**Visual Soil Description:**	brown silty clay
Sample Date:	7/8/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	8/26/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0042
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	58.2	
	Initial	Post-Consolidation
Dry Density (PCF):	76.6	86.1
Void Ratio:	1.201	0.957
Porosity (%):	54.6	48.9
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	54.1	
	Initial	Post-Consolidation
Dry Density (PCF):	78.1	94.3
Void Ratio:	1.157	0.786
Porosity (%):	53.6	44.0
Degree of Saturation (%):	saturated	saturated

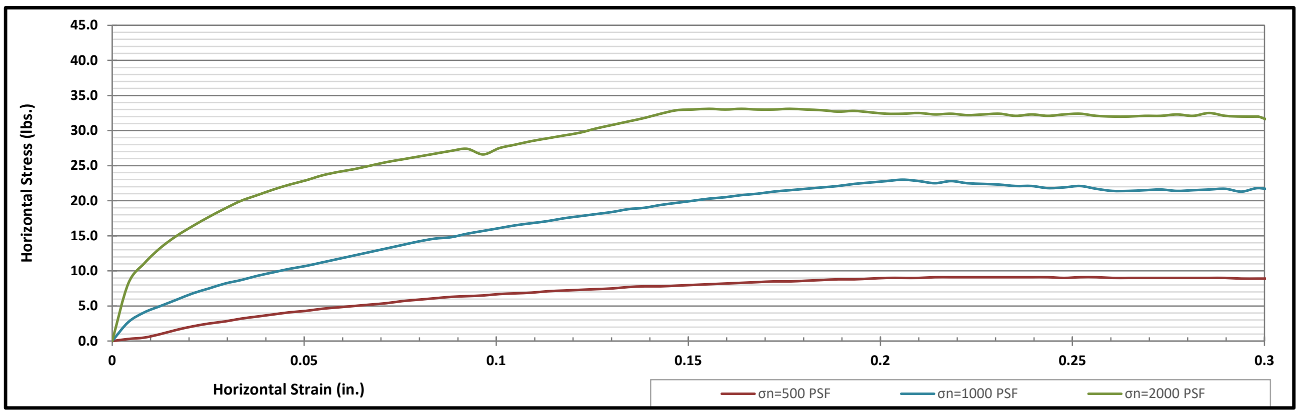
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	57.2	
	Initial	Post-Consolidation
Dry Density (PCF):	78.4	103.4
Void Ratio:	1.149	0.630
Porosity (%):	53.5	38.6
Degree of Saturation (%):	saturated	saturated

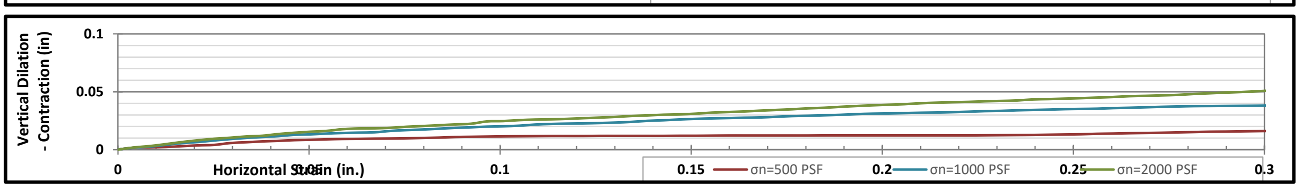


ESTIMATED STRENGTH PARAMETERS

	PEAK	RESIDUAL
Angle of Internal Friction, ϕ (°):	34	33
Cohesion (PSF):	0	0

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	270	730	1360
Residual Horizontal Stress, τ_h (PSF):	230	700	1300





ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	31-Aug-21
Source:	LDW21-GT11-GB-8.5-16.7 ft	**Tested By:**	C. Kriss
Sample #:	B21-1456		

Visual Identification
Clayey Silt
Sample Color
brown

Liquid Limit Determination

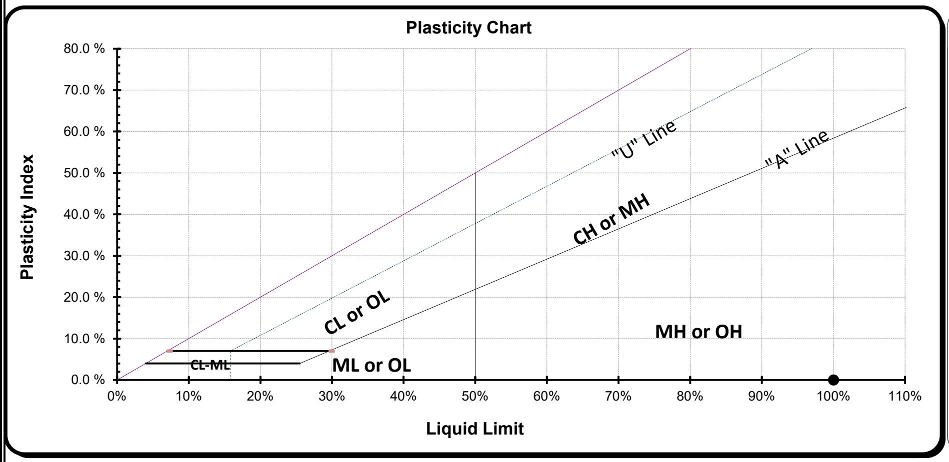
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	33.23	29.16	29.46			
Weight of Dry Soils + Pan:	29.57	25.20	25.24			
Weight of Pan:	19.86	15.05	14.81			
Weight of Dry Soils:	9.71	10.15	10.43			
Weight of Moisture:	3.66	3.96	4.22			
% Moisture:	37.7 %	39.0 %	40.5 %			
Number of Blows:	26	17	11			

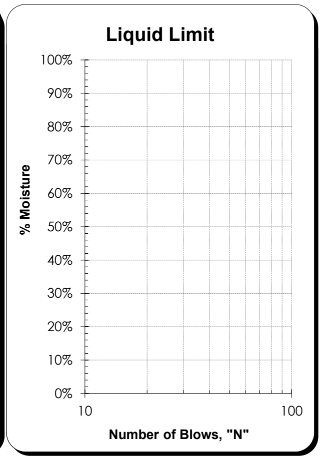
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows:	38 %
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	31-Aug-21
Source:	LDW21-GT11-GB-16.7-18.5 ft	**Tested By:**	C. Kriss
Sample#:	B21-1457		

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

ACCREDITED
Certificate #: 1366.01

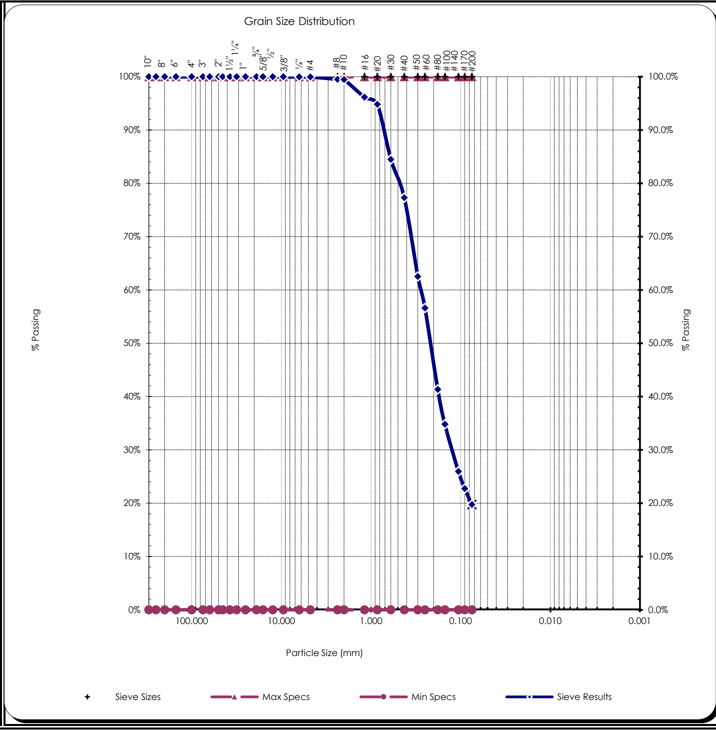
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.019	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C =	1.50
$D_{(10)}$ = 0.038	mm	% Sand =	80.2%	Coeff. of Uniformity, C_U =	7.34
$D_{(15)}$ = 0.057	mm	% Silt & Clay =	19.8%	Fineness Modulus =	1.22
$D_{(30)}$ = 0.126	mm	Liquid Limit =	0.0%	Plastic Limit =	0.0%
$D_{(50)}$ = 0.220	mm	Plasticity Index =	0.0%	Moisture %, as sampled =	27.0%
$D_{(60)}$ = 0.279	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ = 0.733	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio = 23/90		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		96%	100.0%	0.0%
#20	0.850	95%	95%	100.0%	0.0%
#30	0.600		85%	100.0%	0.0%
#40	0.425	77%	77%	100.0%	0.0%
#50	0.300		63%	100.0%	0.0%
#60	0.250	57%	57%	100.0%	0.0%
#80	0.180		41%	100.0%	0.0%
#100	0.150	35%	35%	100.0%	0.0%
#140	0.106		26%	100.0%	0.0%
#170	0.090		23%	100.0%	0.0%
#200	0.075	19.8%	19.8%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	31-Aug-21
Source:	LDW21-GT9-GB-0-1.5 ft	**Tested By:**	C. Kriss
Sample #:	B21-1459		

Visual Identification
Sandy Silt
Sample Color
brown

Liquid Limit Determination

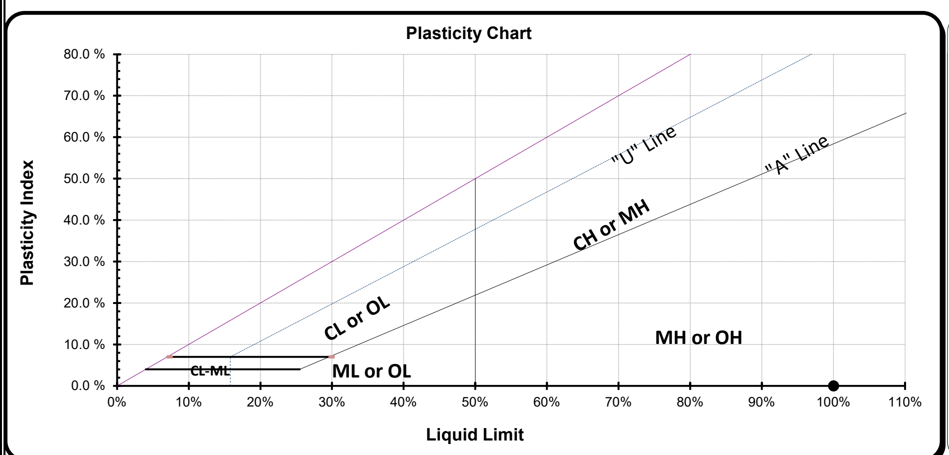
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:	Liquid limit cannot be established					
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

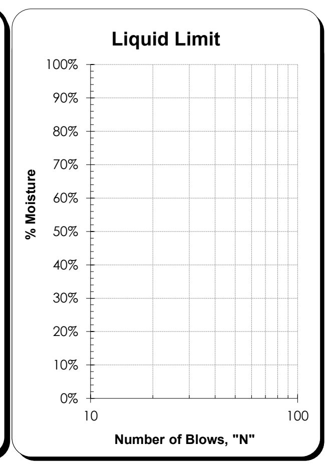
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:	Plastic limit cannot be determined					
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the cup without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT9-GB-~~16-20 ft~~
Sample #: B21-1461

Name correction: LDW21-GT9-GB-10-20

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 31-Aug-21
Tested By: C. Kriss

Visual Identification
Sandy Silt with Clay
Sample Color
brown

Liquid Limit Determination

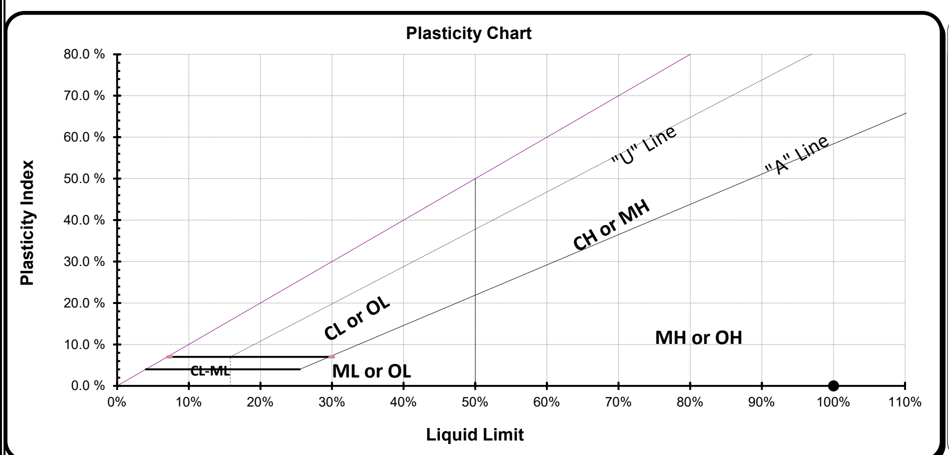
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

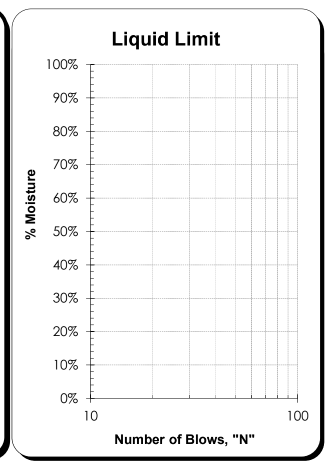
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the cup without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	31-Aug-21
Source:	LDW21-GT9-GB-20-21.5 ft	**Tested By:**	C. Kriss
Sample#:	B21-1462		

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

ACCREDITED
Certificate #: 1366.01

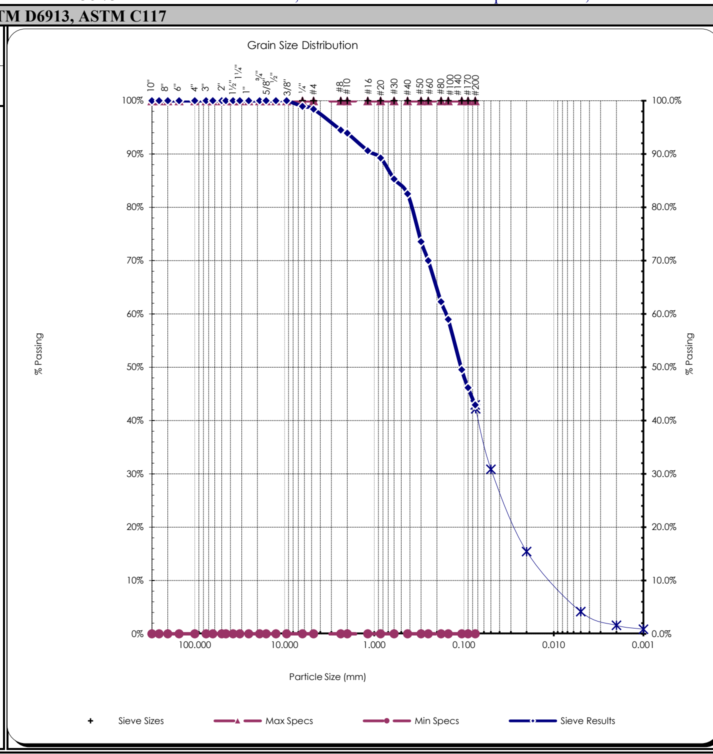
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.006 mm	% Gravel = 1.6%	Coeff. of Curvature, C_C = 2.18		
$D_{(10)}$ = 0.010 mm	% Sand = 55.5%	Coeff. of Uniformity, C_U = 16.63		
$D_{(15)}$ = 0.019 mm	% Silt & Clay = 43.0%	Fineness Modulus = 0.99		
$D_{(30)}$ = 0.058 mm	Liquid Limit = n/a	Plastic Limit = n/a		
$D_{(50)}$ = 0.108 mm	Plasticity Index = n/a	Moisture %, as sampled = 26.8%		
$D_{(60)}$ = 0.159 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =		
$D_{(90)}$ = 1.026 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =		
Dust Ratio = 38/73	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =		

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		99%	100.0%	0.0%
#4	4.75	98%	98%	100.0%	0.0%
#8	2.36		95%	100.0%	0.0%
#10	2.00	94%	94%	100.0%	0.0%
#16	1.18		91%	100.0%	0.0%
#20	0.850	89%	89%	100.0%	0.0%
#30	0.600		85%	100.0%	0.0%
#40	0.425	83%	83%	100.0%	0.0%
#50	0.300		74%	100.0%	0.0%
#60	0.250	70%	70%	100.0%	0.0%
#80	0.180		62%	100.0%	0.0%
#100	0.150	59%	59%	100.0%	0.0%
#140	0.106		50%	100.0%	0.0%
#170	0.090		46%	100.0%	0.0%
#200	0.075	43.0%	43.0%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	31-Aug-21
Source:	LDW21-GT9-GB-20-21.5 ft	**Tested By:**	C. Kriss
Sample#:	B21-1462		

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

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	75.17	grams
Hydroscopic Moist.:	1.11%	
Adj. Sample Wgt :	74.34	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	19	24.0%	0.0496 mm
2	16.5	20.8%	0.0357 mm
5	13.5	17.1%	0.0230 mm
15	9.5	12.0%	0.0136 mm
30	8	10.1%	0.0097 mm
60	5	6.3%	0.0069 mm
240	2	2.5%	0.0035 mm
1440	1	1.3%	0.0014 mm

% Gravel:	1.6%	**Liquid Limit:**	n/a
% Sand:	55.5%	**Plastic Limit:**	n/a
% Silt:	38.8%	**Plasticity Index:**	n/a
% Clay:	4.2%		

ASTM D6913

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"	99%	6.300 mm
	#4	98%	4.750 mm
	#10	94%	2.000 mm
	#20	89%	0.850 mm
	#40	83%	0.425 mm
	#100	59%	0.150 mm
	#200	43.0%	0.075 mm
Silts		42.2%	0.074 mm
		30.9%	0.050 mm
		15.4%	0.020 mm
Clays		4.2%	0.005 mm
		1.6%	0.002 mm
Colloids		0.9%	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: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

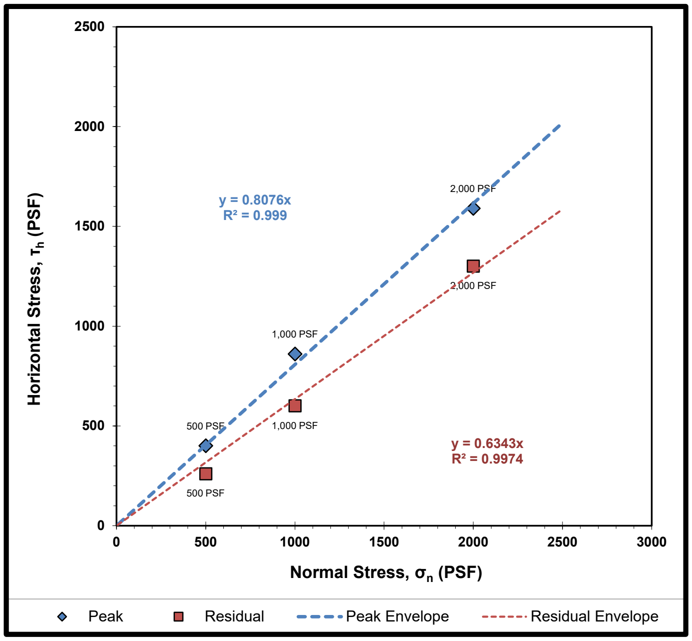
MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway		
Project Number:	21B233	**Sample Source:**	LDW21-GT9-GB-20-21.5 ft
Laboratory Sample ID:	B21-1462	**Visual Soil Description:**	brown silty sand
Sample Date:	7/8/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	8/31/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0042
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		**σ_n=500 PSF**
Initial Moisture Content (%):	22.7	
	Initial	**Post-Consolidation**
Dry Density (PCF):	112.8	114.5
Void Ratio:	0.494	0.471
Porosity (%):	33.0	32.0
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		**σ_n=1000 PSF**
Initial Moisture Content (%):	21.4	
	Initial	**Post-Consolidation**
Dry Density (PCF):	113.5	120.4
Void Ratio:	0.485	0.399
Porosity (%):	32.7	28.5
Degree of Saturation (%):	saturated	saturated

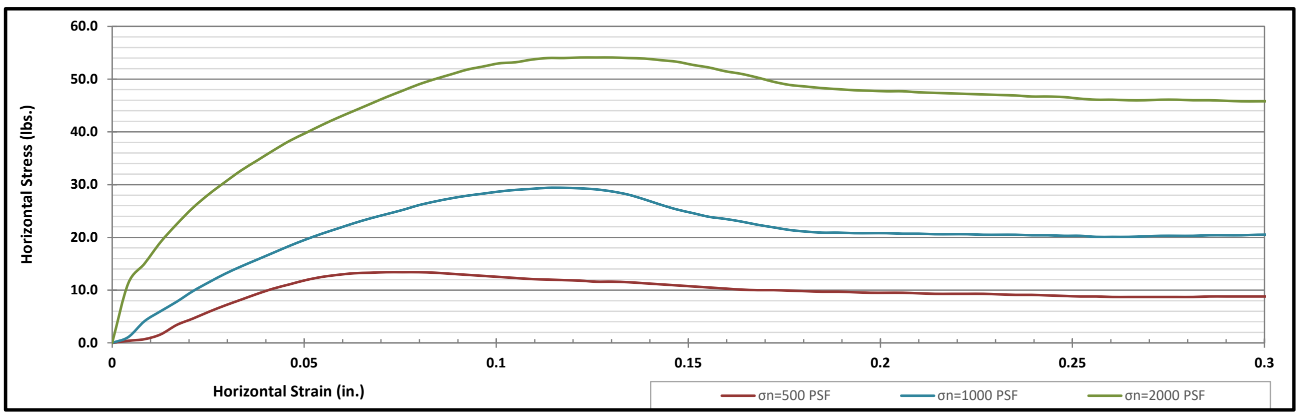
Summary of Sample Data:		**σ_n=2000 PSF**
Initial Moisture Content (%):	19.9	
	Initial	**Post-Consolidation**
Dry Density (PCF):	114.3	123.5
Void Ratio:	0.474	0.364
Porosity (%):	32.1	26.7
Degree of Saturation (%):	saturated	saturated

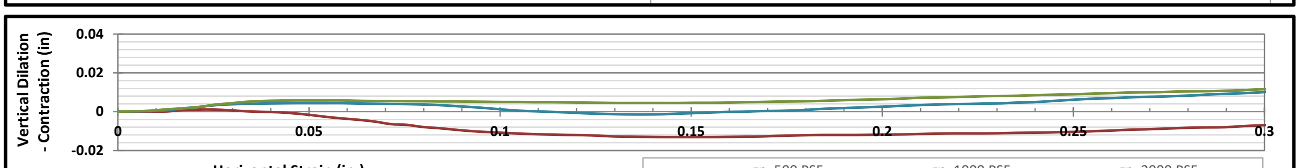


ESTIMATED STRENGTH PARAMETERS

	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	**39**	**32**
Cohesion (PSF):	**0**	**0**

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	400	860	1590
Residual Horizontal Stress, τ_h (PSF):	260	600	1300





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT7-GB-0-5.7 ft
Sample#: B21-1464

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 31-Aug-21
Tested By: C. Kriss

Unified Soil Classification System, ASTM-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

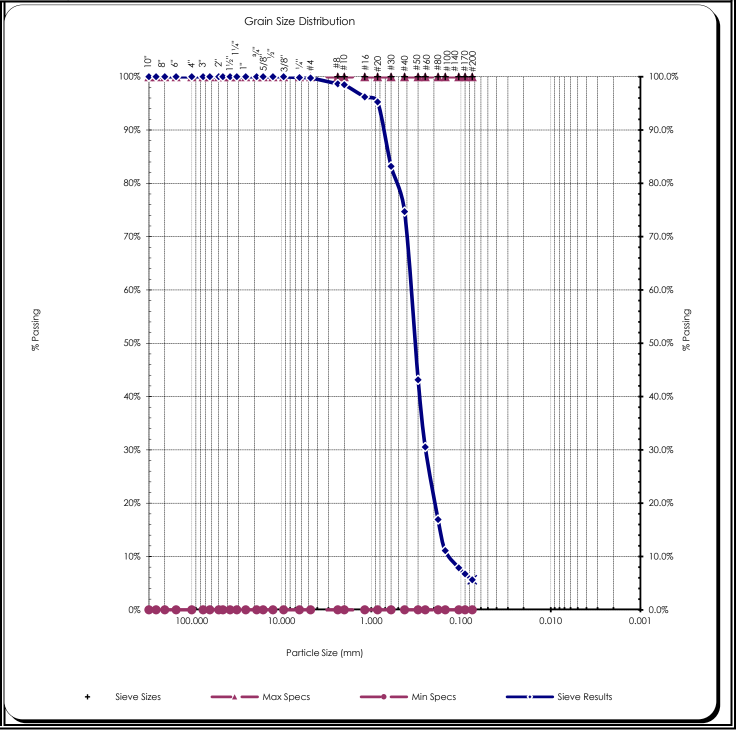
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.066	mm	% Gravel =	0.2%	Coeff. of Curvature, C_C =	1.24
$D_{(10)}$ =	0.135	mm	% Sand =	94.1%	Coeff. of Uniformity, C_U =	2.73
$D_{(15)}$ =	0.170	mm	% Silt & Clay =	5.6%	Fineness Modulus =	1.68
$D_{(30)}$ =	0.247	mm	Liquid Limit =	0.0%	Plastic Limit =	0.0%
$D_{(50)}$ =	0.327	mm	Plasticity Index =	0.0%	Moisture %, as sampled =	29.1%
$D_{(60)}$ =	0.367	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	0.741	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	4/53		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		96%	100.0%	0.0%
#20	0.850	95%	95%	100.0%	0.0%
#30	0.600		83%	100.0%	0.0%
#40	0.425	75%	75%	100.0%	0.0%
#50	0.300		43%	100.0%	0.0%
#60	0.250	31%	31%	100.0%	0.0%
#80	0.180		17%	100.0%	0.0%
#100	0.150	11%	11%	100.0%	0.0%
#140	0.106		8%	100.0%	0.0%
#170	0.090		7%	100.0%	0.0%
#200	0.075	5.6%	5.6%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT7-GB-8.5-18.5 ft
Sample#: B21-1466

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 31-Aug-21
Tested By: C. Kriss

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

ACCREDITED
Certificate #: 1366.01

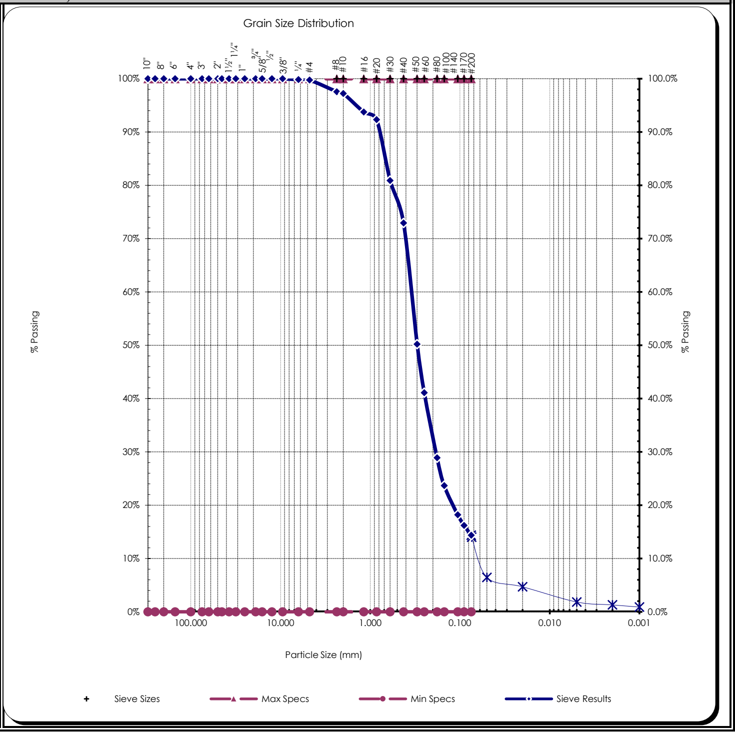
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.022 mm	% Gravel = 0.2%	Coeff. of Curvature, C_C = 1.55
$D_{(10)}$ = 0.063 mm	% Sand = 85.4%	Coeff. of Uniformity, C_U = 5.61
$D_{(15)}$ = 0.080 mm	% Silt & Clay = 14.4%	Fineness Modulus = 1.54
$D_{(30)}$ = 0.186 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.299 mm	Plasticity Index = n/a	Moisture %, as sampled = 33.4%
$D_{(60)}$ = 0.354 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.799 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 13/66	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		98%	100.0%	0.0%
#10	2.00	97%	97%	100.0%	0.0%
#16	1.18		94%	100.0%	0.0%
#20	0.850	92%	92%	100.0%	0.0%
#30	0.600		81%	100.0%	0.0%
#40	0.425	73%	73%	100.0%	0.0%
#50	0.300		50%	100.0%	0.0%
#60	0.250	41%	41%	100.0%	0.0%
#80	0.180		29%	100.0%	0.0%
#100	0.150	24%	24%	100.0%	0.0%
#140	0.106		18%	100.0%	0.0%
#170	0.090		16%	100.0%	0.0%
#200	0.075	14.4%	14.4%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	31-Aug-21
Source:	LDW21-GT7-GB-8.5-18.5 ft	**Tested By:**	C. Kriss
Sample#:	B21-1466		

Unified Soil Classification System, ASTM-2487
SM, Silty Sand

Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	75.16	grams
Hydroscopic Moist.:	1.29%	
Adj. Sample Wgt :	74.20	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	5	6.6%	0.0537 mm
2	4.5	5.9%	0.0381 mm
5	4	5.2%	0.0241 mm
15	3	3.9%	0.0140 mm
30	2.5	3.3%	0.0100 mm
60	2	2.6%	0.0070 mm
240	1	1.3%	0.0035 mm
1440	1	1.3%	0.0014 mm

% Gravel:	0.2%	**Liquid Limit:**	n/a
% Sand:	85.4%	**Plastic Limit:**	n/a
% Silt:	12.5%	**Plasticity Index:**	n/a
% Clay:	1.9%		

ASTM D6913

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	100%	4.750 mm
#10	97%	2.000 mm
#20	92%	0.850 mm
#40	73%	0.425 mm
#100	24%	0.150 mm
#200	14.4%	0.075 mm
Silts	14.0%	0.074 mm
	6.5%	0.050 mm
	4.7%	0.020 mm
Clays	1.9%	0.005 mm
	1.3%	0.002 mm
Colloids	0.9%	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
Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

MATERIALS TESTING & CONSULTING, INC.

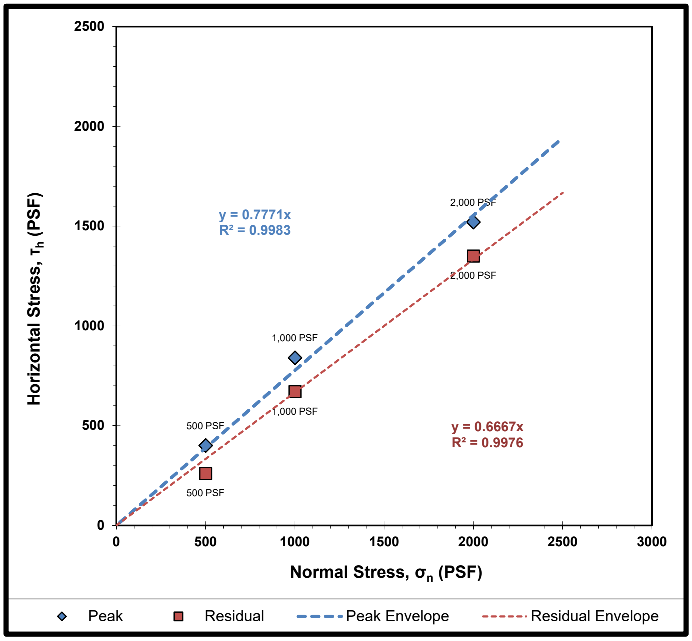
Project: Q.C. - Lower Duwamish Waterway

Project Number:	21B233	**Sample Source:**	LDW21-GT7-GB-8.5-18.5 ft
Laboratory Sample ID:	B21-1466	**Visual Soil Description:**	brown silty sand
Sample Date:	7/9/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	9/1/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	36.5	
	Initial	Post-Consolidation
Dry Density (PCF):	99.2	102.6
Void Ratio:	0.698	0.642
Porosity (%):	41.1	39.1
Degree of Saturation (%):	saturated	saturated

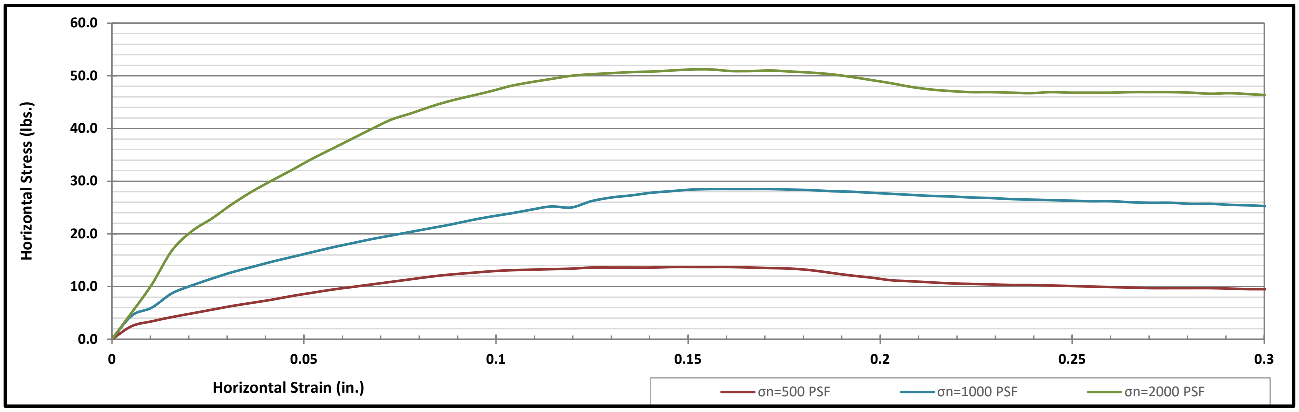
Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	37.7	
	Initial	Post-Consolidation
Dry Density (PCF):	97.5	105.0
Void Ratio:	0.728	0.605
Porosity (%):	42.1	37.7
Degree of Saturation (%):	saturated	saturated

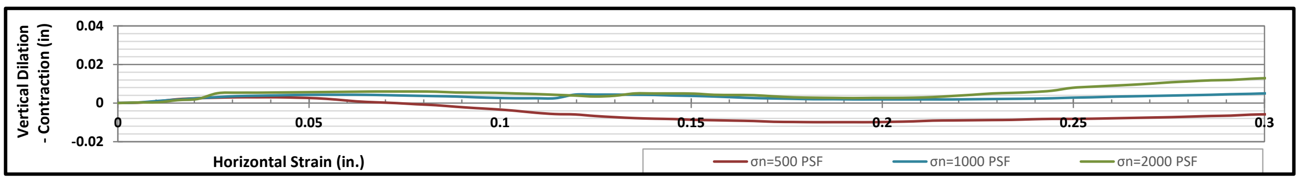
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	36.6	
	Initial	Post-Consolidation
Dry Density (PCF):	99.4	106.9
Void Ratio:	0.694	0.576
Porosity (%):	41.0	36.5
Degree of Saturation (%):	saturated	saturated



ESTIMATED STRENGTH PARAMETERS		
	PEAK	RESIDUAL
Angle of Internal Friction, ϕ (°):	38	34
Cohesion (PSF):	0	0

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	400	840	1520
Residual Horizontal Stress, τ_h (PSF):	260	670	1350





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Client:	Anchor QEA	**Date:**	September 30, 2021
Address:	21328 2nd Drive SE	**Project:**	Q.C. - Lower Duwamish Waterway
	Bothell, WA 98021	**Project #:**	21B233
Attn:	Garrett Timm	**Sample #:**	B21-1535-1552
Revised on:		**Date sampled:**	July 9, 2021

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	Please See Attached Reports		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count			LA Abrasion	
X	Moisture Content	Please See Attached Report	X	Direct Shear	Please See Attached Reports
	Specific Gravity, Coarse		X	Specific Gravity, Soils	Please See Attached Reports
	Specific Gravity, Fine				
X	Hydrometer Analysis	Please See Attached Reports			
X	Atterberg Limits	Please See Attached Reports			

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Meghan Blodgett-Carrillo

Respectfully Submitted,
Meghan Blodgett-Carrillo
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM C566, ASTM D2216

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: September 1, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B21-1535	LDW21-GT7-GB-5.7-8.5 ft	220.0	955.7	691.6	264.1	471.6	56.0%
B21-1536	LDW21-GT7-GB-18.5-23.5 ft	233.7	1022.0	763.2	258.8	529.5	48.9%
B21-1537	LDW21-GT7-GB-23.5-25 ft	229.6	808.5	686.6	121.9	457.0	26.7%
B21-1538	LDW21-GT3-GB-0-1.5 ft	222.7	822.9	608.9	214.0	386.2	55.4%
B21-1539	LDW21-GT3-GB-0-8 ft	223.1	775.1	560.8	214.3	337.7	63.5%
B21-1540	LDW21-GT3-GB-8-9.5 ft	235.0	596.2	499.4	96.8	264.4	36.6%
B21-1541	LDW21-GT3-GB-13.6-18 ft	224.3	840.2	686.6	153.6	462.3	33.2%
B21-1542	LDW21-GT3-GB-18-19.5 ft	208.8	713.1	597.6	115.5	388.8	29.7%
B21-1543	LDW21-GT2-GB-0-1.5 ft	221.9	1015.5	706.7	308.8	484.8	63.7%
B21-1544	LDW21-GT2-GB-0-9 ft	221.9	1057.2	726.4	330.8	504.5	65.6%
B21-1545	LDW21-GT2-GB-9-10.5 ft	234.7	881.9	693.4	188.5	458.7	41.1%
B21-1546	LDW21-GT2-GB-16-19ft	319.9	776.4	594.5	181.9	274.6	66.2%
B21-1547	LDW21-GT1-GB-19-20.5 ft	268.9	932.1	798.3	133.8	529.4	25.3%
B21-1548	LDW21-GT1-GB-0-1.5 ft	270.2	991.8	734.1	257.7	463.9	55.6%
B21-1549	LDW21-GT1-GB-0-10 ft	266.5	951.7	694.7	257.0	428.2	60.0%
B21-1550	LDW21-GT1-GB-10-11.5 ft	303.8	1160.1	875.7	284.4	571.9	49.7%
B21-1551	LDW21-GT1-GB-10-20 ft	311.0	1013.9	756.9	257.0	445.9	57.6%
B21-1552	LDW21-GT1-GB-20-21.5 ft	306.5	1105.1	926.6	178.5	620.1	28.8%

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM D854

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: September 1, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B21-1536	LDW21-GT7-GB-18.5-23.5 ft	414.24	485.84	71.6	TSA-010	180.3	499.5	0.99752	753.80	709.46	23.1	2.6265591	0.99931	2.6247467
B21-1541	LDW21-GT3-GB-13.6-18 ft	379.79	481.87	102.1	TSA-011	190.3	499.5	0.99749	752.15	688.62	23.2	2.6482538	0.99929	2.6463735
B21-1546	LDW21-GT2-GB-16-19ft	417.55	468.99	51.4	TSA-017	187.9	499.4	0.99754	717.30	686.06	23.0	2.546361	0.99933	2.5446549
B21-1549	LDW21-GT1-GB-0-10 ft	411.71	488.70	77.0	TSA-022	198.0	499.5	0.99749	742.60	696.19	23.2	2.5179566	0.99929	2.5161689
B21-1551	LDW21-GT1-GB-10-20 ft	380.03	474.50	94.5	TSA-020	195.0	499.5	0.99749	750.48	693.27	23.2	2.5356867	0.99929	2.5338864

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT7-GB-5.7-8.5 ft
Sample #: B21-1535

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 1-Sep-21
Tested By: C. Kriss

Visual Identification
Sand with Silt and Clay
Sample Color
brown

Liquid Limit Determination

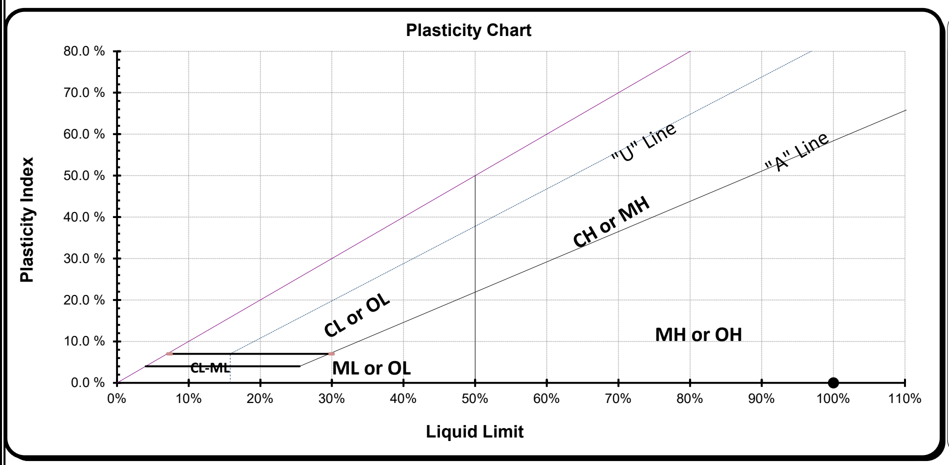
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	34.38	32.59	32.44			
Weight of Dry Soils + Pan:	30.26	28.85	28.70			
Weight of Pan:	19.58	19.73	19.89			
Weight of Dry Soils:	10.68	9.12	8.81			
Weight of Moisture:	4.12	3.74	3.74			
% Moisture:	38.6 %	41.0 %	42.5 %			
Number of Blows:	33	24	13			

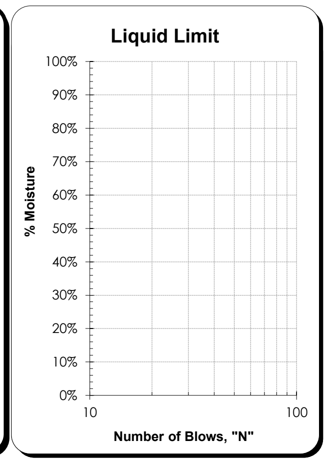
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows:	40 %
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT7-GB-18.5-23.5 ft
Sample#: B21-1536

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 1-Sep-21
Tested By: C. Kriss

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

ACCREDITED
Certificate #: 1366.01

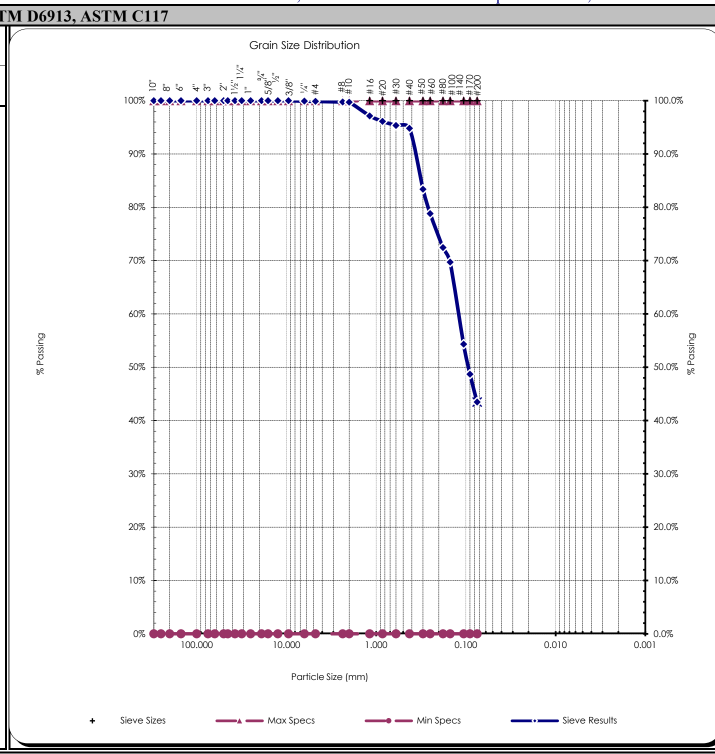
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.009	mm	% Gravel =	0.1%	Coeff. of Curvature, C_C =	1.27
$D_{(10)}$ = 0.017	mm	% Sand =	56.4%	Coeff. of Uniformity, C_U =	7.08
$D_{(15)}$ = 0.026	mm	% Silt & Clay =	43.5%	Fineness Modulus =	0.55
$D_{(30)}$ = 0.052	mm	Liquid Limit =	0.0%	Plastic Limit =	0.0%
$D_{(50)}$ = 0.094	mm	Plasticity Index =	0.0%	Moisture %, as sampled =	48.9%
$D_{(60)}$ = 0.122	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ = 0.372	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio = 11/24		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		97%	100.0%	0.0%
#20	0.850		96%	100.0%	0.0%
#30	0.600		95%	100.0%	0.0%
#40	0.425	95%	95%	100.0%	0.0%
#50	0.300		83%	100.0%	0.0%
#60	0.250		79%	100.0%	0.0%
#80	0.180		72%	100.0%	0.0%
#100	0.150	70%	70%	100.0%	0.0%
#140	0.106		54%	100.0%	0.0%
#170	0.090		49%	100.0%	0.0%
#200	0.075	43.5%	43.5%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT3-GB-0-8 ft
Sample #: B21-1539

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 1-Sep-21
Tested By: C. Kriss

Visual Identification
Sandy Silt
Sample Color
brown

Liquid Limit Determination

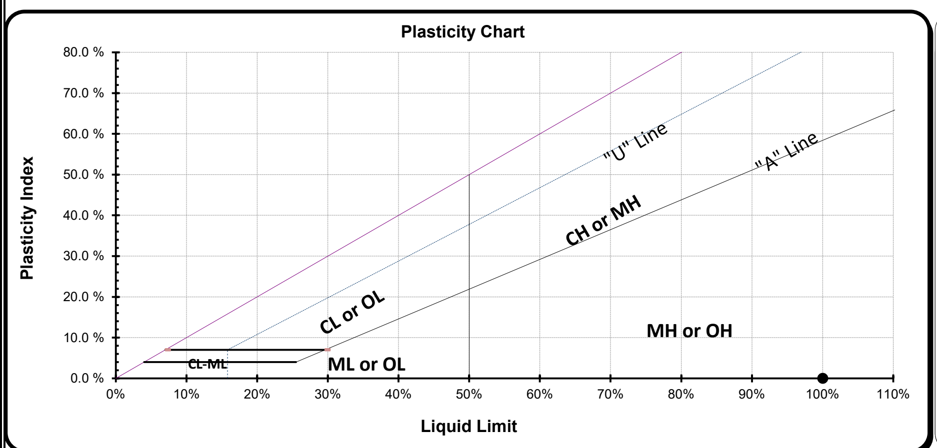
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

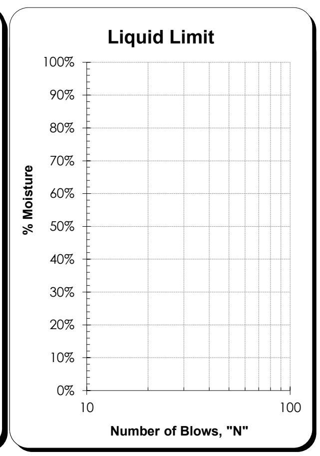
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by:
Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT3-GB-8-9.5 ft
Sample#: B21-1540

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 1-Sep-21
Tested By: C. Kriss

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

ACCREDITED
Certificate #: 1366.01

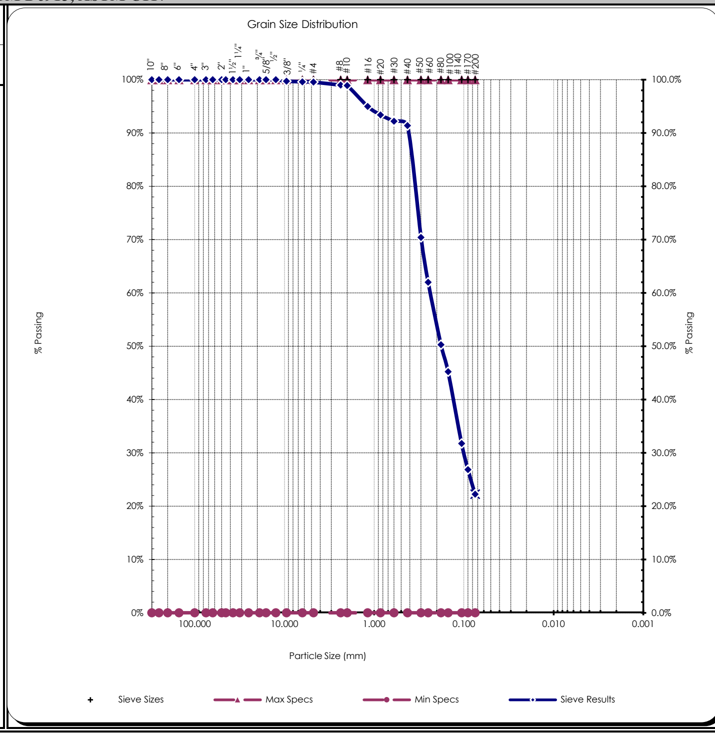
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.017 mm	% Gravel = 0.5%	Coeff. of Curvature, C_C = 1.25
$D_{(10)}$ = 0.034 mm	% Sand = 77.3%	Coeff. of Uniformity, C_U = 7.06
$D_{(15)}$ = 0.051 mm	% Silt & Clay = 22.3%	Fineness Modulus = 0.99
$D_{(30)}$ = 0.100 mm	Liquid Limit = 0.0%	Plastic Limit = 0.0%
$D_{(50)}$ = 0.178 mm	Plasticity Index = 0.0%	Moisture %, as sampled = 36.6%
$D_{(60)}$ = 0.238 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.417 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 19/78	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		95%	100.0%	0.0%
#20	0.850		93%	100.0%	0.0%
#30	0.600		92%	100.0%	0.0%
#40	0.425	91%	91%	100.0%	0.0%
#50	0.300		70%	100.0%	0.0%
#60	0.250		62%	100.0%	0.0%
#80	0.180		50%	100.0%	0.0%
#100	0.150	45%	45%	100.0%	0.0%
#140	0.106		32%	100.0%	0.0%
#170	0.090		27%	100.0%	0.0%
#200	0.075	22.3%	22.3%	100.0%	0.0%



Comments:

Reviewed by:
Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

MATERIALS TESTING & CONSULTING, INC.

Project: Q.C. - Lower Duwamish Waterway

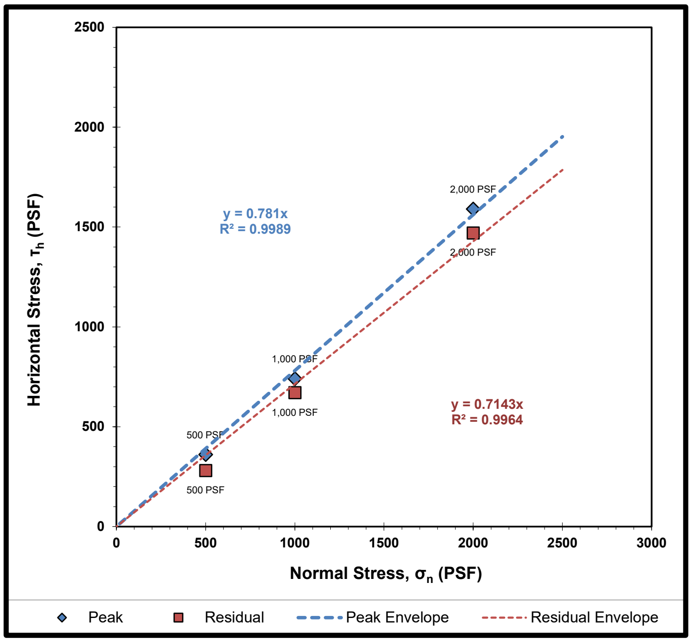
Project Number:	21B233	**Sample Source:**	LDW21-GT3-GB-8-9.5 ft
Laboratory Sample ID:	B21-1540	**Visual Soil Description:**	brown silty sand
Sample Date:	7/9/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	9/24/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	33.7	
	Initial	**Post-Consolidation**
Dry Density (PCF):	102.4	104.0
Void Ratio:	0.645	0.620
Porosity (%):	39.2	38.3
Degree of Saturation (%):	saturated	saturated

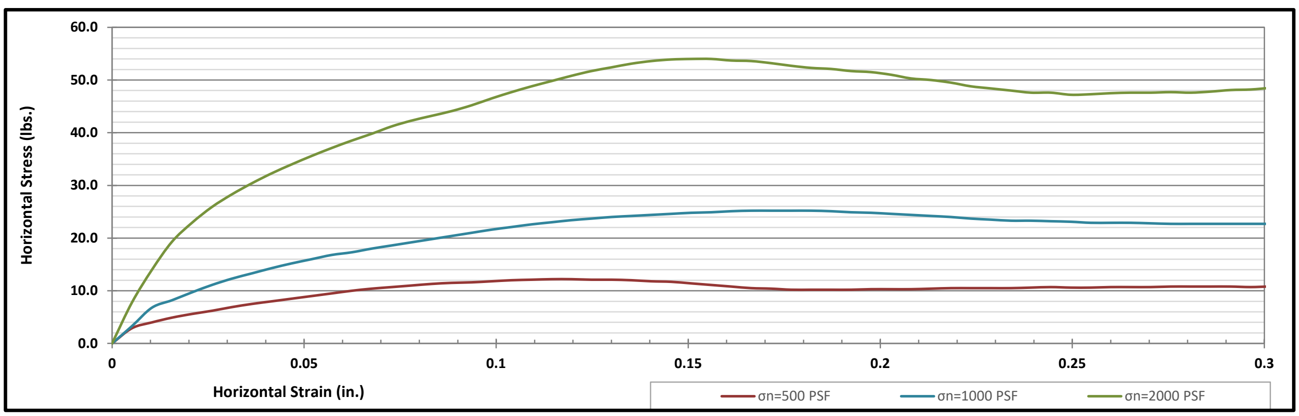
Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	31.2	
	Initial	**Post-Consolidation**
Dry Density (PCF):	104.0	109.1
Void Ratio:	0.620	0.544
Porosity (%):	38.3	35.2
Degree of Saturation (%):	saturated	saturated

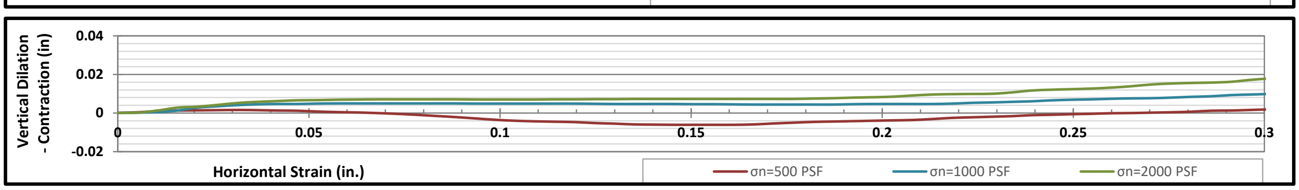
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	30.1	
	Initial	**Post-Consolidation**
Dry Density (PCF):	105.0	110.4
Void Ratio:	0.605	0.526
Porosity (%):	37.7	34.5
Degree of Saturation (%):	saturated	saturated

ESTIMATED STRENGTH PARAMETERS		
	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	**38**	**36**
Cohesion (PSF):	**0**	**0**



Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	360	740	1590
Residual Horizontal Stress, τ_h (PSF):	280	670	1470





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

Sieve Report

Project: Q.C. - Lower Duwamish Waterway	**Date Received:** 29-Jul-21
Project #: 21B233	**Sampled By:** Client
Client: Anchor QEA	**Date Tested:** 1-Sep-21
Source: LDW21-GT3-GB-13.6-18 ft	**Tested By:** C. Kriss
Sample#: B21-1541	

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

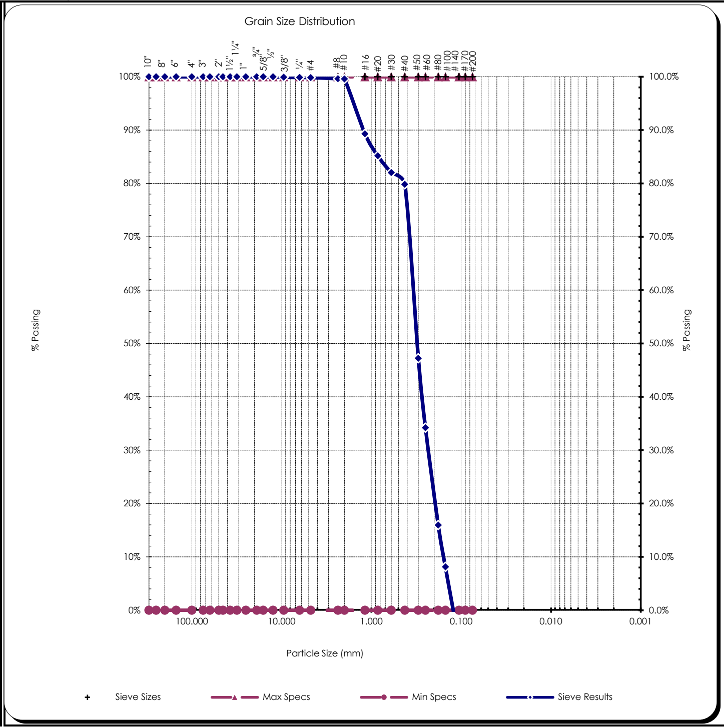
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.140 mm	% Gravel = 0.2%	Coeff. of Curvature, C_C = 1.00
$D_{(10)}$ = 0.157 mm	% Sand = 115.1%	Coeff. of Uniformity, C_U = 2.22
$D_{(15)}$ = 0.176 mm	% Silt & Clay = -15.2%	Fineness Modulus = 1.74
$D_{(30)}$ = 0.234 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.311 mm	Plasticity Index = n/a	Moisture %, as sampled = 33.2%
$D_{(60)}$ = 0.349 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.234 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = - 17/89	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		89%	100.0%	0.0%
#20	0.850		85%	100.0%	0.0%
#30	0.600		82%	100.0%	0.0%
#40	0.425	80%	80%	100.0%	0.0%
#50	0.300		47%	100.0%	0.0%
#60	0.250		34%	100.0%	0.0%
#80	0.180		16%	100.0%	0.0%
#100	0.150	8%	8%	100.0%	0.0%
#140	0.106		-6%	100.0%	0.0%
#170	0.090		-11%	100.0%	0.0%
#200	0.075	-15.2%	-15.2%	100.0%	0.0%



All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT2-GB-0-9 ft
Sample #: B21-1544

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 1-Sep-21
Tested By: C. Kriss

Visual Identification
Sandy Silt
Sample Color
brown

Liquid Limit Determination

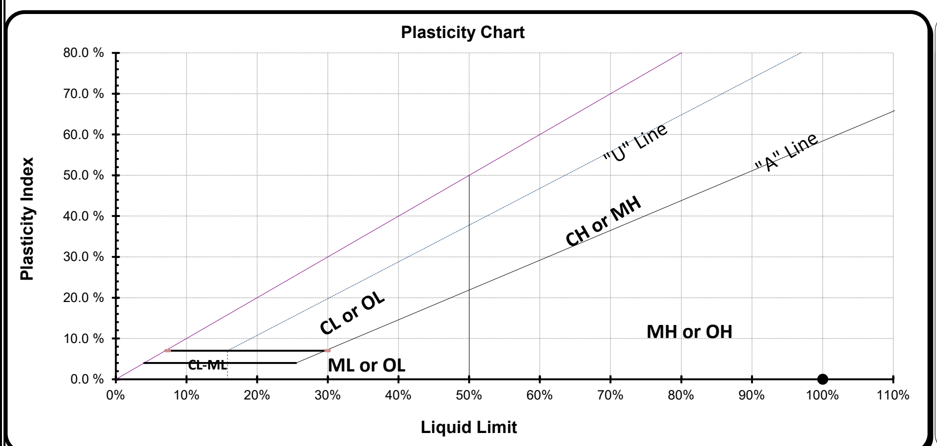
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

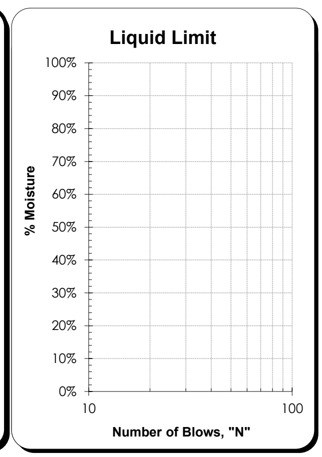
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT2-GB-16-19 ft
Sample#: B21-1546

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 1-Sep-21
Tested By: C. Kriss

Visual Identification
Sandy Silt with Clay
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

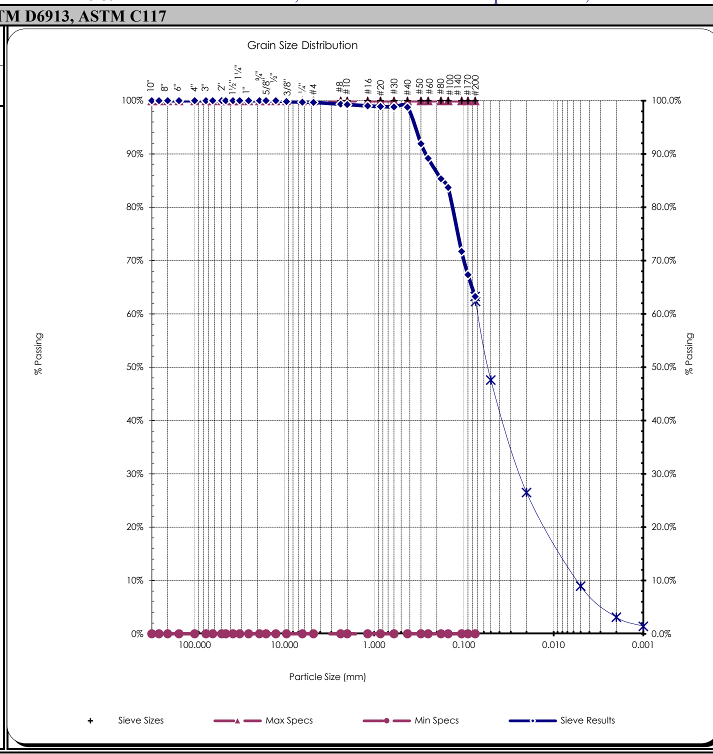
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.003 mm	% Gravel = 0.3%	Coeff. of Curvature, C_C = 1.57
$D_{(10)}$ = 0.006 mm	% Sand = 36.4%	Coeff. of Uniformity, C_U = 12.88
$D_{(15)}$ = 0.009 mm	% Silt & Clay = 63.3%	Fineness Modulus = 0.28
$D_{(30)}$ = 0.025 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.061 mm	Plasticity Index = n/a	Moisture %, as sampled = 66.2%
$D_{(60)}$ = 0.072 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.265 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 25/39	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		92%	100.0%	0.0%
#60	0.250		89%	100.0%	0.0%
#80	0.180		85%	100.0%	0.0%
#100	0.150	84%	84%	100.0%	0.0%
#140	0.106		72%	100.0%	0.0%
#170	0.090		67%	100.0%	0.0%
#200	0.075	63.3%	63.3%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21	**Visual Identification**
Project #:	21B233	**Sampled By:**	Client	Sandy Silt with Clay
Client :	Anchor QEA	**Date Tested:**	1-Sep-21	**Sample Color**
Source:	LDW21-GT2-GB-16-19 ft	**Tested By:**	C. Kriss	brown
Sample#:	B21-1546			

ASTM D7928, HYDROMETER ANALYSIS

Sp Gr :	2.54	
Sample Weight:	75.85	grams
Hydroscopic Moist.:	6.24%	
Adj. Sample Wgt :	71.39	grams

A2LA ACCREDITED Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	27	38.7%	0.0494 mm
2	23.5	33.7%	0.0358 mm
5	20.5	29.4%	0.0231 mm
15	14.5	20.8%	0.0138 mm
30	11.5	16.5%	0.0099 mm
60	9	12.9%	0.0071 mm
240	4.5	6.4%	0.0036 mm
1440	1.5	2.1%	0.0015 mm

% Gravel:	0.3%	**Liquid Limit:**	n/a
% Sand:	36.4%	**Plastic Limit:**	n/a
% Silt:	54.3%	**Plasticity Index:**	n/a
% Clay:	9.0%		

ASTM D6913

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	100%	4.750 mm
#10	99%	2.000 mm
#20	99%	0.850 mm
#40	99%	0.425 mm
#100	84%	0.150 mm
#200	63.3%	0.075 mm
Silts	62.3%	0.074 mm
	47.6%	0.050 mm
	26.5%	0.020 mm
Clays	9.0%	0.005 mm
	3.1%	0.002 mm
Colloids	1.4%	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: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

MTC MATERIALS TESTING & CONSULTING, INC.

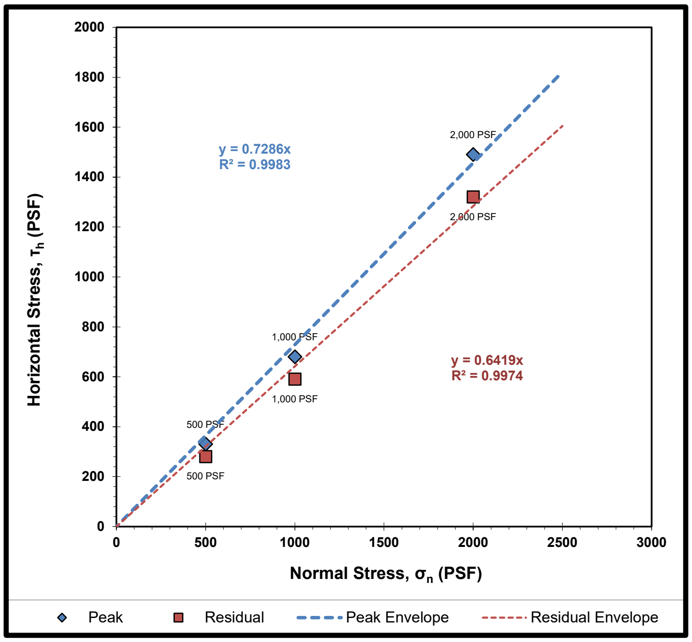
Project: Q.C. - Lower Duwamish Waterway

Project Number:	21B233	**Sample Source:**	LDW21-GT2-GB-16-19 ft
Laboratory Sample ID:	B21-1546	**Visual Soil Description:**	brown sandy silt
Sample Date:	7/9/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	9/27/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0042
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	38.6	
	Initial	Post-Consolidation
Dry Density (PCF):	100.0	106.5
Void Ratio:	0.684	0.581
Porosity (%):	40.6	36.8
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	36.2	
	Initial	Post-Consolidation
Dry Density (PCF):	101.4	111.3
Void Ratio:	0.661	0.514
Porosity (%):	39.8	34.0
Degree of Saturation (%):	saturated	saturated

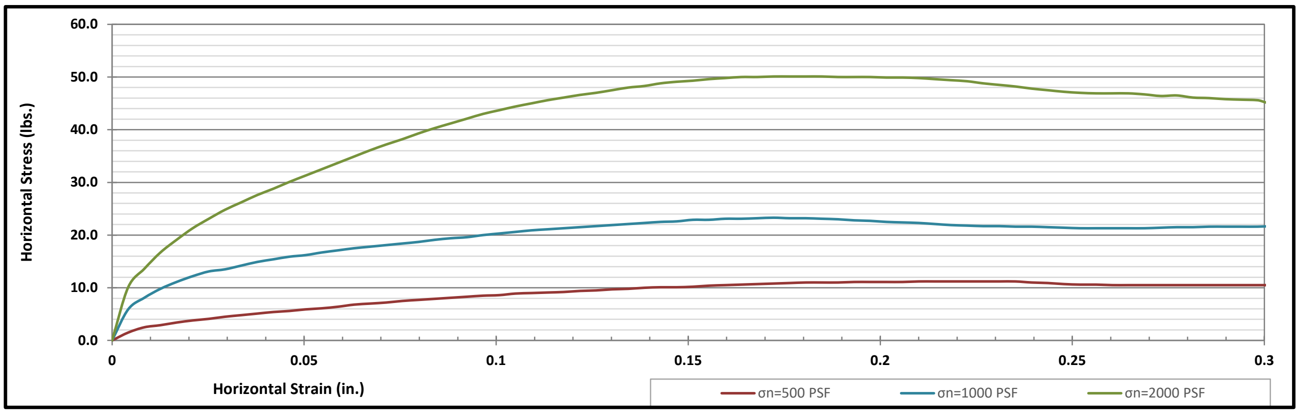
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	34.6	
	Initial	Post-Consolidation
Dry Density (PCF):	102.5	110.5
Void Ratio:	0.643	0.525
Porosity (%):	39.1	34.4
Degree of Saturation (%):	saturated	saturated

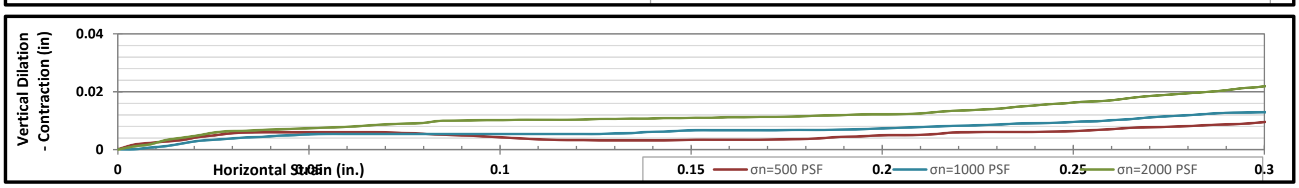


ESTIMATED STRENGTH PARAMETERS

	PEAK	RESIDUAL
Angle of Internal Friction, ϕ (°):	**36**	**33**
Cohesion (PSF):	**0**	**0**

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	330	680	1490
Residual Horizontal Stress, τ_h (PSF):	280	590	1320





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway	**Date Received:** 29-Jul-21	**Visual Identification**
Project #: 21B233	**Sampled By:** Client	Silty Sand
Client: Anchor QEA	**Date Tested:** 1-Sep-21	**Sample Color**
Source: LDW21-GT1-GB-0-10 ft	**Tested By:** C. Kriss	brown
Sample #: B21-1549		

Liquid Limit Determination

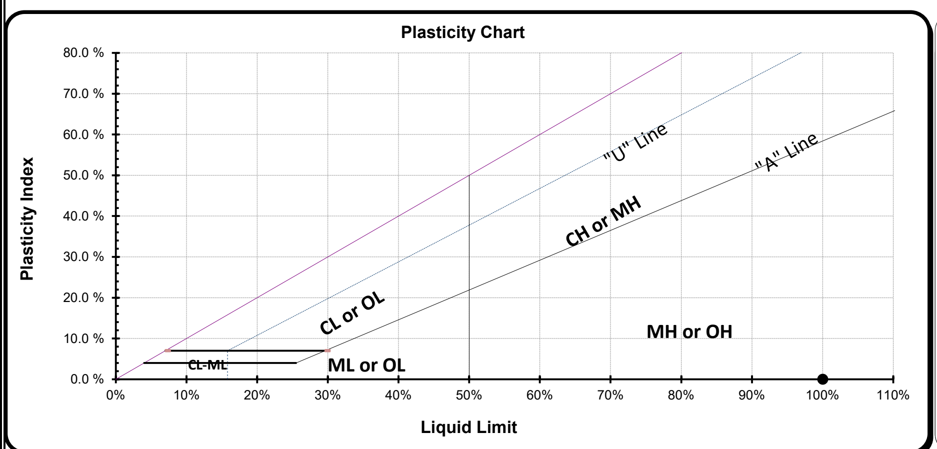
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

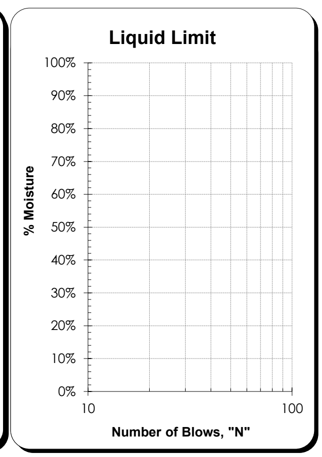
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	1-Sep-21
Source:	LDW21-GT1-GB-10-20 ft	**Tested By:**	C. Kriss
Sample#:	B21-1551		

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

ACCREDITED
Certificate #: 1366.01

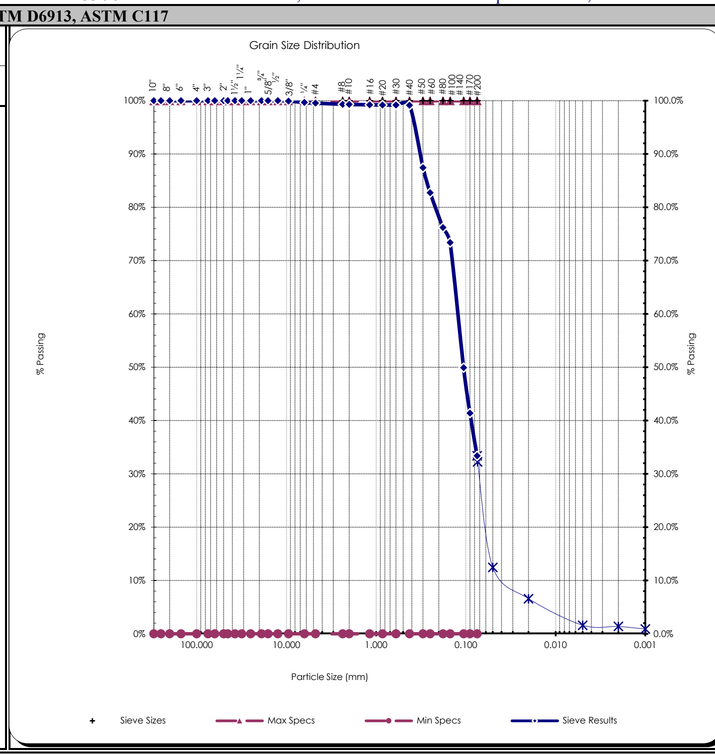
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.013 mm	% Gravel = 0.5%	Coeff. of Curvature, C_C = 1.11
$D_{(10)}$ = 0.037 mm	% Sand = 66.2%	Coeff. of Uniformity, C_U = 3.34
$D_{(15)}$ = 0.059 mm	% Silt & Clay = 33.4%	Fineness Modulus = 0.42
$D_{(30)}$ = 0.072 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.106 mm	Plasticity Index = n/a	Moisture %, as sampled = 57.6%
$D_{(60)}$ = 0.125 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.327 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 33/98	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		87%	100.0%	0.0%
#60	0.250		83%	100.0%	0.0%
#80	0.180		76%	100.0%	0.0%
#100	0.150	73%	73%	100.0%	0.0%
#140	0.106		50%	100.0%	0.0%
#170	0.090		41%	100.0%	0.0%
#200	0.075	33.4%	33.4%	100.0%	0.0%



Comments:

Reviewed by:

Meghan Blodgett-Carrillo

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	1-Sep-21
Source:	LDW21-GT1-GB-10-20 ft	**Tested By:**	C. Kriss
Sample#:	B21-1551		

Unified Soil Classification System, ASTM-2487
SM, Silty Sand

Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Sp Gr :	2.53	
Sample Weight:	75.48	grams
Hydroscopic Moist.:	2.34%	
Adj. Sample Wgt :	73.75	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	8	11.1%	0.0554 mm
2	7.5	10.4%	0.0394 mm
5	5.5	7.6%	0.0252 mm
15	4	5.5%	0.0146 mm
30	3	4.2%	0.0104 mm
60	1.5	2.1%	0.0074 mm
240	1	1.4%	0.0037 mm
1440	1	1.4%	0.0015 mm

% Gravel:	0.5%	**Liquid Limit:**	n/a
% Sand:	66.2%	**Plastic Limit:**	n/a
% Silt:	31.8%	**Plasticity Index:**	n/a
% Clay:	1.6%		

ASTM D6913

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	100%	4.750 mm
#10	99%	2.000 mm
#20	99%	0.850 mm
#40	99%	0.425 mm
#100	73%	0.150 mm
#200	33.4%	0.075 mm
Silts	32.2%	0.074 mm
	12.5%	0.050 mm
	6.6%	0.020 mm
Clays	1.6%	0.005 mm
	1.4%	0.002 mm
Colloids	0.9%	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
Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

MATERIALS TESTING & CONSULTING, INC.

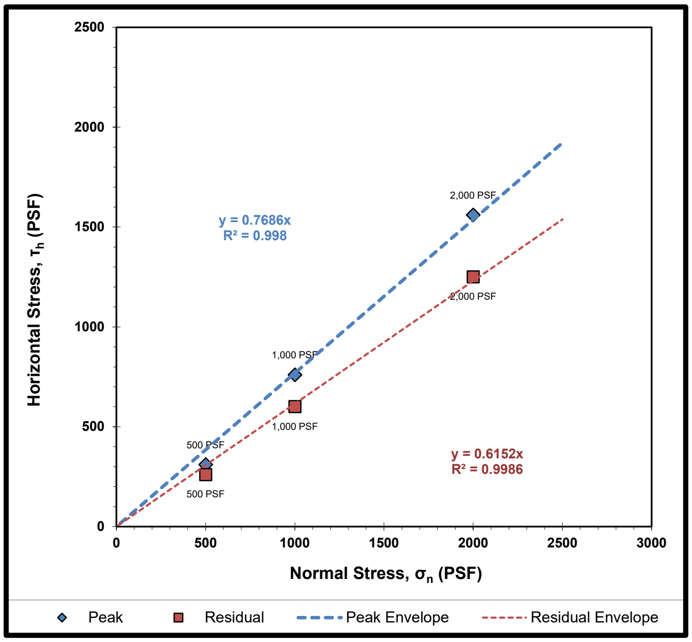
Project: Q.C. - Lower Duwamish Waterway

Project Number:	21B233	**Sample Source:**	LDW21-GT1-GB-10-20 ft
Laboratory Sample ID:	B21-1551	**Visual Soil Description:**	brown silty sand
Sample Date:	7/9/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	9/23/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		**σ_n=500 PSF**
Initial Moisture Content (%):	30.0	
	Initial	**Post-Consolidation**
Dry Density (PCF):	106.5	108.9
Void Ratio:	0.581	0.547
Porosity (%):	36.8	35.4
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		**σ_n=1000 PSF**
Initial Moisture Content (%):	29.7	
	Initial	**Post-Consolidation**
Dry Density (PCF):	598.3	612.5
Void Ratio:	-0.718	-0.725
Porosity (%):	-255.1	-263.6
Degree of Saturation (%):	-111.5	saturated

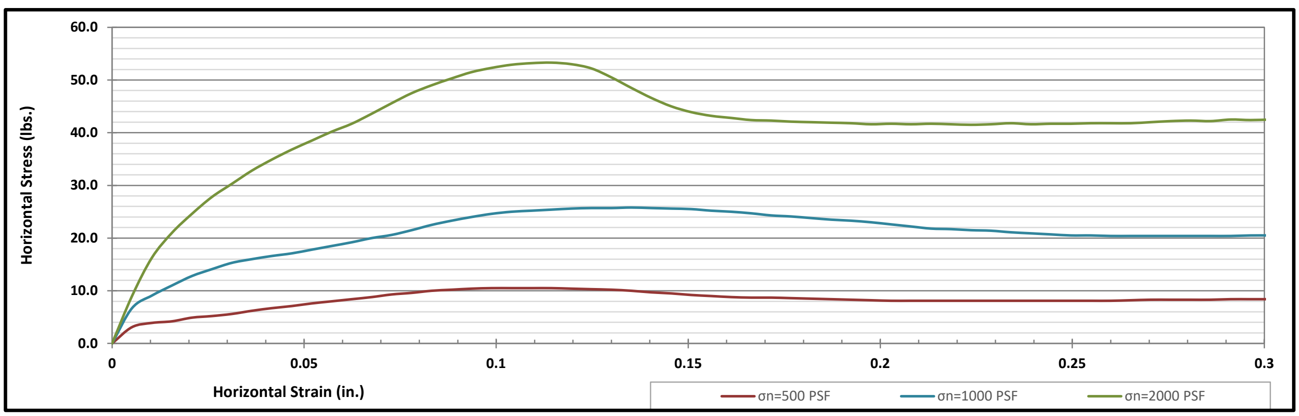
Summary of Sample Data:		**σ_n=2000 PSF**
Initial Moisture Content (%):	29.8	
	Initial	**Post-Consolidation**
Dry Density (PCF):	107.6	113.2
Void Ratio:	0.566	0.488
Porosity (%):	36.1	32.8
Degree of Saturation (%):	saturated	saturated

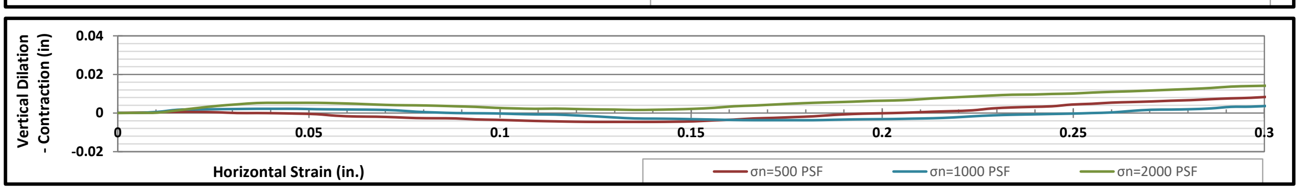


ESTIMATED STRENGTH PARAMETERS

	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	**38**	**32**
Cohesion (PSF):	**0**	**0**

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	310	760	1560
Residual Horizontal Stress, τ_h (PSF):	260	600	1250





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Client:	Anchor QEA	**Date:**	October 1, 2021
Address:	21328 2nd Drive SE	**Project:**	Q.C. - Lower Duwamish Waterway
	Bothell, WA 98021	**Project #:**	21B233
Attn:	Garrett Timm	**Sample #:**	B21-1563-1577
Revised on:		**Date sampled:**	7-12-21 & 7-13-21

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	Please See Attached Reports		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count			LA Abrasion	
X	Moisture Content	Please See Attached Report	X	Direct Shear	Please See Attached Reports
	Specific Gravity, Coarse		X	Specific Gravity, Soils	Please See Attached Reports
	Specific Gravity, Fine				
X	Hydrometer Analysis	Please See Attached Reports			
X	Atterberg Limits	Please See Attached Reports			

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Meghan Blodgett-Carrillo

Respectfully Submitted,
Meghan Blodgett-Carrillo
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM C566, ASTM D2216

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: September 3, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B21-1563	LDW21-GT13-GB-0-1.5 ft	229.0	1015.9	773.9	242.0	544.9	44.4%
B21-1564	LDW21-GT13-GB-0-11 ft	221.0	537.3	449.8	87.5	228.8	38.2%
B21-1565	LDW21-GT13-GB-11-12.5 ft	217.1	1140.1	930.2	209.9	713.1	29.4%
B21-1566	LDW21-GT13-GB-11-21 ft	233.4	922.3	739.9	182.4	506.5	36.0%
B21-1567	LDW21-GT13-GB-21-22.5 ft	222.0	1231.9	1002.3	229.6	780.3	29.4%
B21-1568	LDW21-GT13-GB-21-31 ft	222.1	758.0	621.0	137.0	398.9	34.3%
B21-1569	LDW21-GT13-GB-31-32.5 ft	208.7	1100.3	893.6	206.7	684.9	30.2%
B21-1570	LDW21-GT19-GB-0-1.5 ft	234.8	863.2	678.6	184.6	443.8	41.6%
B21-1571	LDW21-GT19-GB-0-6.9 ft	222.1	761.3	524.7	236.6	302.6	78.2%
B21-1572	LDW21-GT19-GB-6.9-8.5 ft	233.1	1713.9	1391.1	322.8	1158.0	27.9%
B21-1573	LDW21-GT19-GB-8.5-10 ft	220.2	954.0	779.7	174.3	559.5	31.2%
B21-1574	LDW21-GT19-GB-8.5-18.5 ft	224.3	805.4	688.5	116.9	464.2	25.2%
B21-1575	LDW21-GT19-GB-18.5-20 ft	229.6	1121.9	927.8	194.1	698.2	27.8%
B21-1576	LDW21-GT19-GB-18.5-28.5 ft	215.7	1329.2	1088.0	241.2	872.3	27.7%
B21-1577	LDW21-GT19-GB-28.5-30 ft	225.2	725.0	616.3	108.7	391.1	27.8%

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM D854

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: September 1, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B21-1564	LDW21-GT13-GB-0-11 ft	378.85	431.72	52.9	TSA-016	197.2	499.5	0.99747	728.02	695.42	23.3	2.6087558	0.99926	2.6068253
B21-1568	LDW21-GT13-GB-21-31 ft	394.06	438.75	44.7	TSA-012	180.4	499.5	0.99752	706.18	678.65	23.1	2.6041054	0.99931	2.6023085
B21-1571	LDW21-GT19-GB-0-6.9 ft	429.62	462.35	32.7	TSA-014	192.3	499.5	0.99752	710.77	690.55	23.1	2.6160217	0.99931	2.6142167
B21-1574	LDW21-GT19-GB-8.5-18.5 ft	415.36	464.91	49.6	TSA-013	184.0	499.7	0.99754	712.79	682.43	23.0	2.5819681	0.99933	2.5802382

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT13-GB-0-11 ft
Sample#: B21-1564

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 1-Sep-21
Tested By: C. Kriss

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

ACCREDITED
Certificate #: 1366.01

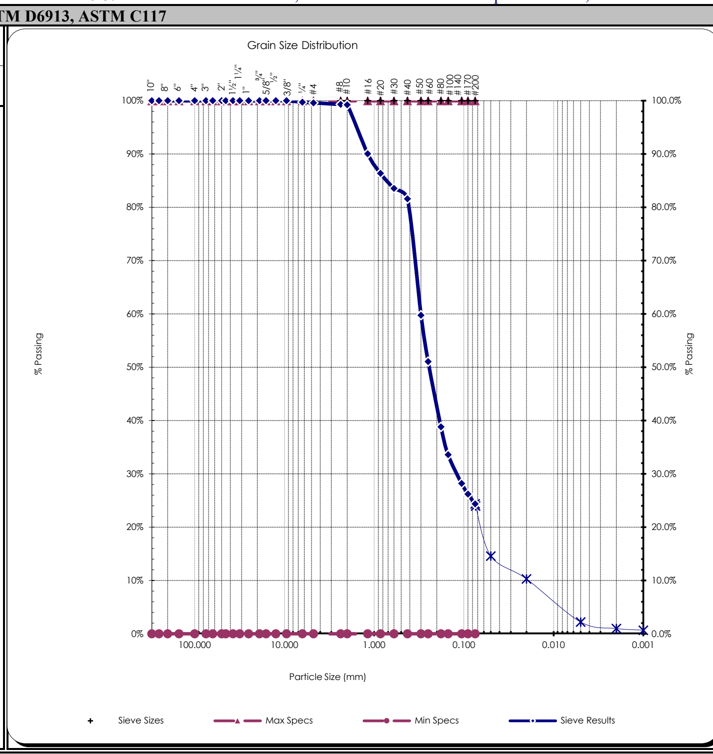
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.008 mm	% Gravel = 0.4%	Coeff. of Curvature, C_C = 2.52
$D_{(10)}$ = 0.019 mm	% Sand = 75.2%	Coeff. of Uniformity, C_U = 15.71
$D_{(15)}$ = 0.053 mm	% Silt & Clay = 24.4%	Fineness Modulus = 1.34
$D_{(30)}$ = 0.121 mm	Liquid Limit = 0.0%	Plastic Limit = 0.0%
$D_{(50)}$ = 0.244 mm	Plasticity Index = 0.0%	Moisture %, as sampled = 38.2%
$D_{(60)}$ = 0.301 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.175 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 26/87	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		90%	100.0%	0.0%
#20	0.850		86%	100.0%	0.0%
#30	0.600		84%	100.0%	0.0%
#40	0.425	82%	82%	100.0%	0.0%
#50	0.300		60%	100.0%	0.0%
#60	0.250		51%	100.0%	0.0%
#80	0.180		39%	100.0%	0.0%
#100	0.150	34%	34%	100.0%	0.0%
#140	0.106		28%	100.0%	0.0%
#170	0.090		26%	100.0%	0.0%
#200	0.075	24.4%	24.4%	100.0%	0.0%



All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	1-Sep-21
Source:	LDW21-GT13-GB-0-11 ft	**Tested By:**	C. Kriss
Sample#:	B21-1564		

Unified Soil Classification System, ASTM-2487
SM, Silty Sand

Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Sp Gr :	2.61	
Sample Weight:	100.15	grams
Hydroscopic Moist.:	0.83%	
Adj. Sample Wgt :	99.33	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	14.5	14.6%	0.0519 mm
2	13	13.1%	0.0369 mm
5	11.5	11.6%	0.0236 mm
15	8	8.1%	0.0139 mm
30	6.5	6.6%	0.0099 mm
60	4	4.0%	0.0071 mm
240	1	1.0%	0.0036 mm
1440	1	1.0%	0.0015 mm

% Gravel:	0.4%	**Liquid Limit:**	0.0 %
% Sand:	75.2%	**Plastic Limit:**	0.0 %
% Silt:	22.2%	**Plasticity Index:**	0.0 %
% Clay:	2.2%		

ASTM D6913

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	100%	4.750 mm
	#10	99%	2.000 mm
	#20	86%	0.850 mm
	#40	82%	0.425 mm
	#100	34%	0.150 mm
	#200	24.4%	0.075 mm
Silts		24.0%	0.074 mm
		14.6%	0.050 mm
		10.3%	0.020 mm
Clays		2.2%	0.005 mm
		1.0%	0.002 mm
Colloids		0.7%	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
Loamy Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

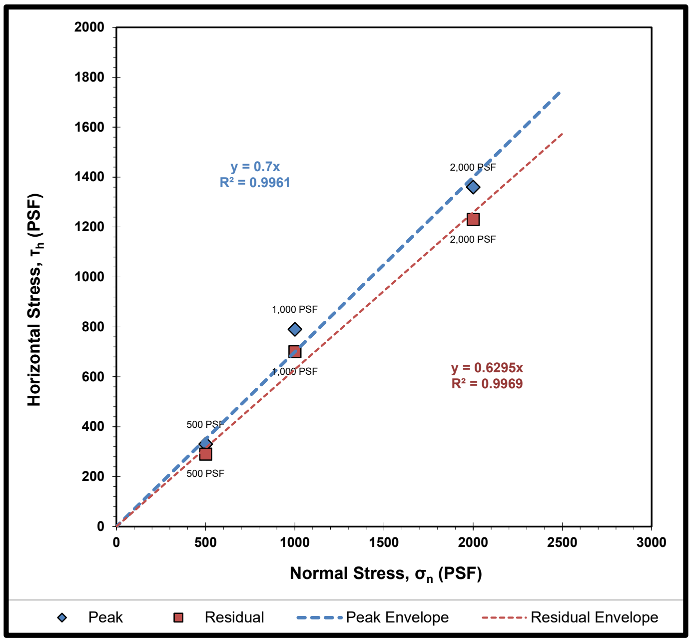
MTC MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway		
Project Number:	21B233	**Sample Source:**	LDW21-GT13-GB-0-11 ft
Laboratory Sample ID:	B21-1564	**Visual Soil Description:**	brown sand with silt
Sample Date:	7/12/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	9/20/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	32.6	
	Initial	**Post-Consolidation**
Dry Density (PCF):	104.7	106.1
Void Ratio:	0.608	0.589
Porosity (%):	37.8	37.0
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	30.5	
	Initial	**Post-Consolidation**
Dry Density (PCF):	105.5	108.0
Void Ratio:	0.597	0.560
Porosity (%):	37.4	35.9
Degree of Saturation (%):	saturated	saturated

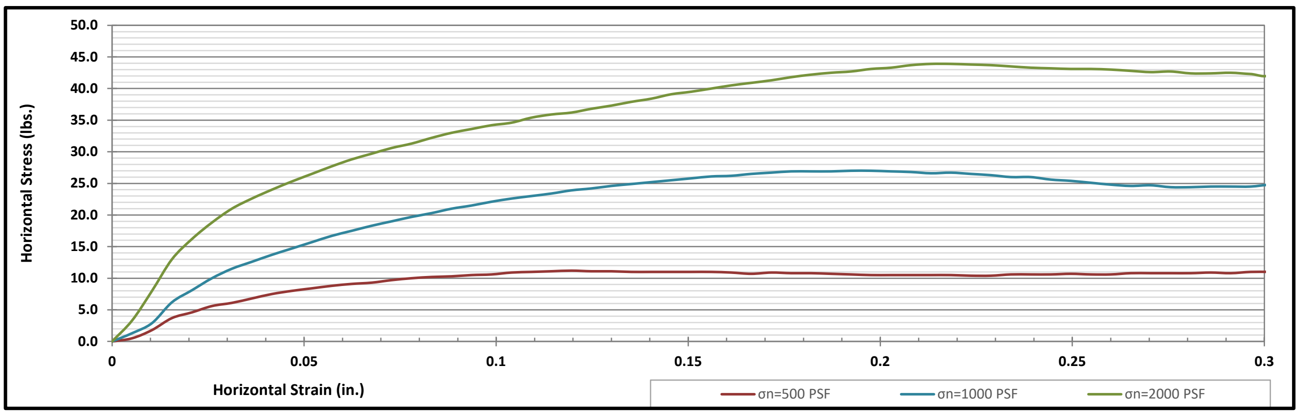
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	31.4	
	Initial	**Post-Consolidation**
Dry Density (PCF):	105.7	113.8
Void Ratio:	0.595	0.481
Porosity (%):	37.3	32.5
Degree of Saturation (%):	saturated	saturated

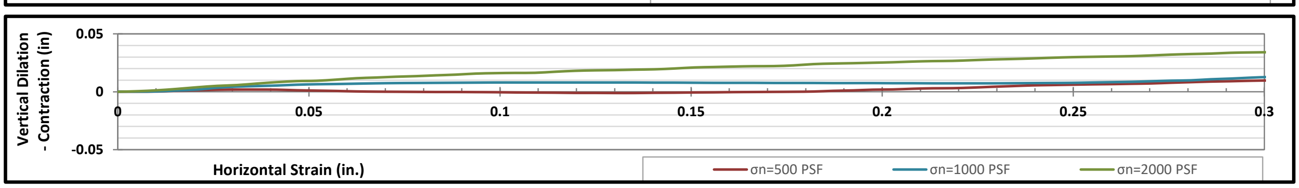


ESTIMATED STRENGTH PARAMETERS

	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	**35**	**32**
Cohesion (PSF):	**0**	**0**

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	330	790	1360
Residual Horizontal Stress, τ_h (PSF):	290	700	1230





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	1-Sep-21
Source:	LDW21-GT13-GB-11-21 ft	**Tested By:**	C. Kriss
Sample#:	B21-1566		

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

ACCREDITED
Certificate #: 1366.01

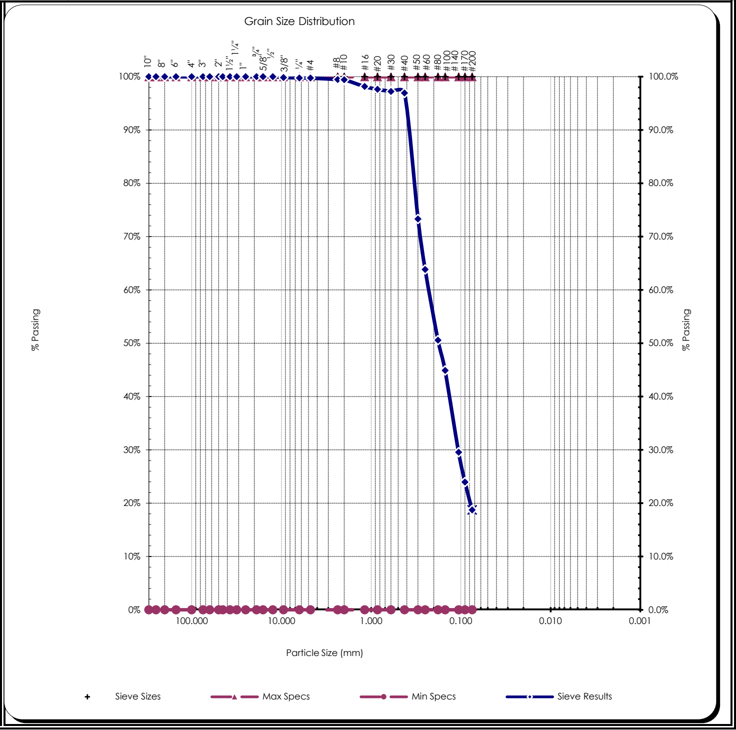
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.020	mm	% Gravel =	0.3%	Coeff. of Curvature, C_C =	1.25
$D_{(10)}$ = 0.040	mm	% Sand =	81.0%	Coeff. of Uniformity, C_U =	5.74
$D_{(15)}$ = 0.060	mm	% Silt & Clay =	18.7%	Fineness Modulus =	0.87
$D_{(30)}$ = 0.107	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ = 0.177	mm	Plasticity Index =	n/a	Moisture %, as sampled =	36.0%
$D_{(60)}$ = 0.230	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ = 0.388	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio = 17/88		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		98%	100.0%	0.0%
#20	0.850		98%	100.0%	0.0%
#30	0.600		97%	100.0%	0.0%
#40	0.425	97%	97%	100.0%	0.0%
#50	0.300		73%	100.0%	0.0%
#60	0.250		64%	100.0%	0.0%
#80	0.180		51%	100.0%	0.0%
#100	0.150	45%	45%	100.0%	0.0%
#140	0.106		30%	100.0%	0.0%
#170	0.090		24%	100.0%	0.0%
#200	0.075	18.7%	18.7%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT13-GB-21-31 ft
Sample#: B21-1568

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 1-Sep-21
Tested By: C. Kriss

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

ACCREDITED
Certificate #: 1366.01

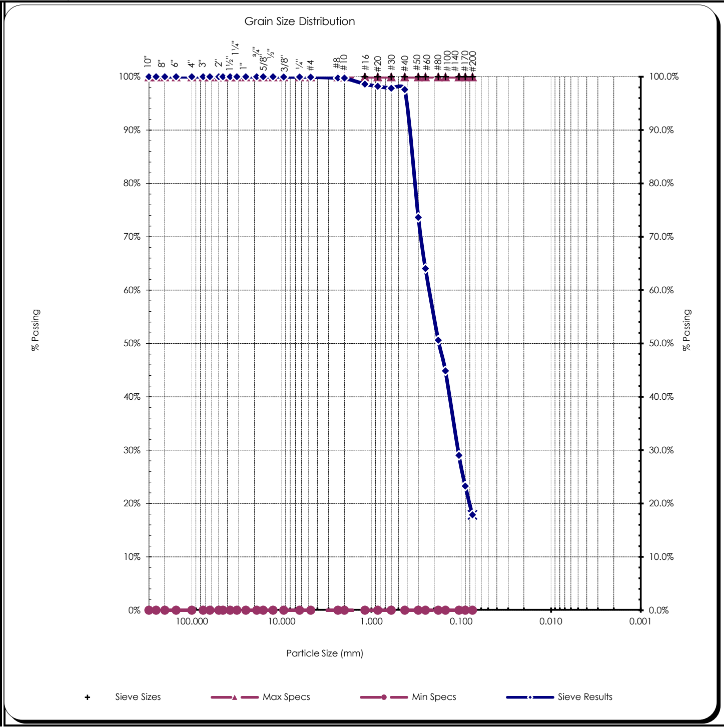
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.021	mm	% Gravel =	0.1%	Coeff. of Curvature, C_C =	1.23
$D_{(10)}$ = 0.042	mm	% Sand =	82.1%	Coeff. of Uniformity, C_U =	5.46
$D_{(15)}$ = 0.063	mm	% Silt & Clay =	17.9%	Fineness Modulus =	0.85
$D_{(30)}$ = 0.109	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ = 0.177	mm	Plasticity Index =	n/a	Moisture %, as sampled =	34.3%
$D_{(60)}$ = 0.229	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ = 0.385	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio = 13/71		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		98%	100.0%	0.0%
#30	0.600		98%	100.0%	0.0%
#40	0.425	98%	98%	100.0%	0.0%
#50	0.300		74%	100.0%	0.0%
#60	0.250		64%	100.0%	0.0%
#80	0.180		51%	100.0%	0.0%
#100	0.150	45%	45%	100.0%	0.0%
#140	0.106		29%	100.0%	0.0%
#170	0.090		23%	100.0%	0.0%
#200	0.075	17.9%	17.9%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	1-Sep-21
Source:	LDW21-GT19-GB-0-6.9 ft	**Tested By:**	C. Kriss
Sample#:	B21-1571		

Unified Soil Classification System, ASTM-2487
ML, Silt with Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

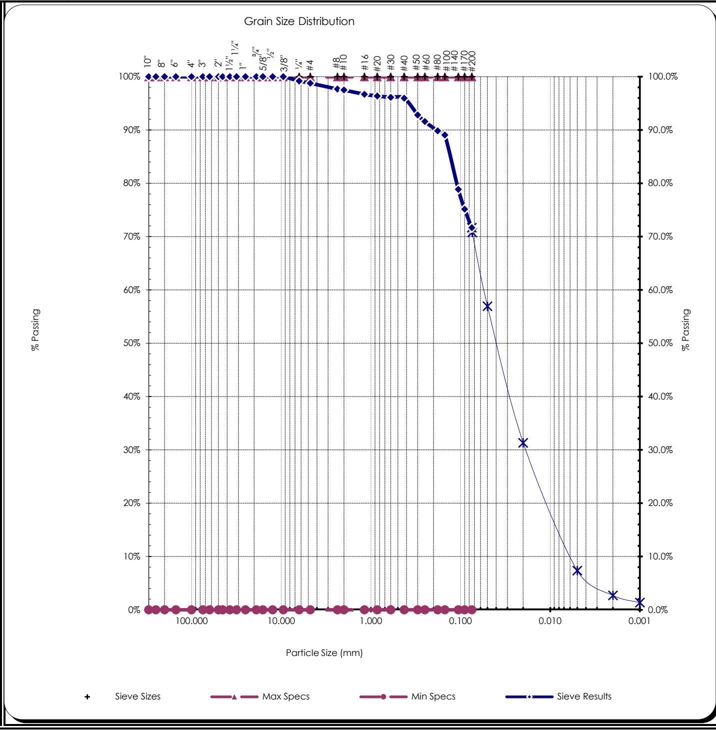
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.004	mm	% Gravel = 1.2%	Coeff. of Curvature, C_C = 0.88
$D_{(10)}$ =	0.007	mm	% Sand = 27.1%	Coeff. of Uniformity, C_U = 9.46
$D_{(15)}$ =	0.009	mm	% Silt & Clay = 71.7%	Fineness Modulus = 0.29
$D_{(30)}$ =	0.019	mm	Liquid Limit = 0.0%	Plastic Limit = 0.0%
$D_{(50)}$ =	0.051	mm	Plasticity Index = 0.0%	Moisture %, as sampled = 78.2%
$D_{(60)}$ =	0.062	mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ =	0.186	mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio =	59/79		Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		99%	100.0%	0.0%
#4	4.75	99%	99%	100.0%	0.0%
#8	2.36		98%	100.0%	0.0%
#10	2.00	98%	98%	100.0%	0.0%
#16	1.18		97%	100.0%	0.0%
#20	0.850		96%	100.0%	0.0%
#30	0.600		96%	100.0%	0.0%
#40	0.425	96%	96%	100.0%	0.0%
#50	0.300		93%	100.0%	0.0%
#60	0.250		92%	100.0%	0.0%
#80	0.180		90%	100.0%	0.0%
#100	0.150	89%	89%	100.0%	0.0%
#140	0.106		79%	100.0%	0.0%
#170	0.090		75%	100.0%	0.0%
#200	0.075	71.7%	71.7%	100.0%	0.0%



Comments:

Reviewed by:
Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	1-Sep-21
Source:	LDW21-GT19-GB-0-6.9 ft	**Tested By:**	C. Kriss
Sample#:	B21-1571		

Unified Soil Classification System, ASTM-2487
ML, Silt with Sand

Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Sp Gr :	2.61	
Sample Weight:	50.97	grams
Hydroscopic Moist.:	2.35%	
Adj. Sample Wgt :	49.80	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	24.5	48.4%	0.0488 mm
2	19.5	38.6%	0.0356 mm
5	17.5	34.6%	0.0228 mm
15	12	23.7%	0.0135 mm
30	9	17.8%	0.0097 mm
60	5.5	10.9%	0.0070 mm
240	2.5	4.9%	0.0036 mm
1440	1	2.0%	0.0015 mm

% Gravel:	1.2%	**Liquid Limit:**	0.0 %
% Sand:	27.1%	**Plastic Limit:**	0.0 %
% Silt:	64.3%	**Plasticity Index:**	0.0 %
% Clay:	7.4%		

ASTM D6913

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"	99%	6.300 mm
#4	99%	4.750 mm
#10	98%	2.000 mm
#20	96%	0.850 mm
#40	96%	0.425 mm
#100	89%	0.150 mm
#200	71.7%	0.075 mm
Silts	70.8%	0.074 mm
	56.9%	0.050 mm
	31.3%	0.020 mm
Clays	7.4%	0.005 mm
	2.7%	0.002 mm
Colloids	1.3%	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
Silt Loam

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT19-GB-0-6.9 ft
Sample #: B21-1571

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 1-Sep-21
Tested By: C. Kriss

Unified Soils Classification System, ASTM D-2487
ML, Silt with Sand
Sample Color
brown

Liquid Limit Determination

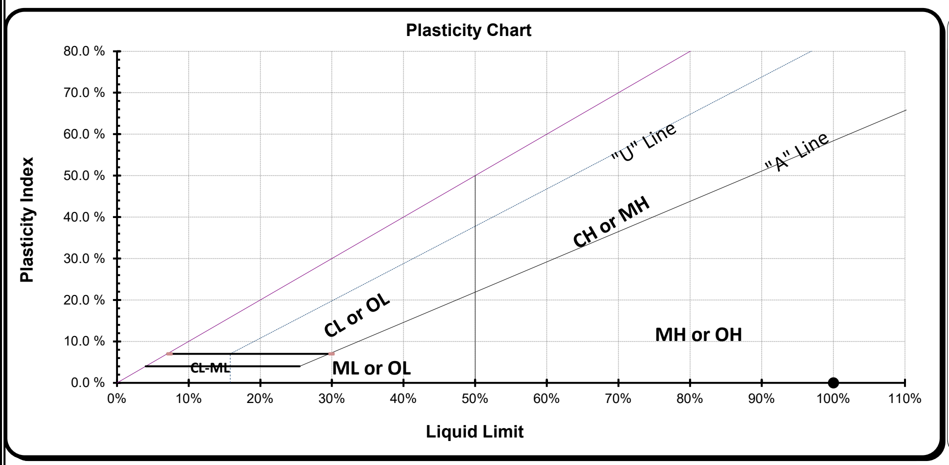
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

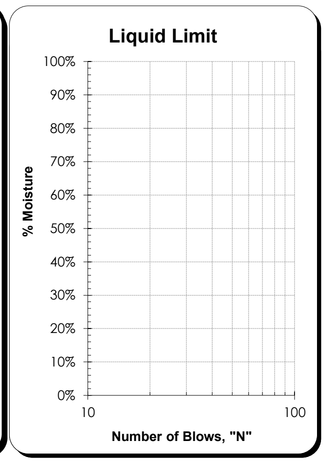
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the liquid limit cup without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	1-Sep-21
Source:	LDW21-GT19-GB-6.9-8.5 ft	**Tested By:**	C. Kriss
Sample#:	B21-1572		

Unified Soil Classification System, ASTM-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

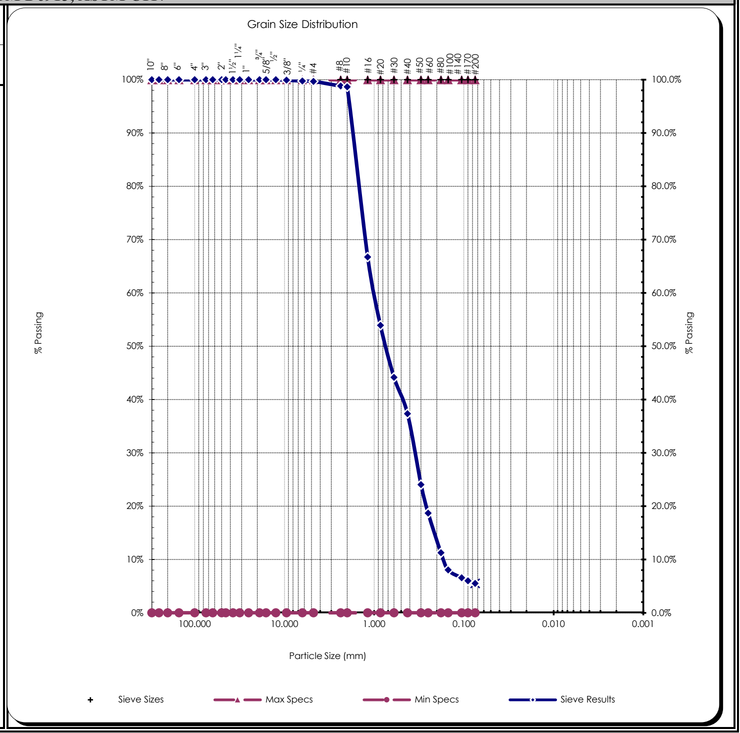
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.068 mm	% Gravel = 0.3%	Coeff. of Curvature, C_C = 0.75
$D_{(10)}$ = 0.168 mm	% Sand = 94.2%	Coeff. of Uniformity, C_U = 5.98
$D_{(15)}$ = 0.215 mm	% Silt & Clay = 5.5%	Fineness Modulus = 2.59
$D_{(30)}$ = 0.356 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.749 mm	Plasticity Index = n/a	Moisture %, as sampled = 27.9%
$D_{(60)}$ = 1.006 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.777 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 9/61	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		67%	100.0%	0.0%
#20	0.850		54%	100.0%	0.0%
#30	0.600		44%	100.0%	0.0%
#40	0.425	37%	37%	100.0%	0.0%
#50	0.300		24%	100.0%	0.0%
#60	0.250		19%	100.0%	0.0%
#80	0.180		11%	100.0%	0.0%
#100	0.150	8%	8%	100.0%	0.0%
#140	0.106		7%	100.0%	0.0%
#170	0.090		6%	100.0%	0.0%
#200	0.075	5.5%	5.5%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	1-Sep-21
Source:	LDW21-GT19-GB-8.5-18.5 ft	**Tested By:**	C. Kriss
Sample#:	B21-1574		

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

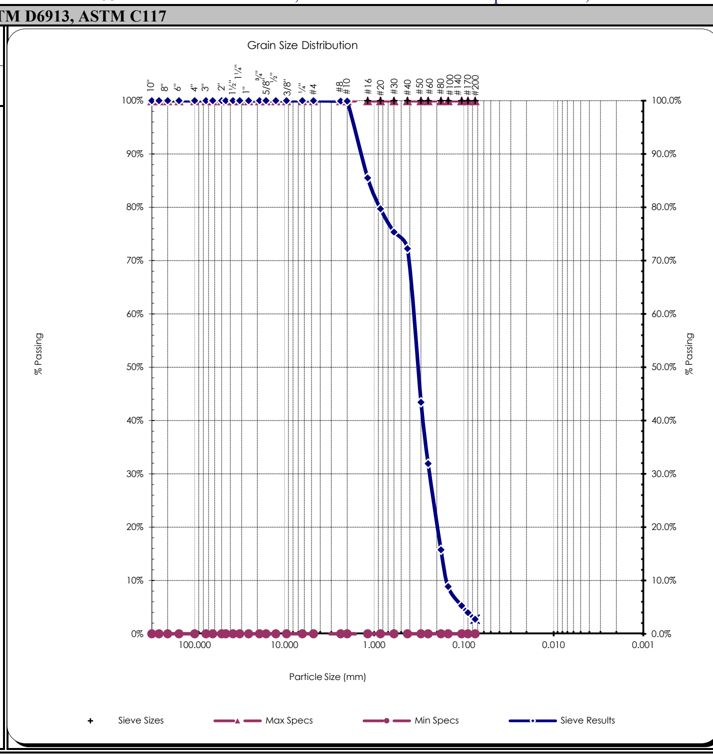
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.103 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.01
$D_{(10)}$ = 0.155 mm	% Sand = 97.3%	Coeff. of Uniformity, C_U = 2.40
$D_{(15)}$ = 0.177 mm	% Silt & Clay = 2.7%	Fineness Modulus = 1.87
$D_{(30)}$ = 0.242 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.328 mm	Plasticity Index = n/a	Moisture %, as sampled = 25.2%
$D_{(60)}$ = 0.372 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.435 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 2/53	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		86%	100.0%	0.0%
#20	0.850		80%	100.0%	0.0%
#30	0.600		75%	100.0%	0.0%
#40	0.425	72%	72%	100.0%	0.0%
#50	0.300		43%	100.0%	0.0%
#60	0.250		32%	100.0%	0.0%
#80	0.180		16%	100.0%	0.0%
#100	0.150	9%	9%	100.0%	0.0%
#140	0.106		5%	100.0%	0.0%
#170	0.090		4%	100.0%	0.0%
#200	0.075	2.7%	2.7%	100.0%	0.0%



Comments:

Reviewed by:
Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

MATERIALS TESTING & CONSULTING, INC.

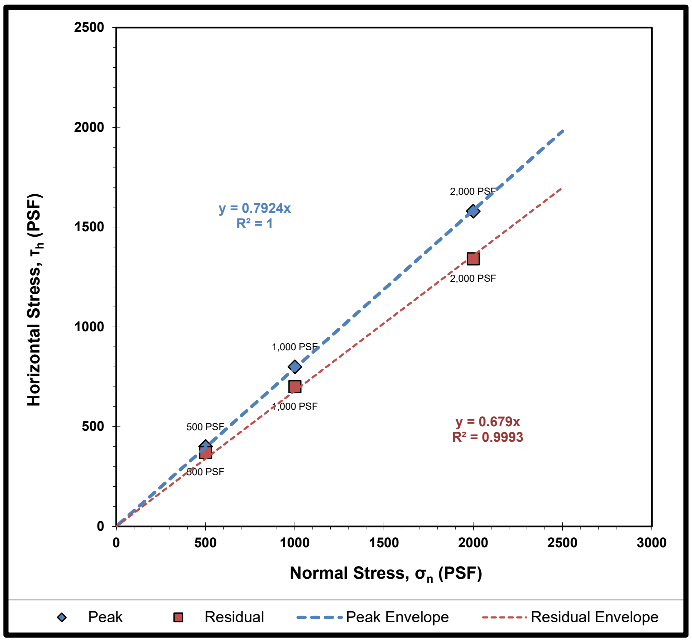
Project: Q.C. - Lower Duwamish Waterway

Project Number:	21B233	**Sample Source:**	LDW21-GT19-GB-8.5-18.5 ft
Laboratory Sample ID:	B21-1574	**Visual Soil Description:**	brown sand with silt
Sample Date:	7/13/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	9/21/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	27.5	
	Initial	**Post-Consolidation**
Dry Density (PCF):	106.2	107.3
Void Ratio:	0.586	0.570
Porosity (%):	37.0	36.3
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	26.1	
	Initial	**Post-Consolidation**
Dry Density (PCF):	108.0	109.7
Void Ratio:	0.560	0.536
Porosity (%):	35.9	34.9
Degree of Saturation (%):	saturated	saturated

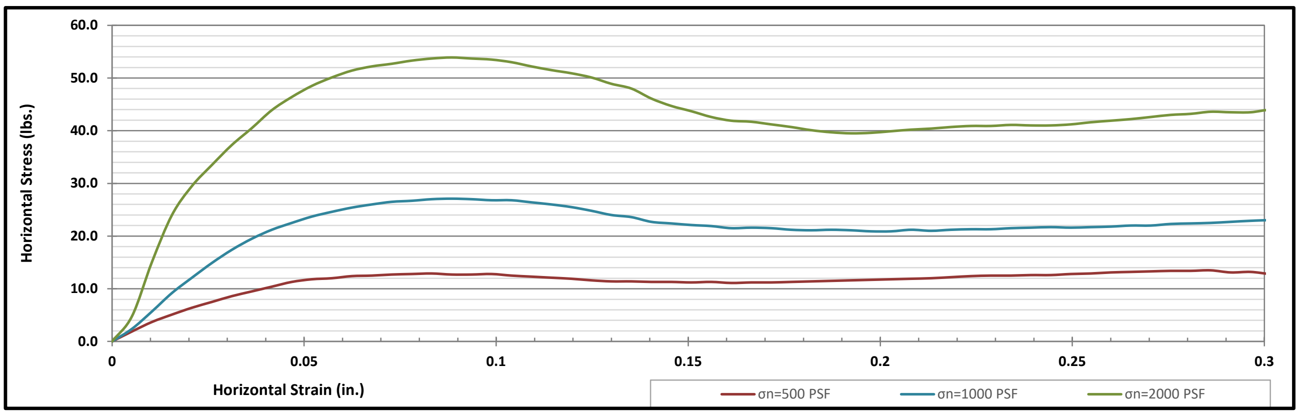
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	24.7	
	Initial	**Post-Consolidation**
Dry Density (PCF):	109.2	111.5
Void Ratio:	0.543	0.511
Porosity (%):	35.2	33.8
Degree of Saturation (%):	saturated	saturated

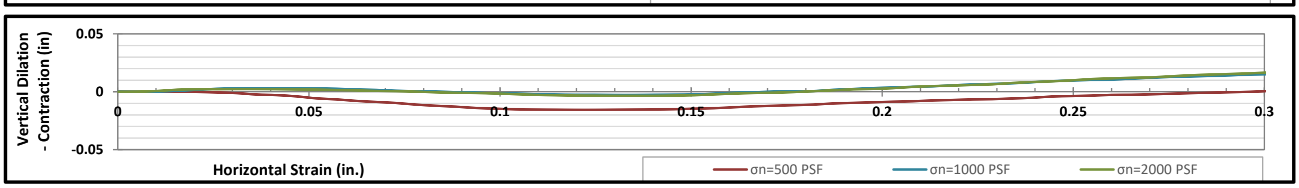


ESTIMATED STRENGTH PARAMETERS

	PEAK	**RESIDUAL**
Angle of Internal Friction, φ (°):	38	34
Cohesion (PSF):	0	0

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	400	800	1580
Residual Horizontal Stress, τ_h (PSF):	370	700	1340





MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	1-Sep-21
Source:	LDW21-GT19-GB-18.5-28.5 ft	**Tested By:**	C. Kriss
Sample#:	B21-1576		

Unified Soil Classification System, ASTM-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

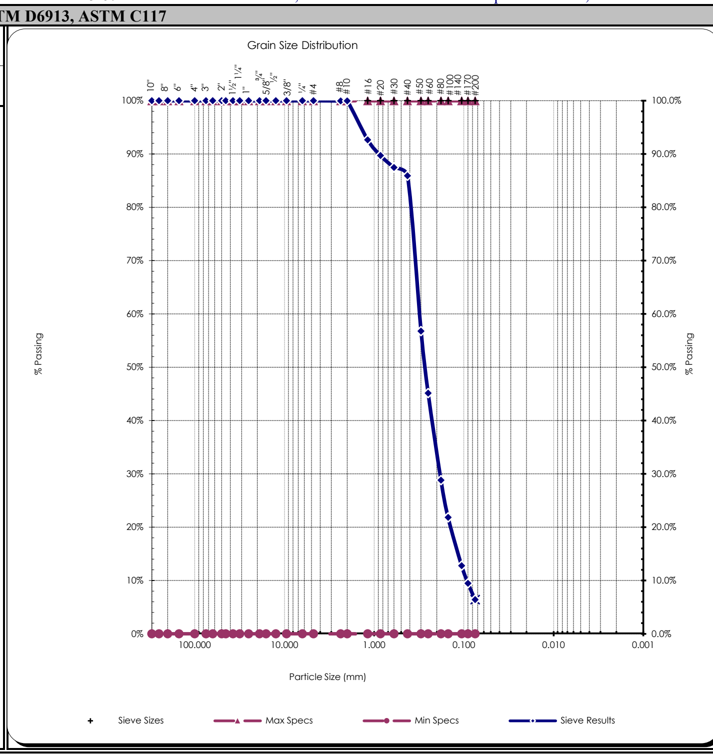
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.058 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.18
$D_{(10)}$ = 0.092 mm	% Sand = 93.6%	Coeff. of Uniformity, C_U = 3.40
$D_{(15)}$ = 0.117 mm	% Silt & Clay = 6.4%	Fineness Modulus = 1.41
$D_{(30)}$ = 0.185 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.271 mm	Plasticity Index = n/a	Moisture %, as sampled = 27.7%
$D_{(60)}$ = 0.314 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.882 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 5/67	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		93%	100.0%	0.0%
#20	0.850		90%	100.0%	0.0%
#30	0.600		87%	100.0%	0.0%
#40	0.425	86%	86%	100.0%	0.0%
#50	0.300		57%	100.0%	0.0%
#60	0.250		45%	100.0%	0.0%
#80	0.180		29%	100.0%	0.0%
#100	0.150	22%	22%	100.0%	0.0%
#140	0.106		13%	100.0%	0.0%
#170	0.090		10%	100.0%	0.0%
#200	0.075	6.4%	6.4%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Client:	Anchor QEA	**Date:**	October 5, 2021
Address:	21328 2nd Drive SE	**Project:**	Q.C. - Lower Duwamish Waterway
	Bothell, WA 98021	**Project #:**	21B233
Attn:	Garrett Timm	**Sample #:**	B21-1693-1706
Revised on:		**Date sampled:**	July 14, 2021

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	Please See Attached Reports		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count			LA Abrasion	
X	Moisture Content	Please See Attached Report	X	Direct Shear	Please See Attached Reports
	Specific Gravity, Coarse		X	Specific Gravity, Soils	Please See Attached Reports
	Specific Gravity, Fine				
X	Hydrometer Analysis	Please See Attached Reports			
X	Atterberg Limits	Please See Attached Reports			

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Respectfully Submitted,
Meghan Blodgett-Carrillo
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM C566, ASTM D2216

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: September 13, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B21-1693	LDW21-GT37-GB-0-1.5 ft	233.7	583.3	440.8	142.5	207.1	68.8%
B21-1694	LDW21-GT37-GB-10-11.5 ft	302.0	688.9	534.6	154.3	232.6	66.3%
B21-1695	LDW21-GT37-GB-10-20 ft	234.3	678.9	534.1	144.8	299.8	48.3%
B21-1696	LDW21-GT37-GB-20-21.5 ft	341.8	864.9	644.8	220.1	303.0	72.6%
B21-1697	LDW21-GT37-GB-20-30 ft	316.0	945.0	766.3	178.7	450.3	39.7%
B21-1698	LDW21-GT37-GB-30-31.5 ft	346.9	1041.2	892.0	149.2	545.1	27.4%
B21-1699	LDW21-GT18-GB-0-1.5 ft	360.3	577.1	507.3	69.8	147.0	47.5%
B21-1700	LDW21-GT18-GB-0-6.5 ft	233.5	726.8	590.5	136.3	357.0	38.2%
B21-1701	LDW21-GT18-GB-6.5-8 ft	357.0	752.8	656.6	96.2	299.6	32.1%
B21-1702	LDW21-GT18-GB-6.5-16.5 ft	217.3	795.2	684.7	110.5	467.4	23.6%
B21-1703	LDW21-GT18-GB-16.5-18 ft	354.3	1016.0	893.3	122.7	539.0	22.8%
B21-1704	LDW21-GT18-GB-16.5-21.4 ft	10.2	159.2	118.5	40.7	108.3	37.6%
B21-1705	LDW21-GT18-GB-21.4-26.5 ft	690.5	1366.5	1179.1	187.4	488.6	38.4%
B21-1706	LDW21-GT18-GB-26.5-28 ft	359.5	929.9	801.2	128.7	441.7	29.1%

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM D854

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: September 13, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B21-1695	LDW21-GT37-GB-10-20 ft	493.21	568.13	74.9	TSA-013	184.0	499.7	0.99756	728.81	682.44	22.9	2.6240964	0.99936	2.6224169
B21-1697	LDW21-GT37-GB-20-30 ft	497.94	575.45	77.5	TSA-011	190.3	499.5	0.99752	736.61	688.63	23.1	2.624687	0.99931	2.6228759
B21-1700	LDW21-GT18-GB-0-6.5 ft	600.24	700.15	99.9	TSA-020	195.0	499.5	0.99752	753.52	693.28	23.1	2.5184539	0.99931	2.5167161
B21-1702	LDW21-GT18-GB-6.5-16.5 ft	510.32	612.20	101.9	TSA-010	180.3	499.5	0.99754	742.28	678.62	23.0	2.6655395	0.99933	2.6637535
B21-1705	LDW21-GT18-GB-21.4-26.5 ft	501.27	576.59	75.3	TSA-021	183.4	499.4	0.99745	727.11	681.56	23.4	2.5303609	0.99924	2.5284379

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MTC MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT37-GB-10-20 ft
Sample#: B21-1695

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 13-Sep-21
Tested By: C. Kriss

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

ACCREDITED
Certificate #: 1366.01

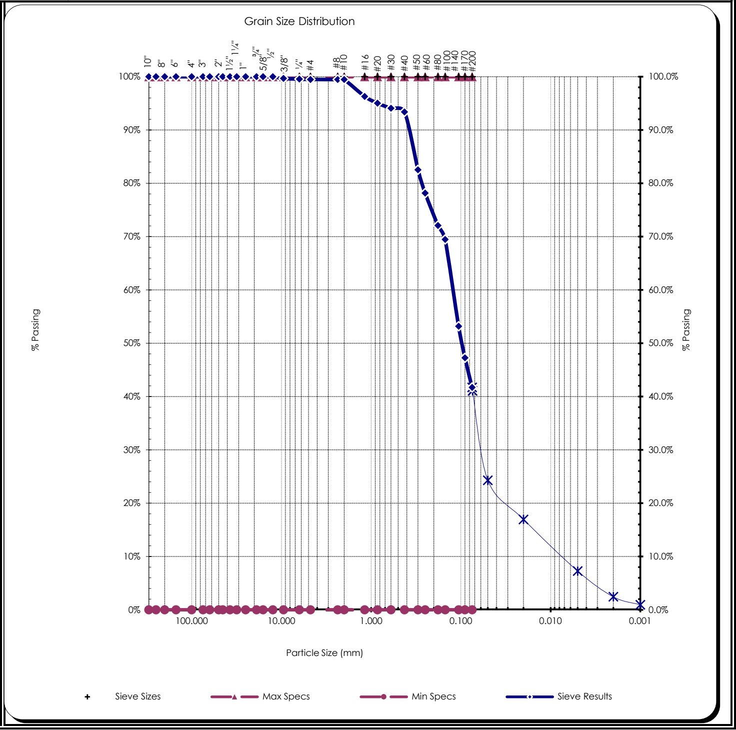
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.003 mm	% Gravel = 0.5%	Coeff. of Curvature, C_C = 3.61
$D_{(10)}$ = 0.007 mm	% Sand = 57.8%	Coeff. of Uniformity, C_U = 17.03
$D_{(15)}$ = 0.016 mm	% Silt & Clay = 41.7%	Fineness Modulus = 0.59
$D_{(30)}$ = 0.057 mm	Liquid Limit = 0.0%	Plastic Limit = 0.0%
$D_{(50)}$ = 0.097 mm	Plasticity Index = 0.0%	Moisture %, as sampled = 48.3%
$D_{(60)}$ = 0.124 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.386 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 21/47	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	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		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		96%	100.0%	0.0%
#20	0.850		95%	100.0%	0.0%
#30	0.600		94%	100.0%	0.0%
#40	0.425	93%	93%	100.0%	0.0%
#50	0.300		83%	100.0%	0.0%
#60	0.250		78%	100.0%	0.0%
#80	0.180		72%	100.0%	0.0%
#100	0.150	69%	69%	100.0%	0.0%
#140	0.106		53%	100.0%	0.0%
#170	0.090		47%	100.0%	0.0%
#200	0.075	41.7%	41.7%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	13-Sep-21
Source:	LDW21-GT37-GB-10-20 ft	**Tested By:**	C. Kriss
Sample#:	B21-1695		

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

ASTM D7928, HYDROMETER ANALYSIS

Sp Gr :	2.62	
Sample Weight:	74.76	grams
Hydroscopic Moist.:	2.84%	
Adj. Sample Wgt :	72.70	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	18.5	25.6%	0.0505 mm
2	15.5	21.4%	0.0364 mm
5	13.5	18.7%	0.0234 mm
15	10	13.8%	0.0137 mm
30	9	12.4%	0.0097 mm
60	7	9.7%	0.0070 mm
240	4	5.5%	0.0035 mm
1440	1	1.4%	0.0015 mm

% Gravel:	0.5%	**Liquid Limit:**	0.0 %
% Sand:	57.8%	**Plastic Limit:**	0.0 %
% Silt:	34.4%	**Plasticity Index:**	0.0 %
% Clay:	7.3%		

ASTM D6913

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	99%	2.000 mm
#20	95%	0.850 mm
#40	93%	0.425 mm
#100	69%	0.150 mm
#200	41.7%	0.075 mm
Silts	41.1%	0.074 mm
	24.3%	0.050 mm
	17.0%	0.020 mm
Clays	7.3%	0.005 mm
	2.5%	0.002 mm
Colloids	0.9%	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
Loamy Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

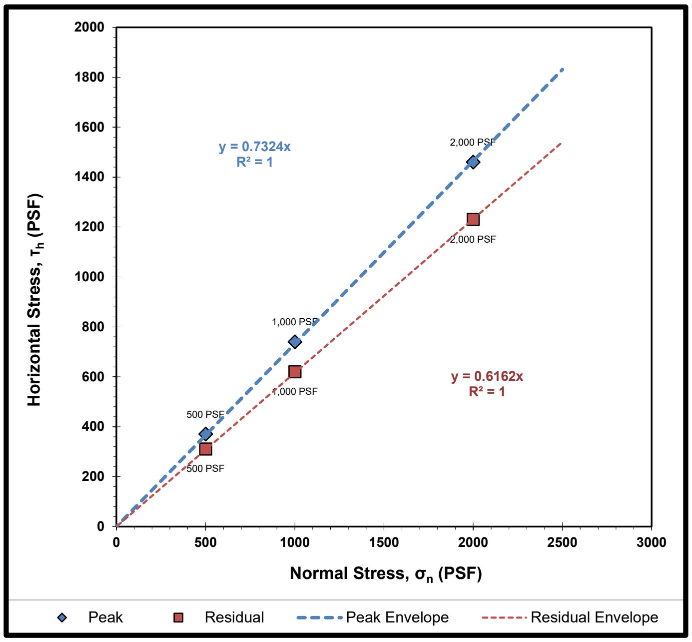
MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway		
Project Number:	21B233	**Sample Source:**	LDW21-GT37-GB-10-20 ft
Laboratory Sample ID:	B21-1695	**Visual Soil Description:**	brown silty sand
Sample Date:	7/14/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	9/16/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		**σ_n=500 PSF**
Initial Moisture Content (%):	35.3	
	Initial	**Post-Consolidation**
Dry Density (PCF):	100.7	102.8
Void Ratio:	0.673	0.639
Porosity (%):	40.2	39.0
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		**σ_n=1000 PSF**
Initial Moisture Content (%):	36.0	
	Initial	**Post-Consolidation**
Dry Density (PCF):	100.9	110.5
Void Ratio:	0.670	0.525
Porosity (%):	40.1	34.4
Degree of Saturation (%):	saturated	saturated

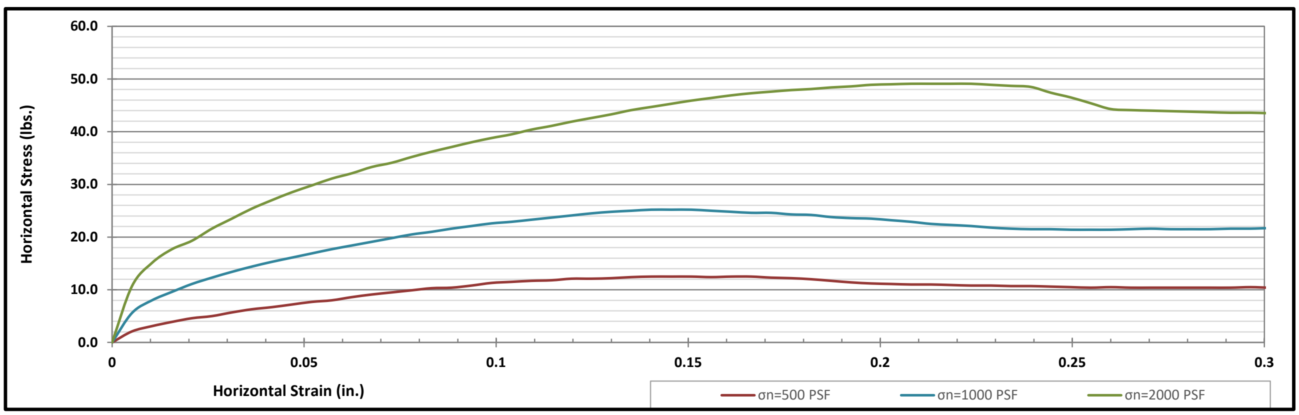
Summary of Sample Data:		**σ_n=2000 PSF**
Initial Moisture Content (%):	35.4	
	Initial	**Post-Consolidation**
Dry Density (PCF):	101.4	114.5
Void Ratio:	0.662	0.471
Porosity (%):	39.8	32.0
Degree of Saturation (%):	saturated	saturated

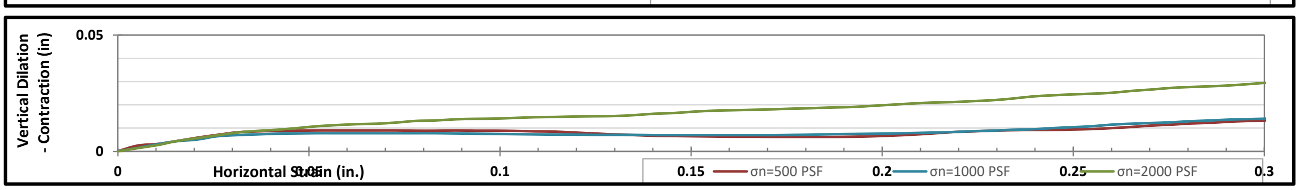


ESTIMATED STRENGTH PARAMETERS

	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	**36**	**32**
Cohesion (PSF):	**0**	**0**

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	370	740	1460
Residual Horizontal Stress, τ_h (PSF):	310	620	1230





MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	13-Sep-21
Source:	LDW21-GT37-GB-20-30 ft	**Tested By:**	C. Kriss
Sample#:	B21-1697		

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

ACCREDITED
Certificate #: 1366.01

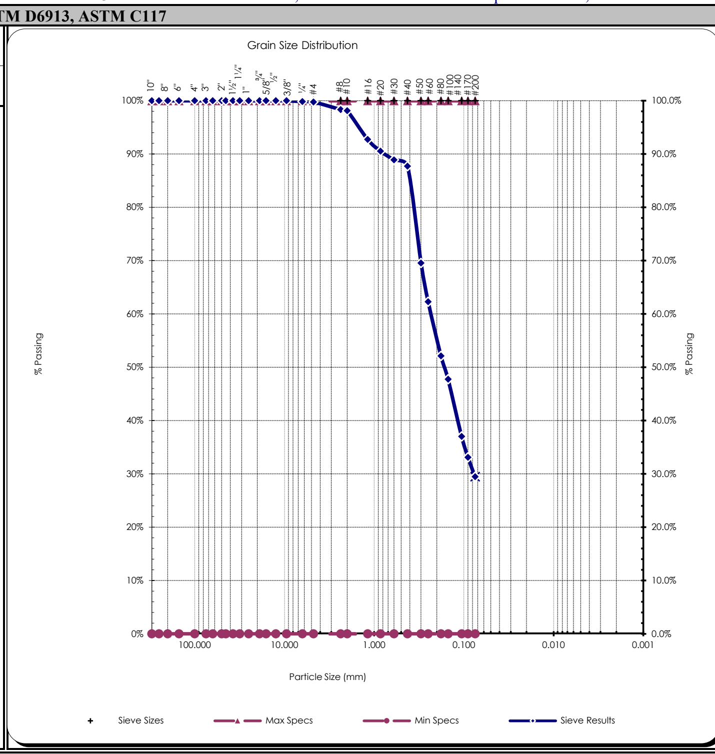
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.013 mm	% Gravel =	0.2%	Coeff. of Curvature, C_C =	1.00
$D_{(10)}$ =	0.025 mm	% Sand =	70.3%	Coeff. of Uniformity, C_U =	9.20
$D_{(15)}$ =	0.038 mm	% Silt & Clay =	29.5%	Fineness Modulus =	1.03
$D_{(30)}$ =	0.077 mm	Liquid Limit =	0.0%	Plastic Limit =	0.0%
$D_{(50)}$ =	0.165 mm	Plasticity Index =	0.0%	Moisture %, as sampled =	39.7%
$D_{(60)}$ =	0.234 mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	0.767 mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	1/3	Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		98%	100.0%	0.0%
#10	2.00	98%	98%	100.0%	0.0%
#16	1.18		93%	100.0%	0.0%
#20	0.850		91%	100.0%	0.0%
#30	0.600		89%	100.0%	0.0%
#40	0.425	88%	88%	100.0%	0.0%
#50	0.300		70%	100.0%	0.0%
#60	0.250		62%	100.0%	0.0%
#80	0.180		52%	100.0%	0.0%
#100	0.150	48%	48%	100.0%	0.0%
#140	0.106		37%	100.0%	0.0%
#170	0.090		33%	100.0%	0.0%
#200	0.075	29.5%	29.5%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway **Project #:** 21B233 **Client:** Anchor QEA **Source:** LDW21-GT37-GB-20-30 ft **Sample #:** B21-1697	**Date Received:** 29-Jul-21 **Sampled By:** Client **Date Tested:** 13-Sep-21 **Tested By:** C. Kriss	**Unified Soils Classification System, ASTM D-2487** SM, Silty Sand **Sample Color** brown

Liquid Limit Determination

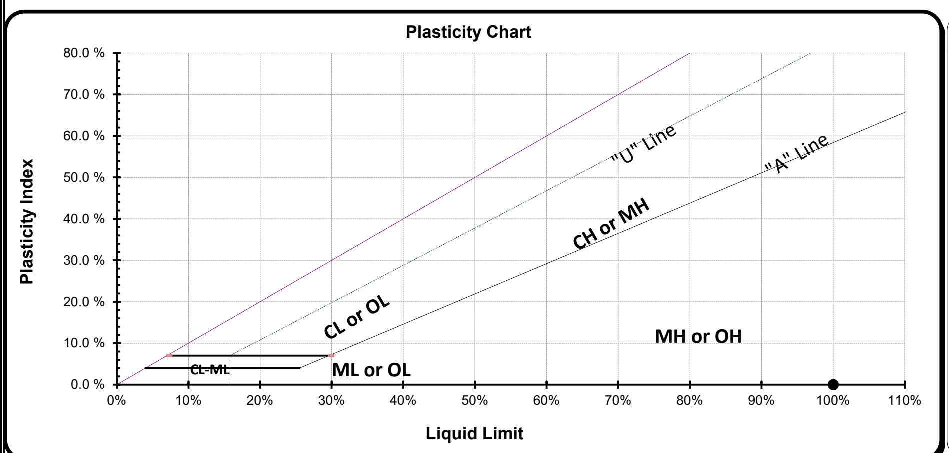
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

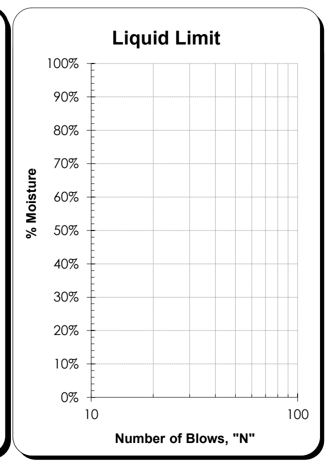
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the liquid limit cup without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	13-Sep-21
Source:	LDW21-GT18-GB-0-6.5 ft	**Tested By:**	C. Kriss
Sample #:	B21-1700		

Visual Identification
Sand with Silt
Sample Color
brown

Liquid Limit Determination

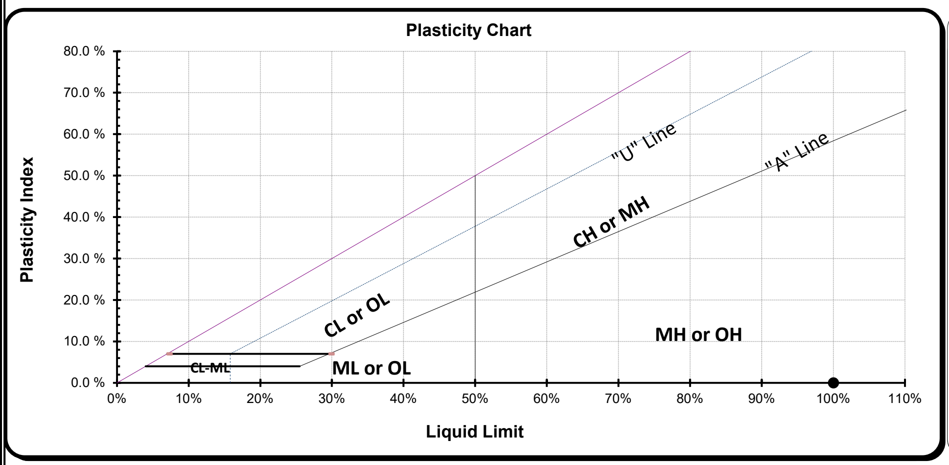
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

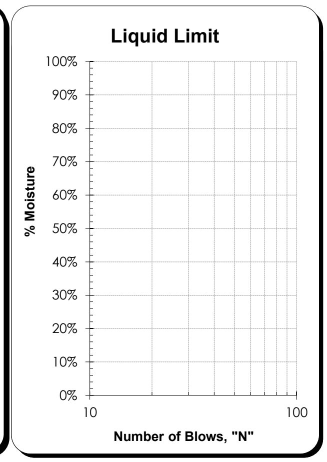
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the liquid limit cup without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT18-GB-6.5-16.5 ft
Sample#: B21-1702

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 13-Sep-21
Tested By: C. Kriss

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

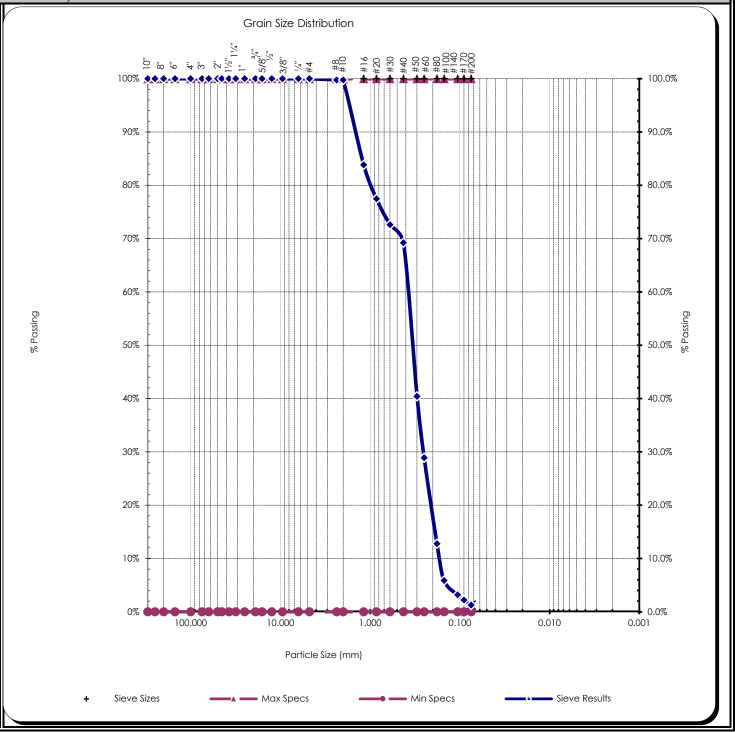
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.136 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.00
$D_{(10)}$ = 0.168 mm	% Sand = 98.7%	Coeff. of Uniformity, C_U = 2.29
$D_{(15)}$ = 0.190 mm	% Silt & Clay = 1.3%	Fineness Modulus = 1.97
$D_{(30)}$ = 0.255 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.342 mm	Plasticity Index = n/a	Moisture %, as sampled = 23.6%
$D_{(60)}$ = 0.385 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.497 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 1/54	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		84%	100.0%	0.0%
#20	0.850		77%	100.0%	0.0%
#30	0.600		73%	100.0%	0.0%
#40	0.425	69%	69%	100.0%	0.0%
#50	0.300		40%	100.0%	0.0%
#60	0.250		29%	100.0%	0.0%
#80	0.180		13%	100.0%	0.0%
#100	0.150	6%	6%	100.0%	0.0%
#140	0.106		3%	100.0%	0.0%
#170	0.090		2%	100.0%	0.0%
#200	0.075	1.3%	1.3%	100.0%	0.0%



Comments:

Reviewed by:
Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	13-Sep-21
Source:	LDW21-GT18-GB-16.5-21.4 ft	**Tested By:**	C. Kriss
Sample#:	B21-1704		

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

ACCREDITED
Certificate #: 1366.01

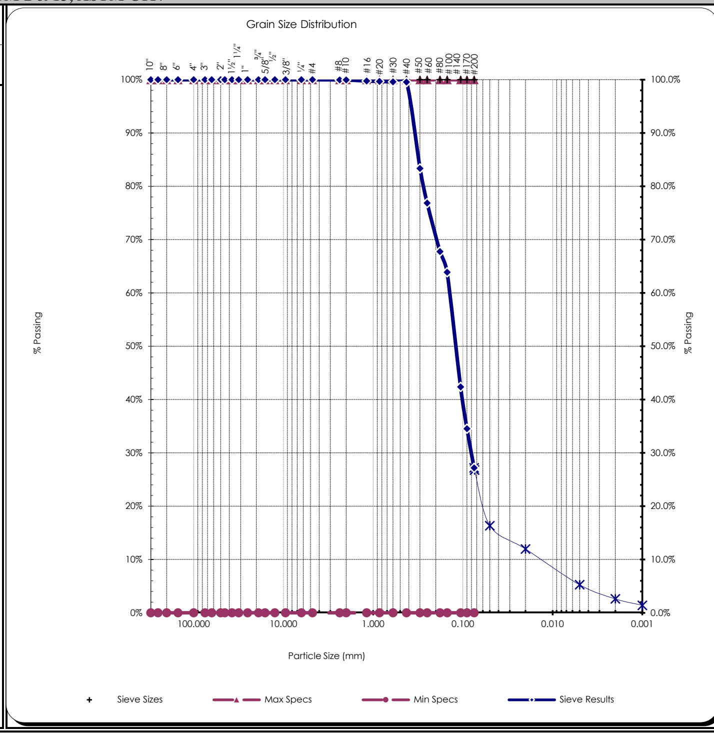
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.005	mm	% Gravel = 0.0%		Coeff. of Curvature, C_C = 3.31	
$D_{(10)}$ = 0.014	mm	% Sand = 72.8%		Coeff. of Uniformity, C_U = 10.24	
$D_{(15)}$ = 0.038	mm	% Silt & Clay = 27.2%		Fineness Modulus = 0.53	
$D_{(30)}$ = 0.081	mm	Liquid Limit = 0.0%		Plastic Limit = 0.0%	
$D_{(50)}$ = 0.122	mm	Plasticity Index = 0.0%		Moisture %, as sampled = 37.6%	
$D_{(60)}$ = 0.142	mm	Sand Equivalent = n/a		Req'd Sand Equivalent =	
$D_{(90)}$ = 0.351	mm	Fracture %, 1 Face = n/a		Req'd Fracture %, 1 Face =	
Dust Ratio = 3/11		Fracture %, 2+ Faces = n/a		Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		100%	100.0%	0.0%
#30	0.600		100%	100.0%	0.0%
#40	0.425	100%	100%	100.0%	0.0%
#50	0.300		83%	100.0%	0.0%
#60	0.250		77%	100.0%	0.0%
#80	0.180		68%	100.0%	0.0%
#100	0.150	64%	64%	100.0%	0.0%
#140	0.106		42%	100.0%	0.0%
#170	0.090		35%	100.0%	0.0%
#200	0.075	27.2%	27.2%	100.0%	0.0%



Comments:

Reviewed by: Megh Blodgett Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	1-Sep-21
Source:	LDW21-GT18-GB-16.5-21.4 ft	**Tested By:**	C. Kriss
Sample#:	B21-1704		

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

ASTM D7928, HYDROMETER ANALYSIS

Sp Gr :	2.53	
Sample Weight:	99.41	grams
Hydroscopic Moist.:	2.98%	
Adj. Sample Wgt :	96.53	grams

A2LA ACCREDITED Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	17	18.1%	0.0526 mm
2	14	14.9%	0.0379 mm
5	12.5	13.3%	0.0242 mm
15	9.5	10.1%	0.0142 mm
30	8	8.5%	0.0101 mm
60	6.5	6.9%	0.0072 mm
240	4	4.3%	0.0036 mm
1440	2	2.1%	0.0015 mm

% Gravel:	0.0%	**Liquid Limit:**	0.0 %
% Sand:	72.8%	**Plastic Limit:**	0.0 %
% Silt:	21.9%	**Plasticity Index:**	0.0 %
% Clay:	5.3%		

ASTM D6913

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	100%	4.750 mm
#10	100%	2.000 mm
#20	100%	0.850 mm
#40	100%	0.425 mm
#100	64%	0.150 mm
#200	27.2%	0.075 mm
Silts	26.8%	0.074 mm
	16.4%	0.050 mm
	12.0%	0.020 mm
Clays	5.3%	0.005 mm
	2.6%	0.002 mm
Colloids	1.4%	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
Loamy Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

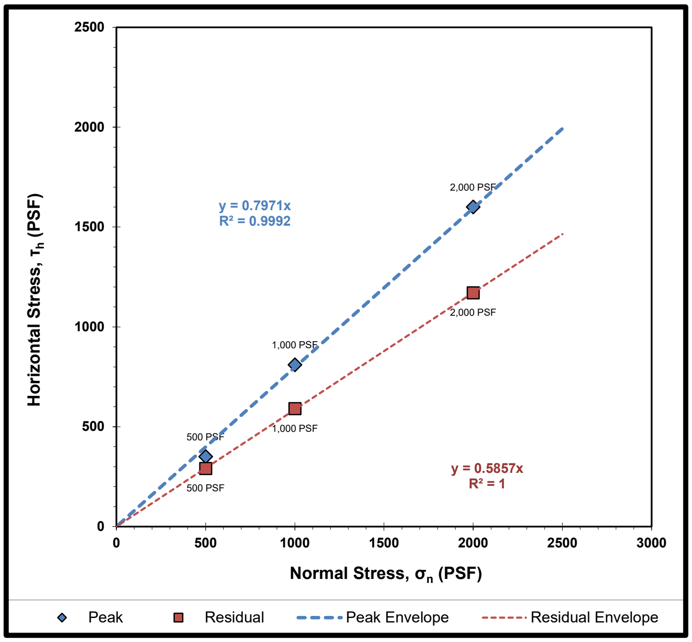
MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway
Project Number:	21B233
Laboratory Sample ID:	B21-1704
Sample Date:	7/14/2021
Test Date:	9/17/2021
Technician:	M. Carrillo
Sample Source:	LDW21-GT18-GB-16.5-21.4 ft
Visual Soil Description:	brown silty sand
Type of Specimen:	Remolded Cylindrical Shear Box
Specimen Diameter (in):	2.5
Specimen Height (in):	1
Rate of Strain (in/min):	0.0208
Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	29.4	
	Initial	**Post-Consolidation**
Dry Density (PCF):	107.0	107.9
Void Ratio:	0.575	0.562
Porosity (%):	36.5	36.0
Degree of Saturation (%):	saturated	saturated

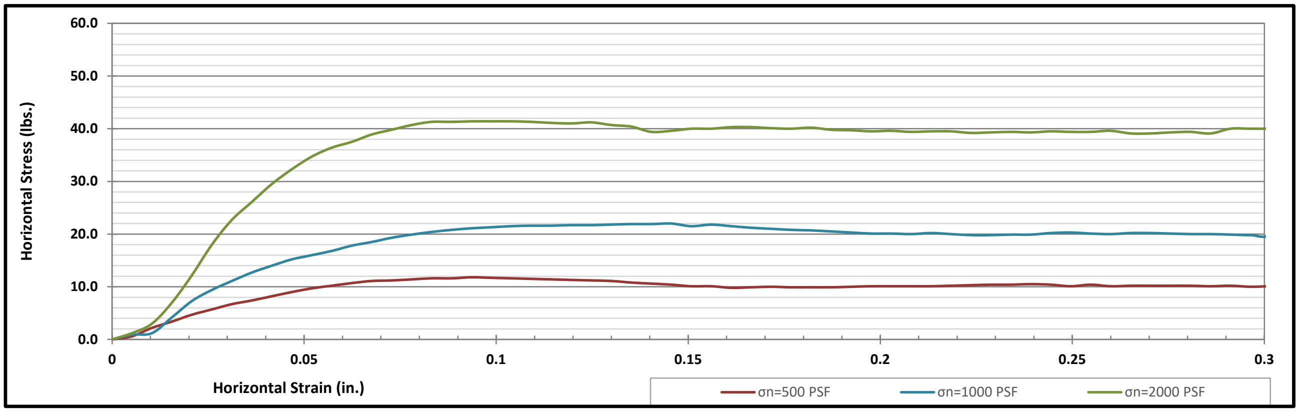
Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	28.3	
	Initial	**Post-Consolidation**
Dry Density (PCF):	107.4	109.9
Void Ratio:	0.569	0.533
Porosity (%):	36.3	34.8
Degree of Saturation (%):	saturated	saturated

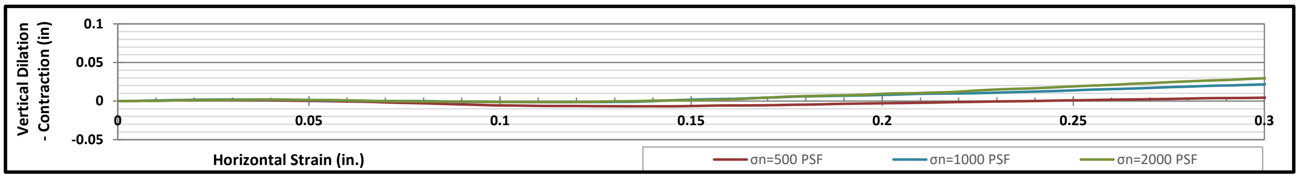
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	29.0	
	Initial	**Post-Consolidation**
Dry Density (PCF):	106.9	110.5
Void Ratio:	0.576	0.525
Porosity (%):	36.5	34.4
Degree of Saturation (%):	saturated	saturated



ESTIMATED STRENGTH PARAMETERS		
	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	39	30
Cohesion (PSF):	0	0

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	350	810	1600
Residual Horizontal Stress, τ_h (PSF):	290	590	1170





MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway	**Date Received:** 29-Jul-21	**Unified Soil Classification System, ASTM-2487**	
Project #: 21B233	**Sampled By:** Client	SM, Silty Sand	
Client: Anchor QEA	**Date Tested:** 13-Sep-21	**Sample Color:**	ACCREDITED
Source: LDW21-GT18-GB-21.4-26.5 ft	**Tested By:** C. Kriss	brown	Certificate #: 1366.01
Sample#: B21-1705			

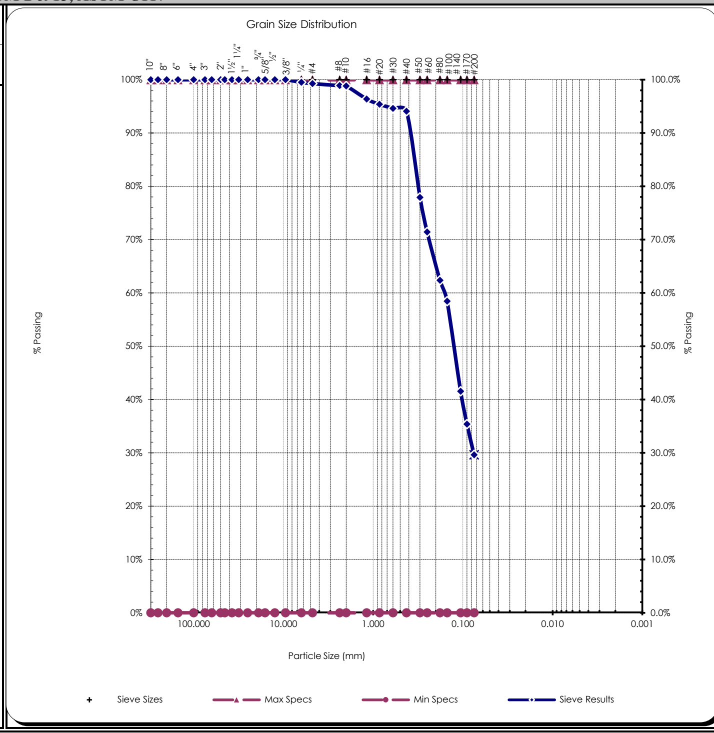
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.013 mm	% Gravel = 0.7%	Coeff. of Curvature, C_C = 1.41
$D_{(10)}$ = 0.025 mm	% Sand = 69.6%	Coeff. of Uniformity, C_U = 6.40
$D_{(15)}$ = 0.038 mm	% Silt & Clay = 29.7%	Fineness Modulus = 0.74
$D_{(30)}$ = 0.076 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.128 mm	Plasticity Index = n/a	Moisture %, as sampled = 38.4%
$D_{(60)}$ = 0.162 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.393 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 23/73	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	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		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		96%	100.0%	0.0%
#20	0.850		95%	100.0%	0.0%
#30	0.600		95%	100.0%	0.0%
#40	0.425	94%	94%	100.0%	0.0%
#50	0.300		78%	100.0%	0.0%
#60	0.250		71%	100.0%	0.0%
#80	0.180		62%	100.0%	0.0%
#100	0.150	58%	58%	100.0%	0.0%
#140	0.106		42%	100.0%	0.0%
#170	0.090		35%	100.0%	0.0%
#200	0.075	29.7%	29.7%	100.0%	0.0%



Comments:

Reviewed by:

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Client:	Anchor QEA	**Date:**	October 6, 2021
Address:	21328 2nd Drive SE	**Project:**	Q.C. - Lower Duwamish Waterway
	Bothell, WA 98021	**Project #:**	21B233
Attn:	Garrett Timm	**Sample #:**	B21-1787-1803
Revised on:		**Date sampled:**	7-12-21 & 7-14-21

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	Please See Attached Reports		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count			LA Abrasion	
X	Moisture Content	Please See Attached Report	**X**	Direct Shear	Please See Attached Reports
	Specific Gravity, Coarse		**X**	Specific Gravity, Soils	Please See Attached Reports
	Specific Gravity, Fine				
X	Hydrometer Analysis	Please See Attached Reports			
X	Atterberg Limits	Please See Attached Reports			

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Meghan Blodgett-Carrillo

Respectfully Submitted,
Meghan Blodgett-Carrillo
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM C566, ASTM D2216

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: September 20, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B21-1787	LDW21-GT15-GB-0-7.5 ft	233.4	1016.2	787.2	229.0	553.8	41.4%
B21-1788	LDW21-GT15-GB-7.5-9 ft	306.7	450.8	422.5	28.3	115.8	24.4%
B21-1789	LDW21-GT15-GB-7.5-15 ft	236.2	1288.2	1043.0	245.2	806.8	30.4%
B21-1790	LDW21-GT15-GB-15-17.5 ft	303.3	997.2	810.9	186.3	507.6	36.7%
B21-1791	LDW21-GT15-GB-17.5-19 ft	311.1	465.1	434.0	31.1	122.9	25.3%
B21-1792	LDW21-GT15-GB-17.5-25.4 ft	270.2	882.6	747.4	135.2	477.2	28.3%
B21-1793	LDW21-GT15-GB-25.4-27.5 ft	260.6	1270.0	1036.1	233.9	775.5	30.2%
B21-1794	LDW21-GT15-GB-27.5-29 ft	222.9	616.1	520.8	95.3	297.9	32.0%
B21-1795	LDW21-GT29-GB-0-1.5 ft	225.1	949.8	644.5	305.3	419.4	72.8%
B21-1796	LDW21-GT29-GB-0-10.6 ft	221.7	746.6	548.6	198.0	326.9	60.6%
B21-1797	LDW21-GT29-GB-11-12.5 ft	221.4	1082.5	801.0	281.5	579.6	48.6%
B21-1798	LDW21-GT29-GB-11-21 ft	224.4	738.0	646.6	91.4	422.2	21.6%
B21-1799	LDW21-GT29-GB-21-22.5 ft	222.3	408.6	349.3	59.3	127.0	46.7%
B21-1800	LDW21-GT29-GB-21-26 ft	233.8	1031.7	903.6	128.1	669.8	19.1%
B21-1801	LDW21-GT29-GB-26-28.9 ft	229.1	776.5	629.0	147.5	399.9	36.9%
B21-1802	LDW21-GT29-GB-28.9-31 ft	188.4	1285.9	988.6	297.3	800.2	37.2%
B21-1803	LDW21-GT29-GB-31-32.5 ft	225.3	925.7	756.5	169.2	531.2	31.9%

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MTC
MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM D854

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: September 20, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B21-1787	LDW21-GT15-GB-0-7.5 ft	584.26	658.50	74.2	TSA-014	192.3	499.5	0.99749	735.04	690.54	23.2	2.4966051	0.99929	2.4948325
B21-1792	LDW21-GT15-GB-17.5-25.4 ft	493.62	594.11	100.5	TSA-016	197.2	499.5	0.99754	757.82	695.45	23.0	2.6360571	0.99933	2.634291
B21-1793	LDW21-GT15-GB-25.4-27.5 ft	500.82	575.98	75.2	TSA-022	198.0	499.5	0.99749	740.87	696.19	23.2	2.4661721	0.99929	2.4644211
B21-1796	LDW21-GT29-GB-0-10.6 ft	600.79	675.86	75.1	TSA-012	180.4	499.5	0.99752	722.04	678.65	23.1	2.3695318	0.99931	2.3678968
B21-1798	LDW21-GT29-GB-11-21 ft	584.33	685.35	101.0	TSA-017	187.9	499.4	0.99749	749.71	686.04	23.2	2.7049457	0.99929	2.7030252

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	20-Sep-21
Source:	LDW21-GT15-GB-0-7.5 ft	**Tested By:**	C. Kriss
Sample #:	B21-1787		

Visual Identification
Silt with Sand and Clay
Sample Color
brown

Liquid Limit Determination

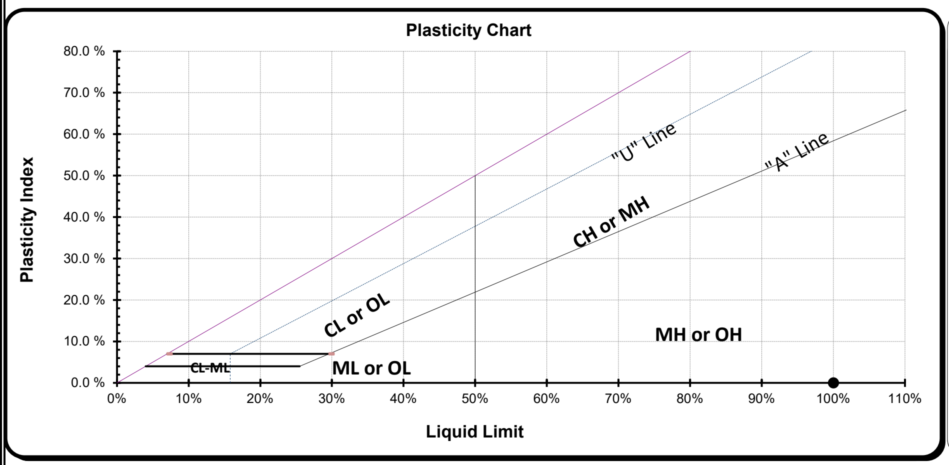
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

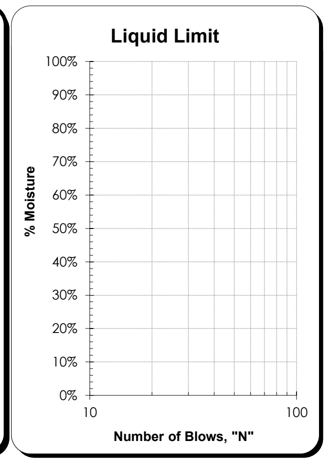
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the liquid limit cup without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	20-Sep-21
Source:	LDW21-GT15-GB-7.5-15 ft	**Tested By:**	C. Kriss
Sample#:	B21-1789		

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

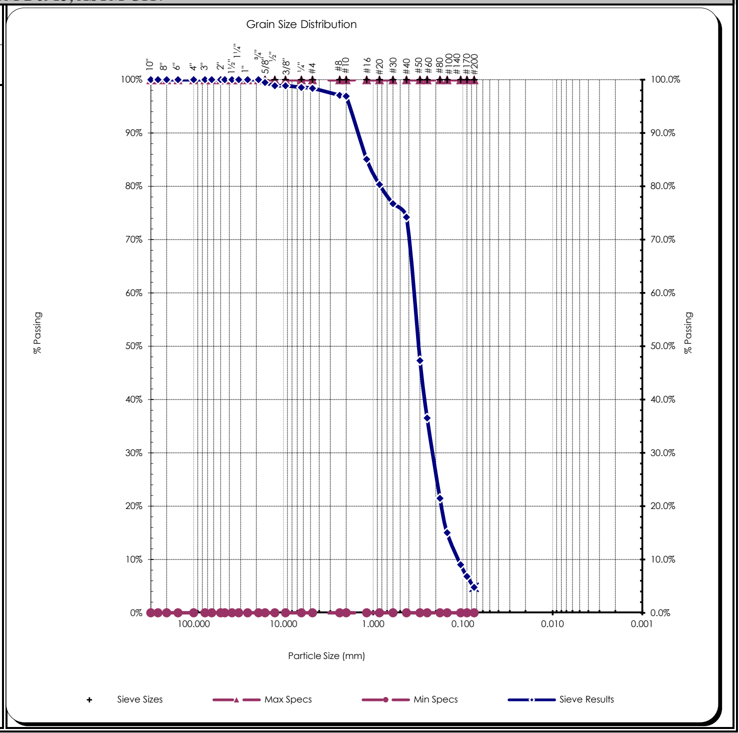
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.076	mm	% Gravel =	1.6%	Coeff. of Curvature, C_C =	1.19
$D_{(10)}$ = 0.113	mm	% Sand =	93.6%	Coeff. of Uniformity, C_U =	3.17
$D_{(15)}$ = 0.150	mm	% Silt & Clay =	4.8%	Fineness Modulus =	1.81
$D_{(30)}$ = 0.220	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ = 0.313	mm	Plasticity Index =	n/a	Moisture %, as sampled =	30.4%
$D_{(60)}$ = 0.359	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ = 1.522	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio = 2/31		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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		99%	100.0%	0.0%
1/2"	12.50	99%	99%	100.0%	0.0%
3/8"	9.50	99%	99%	100.0%	0.0%
1/4"	6.30		99%	100.0%	0.0%
#4	4.75	98%	98%	100.0%	0.0%
#8	2.36		97%	100.0%	0.0%
#10	2.00	97%	97%	100.0%	0.0%
#16	1.18		85%	100.0%	0.0%
#20	0.850		80%	100.0%	0.0%
#30	0.600		77%	100.0%	0.0%
#40	0.425	74%	74%	100.0%	0.0%
#50	0.300		47%	100.0%	0.0%
#60	0.250		37%	100.0%	0.0%
#80	0.180		21%	100.0%	0.0%
#100	0.150	15%	15%	100.0%	0.0%
#140	0.106		9%	100.0%	0.0%
#170	0.090		7%	100.0%	0.0%
#200	0.075	4.8%	4.8%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

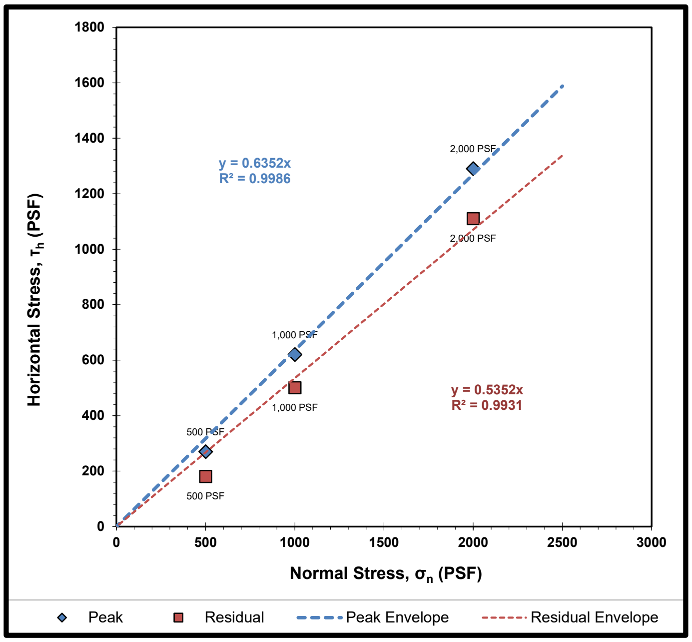
MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway		
Project Number:	21B233	**Sample Source:**	LDW21-GT15-GB-7.5-15 ft
Laboratory Sample ID:	B21-1789	**Visual Soil Description:**	brown sand with silt
Sample Date:	7/12/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	9/28/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	26.1	
	Initial	Post-Consolidation
Dry Density (PCF):	109.2	110.2
Void Ratio:	0.543	0.528
Porosity (%):	35.2	34.6
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	25.9	
	Initial	Post-Consolidation
Dry Density (PCF):	108.7	110.2
Void Ratio:	0.550	0.529
Porosity (%):	35.5	34.6
Degree of Saturation (%):	saturated	saturated

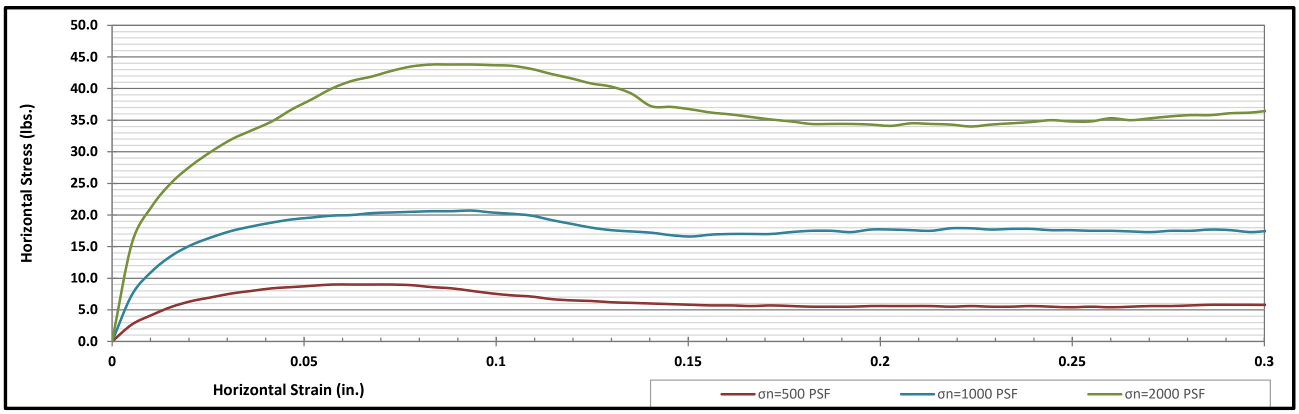
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	25.9	
	Initial	Post-Consolidation
Dry Density (PCF):	110.0	114.4
Void Ratio:	0.532	0.473
Porosity (%):	34.7	32.1
Degree of Saturation (%):	saturated	saturated

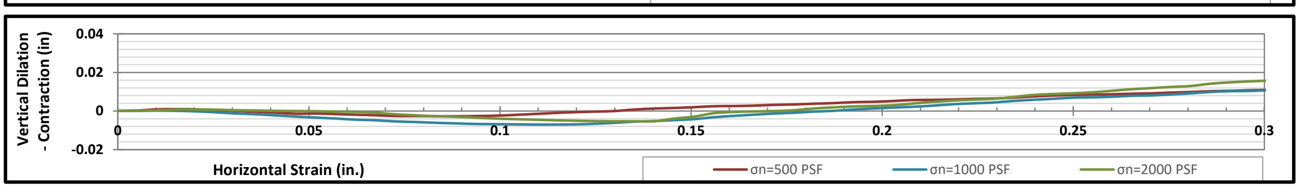


ESTIMATED STRENGTH PARAMETERS

	PEAK	RESIDUAL
Angle of Internal Friction, ϕ (°):	32	28
Cohesion (PSF):	0	0

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	270	620	1290
Residual Horizontal Stress, τ_h (PSF):	180	500	1110





MTC
MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	20-Sep-21
Source:	LDW21-GT15-GB-15-17.5 ft	**Tested By:**	C. Kriss
Sample#:	B21-1790		

Visual Identification
Sandy Silt with Clay
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

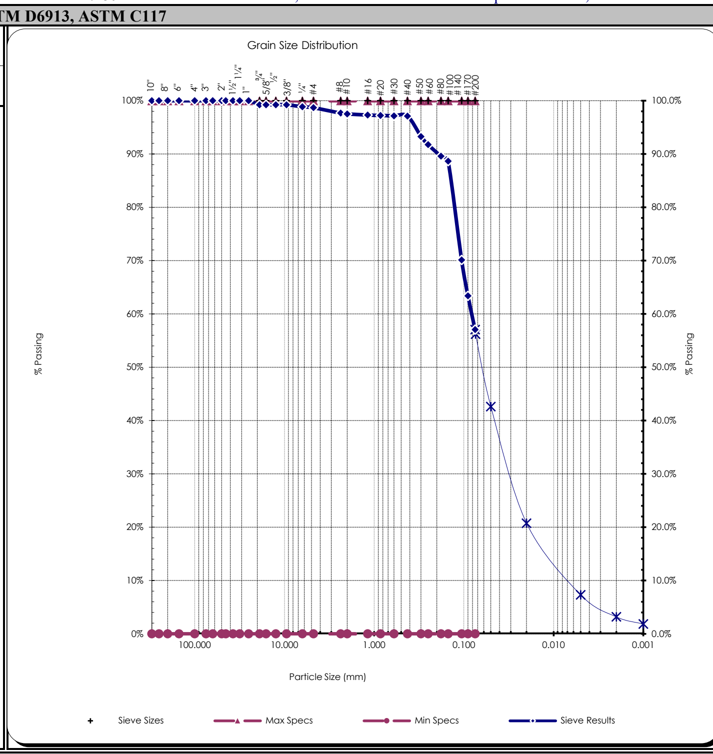
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.004 mm		% Gravel =	1.3%	Coeff. of Curvature, C_C =	2.92
$D_{(10)}$ = 0.006 mm		% Sand =	41.6%	Coeff. of Uniformity, C_U =	12.63
$D_{(15)}$ = 0.012 mm		% Silt & Clay =	57.1%	Fineness Modulus =	0.29
$D_{(30)}$ = 0.039 mm		Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ = 0.067 mm		Plasticity Index =	n/a	Moisture %, as sampled =	36.7%
$D_{(60)}$ = 0.082 mm		Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ = 0.193 mm		Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio = 47/80		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	99%	99%	100.0%	0.0%
5/8"	16.00		99%	100.0%	0.0%
1/2"	12.50	99%	99%	100.0%	0.0%
3/8"	9.50	99%	99%	100.0%	0.0%
1/4"	6.30		99%	100.0%	0.0%
#4	4.75	99%	99%	100.0%	0.0%
#8	2.36		98%	100.0%	0.0%
#10	2.00	98%	98%	100.0%	0.0%
#16	1.18		97%	100.0%	0.0%
#20	0.850		97%	100.0%	0.0%
#30	0.600		97%	100.0%	0.0%
#40	0.425	97%	97%	100.0%	0.0%
#50	0.300		93%	100.0%	0.0%
#60	0.250		92%	100.0%	0.0%
#80	0.180		90%	100.0%	0.0%
#100	0.150	89%	89%	100.0%	0.0%
#140	0.106		70%	100.0%	0.0%
#170	0.090		63%	100.0%	0.0%
#200	0.075	57.1%	57.1%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	20-Sep-21
Source:	LDW21-GT15-GB-15-17.5 ft	**Tested By:**	C. Kriss
Sample#:	B21-1790		

Visual Identification
Sandy Silt with Clay
Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	75.02	grams
Hydroscopic Moist.:	1.96%	
Adj. Sample Wgt :	73.58	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	25.5	33.8%	0.0477 mm
2	21	27.8%	0.0347 mm
5	17	22.5%	0.0224 mm
15	12	15.9%	0.0133 mm
30	10	13.3%	0.0096 mm
60	8	10.6%	0.0068 mm
240	3.5	4.6%	0.0035 mm
1440	2	2.7%	0.0014 mm

% Gravel:	1.3%	**Liquid Limit:**	n/a
% Sand:	41.6%	**Plastic Limit:**	n/a
% Silt:	49.7%	**Plasticity Index:**	n/a
% Clay:	7.3%		

ASTM D6913

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"	99%	19.000 mm
5/8"	99%	16.000 mm
1/2"	99%	12.500 mm
3/8"	99%	9.500 mm
1/4"	99%	6.300 mm
#4	99%	4.750 mm
#10	98%	2.000 mm
#20	97%	0.850 mm
#40	97%	0.425 mm
#100	89%	0.150 mm
#200	57.1%	0.075 mm
Silts	56.2%	0.074 mm
	42.6%	0.050 mm
	20.8%	0.020 mm
Clays	7.3%	0.005 mm
	3.2%	0.002 mm
Colloids	1.8%	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: Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT15-GB-17.5-19 ft
Sample#: B21-1791

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 20-Sep-21
Tested By: C. Kriss

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

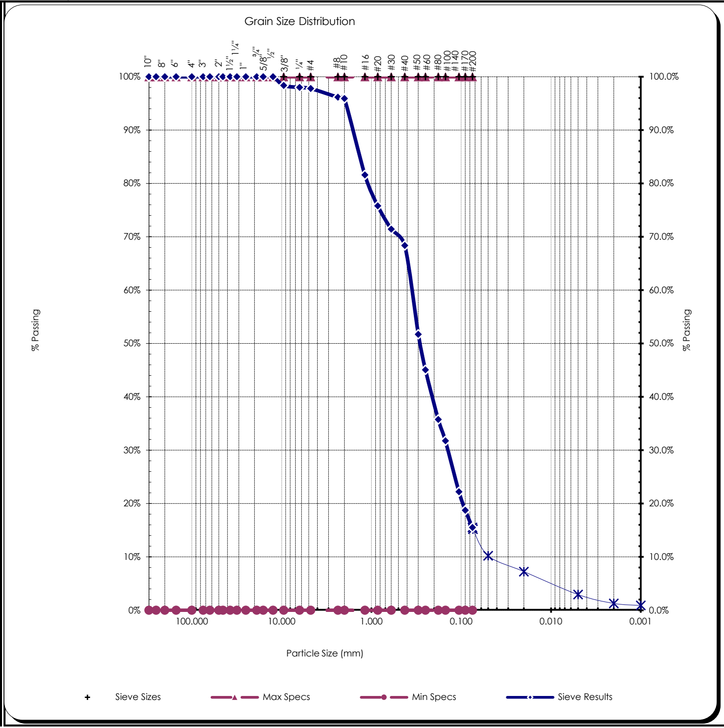
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.007 mm	% Gravel = 2.2%	Coeff. of Curvature, C_C = 0.98
$D_{(10)}$ = 0.056 mm	% Sand = 82.3%	Coeff. of Uniformity, C_U = 6.42
$D_{(15)}$ = 0.073 mm	% Silt & Clay = 15.5%	Fineness Modulus = 1.71
$D_{(30)}$ = 0.142 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.287 mm	Plasticity Index = n/a	Moisture %, as sampled = 25.3%
$D_{(60)}$ = 0.362 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.662 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 22/97	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	98%	98%	100.0%	0.0%
1/4"	6.30		98%	100.0%	0.0%
#4	4.75	98%	98%	100.0%	0.0%
#8	2.36		96%	100.0%	0.0%
#10	2.00	96%	96%	100.0%	0.0%
#16	1.18		82%	100.0%	0.0%
#20	0.850		76%	100.0%	0.0%
#30	0.600		71%	100.0%	0.0%
#40	0.425	68%	68%	100.0%	0.0%
#50	0.300		52%	100.0%	0.0%
#60	0.250		45%	100.0%	0.0%
#80	0.180		36%	100.0%	0.0%
#100	0.150	32%	32%	100.0%	0.0%
#140	0.106		22%	100.0%	0.0%
#170	0.090		19%	100.0%	0.0%
#200	0.075	15.5%	15.5%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	20-Sep-21
Source:	LDW21-GT15-GB-17.5-19 ft	**Tested By:**	C. Kriss
Sample#:	B21-1791		

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	74.97	grams
Hydroscopic Moist.:	1.06%	
Adj. Sample Wgt :	74.18	grams

A2LA ACCREDITED Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	7	9.1%	0.0532 mm
2	7	9.1%	0.0376 mm
5	6	7.8%	0.0239 mm
15	5	6.5%	0.0139 mm
30	4.5	5.8%	0.0098 mm
60	4	5.2%	0.0070 mm
240	1	1.3%	0.0035 mm
1440	1	1.3%	0.0014 mm

% Gravel:	2.2%	**Liquid Limit:**	n/a
% Sand:	82.3%	**Plastic Limit:**	n/a
% Silt:	12.6%	**Plasticity Index:**	n/a
% Clay:	3.0%		

ASTM D6913

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"	98%	9.500 mm
1/4"	98%	6.300 mm
#4	98%	4.750 mm
#10	96%	2.000 mm
#20	76%	0.850 mm
#40	68%	0.425 mm
#100	32%	0.150 mm
#200	15.5%	0.075 mm
Silts	15.2%	0.074 mm
	10.2%	0.050 mm
	7.3%	0.020 mm
Clays	3.0%	0.005 mm
	1.3%	0.002 mm
Colloids	0.9%	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
Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	20-Sep-21
Source:	LDW21-GT15-GB-17.5-25.4 ft	**Tested By:**	C. Kriss
Sample#:	B21-1792		

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

ACCREDITED
Certificate #: 1366.01

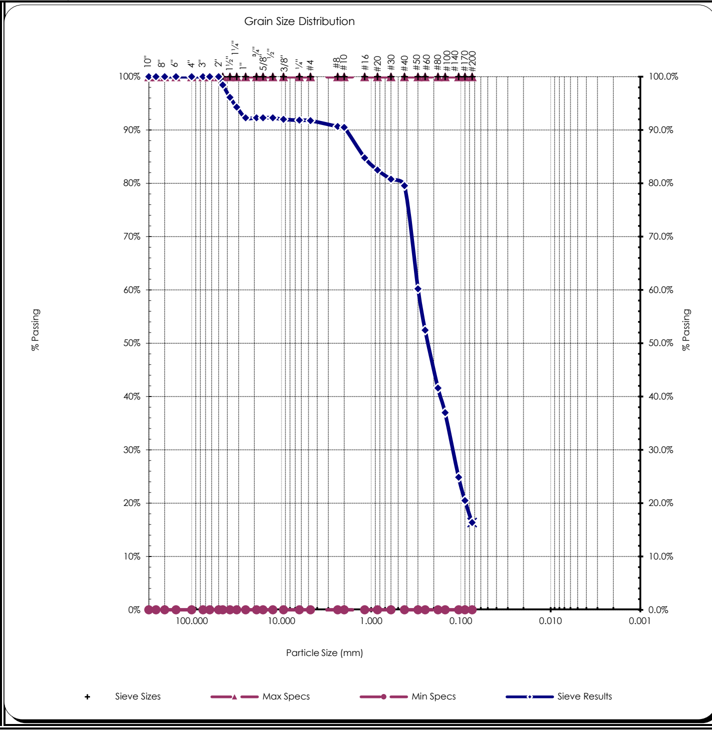
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.023 mm	% Gravel = 8.2%	Coeff. of Curvature, C_C = 1.13
$D_{(10)}$ = 0.046 mm	% Sand = 75.4%	Coeff. of Uniformity, C_U = 6.52
$D_{(15)}$ = 0.069 mm	% Silt & Clay = 16.4%	Fineness Modulus = 1.71
$D_{(30)}$ = 0.125 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.234 mm	Plasticity Index = n/a	Moisture %, as sampled = 28.3%
$D_{(60)}$ = 0.299 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.927 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 7/34	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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		98%	100.0%	0.0%
1.50"	37.50		96%	100.0%	0.0%
1.25"	31.50		94%	100.0%	0.0%
1.00"	25.00	92%	92%	100.0%	0.0%
3/4"	19.00	92%	92%	100.0%	0.0%
5/8"	16.00		92%	100.0%	0.0%
1/2"	12.50	92%	92%	100.0%	0.0%
3/8"	9.50	92%	92%	100.0%	0.0%
1/4"	6.30		92%	100.0%	0.0%
#4	4.75	92%	92%	100.0%	0.0%
#8	2.36		91%	100.0%	0.0%
#10	2.00	91%	91%	100.0%	0.0%
#16	1.18		85%	100.0%	0.0%
#20	0.850		83%	100.0%	0.0%
#30	0.600		81%	100.0%	0.0%
#40	0.425	80%	80%	100.0%	0.0%
#50	0.300		60%	100.0%	0.0%
#60	0.250		52%	100.0%	0.0%
#80	0.180		42%	100.0%	0.0%
#100	0.150	37%	37%	100.0%	0.0%
#140	0.106		25%	100.0%	0.0%
#170	0.090		20%	100.0%	0.0%
#200	0.075	16.4%	16.4%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT15-GB-25.4-27.5 ft
Sample#: B21-1793

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 20-Sep-21
Tested By: C. Kriss

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

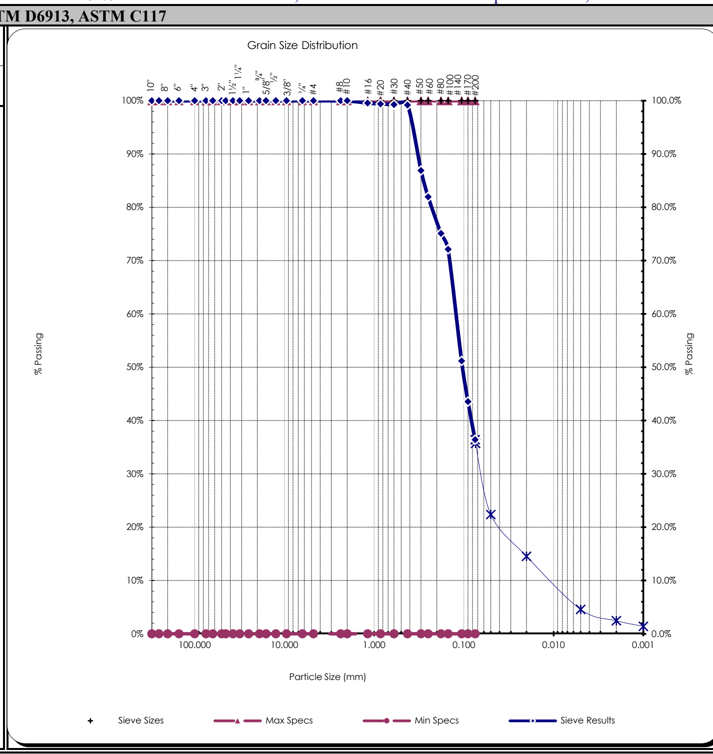
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.006 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 3.56
$D_{(10)}$ = 0.010 mm	% Sand = 63.6%	Coeff. of Uniformity, C_U = 12.70
$D_{(15)}$ = 0.022 mm	% Silt & Clay = 36.4%	Fineness Modulus = 0.42
$D_{(30)}$ = 0.066 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.104 mm	Plasticity Index = n/a	Moisture %, as sampled = 30.2%
$D_{(60)}$ = 0.125 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.331 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 29/79	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		87%	100.0%	0.0%
#60	0.250		82%	100.0%	0.0%
#80	0.180		75%	100.0%	0.0%
#100	0.150	72%	72%	100.0%	0.0%
#140	0.106		51%	100.0%	0.0%
#170	0.090		44%	100.0%	0.0%
#200	0.075	36.4%	36.4%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	20-Sep-21
Source:	LDW21-GT15-GB-25.4-27.5 ft	**Tested By:**	C. Kriss
Sample#:	B21-1793		

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand

Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Sp Gr :	2.46	
Sample Weight:	76.16	grams
Hydroscopic Moist.:	4.72%	
Adj. Sample Wgt :	72.73	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	15	21.7%	0.0541 mm
2	13.5	19.5%	0.0388 mm
5	11	15.9%	0.0248 mm
15	9	13.0%	0.0145 mm
30	7.5	10.8%	0.0104 mm
60	4.5	6.5%	0.0074 mm
240	2.5	3.6%	0.0038 mm
1440	1.5	2.2%	0.0015 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	63.6%	**Plastic Limit:**	n/a
% Silt:	31.8%	**Plasticity Index:**	n/a
% Clay:	4.6%		

ASTM D6913

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	100%	4.750 mm
	#10	100%	2.000 mm
	#20	99%	0.850 mm
	#40	99%	0.425 mm
	#100	72%	0.150 mm
	#200	36.4%	0.075 mm
Silts		35.7%	0.074 mm
		22.4%	0.050 mm
		14.5%	0.020 mm
Clays		4.6%	0.005 mm
		2.5%	0.002 mm
Colloids		1.4%	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
Loamy Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT29-0-10.6 ft
Sample #: B21-1796

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 21-Sep-21
Tested By: C. Kriss

Visual Identification
Silt
Sample Color
brown

Liquid Limit Determination

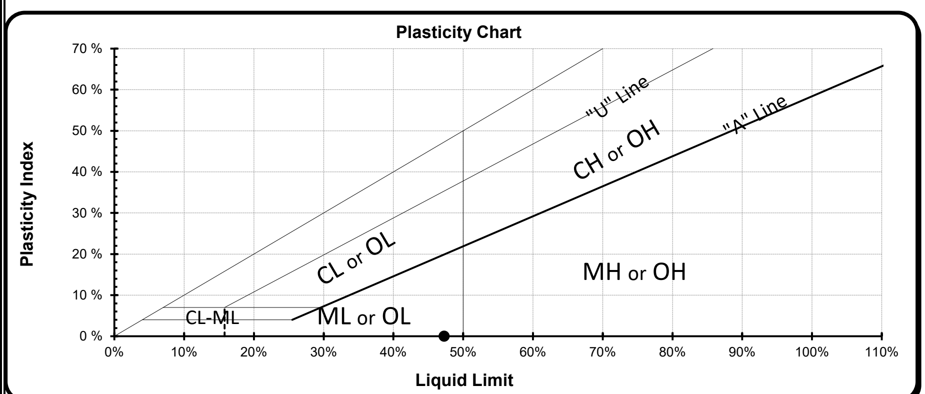
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	32.74	33.79	36.07			
Weight of Dry Soils + Pan:	28.61	29.18	30.52			
Weight of Pan:	19.91	19.73	19.61			
Weight of Dry Soils:	8.70	9.45	10.91			
Weight of Moisture:	4.13	4.61	5.55			
% Moisture:	47.5 %	48.8 %	50.9 %			
Number of Blows:	25	16	11			

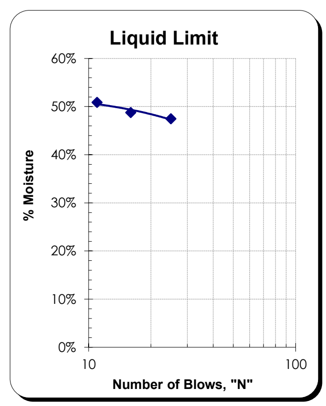
Liquid Limit @ 25 Blows: 47 %
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	Plastic limit cannot be determined					
Weight of Dry Soils + Pan:						
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT29-GB-11-21 ft
Sample#: B21-1798

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 20-Sep-21
Tested By: C. Kriss

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

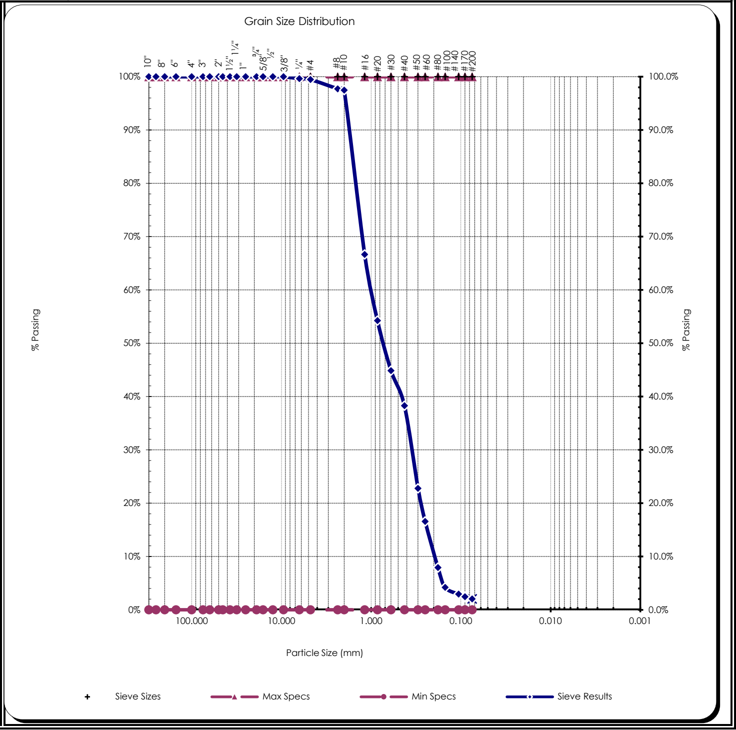
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.156 mm	% Gravel = 0.5%	Coeff. of Curvature, C_C = 0.65
$D_{(10)}$ = 0.197 mm	% Sand = 97.4%	Coeff. of Uniformity, C_U = 5.10
$D_{(15)}$ = 0.237 mm	% Silt & Clay = 2.0%	Fineness Modulus = 2.64
$D_{(30)}$ = 0.358 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.737 mm	Plasticity Index = n/a	Moisture %, as sampled = 21.6%
$D_{(60)}$ = 1.003 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.801 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 3/56	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	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		98%	100.0%	0.0%
#10	2.00	97%	97%	100.0%	0.0%
#16	1.18		67%	100.0%	0.0%
#20	0.850		54%	100.0%	0.0%
#30	0.600		45%	100.0%	0.0%
#40	0.425	38%	38%	100.0%	0.0%
#50	0.300		23%	100.0%	0.0%
#60	0.250		17%	100.0%	0.0%
#80	0.180		8%	100.0%	0.0%
#100	0.150	4%	4%	100.0%	0.0%
#140	0.106		3%	100.0%	0.0%
#170	0.090		2%	100.0%	0.0%
#200	0.075	2.0%	2.0%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	20-Sep-21
Source:	LDW21-GT29-GB-21-26 ft	**Tested By:**	C. Kriss
Sample#:	B21-1800		

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
gray

ACCREDITED
Certificate #: 1366.01

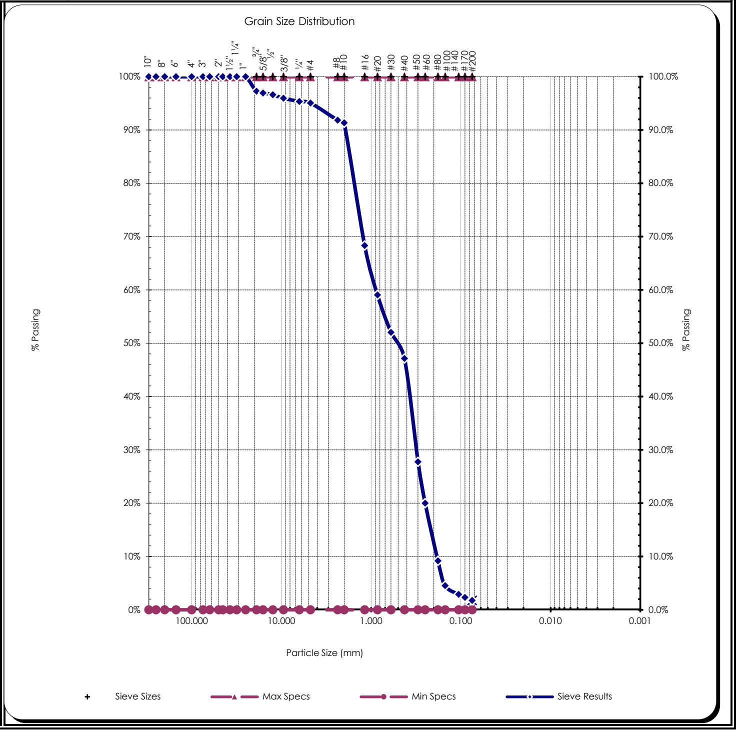
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.153 mm	% Gravel = 4.9%	Coeff. of Curvature, C_C = 0.60
$D_{(10)}$ = 0.185 mm	% Sand = 93.3%	Coeff. of Uniformity, C_U = 4.77
$D_{(15)}$ = 0.218 mm	% Silt & Clay = 1.8%	Fineness Modulus = 2.67
$D_{(30)}$ = 0.314 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.527 mm	Plasticity Index = n/a	Moisture %, as sampled = 18.8%
$D_{(60)}$ = 0.883 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.952 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 3/80	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	97%	97%	100.0%	0.0%
5/8"	16.00		97%	100.0%	0.0%
1/2"	12.50	97%	97%	100.0%	0.0%
3/8"	9.50	96%	96%	100.0%	0.0%
1/4"	6.30		95%	100.0%	0.0%
#4	4.75	95%	95%	100.0%	0.0%
#8	2.36		92%	100.0%	0.0%
#10	2.00	91%	91%	100.0%	0.0%
#16	1.18		68%	100.0%	0.0%
#20	0.850		59%	100.0%	0.0%
#30	0.600		52%	100.0%	0.0%
#40	0.425	47%	47%	100.0%	0.0%
#50	0.300		28%	100.0%	0.0%
#60	0.250		20%	100.0%	0.0%
#80	0.180		9%	100.0%	0.0%
#100	0.150	5%	5%	100.0%	0.0%
#140	0.106		3%	100.0%	0.0%
#170	0.090		2%	100.0%	0.0%
#200	0.075	1.8%	1.8%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

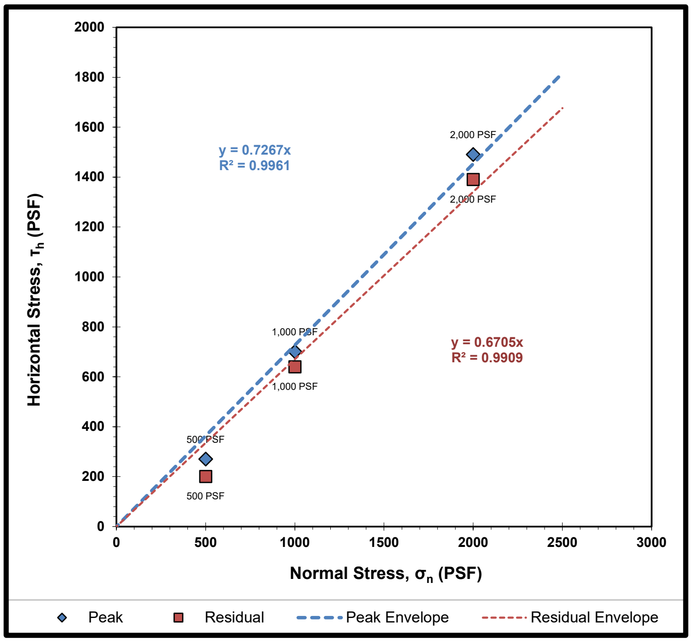
MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway		
Project Number:	21B233	**Sample Source:**	LDW21-GT29-GB-21-26 ft
Laboratory Sample ID:	B21-1800	**Visual Soil Description:**	gray sand
Sample Date:	7/14/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	9/29/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	23.0	
	Initial	Post-Consolidation
Dry Density (PCF):	107.5	108.1
Void Ratio:	0.567	0.558
Porosity (%):	36.2	35.8
Degree of Saturation (%):	saturated	saturated

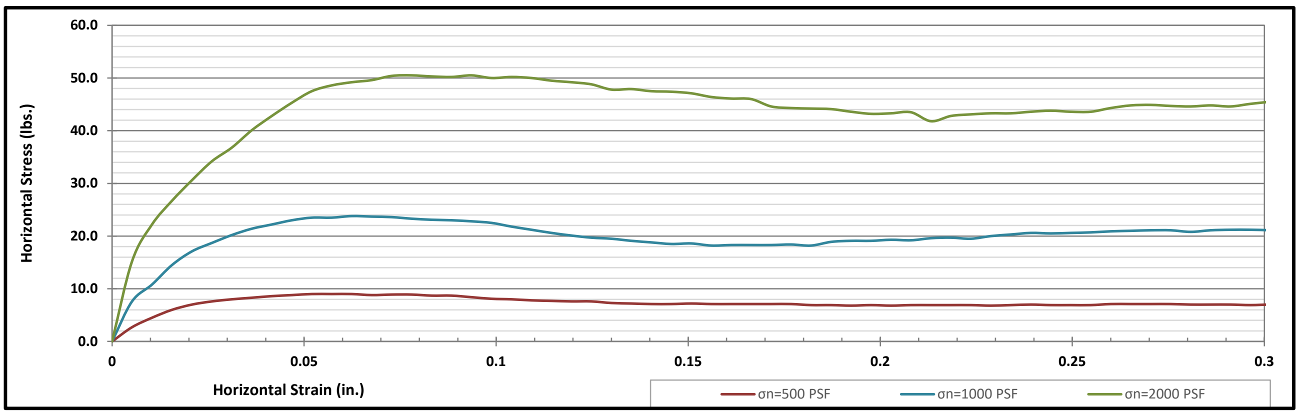
Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	22.3	
	Initial	Post-Consolidation
Dry Density (PCF):	107.1	108.5
Void Ratio:	0.572	0.552
Porosity (%):	36.4	35.6
Degree of Saturation (%):	saturated	saturated

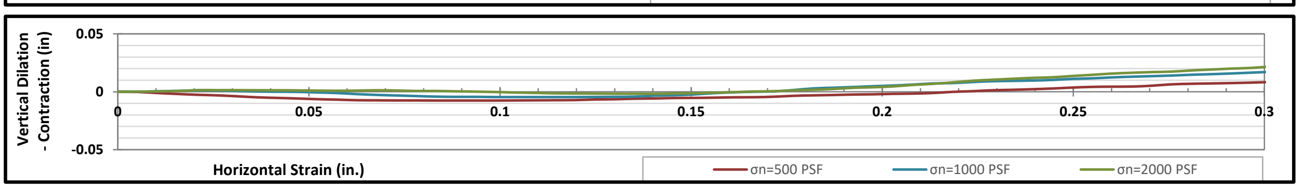
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	21.8	
	Initial	Post-Consolidation
Dry Density (PCF):	108.8	110.9
Void Ratio:	0.548	0.519
Porosity (%):	35.4	34.2
Degree of Saturation (%):	saturated	saturated



ESTIMATED STRENGTH PARAMETERS		
	PEAK	RESIDUAL
Angle of Internal Friction, ϕ (°):	36	34
Cohesion (PSF):	0	0

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	270	700	1490
Residual Horizontal Stress, τ_h (PSF):	200	640	1390





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT29-GB-26-28.9 ft
Sample#: B21-1801

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 20-Sep-21
Tested By: C. Kriss

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

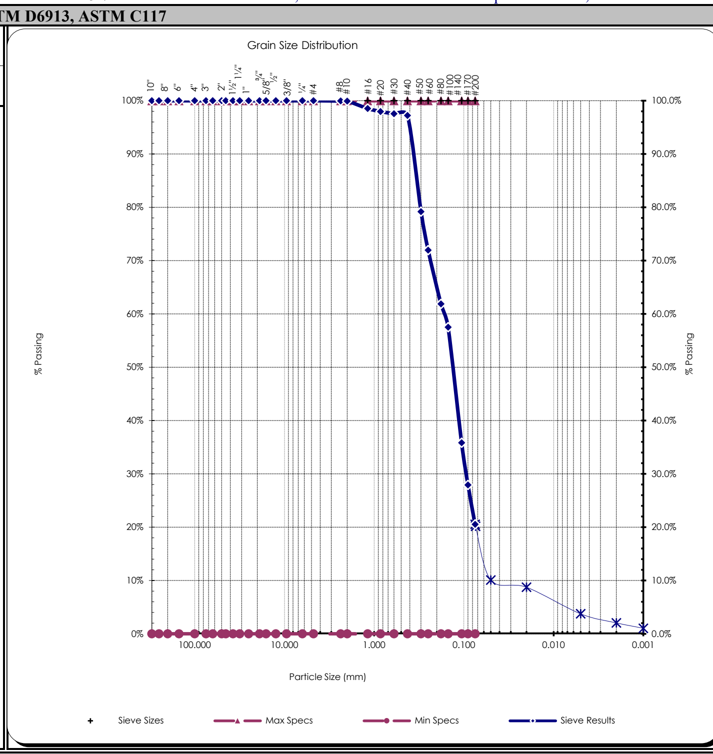
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.008	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C =	1.33
$D_{(10)}$ = 0.040	mm	% Sand =	79.4%	Coeff. of Uniformity, C_U =	4.18
$D_{(15)}$ = 0.061	mm	% Silt & Clay =	20.6%	Fineness Modulus =	0.67
$D_{(30)}$ = 0.094	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ = 0.135	mm	Plasticity Index =	n/a	Moisture %, as sampled =	36.9%
$D_{(60)}$ = 0.167	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ = 0.375	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio = 15/71		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		98%	100.0%	0.0%
#30	0.600		98%	100.0%	0.0%
#40	0.425	97%	97%	100.0%	0.0%
#50	0.300		79%	100.0%	0.0%
#60	0.250		72%	100.0%	0.0%
#80	0.180		62%	100.0%	0.0%
#100	0.150	58%	58%	100.0%	0.0%
#140	0.106		36%	100.0%	0.0%
#170	0.090		28%	100.0%	0.0%
#200	0.075	20.6%	20.6%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	20-Sep-21
Source:	LDW21-GT29-GB-26-28.9 ft	**Tested By:**	C. Kriss
Sample#:	B21-1801		

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	100.10	grams
Hydroscopic Moist.:	1.34%	
Adj. Sample Wgt :	98.78	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	11.5	11.6%	0.0520 mm
2	9.5	9.6%	0.0371 mm
5	9	9.1%	0.0235 mm
15	8	8.1%	0.0137 mm
30	6	6.1%	0.0097 mm
60	4	4.0%	0.0070 mm
240	3.5	3.5%	0.0035 mm
1440	1.5	1.5%	0.0014 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	79.4%	**Plastic Limit:**	n/a
% Silt:	16.8%	**Plasticity Index:**	n/a
% Clay:	3.8%		

ASTM D6913

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	100%	4.750 mm
#10	100%	2.000 mm
#20	98%	0.850 mm
#40	97%	0.425 mm
#100	58%	0.150 mm
#200	20.6%	0.075 mm
Silts	20.2%	0.074 mm
	10.1%	0.050 mm
	8.7%	0.020 mm
Clays	3.8%	0.005 mm
	2.1%	0.002 mm
Colloids	1.1%	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
Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	20-Sep-21
Source:	LDW21-GT29-GB-28.9-31 ft	**Tested By:**	C. Kriss
Sample#:	B21-1802		

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

ACCREDITED
Certificate #: 1366.01

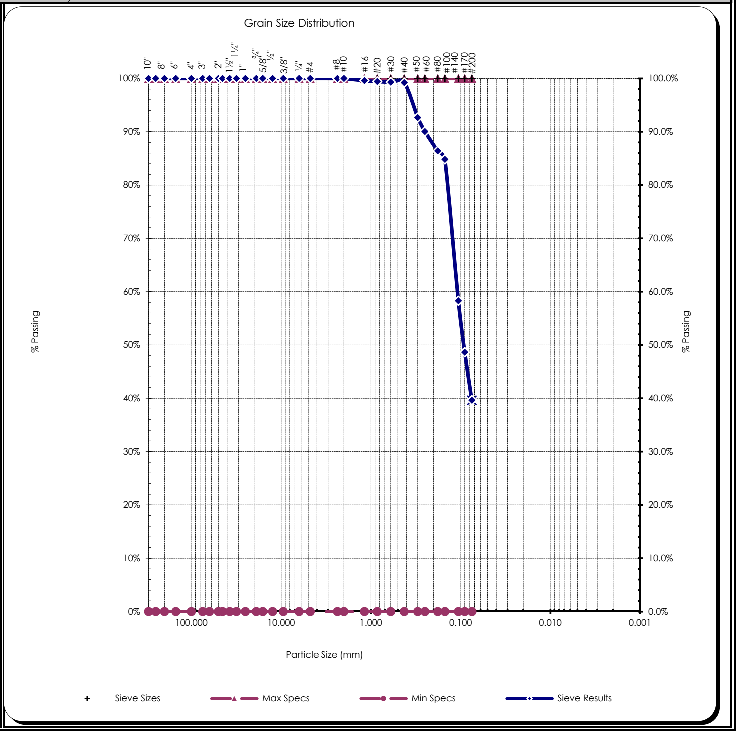
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.009 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.57
$D_{(10)}$ = 0.019 mm	% Sand = 60.4%	Coeff. of Uniformity, C_U = 5.75
$D_{(15)}$ = 0.028 mm	% Silt & Clay = 39.6%	Fineness Modulus = 0.24
$D_{(30)}$ = 0.057 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.092 mm	Plasticity Index = n/a	Moisture %, as sampled = 37.2%
$D_{(60)}$ = 0.109 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.249 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 2/5	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		93%	100.0%	0.0%
#60	0.250		90%	100.0%	0.0%
#80	0.180		86%	100.0%	0.0%
#100	0.150	85%	85%	100.0%	0.0%
#140	0.106		58%	100.0%	0.0%
#170	0.090		49%	100.0%	0.0%
#200	0.075	39.6%	39.6%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Client:	Anchor QEA	**Date:**	October 14, 2021
Address:	21328 2nd Drive SE	**Project:**	Q.C. - Lower Duwamish Waterway
	Bothell, WA 98021	**Project #:**	21B233
Attn:	Garrett Timm	**Sample #:**	B21-1812 - 1832
Revised on:		**Date sampled:**	July 15, 2021

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	Please See Attached Reports		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count			LA Abrasion	
X	Moisture Content	Please See Attached Report	**X**	Direct Shear	Please See Attached Reports
	Specific Gravity, Coarse		**X**	Specific Gravity, Soils	Please See Attached Reports
	Specific Gravity, Fine				
X	Hydrometer Analysis	Please See Attached Reports			
X	Atterberg Limits	Please See Attached Reports			

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Respectfully Submitted,
Meghan Blodgett-Carrillo
WABO Supervising Laboratory Technician

Moisture Content - ASTM C566, ASTM D2216

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: September 23, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B21-1812	LDW21-GT25-GB-0-1.5 ft	233.7	903.3	628.8	274.5	395.1	69.5%
B21-1813	LDW21-GT25-GB-0-8.5 ft	260.6	578.9	450.1	128.8	189.5	68.0%
B21-1814	LDW21-GT25-GB-8.5-10 ft	306.5	1244.3	1034.1	210.2	727.6	28.9%
B21-1815	LDW21-GT25-GB-8.5-16.2 ft	234.4	975.8	829.1	146.7	594.7	24.7%
B21-1816	LDW21-GT25-GB-16.2-18.5 ft	301.0	1029.3	834.6	194.7	533.6	36.5%
B21-1817	LDW21-GT25-GB-18.5-20 ft	311.0	1016.3	872.1	144.2	561.1	25.7%
B21-1818	LDW21-GT25-GB-18.5-24.4 ft	182.5	963.7	746.1	217.6	563.6	38.6%
B21-1819	LDW21-GT25-GB-24.4-26ft	268.9	846.8	702.0	144.8	433.1	33.4%
B21-1820	LDW21-GT25-GB-26-28.5 ft	229.0	653.6	545.0	108.6	316.0	34.4%
B21-1821	LDW21-GT25-GB-28.5-30 ft	221.8	847.9	689.3	158.6	467.5	33.9%
B21-1822	LDW21-GT33-GB-0-1.5 ft	223.1	962.3	671.6	290.7	448.5	64.8%
B21-1823	LDW21-GT33-GB-0-10.4 ft	225.2	643.8	515.2	128.6	290.0	44.3%
B21-1824	LDW21-GT33-GB-11-12.5 ft	221.3	1042.8	776.6	266.2	555.3	47.9%
B21-1825	LDW21-GT33-GB-11-18.5 ft	225.3	614.1	543.5	70.6	318.2	22.2%
B21-1826	LDW21-GT33-GB-18.3-21 ft	215.8	753.3	613.6	139.7	397.8	35.1%
B21-1827	LDW21-GT33-GB-21-22.5 ft	220.8	673.2	554.6	118.6	333.8	35.5%
B21-1828	LDW21-GT33-GB-21-26.8 ft	217.3	766.4	626.0	140.4	408.7	34.4%
B21-1829	LDW21-GT33-GB-26.8-28.8 ft	233.1	799.7	630.2	169.5	397.1	42.7%
B21-1830	LDW21-GT33-GB-28.8-29.5 ft	223.1	1026.1	824.1	202.0	601.0	33.6%
B21-1831	LDW21-GT33-GB-29.5-31 ft	221.8	989.1	767.9	221.2	546.1	40.5%
B21-1832	LDW21-GT33-GB-31-32.5 ft	208.9	577.5	479.9	97.6	271.0	36.0%

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM D854

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: September 20, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B21-1813	LDW21-GT25-GB-0-8.5 ft	498.19	565.01	66.8	TSA-022	198.0	499.5	0.99759	737.17	696.24	22.8	2.5812856	0.99938	2.5796852
B21-1820	LDW21-GT25-GB-26-28.5 ft	510.35	585.58	75.2	TSA-015	187.6	499.5	0.99780	732.43	686.00	21.9	2.612047	0.99959	2.6109761
B21-1825	LDW21-GT33-GB-11-18.5 ft	502.55	602.33	99.8	TSA-023	163.9	498.7	0.99786	723.74	661.59	21.6	2.6514178	0.99966	2.6505163

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.
Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA, LLC
Source: LDW21-GT25-GB-0-8.5 ft
Sample #: B21-1813

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Sep-21
Tested By: K. Mendez

Visual Identification
Silt with Clay
Sample Color
brown

Liquid Limit Determination

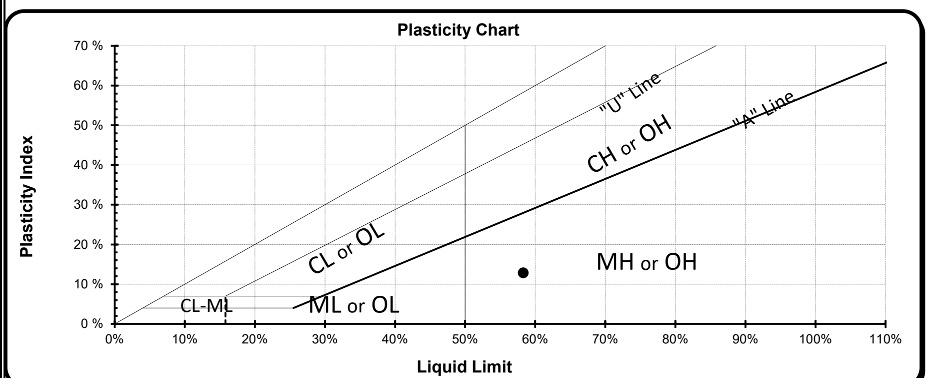
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.60	25.42	26.01			
Weight of Dry Soils + Pan:	25.96	21.62	21.93			
Weight of Pan:	19.65	15.20	15.00			
Weight of Dry Soils:	6.31	6.42	6.93			
Weight of Moisture:	3.64	3.80	4.08			
% Moisture:	57.7 %	59.2 %	58.9 %			
Number of Blows:	28	22	17			

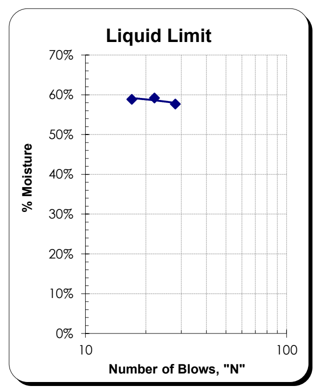
Liquid Limit @ 25 Blows: 58 %
Plastic Limit: 45 %
Plasticity Index, I_P: 13 %

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	35.15	34.29				
Weight of Dry Soils + Pan:	33.00	32.39				
Weight of Pan:	28.27	28.20				
Weight of Dry Soils:	4.73	4.19				
Weight of Moisture:	2.15	1.90				
% Moisture:	45.5 %	45.4 %				

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT25-GB-8.5-16.2 ft
Sample#: B21-1815

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Sep-21
Tested By: K. Mendez

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

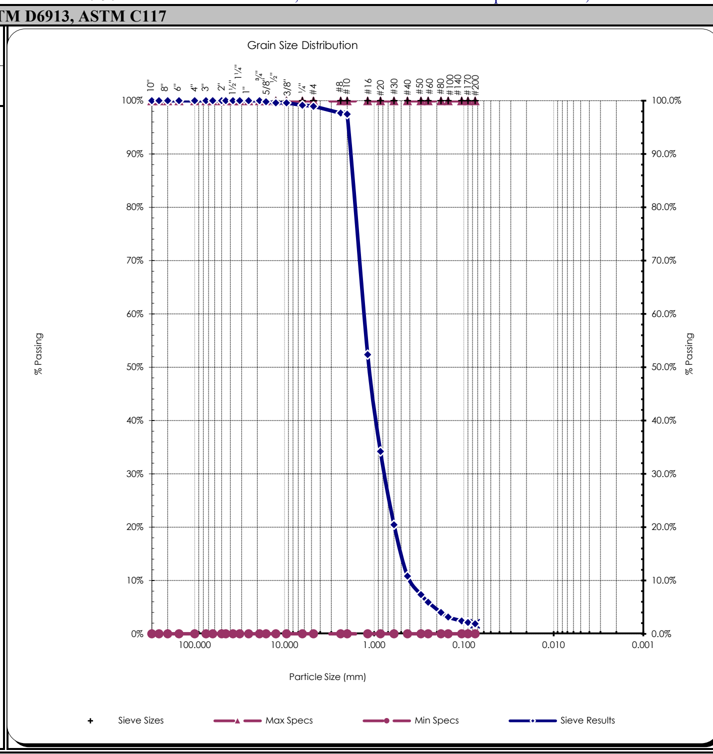
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.216 mm	% Gravel = 1.1%	Coeff. of Curvature, C_C = 1.15
$D_{(10)}$ = 0.395 mm	% Sand = 97.0%	Coeff. of Uniformity, C_U = 3.34
$D_{(15)}$ = 0.501 mm	% Silt & Clay = 1.9%	Fineness Modulus = 3.20
$D_{(30)}$ = 0.773 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 1.137 mm	Plasticity Index = n/a	Moisture %, as sampled = 24.7%
$D_{(60)}$ = 1.318 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.864 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 17/97	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		99%	100.0%	0.0%
#4	4.75	99%	99%	100.0%	0.0%
#8	2.36		98%	100.0%	0.0%
#10	2.00	97%	97%	100.0%	0.0%
#16	1.18		52%	100.0%	0.0%
#20	0.850		34%	100.0%	0.0%
#30	0.600		20%	100.0%	0.0%
#40	0.425	11%	11%	100.0%	0.0%
#50	0.300		7%	100.0%	0.0%
#60	0.250		6%	100.0%	0.0%
#80	0.180		4%	100.0%	0.0%
#100	0.150	3%	3%	100.0%	0.0%
#140	0.106		2%	100.0%	0.0%
#170	0.090		2%	100.0%	0.0%
#200	0.075	1.9%	1.9%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

MATERIALS TESTING & CONSULTING, INC.

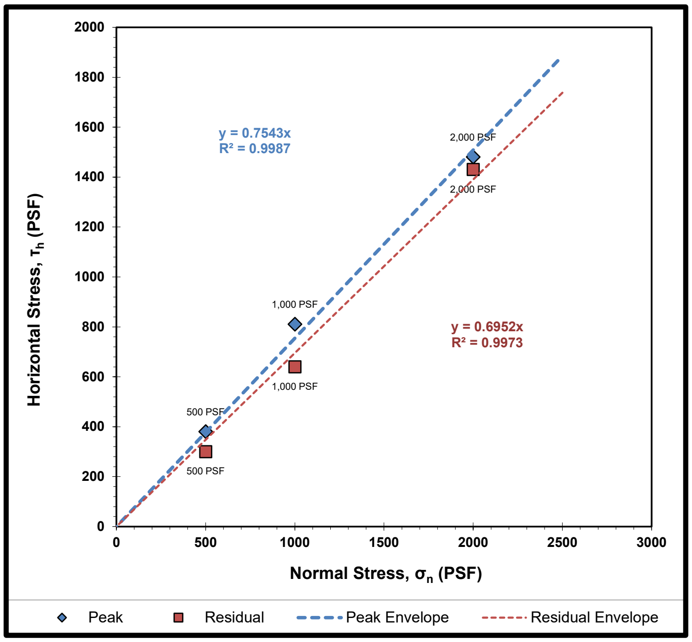
Project: Q.C. - Lower Duwamish Waterway

Project Number:	21B233	**Sample Source:**	LDW21-GT25-GB-8.5-16.2 ft
Laboratory Sample ID:	B21-1815	**Visual Soil Description:**	brown sand with silt
Sample Date:	7/15/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	9/30/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	25.1	
	Initial	**Post-Consolidation**
Dry Density (PCF):	108.7	109.7
Void Ratio:	0.550	0.536
Porosity (%):	35.5	34.9
Degree of Saturation (%):	saturated	saturated

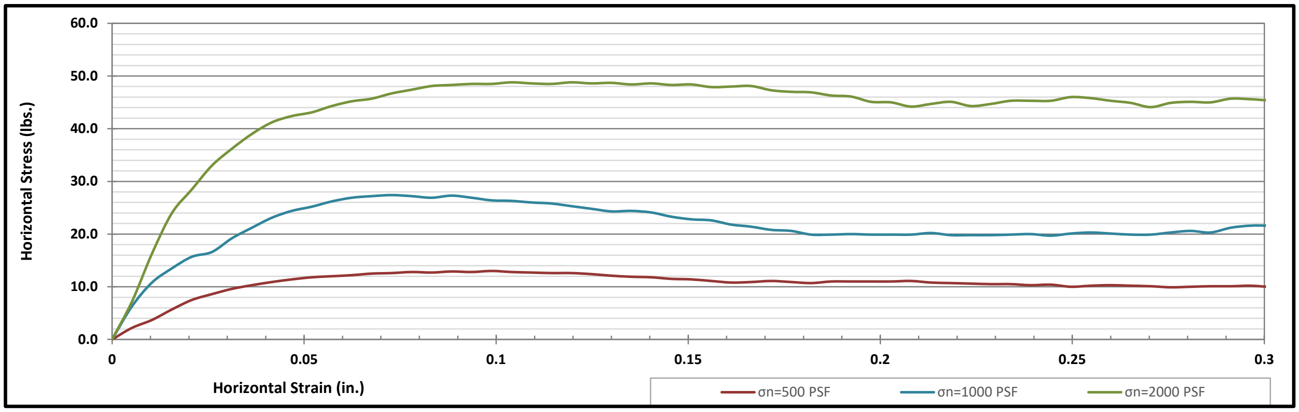
Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	24.7	
	Initial	**Post-Consolidation**
Dry Density (PCF):	107.3	108.8
Void Ratio:	0.571	0.549
Porosity (%):	36.3	35.4
Degree of Saturation (%):	saturated	saturated

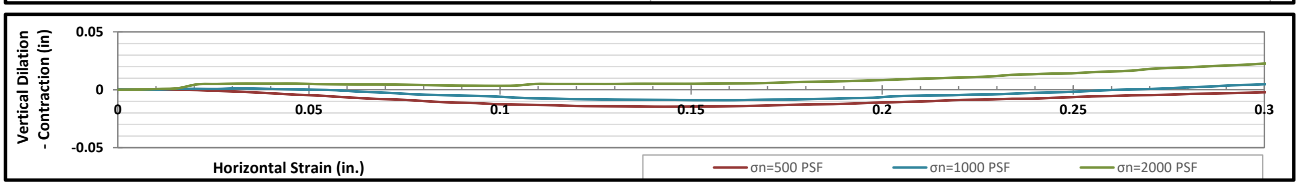
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	25.6	
	Initial	**Post-Consolidation**
Dry Density (PCF):	107.7	110.3
Void Ratio:	0.564	0.527
Porosity (%):	36.0	34.5
Degree of Saturation (%):	saturated	saturated



ESTIMATED STRENGTH PARAMETERS		
	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	**37**	**35**
Cohesion (PSF):	**0**	**0**

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	380	810	1480
Residual Horizontal Stress, τ_h (PSF):	300	640	1430





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA, LLC	**Date Tested:**	25-Sep-21
Source:	LDW21-GT25-GB-16.2-18.5 ft	**Tested By:**	K. Mendez
Sample #:	B21-1816		

Visual Identification
Sand
Sample Color
grayish-brown

Liquid Limit Determination

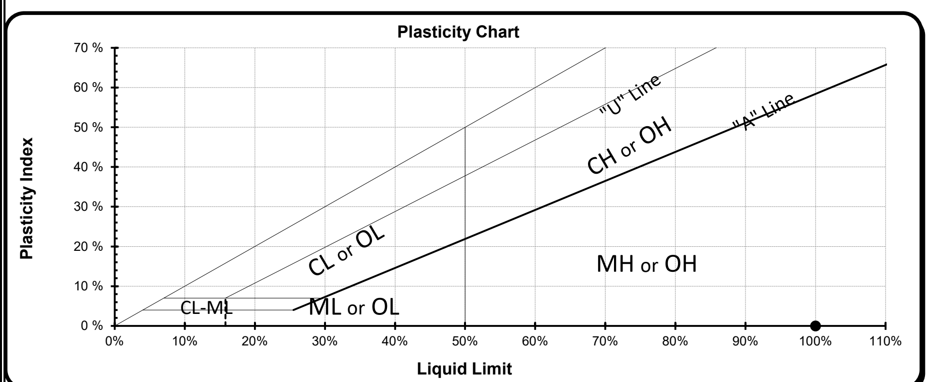
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to esablish liquid limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

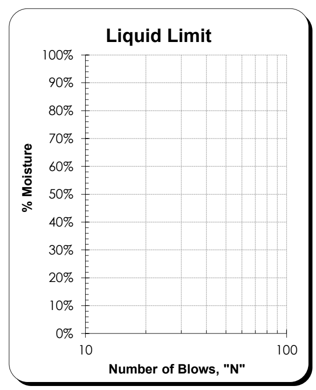
Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Cannot determined plastic limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Liquid limit cannot be established as the material displays rapid dilation. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the sample does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.
Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21	**Visual Identification** Sand
Project #:	21B233	**Sampled By:**	Client	
Client:	Anchor QEA, LLC	**Date Tested:**	25-Sep-21	**Sample Color** grayish-brown
Source:	LDW21-GT25-GB-18.5-24.4 ft	**Tested By:**	K. Mendez	
Sample #:	B21-1818			

Liquid Limit Determination

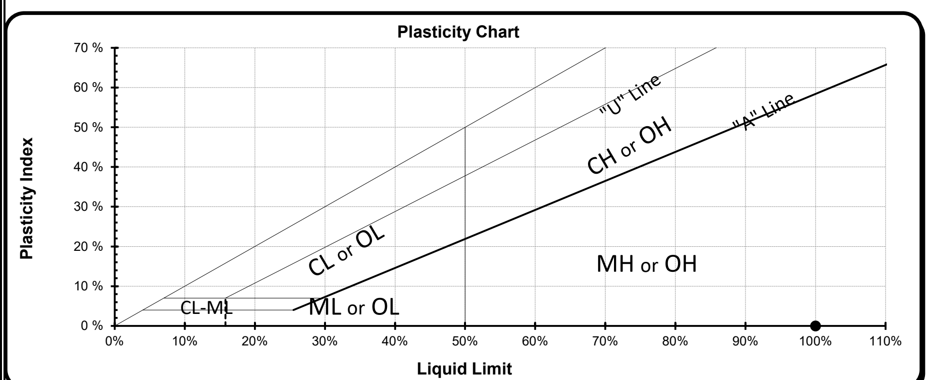
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to esablish liquid limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

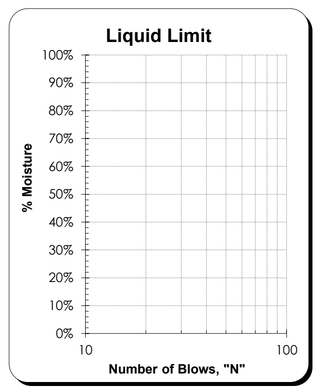
Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Cannot determined plastic limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Liquid limit cannot be established as the material displays rapid dilation. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the sample does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	25-Sep-21
Source:	LDW21-GT25-GB-26-28.5 ft	**Tested By:**	K. Mendez
Sample#:	B21-1820		

Visual Identification
Sandy Silt with Clay
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

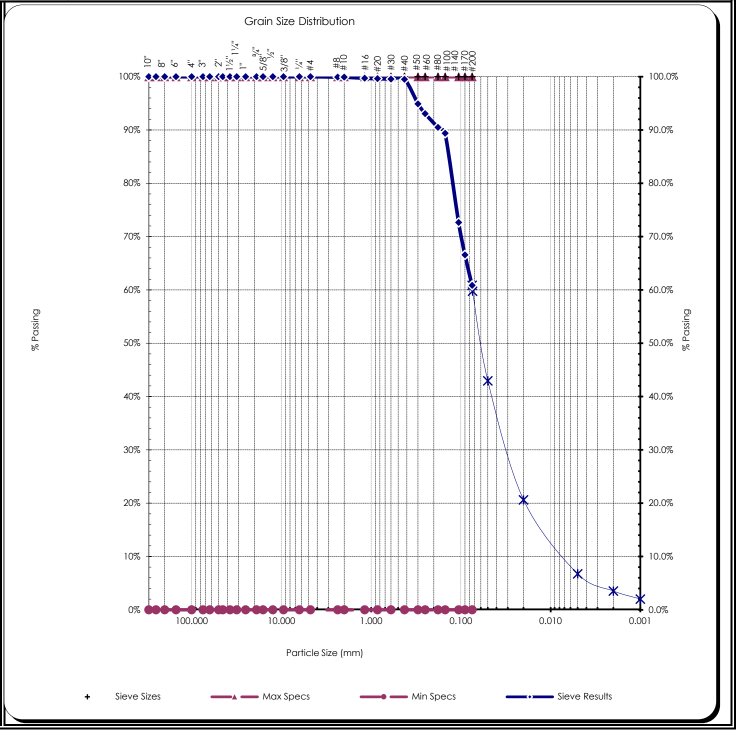
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.003 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 3.28
$D_{(10)}$ = 0.008 mm	% Sand = 39.1%	Coeff. of Uniformity, C_U = 9.69
$D_{(15)}$ = 0.013 mm	% Silt & Clay = 60.9%	Fineness Modulus = 0.16
$D_{(30)}$ = 0.043 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.065 mm	Plasticity Index = n/a	Moisture %, as sampled = 34.2%
$D_{(60)}$ = 0.074 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.167 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 11/18	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		100%	100.0%	0.0%
#30	0.600		100%	100.0%	0.0%
#40	0.425	100%	100%	100.0%	0.0%
#50	0.300		95%	100.0%	0.0%
#60	0.250		93%	100.0%	0.0%
#80	0.180		90%	100.0%	0.0%
#100	0.150	89%	89%	100.0%	0.0%
#140	0.106		73%	100.0%	0.0%
#170	0.090		67%	100.0%	0.0%
#200	0.075	60.9%	60.9%	100.0%	0.0%



Comments:

Reviewed by:
Meghan Blodgett-Carrillo

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	25-Sep-21
Source:	LDW21-GT25-GB-26-28.5 ft	**Tested By:**	K. Mendez
Sample#:	B21-1820		

Visual Identification
Sandy Silt with Clay

Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Sp Gr :	2.61	
Sample Weight:	75.00	grams
Hydroscopic Moist.:	10.50%	
Adj. Sample Wgt :	67.87	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	22	32.7%	0.0494 mm
2	18	26.8%	0.0357 mm
5	15.5	23.0%	0.0230 mm
15	10.5	15.6%	0.0137 mm
30	9	13.4%	0.0097 mm
60	6	8.9%	0.0070 mm
240	3.5	5.2%	0.0036 mm
1440	2	3.0%	0.0015 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	39.1%	**Plastic Limit:**	n/a
% Silt:	54.1%	**Plasticity Index:**	n/a
% Clay:	6.8%		

ASTM D6913

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	100%	4.750 mm
	#10	100%	2.000 mm
	#20	100%	0.850 mm
	#40	100%	0.425 mm
	#100	89%	0.150 mm
	#200	60.9%	0.075 mm
Silts		59.8%	0.074 mm
		42.9%	0.050 mm
		20.6%	0.020 mm
Clays		6.8%	0.005 mm
		3.5%	0.002 mm
Colloids		2.0%	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: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA, LLC
Source: LDW21-GT33-GB-0-10.4 ft
Sample #: B21-1823

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Sep-21
Tested By: K. Mendez

Visual Identification
Silt with Clay
Sample Color
brown

Liquid Limit Determination

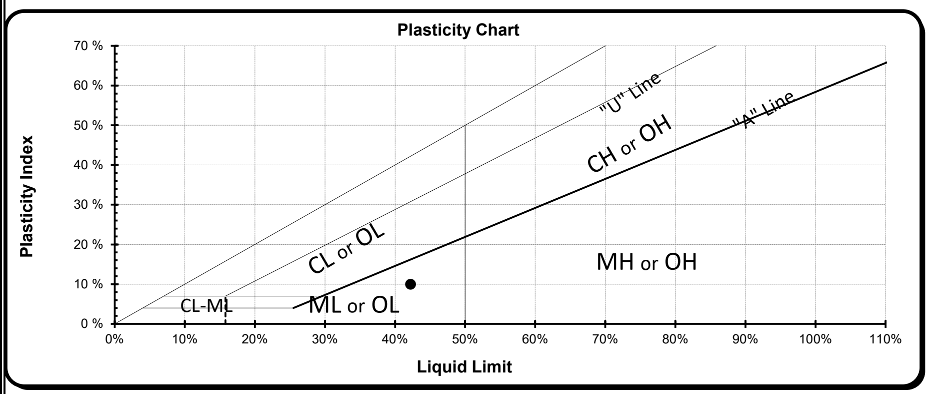
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	28.38	32.44	32.76			
Weight of Dry Soils + Pan:	24.50	28.64	28.74			
Weight of Pan:	15.01	19.79	19.63			
Weight of Dry Soils:	9.49	8.85	9.11			
Weight of Moisture:	3.88	3.80	4.02			
% Moisture:	40.9 %	42.9 %	44.1 %			
Number of Blows:	32	21	15			

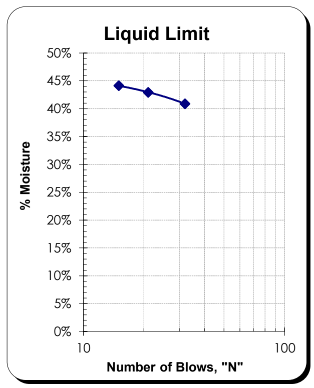
Liquid Limit @ 25 Blows: 42 %
Plastic Limit: 32 %
Plasticity Index, I_P: 10 %

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	35.43	35.12				
Weight of Dry Soils + Pan:	33.78	33.45				
Weight of Pan:	28.65	28.27				
Weight of Dry Soils:	5.13	5.18				
Weight of Moisture:	1.65	1.67				
% Moisture:	32.2 %	32.2 %				

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	25-Sep-21
Source:	LDW21-GT33-GB-11-18.5 ft	**Tested By:**	K. Mendez
Sample#:	B21-1825		

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

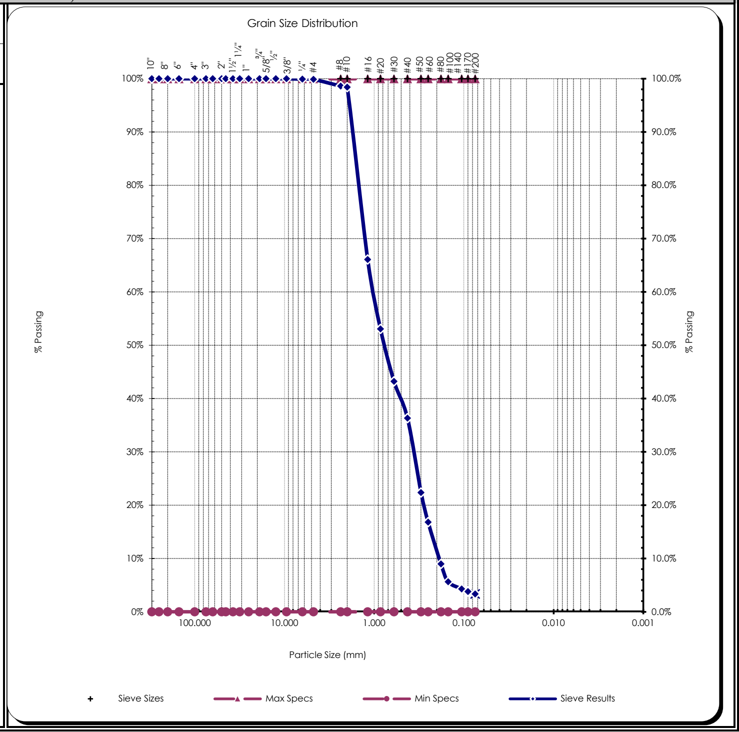
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.128 mm	% Gravel = 0.1%	Coeff. of Curvature, C_C = 0.70
$D_{(10)}$ = 0.189 mm	% Sand = 96.5%	Coeff. of Uniformity, C_U = 5.43
$D_{(15)}$ = 0.234 mm	% Silt & Clay = 3.4%	Fineness Modulus = 2.64
$D_{(30)}$ = 0.368 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.772 mm	Plasticity Index = n/a	Moisture %, as sampled = 22.2%
$D_{(60)}$ = 1.025 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.786 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 5/54	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	98%	98%	100.0%	0.0%
#16	1.18		66%	100.0%	0.0%
#20	0.850		53%	100.0%	0.0%
#30	0.600		43%	100.0%	0.0%
#40	0.425	36%	36%	100.0%	0.0%
#50	0.300		22%	100.0%	0.0%
#60	0.250		17%	100.0%	0.0%
#80	0.180		9%	100.0%	0.0%
#100	0.150	6%	6%	100.0%	0.0%
#140	0.106		4%	100.0%	0.0%
#170	0.090		4%	100.0%	0.0%
#200	0.075	3.4%	3.4%	100.0%	0.0%



Comments:

Reviewed by:
Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

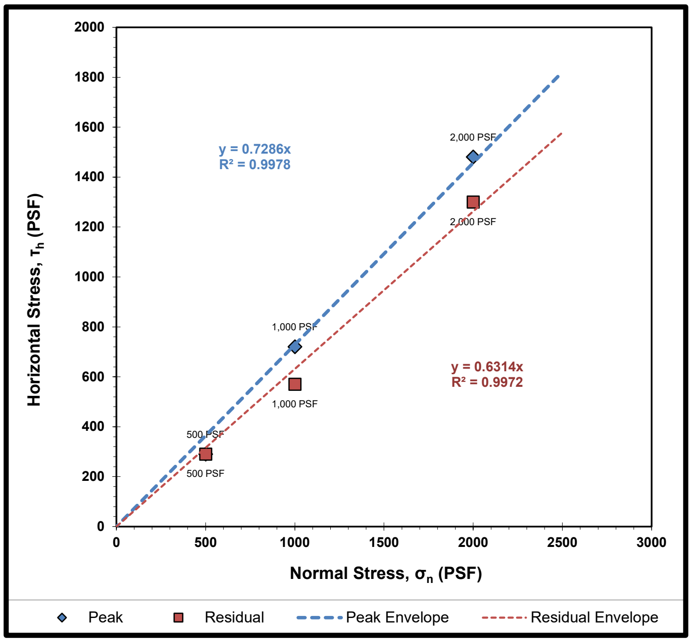
MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway
Project Number:	21B233
Laboratory Sample ID:	B21-1825
Sample Date:	7/15/2021
Test Date:	10/1/2021
Technician:	M. Carrillo
Sample Source:	LDW21-GT33-GB-11-18.5 ft
Visual Soil Description:	brown sand with silt
Type of Specimen:	Remolded Cylindrical Shear Box
Specimen Diameter (in):	2.5
Specimen Height (in):	1
Rate of Strain (in/min):	0.0208
Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	27.4	
	Initial	Post-Consolidation
Dry Density (PCF):	105.9	106.9
Void Ratio:	0.591	0.577
Porosity (%):	37.2	36.6
Degree of Saturation (%):	saturated	saturated

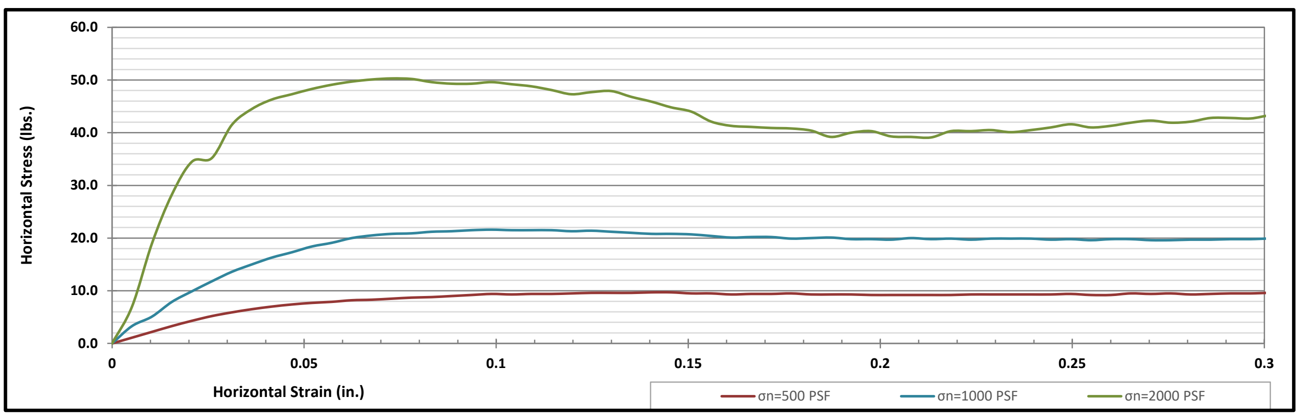
Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	27.4	
	Initial	Post-Consolidation
Dry Density (PCF):	106.2	107.7
Void Ratio:	0.586	0.564
Porosity (%):	36.9	36.1
Degree of Saturation (%):	saturated	saturated

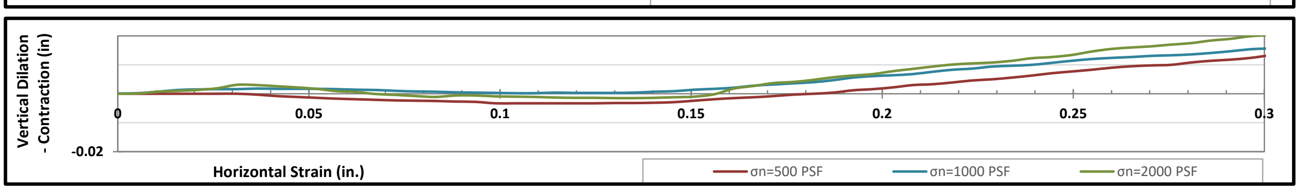
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	26.6	
	Initial	Post-Consolidation
Dry Density (PCF):	106.1	108.6
Void Ratio:	0.589	0.551
Porosity (%):	37.0	35.5
Degree of Saturation (%):	saturated	saturated



ESTIMATED STRENGTH PARAMETERS		
	PEAK	RESIDUAL
Angle of Internal Friction, φ (°):	38	32
Cohesion (PSF):	0	0

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	290	720	1480
Residual Horizontal Stress, τ_h (PSF):	290	570	1300





Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA, LLC
Source: ~~LDW21-GT25-GB-18.3-21 ft~~
Sample #: B21-1826

NAME CORRECTION: LDW21-GT33-18.5-21

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Sep-21
Tested By: K. Mendez

Visual Identification
Silty Sand
Sample Color
brown

Liquid Limit Determination

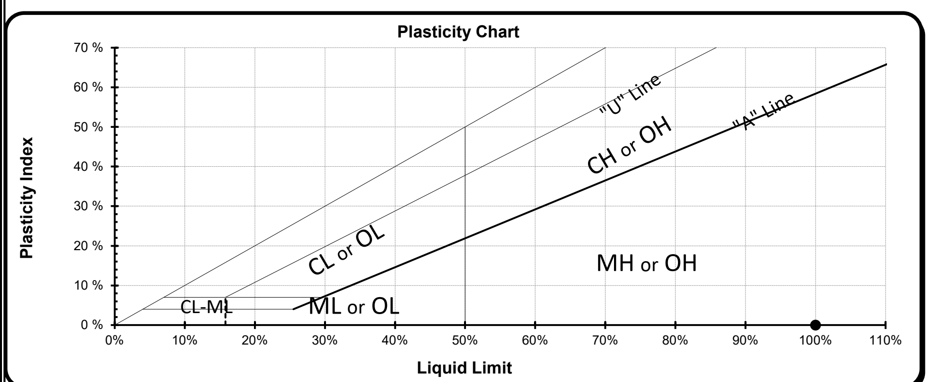
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to esablish liquid limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

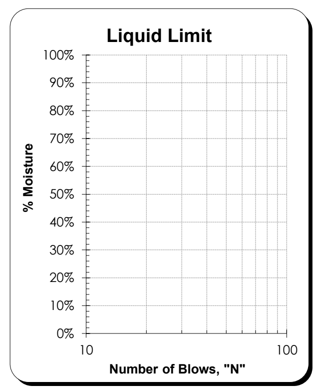
Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Cannot determined plastic limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Liquid limit cannot be established as the material displays rapid dilation. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the sample does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Corporate ~ 777 Chrysler Drive • Burlington, WA 98233 • Phone (360) 755-1990 • Fax (360) 755-1980
Regional Offices: Olympia ~ 360.534.9777 Bellingham ~ 360.647.6111 Silverdale ~ 360.698.6787 Tukwila ~ 206.241.1974
Visit our website: www.mtc-inc.net

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT33-GB-21-26.8 ft
Sample#: B21-1828

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Sep-21
Tested By: K. Mendez

Unified Soils Classification System, ASTM D-2487
ML, Sandy Silt
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

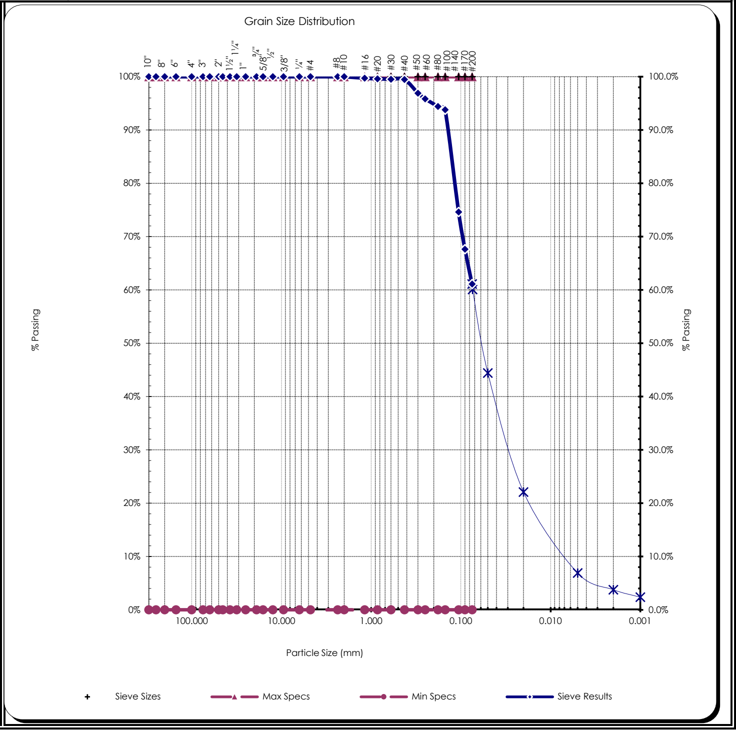
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.004 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 2.51
$D_{(10)}$ = 0.007 mm	% Sand = 38.9%	Coeff. of Uniformity, C_U = 10.39
$D_{(15)}$ = 0.010 mm	% Silt & Clay = 61.1%	Fineness Modulus = 0.10
$D_{(30)}$ = 0.036 mm	Liquid Limit = 0.0%	Plastic Limit = 0.0%
$D_{(50)}$ = 0.064 mm	Plasticity Index = 0.0%	Moisture %, as sampled = 34.4%
$D_{(60)}$ = 0.074 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.141 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 43/70	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		100%	100.0%	0.0%
#30	0.600		100%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		97%	100.0%	0.0%
#60	0.250		96%	100.0%	0.0%
#80	0.180		94%	100.0%	0.0%
#100	0.150	94%	94%	100.0%	0.0%
#140	0.106		75%	100.0%	0.0%
#170	0.090		68%	100.0%	0.0%
#200	0.075	61.1%	61.1%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Hydrometer Report

Project: Q.C. - Lower Duwamish Waterway	**Date Received:** 29-Jul-21	**Unified Soils Classification System, ASTM D-2487**
Project #: 21B233	**Sampled By:** Client	ML, Sandy Silt
Client : Anchor QEA	**Date Tested:** 25-Sep-21	**Sample Color**
Source: LDW21-GT33-GB-21-26.8 ft	**Tested By:** K. Mendez	brown
Sample#: B21-1828		

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	75.85	grams
Hydroscopic Moist.:	3.68%	
Adj. Sample Wgt :	73.16	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	25	34.2%	0.0477 mm
2	21.5	29.4%	0.0347 mm
5	17.5	23.9%	0.0224 mm
15	12.5	17.1%	0.0133 mm
30	10.5	14.4%	0.0096 mm
60	7	9.6%	0.0069 mm
240	3.5	4.8%	0.0035 mm
1440	2.5	3.4%	0.0014 mm

% Gravel:	0.0%	**Liquid Limit:**	0.0 %
% Sand:	38.9%	**Plastic Limit:**	0.0 %
% Silt:	54.2%	**Plasticity Index:**	0.0 %
% Clay:	6.9%		

ASTM D6913

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	100%	4.750 mm
#10	100%	2.000 mm
#20	100%	0.850 mm
#40	99%	0.425 mm
#100	94%	0.150 mm
#200	61.1%	0.075 mm
Silts	60.1%	0.074 mm
	44.4%	0.050 mm
	22.1%	0.020 mm
Clays	6.9%	0.005 mm
	3.8%	0.002 mm
Colloids	2.4%	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: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA, LLC	**Date Tested:**	25-Sep-21
Source:	LDW21-GT33-GB-21-26.8 ft	**Tested By:**	K. Mendez
Sample #:	B21-1828		

Unified Soils Classification System, ASTM D-2487
ML, Sandy Silt
Sample Color
brown

Liquid Limit Determination

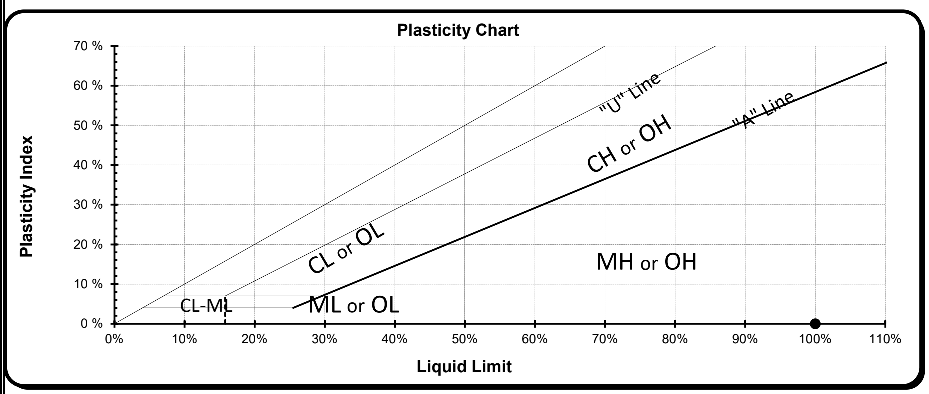
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to esablish liquid limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

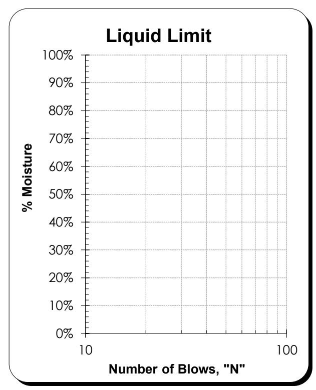
Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Cannot determined plastic limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Liquid limit cannot be established as the material displays rapid dilation. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the sample does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.
Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA, LLC
Source: LDW21-GT33-GB-26.8-28.8 ft
Sample #: B21-1829

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Sep-21
Tested By: K. Mendez

Visual Identification
Silty Sand
Sample Color
brown

Liquid Limit Determination

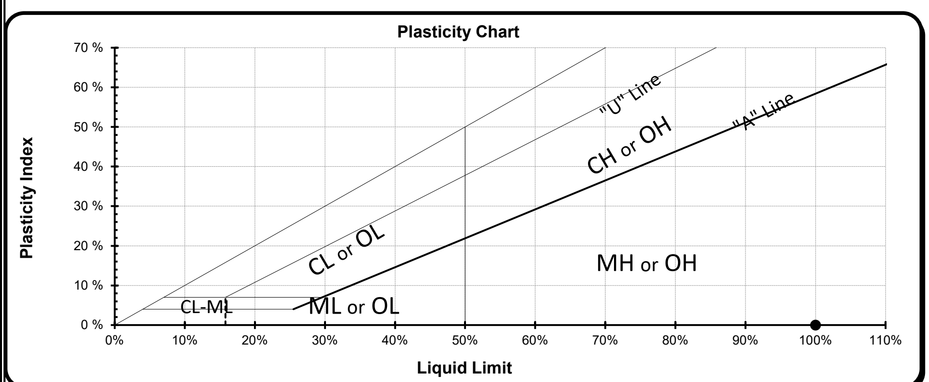
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to esablish liquid limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

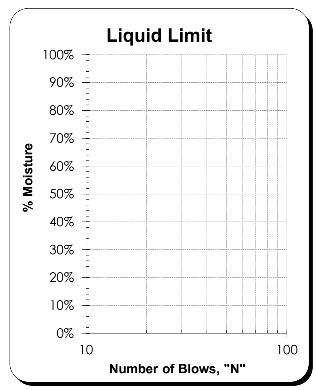
Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Cannot determined plastic limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Liquid limit cannot be established as the material displays rapid dilation. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the sample does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT33-GB-28.8-29.5 ft
Sample#: B21-1830

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Sep-21
Tested By: K. Mendez

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

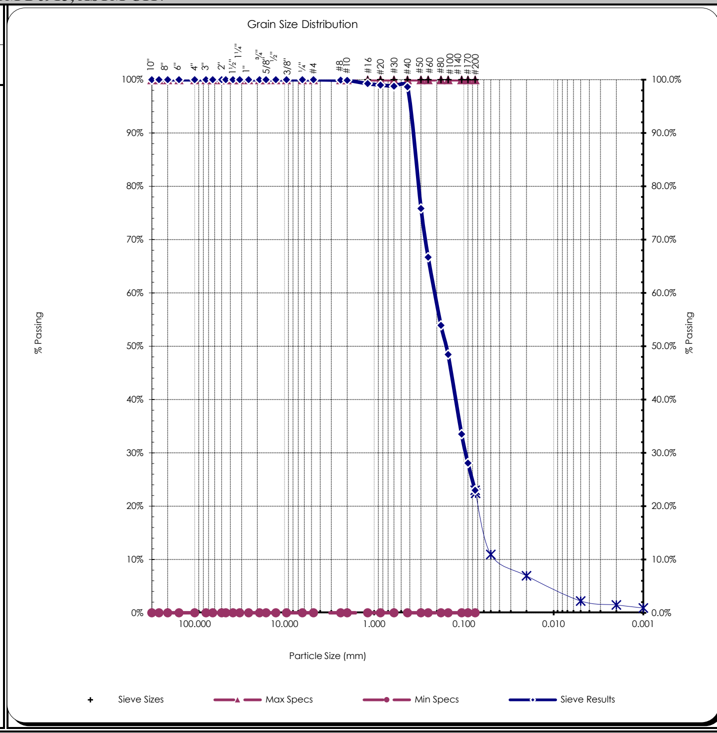
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.010 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 0.90
$D_{(10)}$ = 0.047 mm	% Sand = 77.0%	Coeff. of Uniformity, C_U = 4.50
$D_{(15)}$ = 0.061 mm	% Silt & Clay = 23.0%	Fineness Modulus = 0.78
$D_{(30)}$ = 0.096 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.158 mm	Plasticity Index = n/a	Moisture %, as sampled = 33.6%
$D_{(60)}$ = 0.213 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.378 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 7/30	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		76%	100.0%	0.0%
#60	0.250		67%	100.0%	0.0%
#80	0.180		54%	100.0%	0.0%
#100	0.150	48%	48%	100.0%	0.0%
#140	0.106		34%	100.0%	0.0%
#170	0.090		28%	100.0%	0.0%
#200	0.075	23.0%	23.0%	100.0%	0.0%



Comments:

Reviewed by:
Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	25-Sep-21
Source:	LDW21-GT33-GB-28.8-29.5 ft	**Tested By:**	K. Mendez
Sample#:	B21-1830		

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	80.02	grams
Hydroscopic Moist.:	4.80%	
Adj. Sample Wgt :	76.35	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	8	10.5%	0.0529 mm
2	7	9.2%	0.0376 mm
5	5.5	7.2%	0.0240 mm
15	5	6.5%	0.0139 mm
30	4	5.2%	0.0098 mm
60	2	2.6%	0.0070 mm
240	1.5	2.0%	0.0035 mm
1440	1	1.3%	0.0014 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	77.0%	**Plastic Limit:**	n/a
% Silt:	20.8%	**Plasticity Index:**	n/a
% Clay:	2.2%		

ASTM D6913

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	100%	4.750 mm
#10	100%	2.000 mm
#20	99%	0.850 mm
#40	99%	0.425 mm
#100	48%	0.150 mm
#200	23.0%	0.075 mm
Silts	22.4%	0.074 mm
	10.9%	0.050 mm
	6.9%	0.020 mm
Clays	2.2%	0.005 mm
	1.5%	0.002 mm
Colloids	0.9%	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

Sand

Comments:

Reviewed by: Megh Blodgett Carrillo
Meghan Blodgett-Carrillo

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA, LLC
Source: LDW21-GT33-GB-29.5-31 ft
Sample #: B21-1831

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 25-Sep-21
Tested By: K. Mendez

Visual Identification
Sandy Silt
Sample Color
brown

Liquid Limit Determination

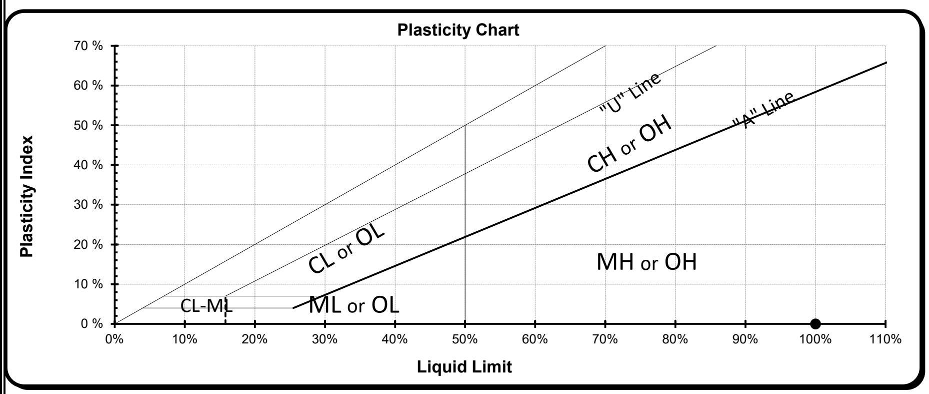
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to esablish liquid limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

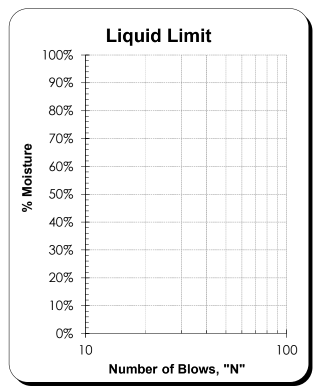
Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Cannot determined plastic limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Liquid limit cannot be established as the material displays rapid dilation. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the sample does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

Client:	Anchor QEA	**Date:**	October 19, 2021
Address:	21328 2nd Drive SE	**Project:**	Q.C. - Lower Duwamish Waterway
	Bothell, WA 98021	**Project #:**	21B233
Attn:	Garrett Timm	**Sample #:**	B21-1948 - 1965
Revised on:		**Date sampled:**	July 16, 2021

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	Please See Attached Reports		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count			LA Abrasion	
X	Moisture Content	Please See Attached Report	X	Direct Shear	Please See Attached Reports
	Specific Gravity, Coarse		X	Specific Gravity, Soils	Please See Attached Reports
	Specific Gravity, Fine				
X	Hydrometer Analysis	Please See Attached Reports			
X	Atterberg Limits	Please See Attached Reports			

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Respectfully Submitted,
Meghan Blodgett-Carrillo
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM C566, ASTM D2216

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: October 1, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B21-1948	LDW21-GT39-GB-0-1.5 ft	182.2	359.3	304.7	54.6	122.5	44.6%
B21-1949	LDW21-GT39-GB-0-8.8 ft	229.5	1120.6	890.6	230.0	661.1	34.8%
B21-1950	LDW21-GT39-GB-8.8-10.5 ft	234.3	1839.1	1517.6	321.5	1283.3	25.1%
B21-1951	LDW21-GT39-GB-10.5-12 ft	222.9	1270.1	1072.1	198.0	849.2	23.3%
B21-1952	LDW21-GT39-GB-10.5-20.5 ft	228.8	652.9	584.6	68.3	355.8	19.2%
B21-1953	LDW21-GT39-GB-20.5-21 ft	225.2	577.3	508.6	68.7	283.4	24.2%
B21-1954	LDW21-GT39-GB-20.5-30.5 ft	234.4	1327.0	1148.4	178.6	914.0	19.5%
B21-1955	LDW21-GT39-GB-30.5-32 ft	233.2	876.4	747.6	128.8	514.4	25.0%
B21-1956	LDW21-GT23-GB-0-1.5 ft	223.0	462.7	361.7	101.0	138.7	72.8%
B21-1957	LDW21-GT23-GB-0-8.2 ft	221.9	900.9	625.0	275.9	403.1	68.4%
B21-1958	LDW21-GT23-GB-8.5-10 ft	215.4	919.5	775.8	143.7	560.4	25.6%
B21-1959	LDW21-GT23-GB-8.5-17.6 ft	234.7	1060.0	934.4	125.6	699.7	18.0%
B21-1960	LDW21-GT23-GB-17.6-18.5 ft	217.3	972.1	771.5	200.6	554.2	36.2%
B21-1961	LDW21-GT23-GB-18.5-20 ft	270.1	687.9	581.4	106.5	311.3	34.2%
B21-1962	LDW21-GT23-GB-21.1-22.8 ft	222.3	1022.4	815.3	207.1	593.0	34.9%
B21-1963	LDW21-GT23-GB-22.8-26.8 ft	266.3	870.9	724.1	146.8	457.8	32.1%
B21-1964	LDW21-GT23-GB-27.7-28.5 ft	224.7	963.8	779.9	183.9	555.2	33.1%
B21-1965	LDW21-GT23-GB-30.5-32 ft	235.2	627.7	539.1	88.6	303.9	29.2%

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Moisture Content - ASTM D854

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: September 20, 2021
Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B21-1952	LDW21-GT39-GB-10.5-20.5 ft	493.16	568.87	75.7	TSA-014	192.3	499.5	0.99858	738.22	691.08	18.1	2.6499101	1.00037	2.6508905
B21-1957	LDW21-GT23-GB-0-8.2 ft	584.01	660.92	76.9	TSA-013	184.0	499.7	0.99858	729.36	682.95	18.1	2.5216018	1.00037	2.5225348

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA, LLC	**Date Tested:**	6-Oct-21
Source:	LDW21-GT39-GB-0-8.8 ft	**Tested By:**	C. Kriss
Sample #:	B21-1949		

Visual Identification
Silt with Sand
Sample Color
brown

Liquid Limit Determination

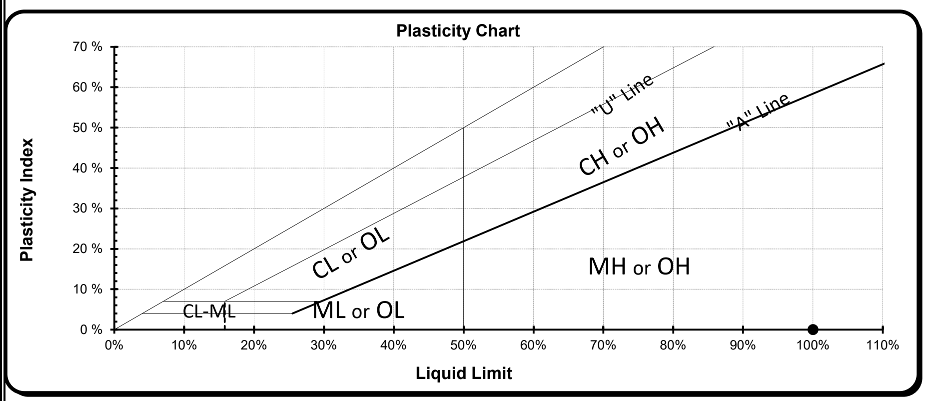
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to determine				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

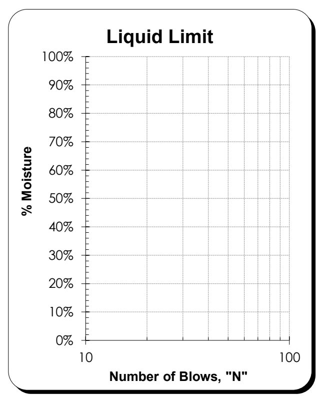
Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to establish				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Liquid limit cannot be determined as the material displays rapid dilation. At lower moistures the sample does not spread into the cup without tearing the soil cake. Unable to establish plastic limit as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Corporate ~ 777 Chrysler Drive • Burlington, WA 98233 • Phone (360) 755-1990 • Fax (360) 755-1980

Regional Offices: Olympia ~ 360.534.9777 Bellingham ~ 360.647.6111 Silverdale ~ 360.698.6787 Tukwila ~ 206.241.1974

Visit our website: www.mtc-inc.net

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	4-Oct-21
Source:	LDW21-GT39-GB-8.8-10.5 ft	**Tested By:**	K. Mendez
Sample#:	B21-1950		

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
grayish-brown

ACCREDITED
Certificate #: 1366.01

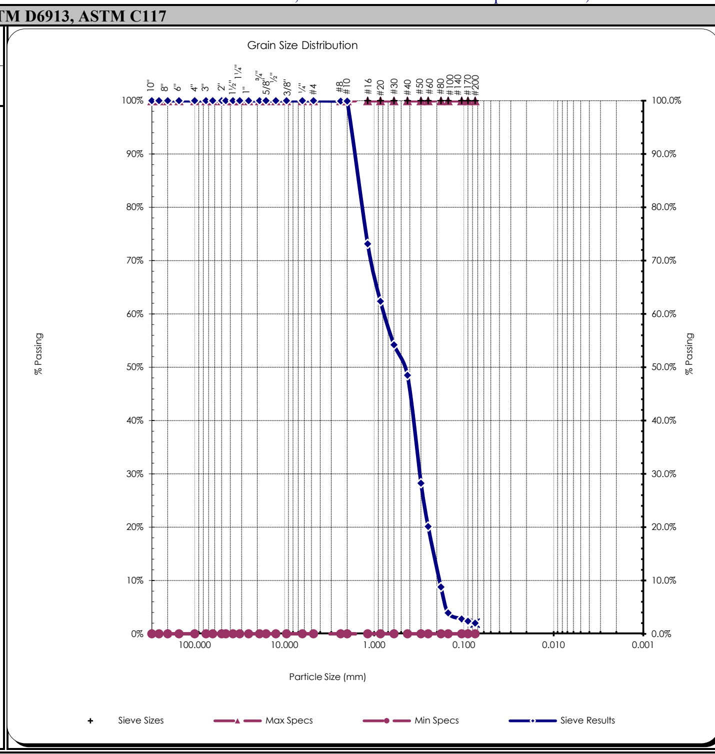
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.157 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 0.66
$D_{(10)}$ = 0.187 mm	% Sand = 98.0%	Coeff. of Uniformity, C_U = 4.15
$D_{(15)}$ = 0.218 mm	% Silt & Clay = 2.0%	Fineness Modulus = 2.40
$D_{(30)}$ = 0.311 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.471 mm	Plasticity Index = n/a	Moisture %, as sampled = 25.0%
$D_{(60)}$ = 0.777 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.696 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 1/24	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		73%	100.0%	0.0%
#20	0.850		62%	100.0%	0.0%
#30	0.600		54%	100.0%	0.0%
#40	0.425	49%	49%	100.0%	0.0%
#50	0.300		28%	100.0%	0.0%
#60	0.250		20%	100.0%	0.0%
#80	0.180		9%	100.0%	0.0%
#100	0.150	4%	4%	100.0%	0.0%
#140	0.106		3%	100.0%	0.0%
#170	0.090		2%	100.0%	0.0%
#200	0.075	2.0%	2.0%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT39-GB-10.5-20.5 ft
Sample#: B21-1952

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 4-Oct-21
Tested By: K. Mendez

Unified Soil Classification System, ASTM-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
grayish-brown

ACCREDITED
Certificate #: 1366.01

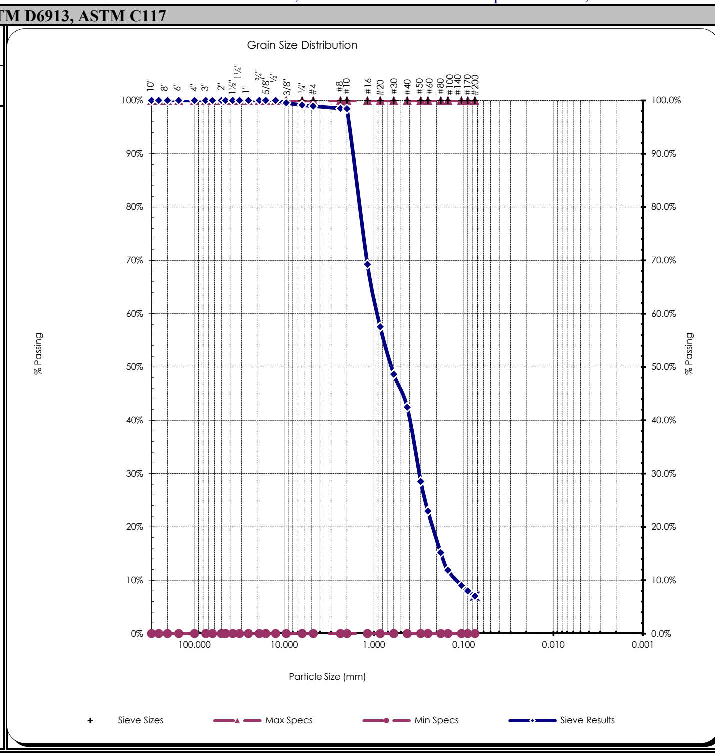
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.053 mm	% Gravel = 1.1%	Coeff. of Curvature, C_C = 0.88
$D_{(10)}$ = 0.121 mm	% Sand = 91.9%	Coeff. of Uniformity, C_U = 7.60
$D_{(15)}$ = 0.178 mm	% Silt & Clay = 7.0%	Fineness Modulus = 2.45
$D_{(30)}$ = 0.313 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.638 mm	Plasticity Index = n/a	Moisture %, as sampled = 19.2%
$D_{(60)}$ = 0.919 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.762 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 1/6	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		99%	100.0%	0.0%
#4	4.75	99%	99%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	98%	98%	100.0%	0.0%
#16	1.18		69%	100.0%	0.0%
#20	0.850		58%	100.0%	0.0%
#30	0.600		49%	100.0%	0.0%
#40	0.425	42%	42%	100.0%	0.0%
#50	0.300		29%	100.0%	0.0%
#60	0.250		23%	100.0%	0.0%
#80	0.180		15%	100.0%	0.0%
#100	0.150	12%	12%	100.0%	0.0%
#140	0.106		9%	100.0%	0.0%
#170	0.090		8%	100.0%	0.0%
#200	0.075	7.0%	7.0%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

MATERIALS TESTING & CONSULTING, INC.

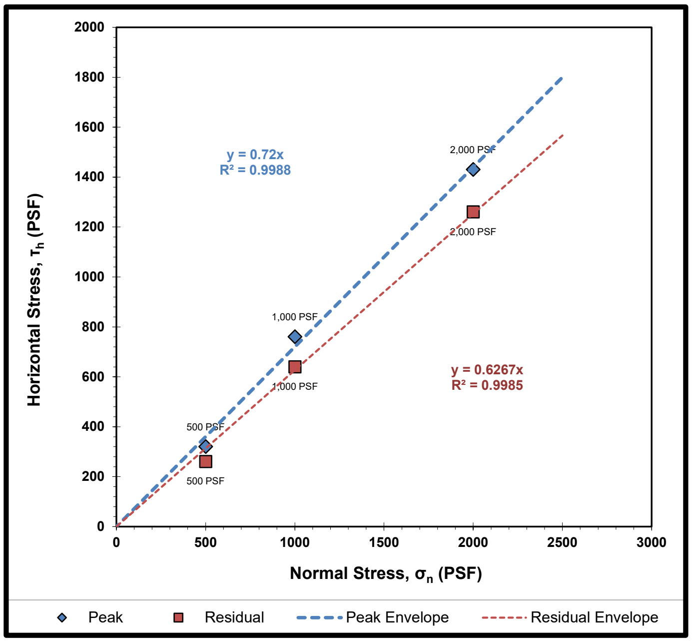
Project: Q.C. - Lower Duwamish Waterway

Project Number:	21B233	**Sample Source:**	LDW21-GT39-GB-10.5-20.5 ft
Laboratory Sample ID:	B21-1952	**Visual Soil Description:**	grayish-brown sand
Sample Date:	7/16/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	10/4/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	26.0	
	Initial	**Post-Consolidation**
Dry Density (PCF):	109.4	111.1
Void Ratio:	0.540	0.516
Porosity (%):	35.1	34.0
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	26.7	
	Initial	**Post-Consolidation**
Dry Density (PCF):	107.4	109.6
Void Ratio:	0.569	0.537
Porosity (%):	36.3	34.9
Degree of Saturation (%):	saturated	saturated

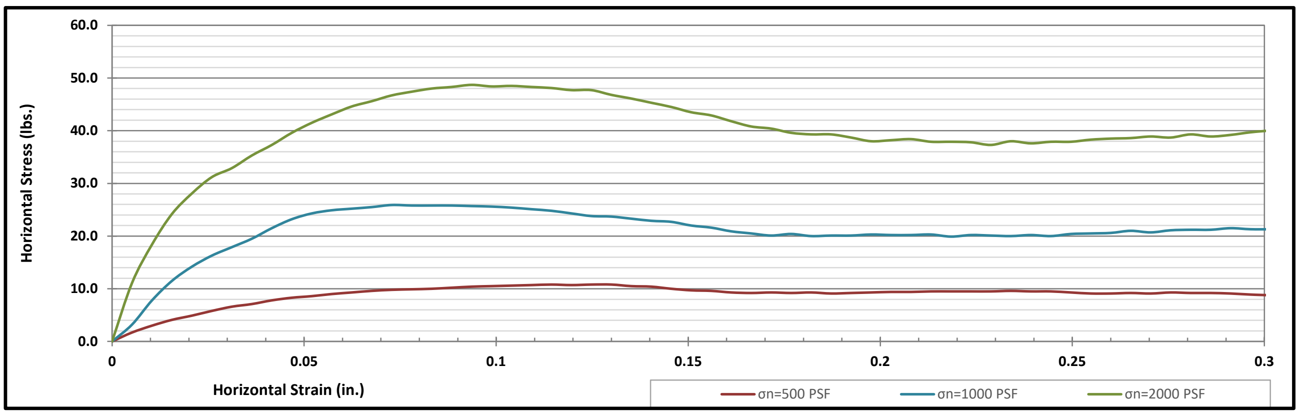
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	25.2	
	Initial	**Post-Consolidation**
Dry Density (PCF):	109.0	113.2
Void Ratio:	0.546	0.488
Porosity (%):	35.3	32.8
Degree of Saturation (%):	saturated	saturated

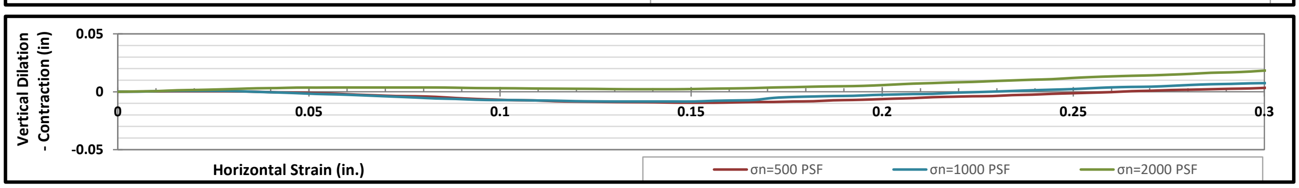


ESTIMATED STRENGTH PARAMETERS

	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	36	32
Cohesion (PSF):	0	0

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	320	760	1430
Residual Horizontal Stress, τ_h (PSF):	260	640	1260





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT39-GB-20.5-30.5 ft
Sample#: B21-1954

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 4-Oct-21
Tested By: K. Mendez

Unified Soil Classification System, ASTM-2487
SP, Poorly graded Sand
Sample Color:
gray

ACCREDITED
Certificate #: 1366.01

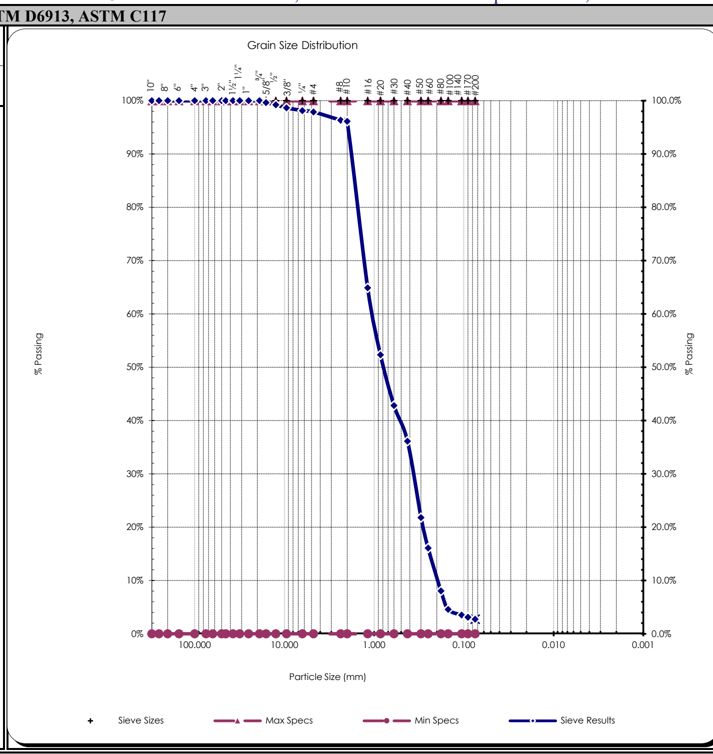
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.153 mm	% Gravel = 2.1%	Coeff. of Curvature, C_C = 0.67
$D_{(10)}$ = 0.197 mm	% Sand = 95.1%	Coeff. of Uniformity, C_U = 5.34
$D_{(15)}$ = 0.241 mm	% Silt & Clay = 2.8%	Fineness Modulus = 2.73
$D_{(30)}$ = 0.371 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.789 mm	Plasticity Index = n/a	Moisture %, as sampled = 19.5%
$D_{(60)}$ = 1.051 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.839 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 1/13	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	99%	99%	100.0%	0.0%
3/8"	9.50	99%	99%	100.0%	0.0%
1/4"	6.30		98%	100.0%	0.0%
#4	4.75	98%	98%	100.0%	0.0%
#8	2.36		96%	100.0%	0.0%
#10	2.00	96%	96%	100.0%	0.0%
#16	1.18		65%	100.0%	0.0%
#20	0.850		52%	100.0%	0.0%
#30	0.600		43%	100.0%	0.0%
#40	0.425	36%	36%	100.0%	0.0%
#50	0.300		22%	100.0%	0.0%
#60	0.250		16%	100.0%	0.0%
#80	0.180		8%	100.0%	0.0%
#100	0.150	5%	5%	100.0%	0.0%
#140	0.106		4%	100.0%	0.0%
#170	0.090		3%	100.0%	0.0%
#200	0.075	2.8%	2.8%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.
Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA, LLC	**Date Tested:**	6-Oct-21
Source:	LDW21-GT23-GB-0-8.2 ft	**Tested By:**	C. Kriss
Sample #:	B21-1957		

Visual Identification
Silt with Sand
Sample Color
brown

Liquid Limit Determination

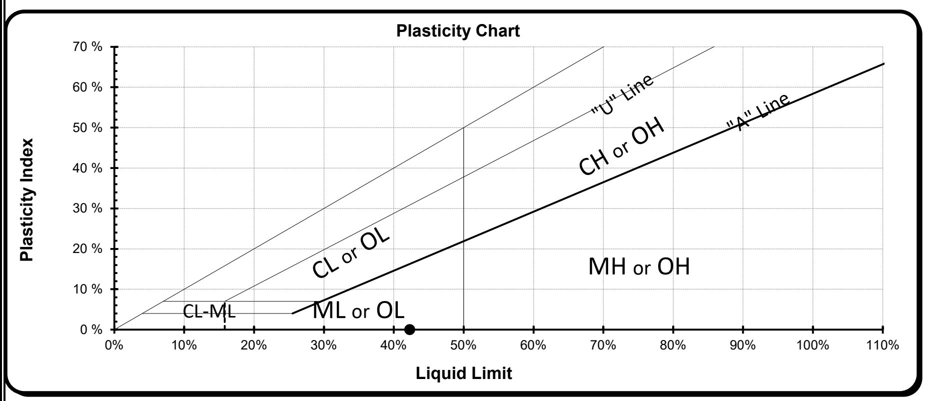
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	33.87	31.07	35.40			
Weight of Dry Soils + Pan:	29.74	27.66	30.53			
Weight of Pan:	19.98	19.72	19.51			
Weight of Dry Soils:	9.76	7.94	11.02			
Weight of Moisture:	4.13	3.41	4.87			
% Moisture:	42.3 %	43.0 %	44.2 %			
Number of Blows:	25	20	13			

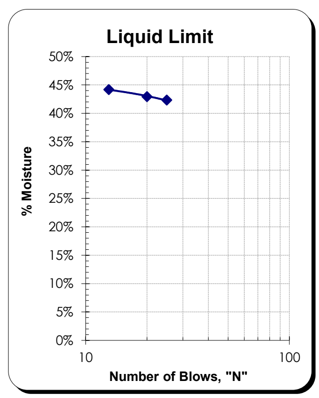
Liquid Limit @ 25 Blows:	42 %
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to establish				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Unable to establish plastic limit as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT23-GB-8.5-17.6 ft
Sample#: B21-1959

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 4-Oct-21
Tested By: K. Mendez

Unified Soil Classification System, ASTM-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
grayish-brown

ACCREDITED
Certificate #: 1366.01

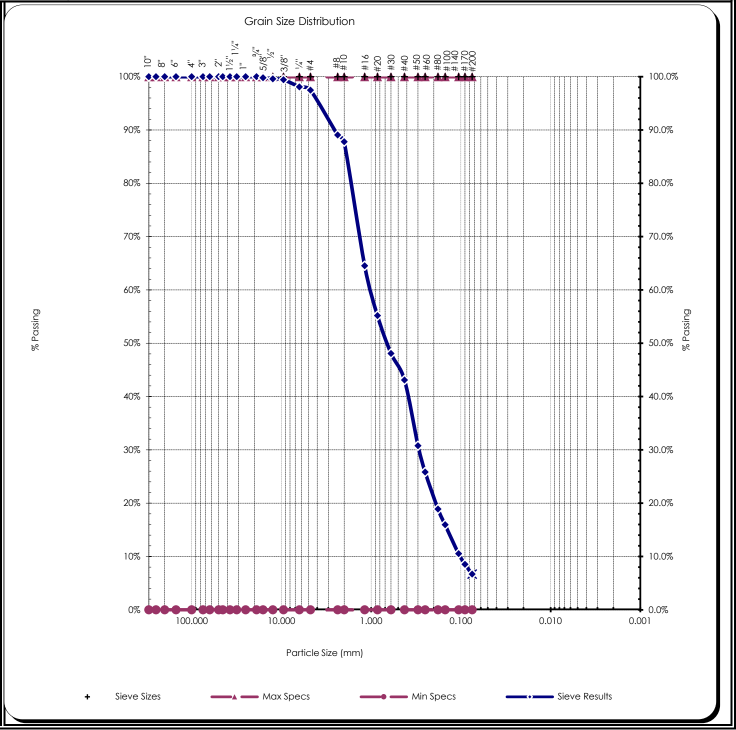
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.056 mm	% Gravel = 2.5%	Coeff. of Curvature, C_C = 0.82
$D_{(10)}$ = 0.102 mm	% Sand = 90.8%	Coeff. of Uniformity, C_U = 10.03
$D_{(15)}$ = 0.142 mm	% Silt & Clay = 6.7%	Fineness Modulus = 2.55
$D_{(30)}$ = 0.292 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.667 mm	Plasticity Index = n/a	Moisture %, as sampled = 18.0%
$D_{(60)}$ = 1.020 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 2.624 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 7/45	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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		98%	100.0%	0.0%
#4	4.75	97%	97%	100.0%	0.0%
#8	2.36		89%	100.0%	0.0%
#10	2.00	88%	88%	100.0%	0.0%
#16	1.18		65%	100.0%	0.0%
#20	0.850		55%	100.0%	0.0%
#30	0.600		48%	100.0%	0.0%
#40	0.425	43%	43%	100.0%	0.0%
#50	0.300		31%	100.0%	0.0%
#60	0.250		26%	100.0%	0.0%
#80	0.180		19%	100.0%	0.0%
#100	0.150	16%	16%	100.0%	0.0%
#140	0.106		11%	100.0%	0.0%
#170	0.090		9%	100.0%	0.0%
#200	0.075	6.7%	6.7%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

MATERIALS TESTING & CONSULTING, INC.

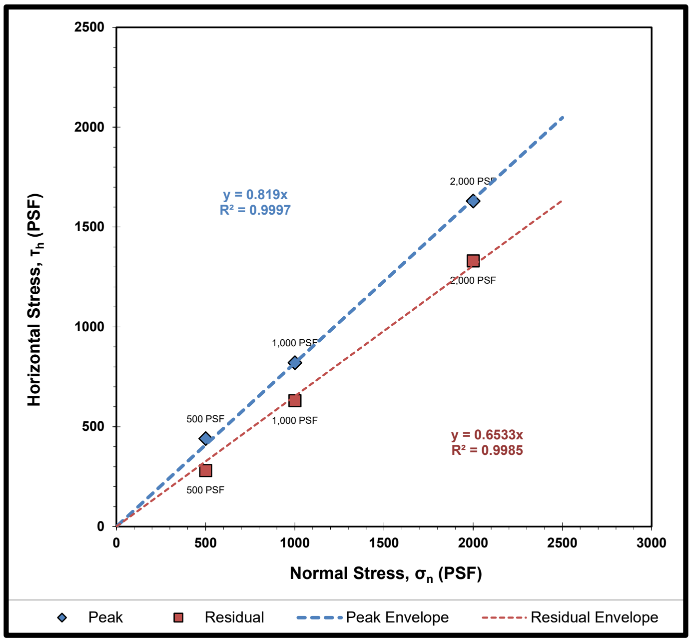
Project: Q.C. - Lower Duwamish Waterway

Project Number:	21B233	**Sample Source:**	LDW21-GT23-GB-8.5-17.6 ft
Laboratory Sample ID:	B21-1959	**Visual Soil Description:**	grayish-brown sand
Sample Date:	7/16/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	10/5/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	22.6	
	Initial	**Post-Consolidation**
Dry Density (PCF):	109.4	111.1
Void Ratio:	0.539	0.517
Porosity (%):	35.0	34.1
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	22.2	
	Initial	**Post-Consolidation**
Dry Density (PCF):	110.1	111.8
Void Ratio:	0.531	0.507
Porosity (%):	34.7	33.7
Degree of Saturation (%):	saturated	saturated

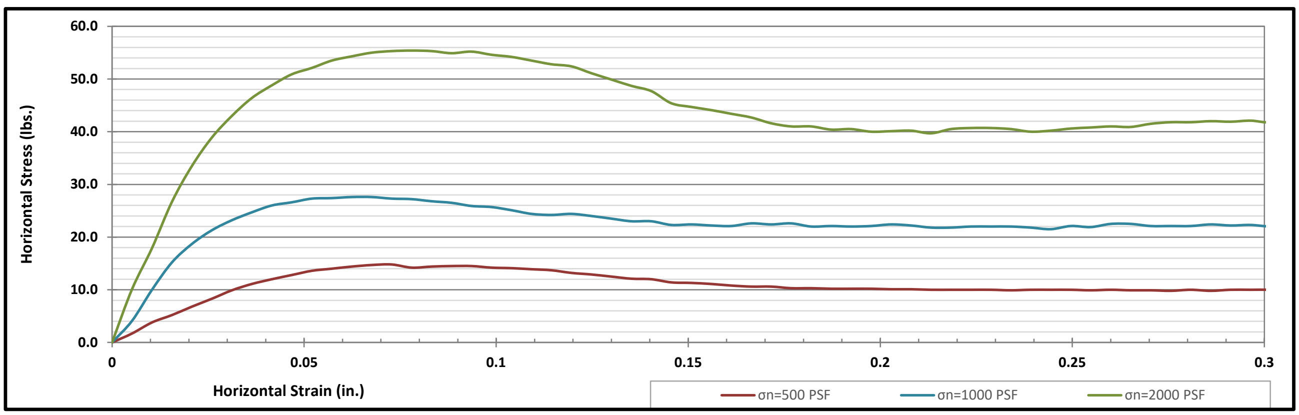
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	23.3	
	Initial	**Post-Consolidation**
Dry Density (PCF):	109.0	114.1
Void Ratio:	0.545	0.476
Porosity (%):	35.3	32.3
Degree of Saturation (%):	saturated	saturated

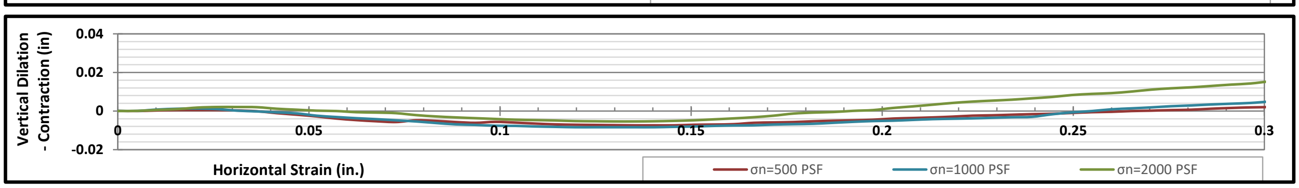


ESTIMATED STRENGTH PARAMETERS

	PEAK	RESIDUAL
Angle of Internal Friction, ϕ (°):	**39**	**33**
Cohesion (PSF):	**0**	**0**

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	440	820	1630
Residual Horizontal Stress, τ_h (PSF):	280	630	1330





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	4-Oct-21
Source:	LDW21-GT23-GB-17.6-18.5 ft	**Tested By:**	K. Mendez
Sample#:	B21-1960		

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

ACCREDITED
Certificate #: 1366.01

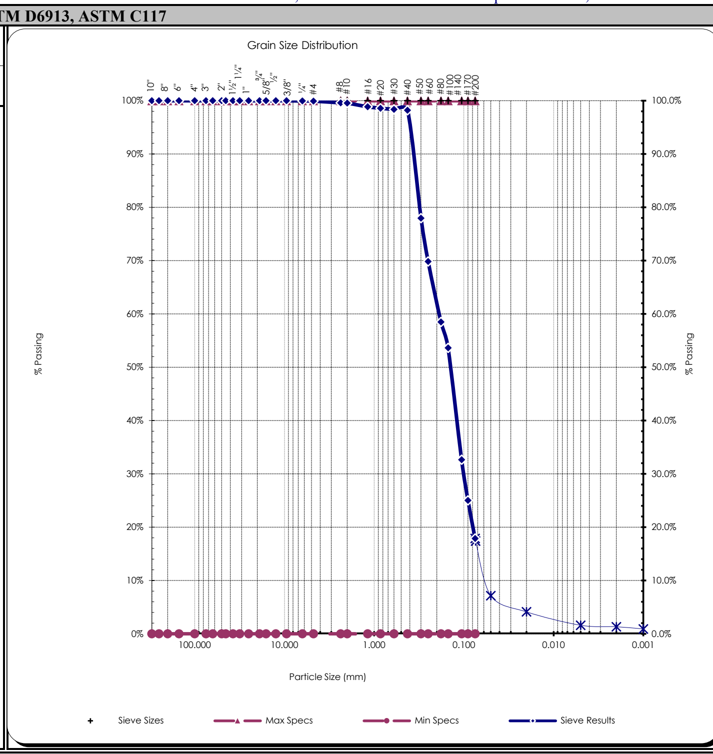
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.028 mm	% Gravel = 0.1%	Coeff. of Curvature, C_C = 0.90
$D_{(10)}$ = 0.059 mm	% Sand = 82.0%	Coeff. of Uniformity, C_U = 3.20
$D_{(15)}$ = 0.069 mm	% Silt & Clay = 17.9%	Fineness Modulus = 0.72
$D_{(30)}$ = 0.100 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.142 mm	Plasticity Index = n/a	Moisture %, as sampled = 36.2%
$D_{(60)}$ = 0.189 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.374 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 2/11	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		98%	100.0%	0.0%
#40	0.425	98%	98%	100.0%	0.0%
#50	0.300		78%	100.0%	0.0%
#60	0.250		70%	100.0%	0.0%
#80	0.180		59%	100.0%	0.0%
#100	0.150	54%	54%	100.0%	0.0%
#140	0.106		33%	100.0%	0.0%
#170	0.090		25%	100.0%	0.0%
#200	0.075	17.9%	17.9%	100.0%	0.0%



Comments:

Reviewed by:

Meghan Blodgett-Carrillo

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	4-Oct-21
Source:	LDW21-GT23-GB-17.6-18.5 ft	**Tested By:**	K. Mendez
Sample#:	B21-1960		

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

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	75.28	grams
Hydroscopic Moist.:	1.16%	
Adj. Sample Wgt :	74.42	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	5.5	7.4%	0.0537 mm
2	4.5	6.0%	0.0381 mm
5	3.5	4.7%	0.0243 mm
15	2.5	3.3%	0.0141 mm
30	2	2.7%	0.0100 mm
60	1.5	2.0%	0.0071 mm
240	1	1.3%	0.0035 mm
1440	1	1.3%	0.0014 mm

% Gravel:	0.1%	**Liquid Limit:**	n/a
% Sand:	82.0%	**Plastic Limit:**	n/a
% Silt:	16.3%	**Plasticity Index:**	n/a
% Clay:	1.6%		

ASTM D6913

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	100%	4.750 mm
	#10	100%	2.000 mm
	#20	99%	0.850 mm
	#40	98%	0.425 mm
	#100	54%	0.150 mm
	#200	17.9%	0.075 mm
Silts		17.4%	0.074 mm
		7.2%	0.050 mm
		4.1%	0.020 mm
Clays		1.6%	0.005 mm
		1.3%	0.002 mm
Colloids		0.9%	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
Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

MATERIALS TESTING & CONSULTING, INC.

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA, LLC	**Date Tested:**	6-Oct-21
Source:	LDW21-GT23-GB-21.1-22.8 ft	**Tested By:**	C. Kriss
Sample #:	B21-1962		

Visual Identification
Sandy Silt
Sample Color
brown

Liquid Limit Determination

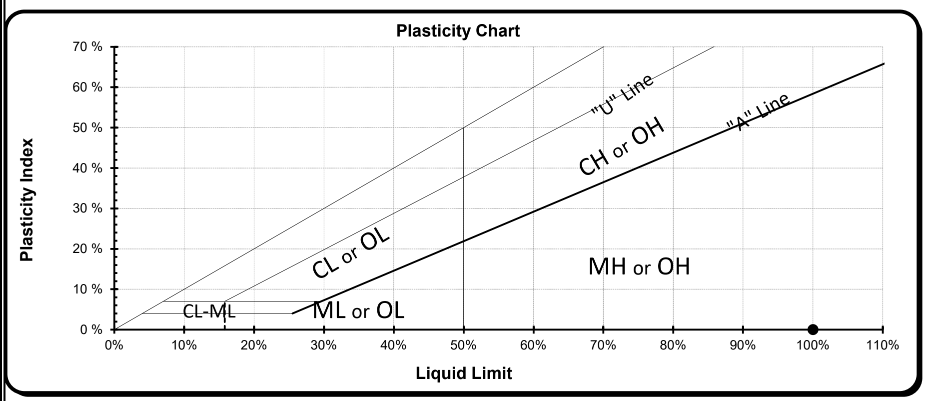
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to determine				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

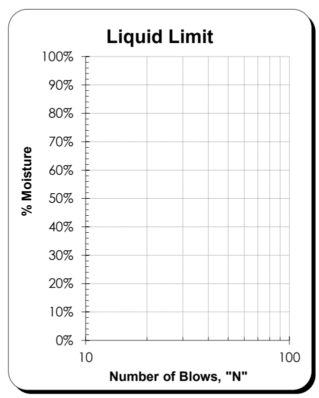
Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to establish				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Liquid limit cannot be determined as the material displays rapid dilation. At lower moistures the sample does not spread into the cup without tearing the soil cake. Unable to establish plastic limit as the material does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Corporate ~ 777 Chrysler Drive • Burlington, WA 98233 • Phone (360) 755-1990 • Fax (360) 755-1980

Regional Offices: Olympia ~ 360.534.9777 Bellingham ~ 360.647.6111 Silverdale ~ 360.698.6787 Tukwila ~ 206.241.1974

Visit our website: www.mtc-inc.net

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	4-Oct-21
Source:	LDW21-GT23-GB-22.8-26.8 ft	**Tested By:**	K. Mendez
Sample#:	B21-1963		

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

ACCREDITED
Certificate #: 1366.01

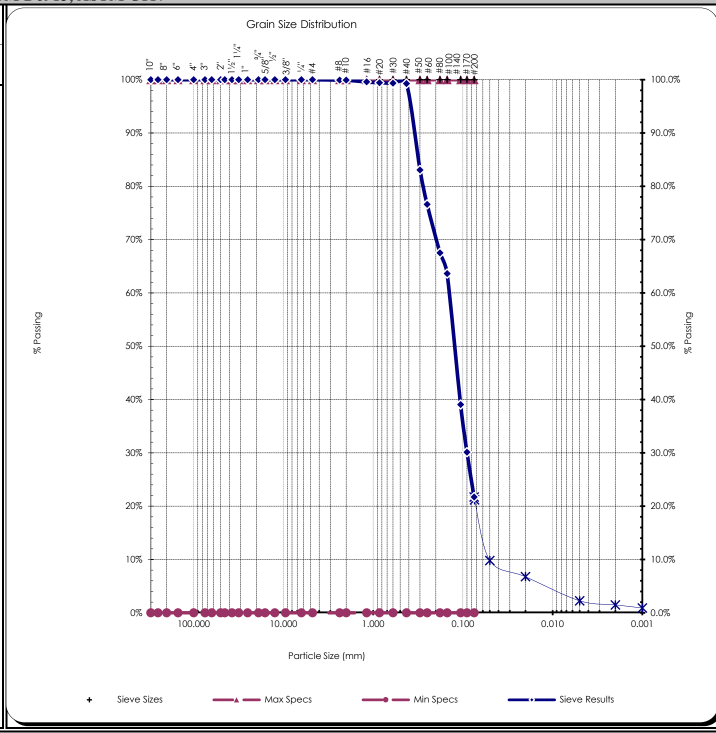
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.011	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C =	1.05
$D_{(10)}$ =	0.053	mm	% Sand =	78.3%	Coeff. of Uniformity, C_U =	2.69
$D_{(15)}$ =	0.063	mm	% Silt & Clay =	21.7%	Fineness Modulus =	0.54
$D_{(30)}$ =	0.090	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.126	mm	Plasticity Index =	n/a	Moisture %, as sampled =	32.1%
$D_{(60)}$ =	0.143	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	0.353	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	7/32		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		83%	100.0%	0.0%
#60	0.250		77%	100.0%	0.0%
#80	0.180		68%	100.0%	0.0%
#100	0.150	64%	64%	100.0%	0.0%
#140	0.106		39%	100.0%	0.0%
#170	0.090		30%	100.0%	0.0%
#200	0.075	21.7%	21.7%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	4-Oct-21
Source:	LDW21-GT23-GB-22.8-26.8 ft	**Tested By:**	K. Mendez
Sample#:	B21-1963		

Unified Soil Classification System, ASTM-2487
SM, Silty Sand

Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	76.06	grams
Hydroscopic Moist.:	1.08%	
Adj. Sample Wgt :	75.25	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	7.5	10.0%	0.0532 mm
2	6.5	8.6%	0.0378 mm
5	5.5	7.3%	0.0240 mm
15	4.5	6.0%	0.0139 mm
30	3.5	4.6%	0.0099 mm
60	2	2.7%	0.0070 mm
240	1.5	2.0%	0.0035 mm
1440	1	1.3%	0.0014 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	78.3%	**Plastic Limit:**	n/a
% Silt:	19.5%	**Plasticity Index:**	n/a
% Clay:	2.3%		

ASTM D6913

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	100%	4.750 mm
#10	100%	2.000 mm
#20	99%	0.850 mm
#40	99%	0.425 mm
#100	64%	0.150 mm
#200	21.7%	0.075 mm
Silts	21.2%	0.074 mm
	9.8%	0.050 mm
	6.8%	0.020 mm
Clays	2.3%	0.005 mm
	1.5%	0.002 mm
Colloids	0.9%	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
Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Client:	Anchor QEA	**Date:**	October 19, 2021
Address:	21328 2nd Drive SE	**Project:**	Q.C. - Lower Duwamish Waterway
	Bothell, WA 98021	**Project #:**	21B233
Attn:	Garrett Timm	**Sample #:**	B21-2050-2069
Revised on:		**Date sampled:**	8-4-21 & 8-5-21

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	Please See Attached Reports		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count			LA Abrasion	
X	Moisture Content	Please See Attached Report	**X**	Direct Shear	Please See Attached Reports
	Specific Gravity, Coarse		**X**	Specific Gravity, Soils	Please See Attached Reports
	Specific Gravity, Fine				
X	Hydrometer Analysis	Please See Attached Reports			
X	Atterberg Limits	Please See Attached Reports			

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Respectfully Submitted,
Meghan Blodgett-Carrillo
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM C566, ASTM D2216

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: October 8, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B21-2050	LDW21-GT44-GB-0-5 ft	341.8	1294.0	1086.4	207.6	744.6	27.9%
B21-2051	LDW21-GT44-GB-5-6.1 ft	354.2	977.3	871.3	106.0	517.1	20.5%
B21-2052	LDW21-GT44-GB-6.1-6.5 ft	359.6	665.7	593.5	72.2	233.9	30.9%
B21-2053	LDW21-GT44-GB-5-10 ft	357.1	1289.6	1063.4	226.2	706.3	32.0%
B21-2054	LDW21-GT44-GB-10-11.5 ft	360.2	1379.9	1209.6	170.3	849.4	20.0%
B21-2055	LDW21-GT44-GB-10-15 ft	346.4	1230.1	1027.5	202.6	681.1	29.7%
B21-2056	LDW21-GT44-GB-15.5-16.5 ft	225.1	974.7	803.8	170.9	578.7	29.5%
B21-2057	LDW21-GT44-GB-15-20 ft	266.4	1004.4	805.9	198.5	539.5	36.8%
B21-2058	LDW21-GT44-GB-20-21.5 ft	301.2	1328.5	1051.3	277.2	750.1	37.0%
B21-2059	LDW21-GT44-GB-20-25 ft	224.4	1222.2	950.5	271.7	726.1	37.4%
B21-2060	LDW21-GT44-GB-25-28.7 ft	270.1	1116.1	1011.0	105.1	740.9	14.2%
B21-2061	LDW21-GT44-GB-28.7-30 ft	182.4	916.9	718.4	198.5	536.0	37.0%
B21-2062	LDW21-GT44-GB-30-31.5 ft	220.5	1200.8	943.4	257.4	722.9	35.6%
B21-2063	LDW21-GT48-GB-0-5 ft	234.7	1032.0	887.3	144.7	652.6	22.2%
B21-2064	LDW21-GT48-GB-5-6.5 ft	221.5	1216.7	1036.8	179.9	815.3	22.1%
B21-2065	LDW21-GT48-GB-5-10 ft	233.9	698.1	566.7	131.4	332.8	39.5%
B21-2066	LDW21-GT48-GB-10-15 ft	233.2	798.5	665.7	132.8	432.5	30.7%
B21-2067	LDW21-GT48-GB-15-18.2 ft	224.4	960.1	827.8	132.3	603.4	21.9%
B21-2068	LDW21-GT48-GB-18.2-19.5 ft	221.9	948.5	777.2	171.3	555.3	30.8%
B21-2069	LDW21-GT48-GB-20-21.6 ft	306.7	947.8	795.3	152.5	488.6	31.2%

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM D854

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: September 20, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B21-2055	LDW21-GT44-GB-10-15 ft	497.91	595.93	98.0	TSA-017	187.9	499.4	0.99858	747.34	686.58	18.1	2.630647	1.00037	2.6316204
B21-2066	LDW21-GT48-GB-10-15 ft	510.08	607.93	97.9	TSA-011	190.3	499.5	0.99856	749.61	689.15	18.2	2.6169635	1.00035	2.6178795

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT44-GB-0-5 ft
Sample#: B21-2050

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 8-Oct-21
Tested By: A. Eifrig

Unified Soil Classification System, ASTM-2487
SW-SC, Well-graded Sand with Silty Clay
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

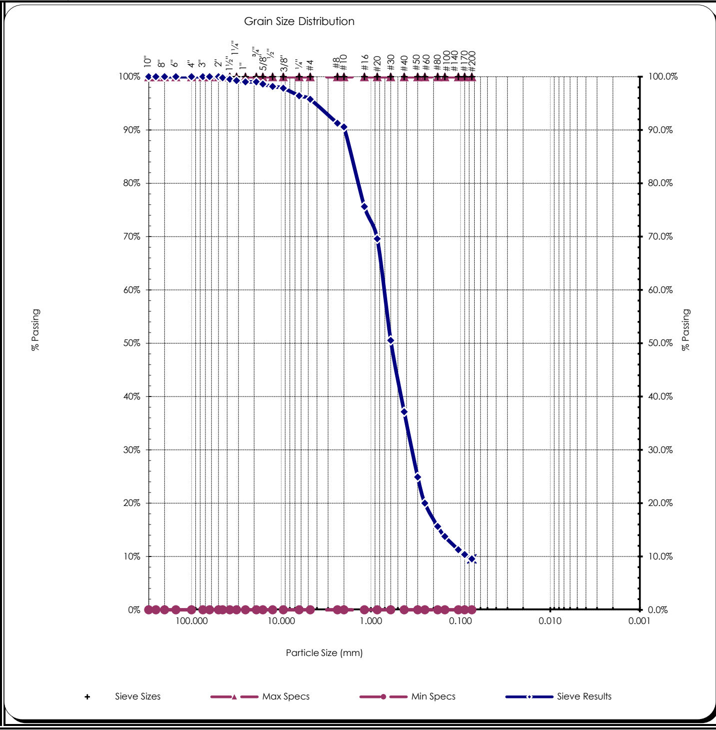
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.039 mm	% Gravel = 4.2%	Coeff. of Curvature, C_C = 2.07
$D_{(10)}$ = 0.083 mm	% Sand = 86.2%	Coeff. of Uniformity, C_U = 8.74
$D_{(15)}$ = 0.170 mm	% Silt & Clay = 9.6%	Fineness Modulus = 2.51
$D_{(30)}$ = 0.352 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.593 mm	Plasticity Index = n/a	Moisture %, as sampled = 27.9%
$D_{(60)}$ = 0.724 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.967 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 9/35	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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		99%	100.0%	0.0%
1.00"	25.00	99%	99%	100.0%	0.0%
3/4"	19.00	99%	99%	100.0%	0.0%
5/8"	16.00		99%	100.0%	0.0%
1/2"	12.50	98%	98%	100.0%	0.0%
3/8"	9.50	98%	98%	100.0%	0.0%
1/4"	6.30		96%	100.0%	0.0%
#4	4.75	96%	96%	100.0%	0.0%
#8	2.36		91%	100.0%	0.0%
#10	2.00	91%	91%	100.0%	0.0%
#16	1.18		76%	100.0%	0.0%
#20	0.850	70%	70%	100.0%	0.0%
#30	0.600		51%	100.0%	0.0%
#40	0.425	37%	37%	100.0%	0.0%
#50	0.300		25%	100.0%	0.0%
#60	0.250	20%	20%	100.0%	0.0%
#80	0.180		16%	100.0%	0.0%
#100	0.150	14%	14%	100.0%	0.0%
#140	0.106		11%	100.0%	0.0%
#170	0.090		10%	100.0%	0.0%
#200	0.075	9.6%	9.6%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

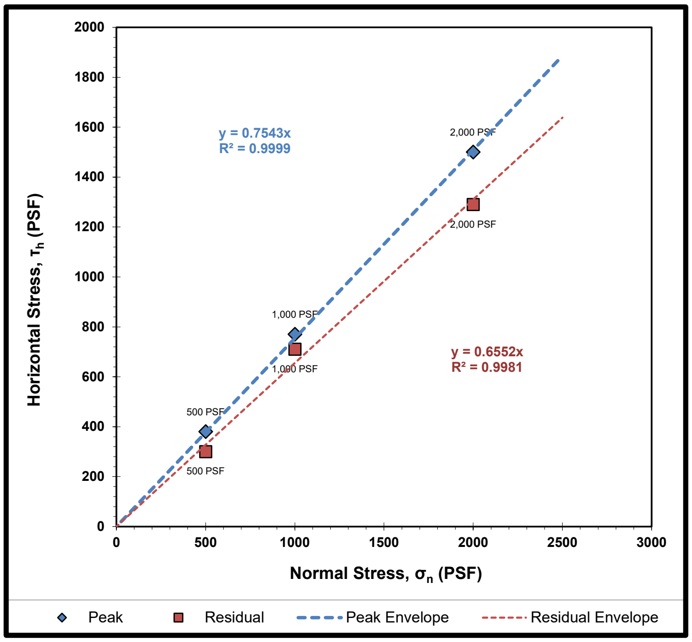
MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway		
Project Number:	21B233	**Sample Source:**	LDW21-GT44-GB-0-5 ft
Laboratory Sample ID:	B21-2050	**Visual Soil Description:**	brown silty sand with gravel
Sample Date:	8/4/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	10/13/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		**σ_n=500 PSF**
Initial Moisture Content (%):	24.6	
	Initial	**Post-Consolidation**
Dry Density (PCF):	109.7	110.8
Void Ratio:	0.536	0.520
Porosity (%):	34.9	34.2
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		**σ_n=1000 PSF**
Initial Moisture Content (%):	23.8	
	Initial	**Post-Consolidation**
Dry Density (PCF):	110.7	113.4
Void Ratio:	0.523	0.486
Porosity (%):	34.3	32.7
Degree of Saturation (%):	saturated	saturated

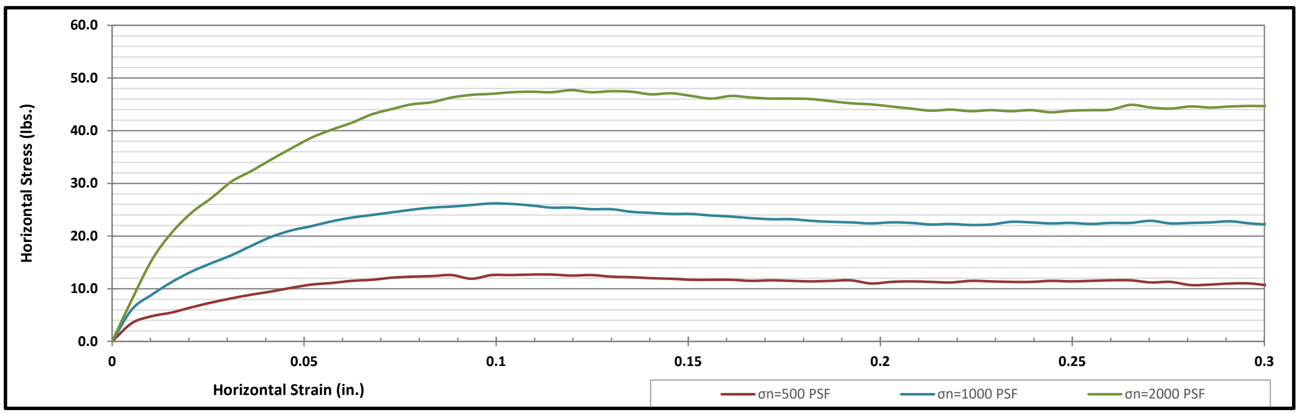
Summary of Sample Data:		**σ_n=2000 PSF**
Initial Moisture Content (%):	23.8	
	Initial	**Post-Consolidation**
Dry Density (PCF):	110.9	114.3
Void Ratio:	0.520	0.473
Porosity (%):	34.2	32.1
Degree of Saturation (%):	saturated	saturated

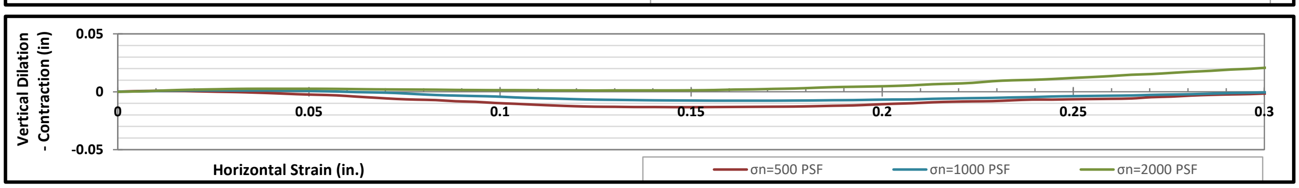


ESTIMATED STRENGTH PARAMETERS

	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	**37**	**33**
Cohesion (PSF):	**0**	**0**

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	380	770	1500
Residual Horizontal Stress, τ_h (PSF):	300	710	1290





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT44-GB-5-10 ft
Sample#: B21-2053

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 8-Oct-21
Tested By: A. Eifrig

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

ACCREDITED
Certificate #: 1366.01

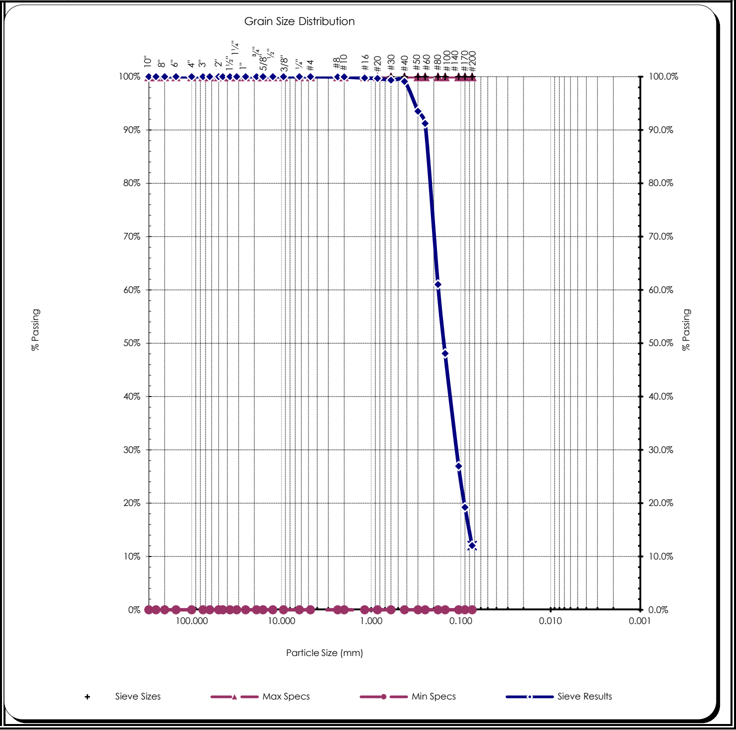
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.031 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.14
$D_{(10)}$ = 0.062 mm	% Sand = 88.0%	Coeff. of Uniformity, C_U = 2.85
$D_{(15)}$ = 0.081 mm	% Silt & Clay = 12.0%	Fineness Modulus = 0.59
$D_{(30)}$ = 0.112 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.154 mm	Plasticity Index = n/a	Moisture %, as sampled = 32.0%
$D_{(60)}$ = 0.178 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.247 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 9/74	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850	100%	100%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		93%	100.0%	0.0%
#60	0.250	91%	91%	100.0%	0.0%
#80	0.180		61%	100.0%	0.0%
#100	0.150	48%	48%	100.0%	0.0%
#140	0.106		27%	100.0%	0.0%
#170	0.090		19%	100.0%	0.0%
#200	0.075	12.0%	12.0%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT44-GB-10-15 ft
Sample#: B21-2055

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 8-Oct-21
Tested By: A. Eifrig

Unified Soil Classification System, ASTM-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
dark brown

ACCREDITED
Certificate #: 1366.01

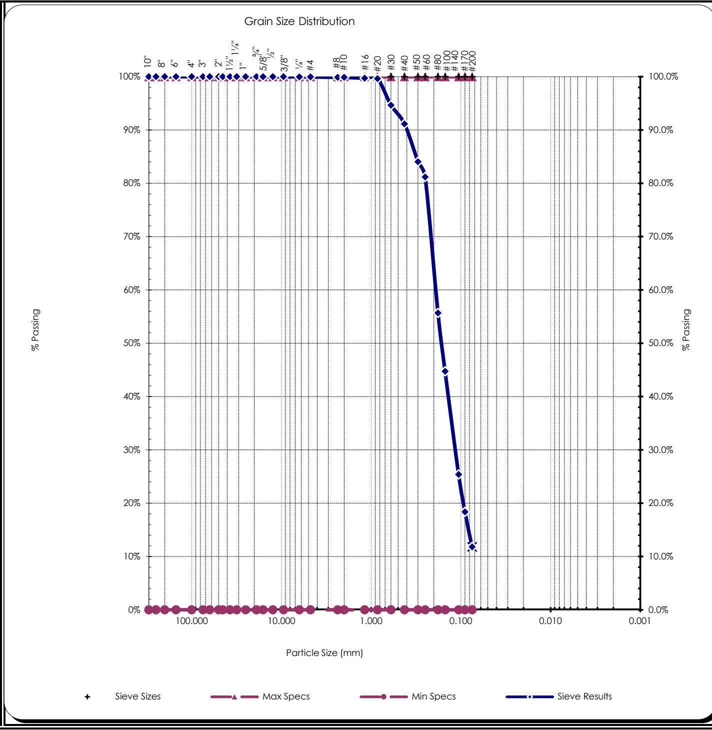
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.032 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.11
$D_{(10)}$ = 0.064 mm	% Sand = 88.2%	Coeff. of Uniformity, C_U = 3.02
$D_{(15)}$ = 0.082 mm	% Silt & Clay = 11.8%	Fineness Modulus = 0.77
$D_{(30)}$ = 0.116 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.164 mm	Plasticity Index = n/a	Moisture %, as sampled = 29.7%
$D_{(60)}$ = 0.192 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.404 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 11/85	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850	100%	100%	100.0%	0.0%
#30	0.600		95%	100.0%	0.0%
#40	0.425	91%	91%	100.0%	0.0%
#50	0.300		84%	100.0%	0.0%
#60	0.250	81%	81%	100.0%	0.0%
#80	0.180		56%	100.0%	0.0%
#100	0.150	45%	45%	100.0%	0.0%
#140	0.106		25%	100.0%	0.0%
#170	0.090		18%	100.0%	0.0%
#200	0.075	11.8%	11.8%	100.0%	0.0%



Comments:

Reviewed by:
Meghan Blodgett-Carrillo

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT44-GB-15-20 ft
Sample#: B21-2057

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 8-Oct-21
Tested By: A. Eifrig

Visual Identification
Sandy Silt
Sample Color:
dark brown

ACCREDITED
Certificate #: 1366.01

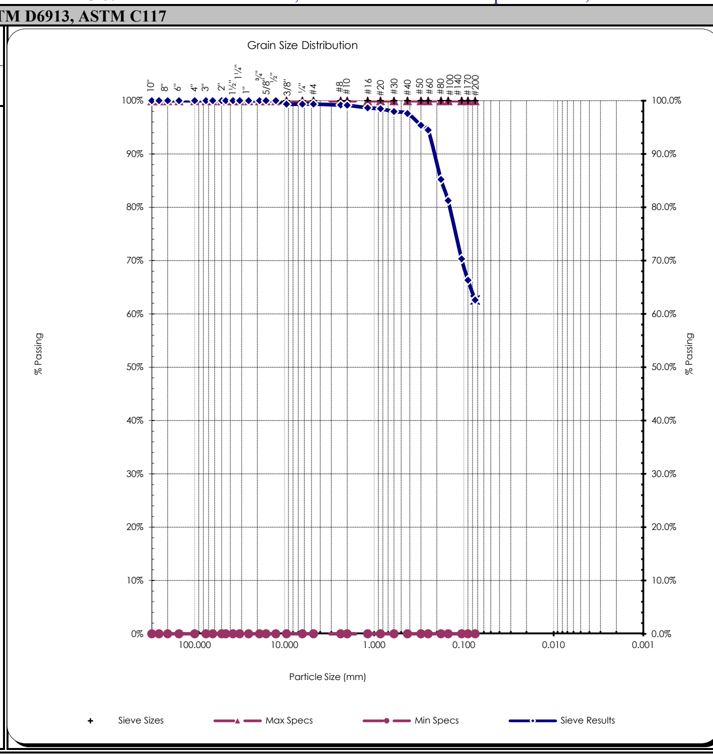
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.006 mm	% Gravel = 0.6%	Coeff. of Curvature, C_C = 1.50
$D_{(10)}$ = 0.012 mm	% Sand = 36.7%	Coeff. of Uniformity, C_U = 6.00
$D_{(15)}$ = 0.018 mm	% Silt & Clay = 62.6%	Fineness Modulus = 0.29
$D_{(30)}$ = 0.036 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.060 mm	Plasticity Index = n/a	Moisture %, as sampled = 36.8%
$D_{(60)}$ = 0.072 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.216 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 43/67	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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		99%	100.0%	0.0%
#4	4.75	99%	99%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850	98%	98%	100.0%	0.0%
#30	0.600		98%	100.0%	0.0%
#40	0.425	98%	98%	100.0%	0.0%
#50	0.300		95%	100.0%	0.0%
#60	0.250	94%	94%	100.0%	0.0%
#80	0.180		85%	100.0%	0.0%
#100	0.150	81%	81%	100.0%	0.0%
#140	0.106		70%	100.0%	0.0%
#170	0.090		66%	100.0%	0.0%
#200	0.075	62.6%	62.6%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT44-GB-20-25 ft
Sample#: B21-2059

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 8-Oct-21
Tested By: A. Eifrig

Visual Identification
Sandy Silt with Clay
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

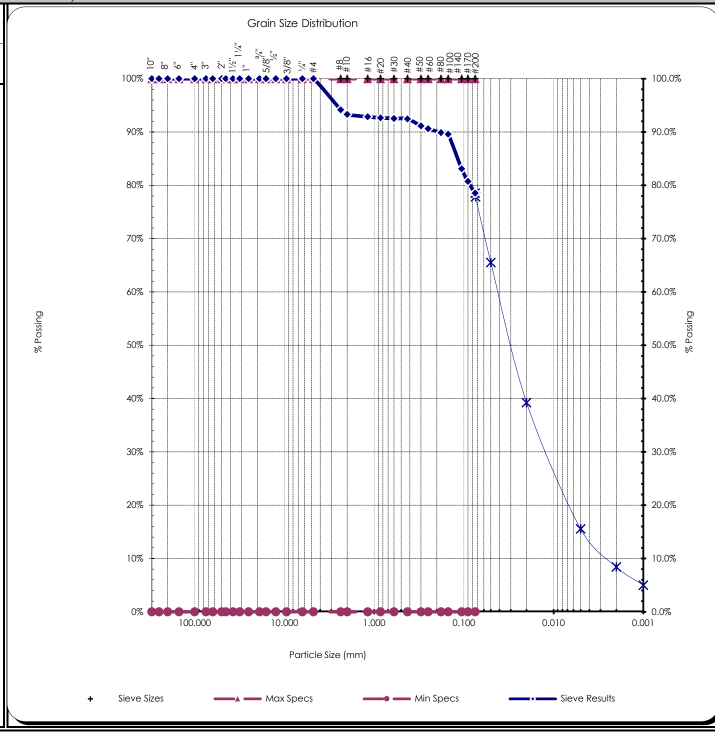
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.001 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.61
$D_{(10)}$ = 0.003 mm	% Sand = 21.5%	Coeff. of Uniformity, C_U = 17.87
$D_{(15)}$ = 0.005 mm	% Silt & Clay = 78.5%	Fineness Modulus = 0.40
$D_{(30)}$ = 0.014 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.032 mm	Plasticity Index = n/a	Moisture %, as sampled = 37.4%
$D_{(60)}$ = 0.048 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.190 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 17/20	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		94%	100.0%	0.0%
#10	2.00	93%	93%	100.0%	0.0%
#16	1.18		93%	100.0%	0.0%
#20	0.850		93%	100.0%	0.0%
#30	0.600		93%	100.0%	0.0%
#40	0.425	92%	92%	100.0%	0.0%
#50	0.300		91%	100.0%	0.0%
#60	0.250		91%	100.0%	0.0%
#80	0.180		90%	100.0%	0.0%
#100	0.150	90%	90%	100.0%	0.0%
#140	0.106		83%	100.0%	0.0%
#170	0.090		81%	100.0%	0.0%
#200	0.075	78.5%	78.5%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	8-Oct-21
Source:	LDW21-GT44-GB-20-25 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2059		

Visual Identification
Sandy Silt with Clay
Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	75.15	grams
Hydroscopic Moist.:	3.83%	
Adj. Sample Wgt :	72.38	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	43	55.4%	0.0414 mm
2	38	49.0%	0.0307 mm
5	31	40.0%	0.0204 mm
15	21	27.1%	0.0127 mm
30	18	23.2%	0.0091 mm
60	15	19.3%	0.0065 mm
240	9	11.6%	0.0034 mm
1440	5.5	7.1%	0.0014 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	21.5%	**Plastic Limit:**	n/a
% Silt:	63.0%	**Plasticity Index:**	n/a
% Clay:	15.5%		

ASTM D6913

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	100%	4.750 mm
#10	93%	2.000 mm
#20	93%	0.850 mm
#40	92%	0.425 mm
#100	90%	0.150 mm
#200	78.5%	0.075 mm
Silts	77.8%	0.074 mm
	65.5%	0.050 mm
	39.3%	0.020 mm
Clays	15.5%	0.005 mm
	8.4%	0.002 mm
Colloids	5.0%	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
Silt Loam

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	8-Oct-21
Source:	LDW21-GT44-GB-25-28.7 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2060		

Unified Soils Classification System, ASTM D-2487
SP, Poorly graded Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

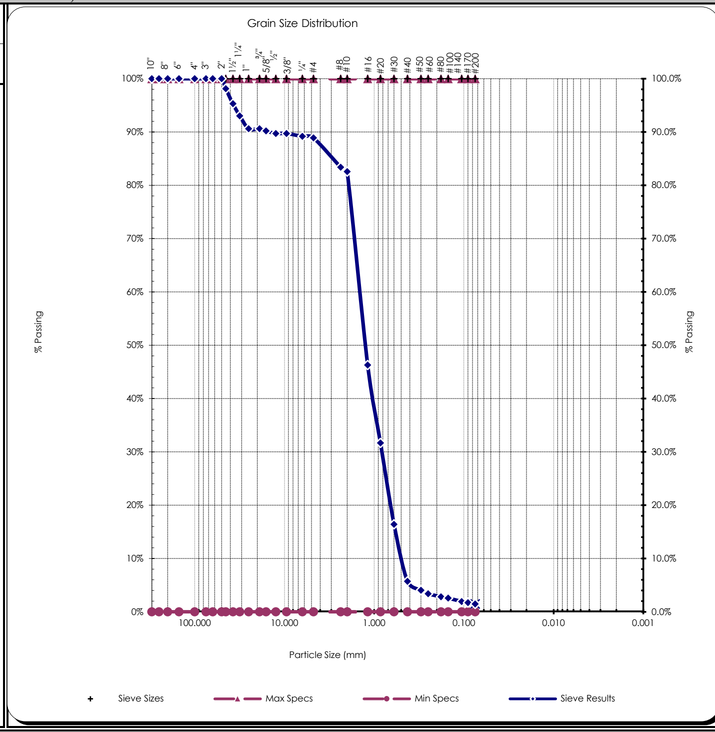
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.370 mm	% Gravel = 11.1%	Coeff. of Curvature, C_C = 0.92
$D_{(10)}$ = 0.495 mm	% Sand = 87.4%	Coeff. of Uniformity, C_U = 3.01
$D_{(15)}$ = 0.577 mm	% Silt & Clay = 1.5%	Fineness Modulus = 3.78
$D_{(30)}$ = 0.822 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 1.264 mm	Plasticity Index = n/a	Moisture %, as sampled = 14.2%
$D_{(60)}$ = 1.490 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 14.510 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 6/23	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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		98%	100.0%	0.0%
1.50"	37.50		95%	100.0%	0.0%
1.25"	31.50		93%	100.0%	0.0%
1.00"	25.00	91%	91%	100.0%	0.0%
3/4"	19.00	91%	91%	100.0%	0.0%
5/8"	16.00		90%	100.0%	0.0%
1/2"	12.50	90%	90%	100.0%	0.0%
3/8"	9.50	90%	90%	100.0%	0.0%
1/4"	6.30		89%	100.0%	0.0%
#4	4.75	89%	89%	100.0%	0.0%
#8	2.36		83%	100.0%	0.0%
#10	2.00	83%	83%	100.0%	0.0%
#16	1.18		46%	100.0%	0.0%
#20	0.850	32%	32%	100.0%	0.0%
#30	0.600		16%	100.0%	0.0%
#40	0.425	6%	6%	100.0%	0.0%
#50	0.300		4%	100.0%	0.0%
#60	0.250	3%	3%	100.0%	0.0%
#80	0.180		3%	100.0%	0.0%
#100	0.150	3%	3%	100.0%	0.0%
#140	0.106		2%	100.0%	0.0%
#170	0.090		2%	100.0%	0.0%
#200	0.075	1.5%	1.5%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Sieve Report

Project: Q.C. - Lower Duwamish Waterway	**Date Received:** 29-Jul-21	**Visual Identification**	
Project #: 21B233	**Sampled By:** Client	Sandy Silt	
Client: Anchor QEA	**Date Tested:** 8-Oct-21	**Sample Color:**	
Source: LDW21-GT44-GB-28.7-30 ft	**Tested By:** A. Eifrig	brown	ACCREDITED Certificate #: 1366.01
Sample#: B21-2061			

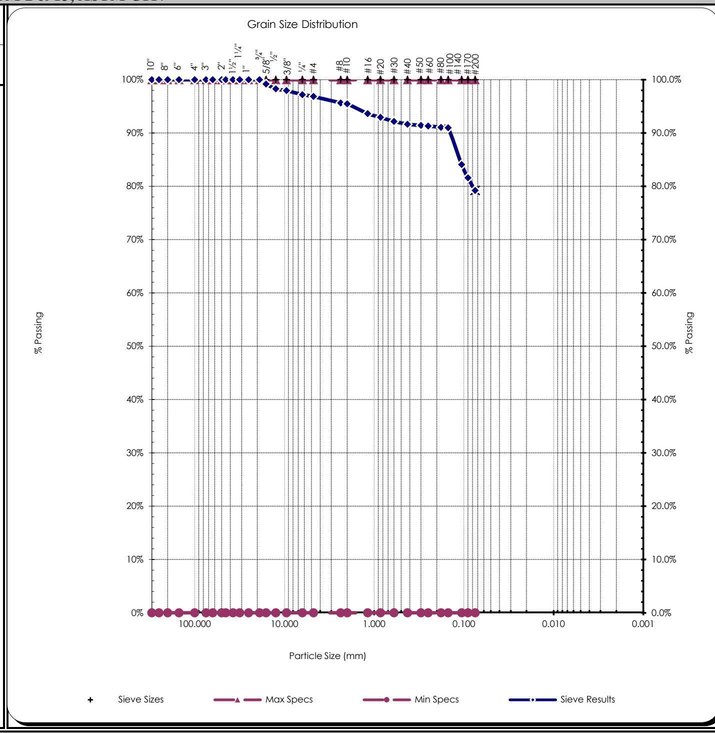
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.005 mm	% Gravel = 3.2%	Coeff. of Curvature, C_C = 1.50
$D_{(10)}$ = 0.009 mm	% Sand = 17.6%	Coeff. of Uniformity, C_U = 6.00
$D_{(15)}$ = 0.014 mm	% Silt & Clay = 79.2%	Fineness Modulus = 0.41
$D_{(30)}$ = 0.028 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.047 mm	Plasticity Index = n/a	Moisture %, as sampled = 37.0%
$D_{(60)}$ = 0.057 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.144 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 51/59	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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		99%	100.0%	0.0%
1/2"	12.50	98%	98%	100.0%	0.0%
3/8"	9.50	98%	98%	100.0%	0.0%
1/4"	6.30		97%	100.0%	0.0%
#4	4.75	97%	97%	100.0%	0.0%
#8	2.36		96%	100.0%	0.0%
#10	2.00	95%	95%	100.0%	0.0%
#16	1.18		94%	100.0%	0.0%
#20	0.850	93%	93%	100.0%	0.0%
#30	0.600		92%	100.0%	0.0%
#40	0.425	92%	92%	100.0%	0.0%
#50	0.300		91%	100.0%	0.0%
#60	0.250	91%	91%	100.0%	0.0%
#80	0.180		91%	100.0%	0.0%
#100	0.150	91%	91%	100.0%	0.0%
#140	0.106		84%	100.0%	0.0%
#170	0.090		82%	100.0%	0.0%
#200	0.075	79.2%	79.2%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

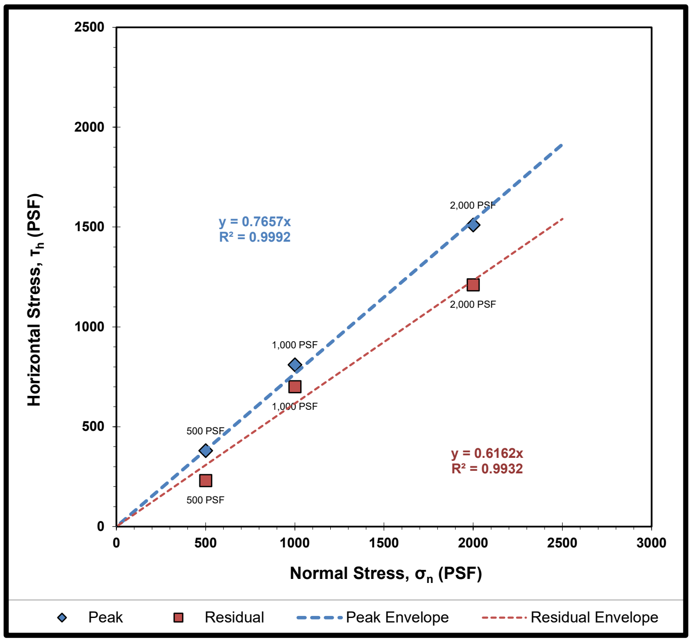
MTC MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway		
Project Number:	21B233	**Sample Source:**	LDW21-GT48-GB-5-10 ft
Laboratory Sample ID:	B21-2065	**Visual Soil Description:**	brown silty sand with gravel
Sample Date:	8/5/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	10/15/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	37.5	
	Initial	Post-Consolidation
Dry Density (PCF):	-4530.4	-4603.6
Void Ratio:	-1.037	-1.037
Porosity (%):	2789.0	2832.4
Degree of Saturation (%):	-97.6	saturated

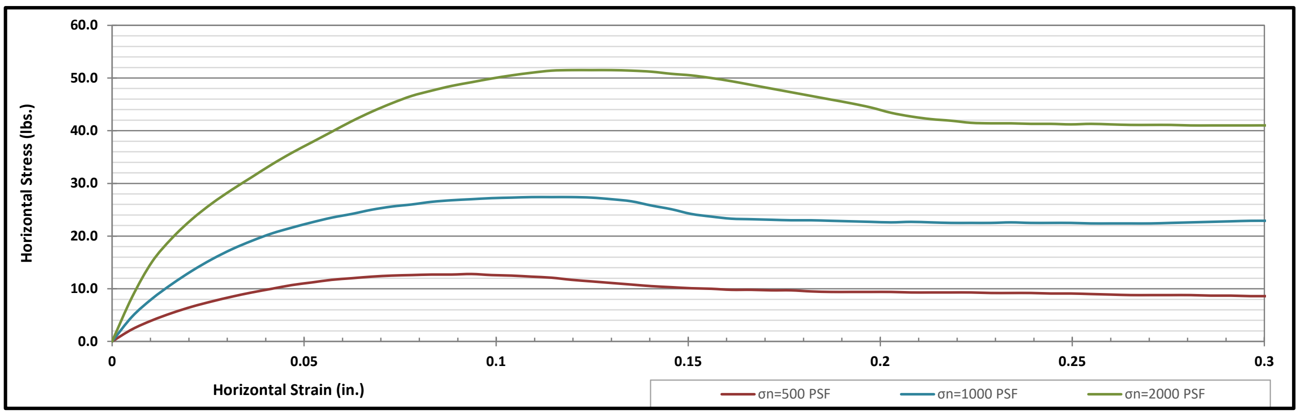
Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	34.3	
	Initial	Post-Consolidation
Dry Density (PCF):	100.8	104.7
Void Ratio:	0.672	0.610
Porosity (%):	40.2	37.9
Degree of Saturation (%):	saturated	saturated

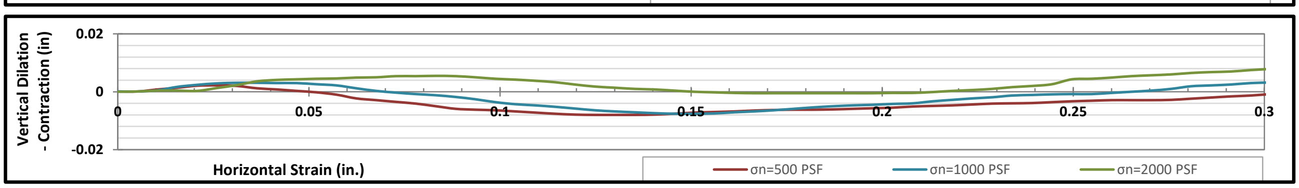
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	35.3	
	Initial	Post-Consolidation
Dry Density (PCF):	100.6	106.4
Void Ratio:	0.675	0.584
Porosity (%):	40.3	36.9
Degree of Saturation (%):	saturated	saturated



ESTIMATED STRENGTH PARAMETERS		
	PEAK	RESIDUAL
Angle of Internal Friction, ϕ (°):	37	32
Cohesion (PSF):	0	0

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	380	810	1510
Residual Horizontal Stress, τ_h (PSF):	230	700	1210





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway	**Date Received:** 29-Jul-21	**Unified Soils Classification System, ASTM D-2487**	
Project #: 21B233	**Sampled By:** Client	SP, Poorly graded Sand	
Client: Anchor QEA	**Date Tested:** 8-Oct-21	**Sample Color:**	
Source: LDW21-GT48-GB-0-5 ft	**Tested By:** A. Eifrig	brown	ACCREDITED Certificate #: 1366.01
Sample#: B21-2063			

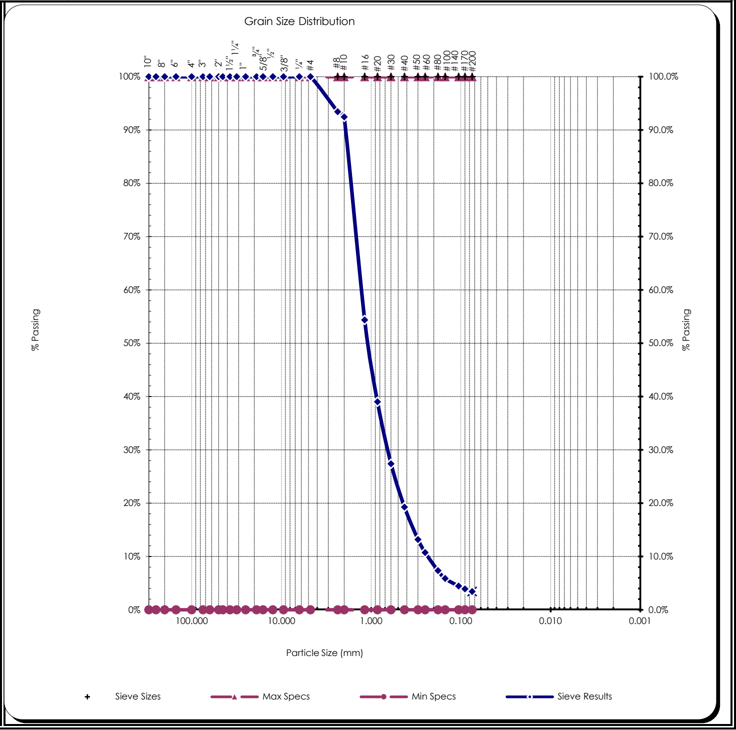
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.123	mm	% Gravel =	0.0%	Coeff. of Curvature, C_C =	1.41
$D_{(10)}$ =	0.234	mm	% Sand =	96.5%	Coeff. of Uniformity, C_U =	5.55
$D_{(15)}$ =	0.337	mm	% Silt & Clay =	3.5%	Fineness Modulus =	3.06
$D_{(30)}$ =	0.655	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	1.086	mm	Plasticity Index =	n/a	Moisture %, as sampled =	22.2%
$D_{(60)}$ =	1.301	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	1.947	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	7/39		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		93%	100.0%	0.0%
#10	2.00	92%	92%	100.0%	0.0%
#16	1.18		54%	100.0%	0.0%
#20	0.850		39%	100.0%	0.0%
#30	0.600		27%	100.0%	0.0%
#40	0.425	19%	19%	100.0%	0.0%
#50	0.300		13%	100.0%	0.0%
#60	0.250		11%	100.0%	0.0%
#80	0.180		7%	100.0%	0.0%
#100	0.150	6%	6%	100.0%	0.0%
#140	0.106		4%	100.0%	0.0%
#170	0.090		4%	100.0%	0.0%
#200	0.075	3.5%	3.5%	100.0%	0.0%



All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	8-Oct-21
Source:	LDW21-GT48-GB-5-10 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2065		

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

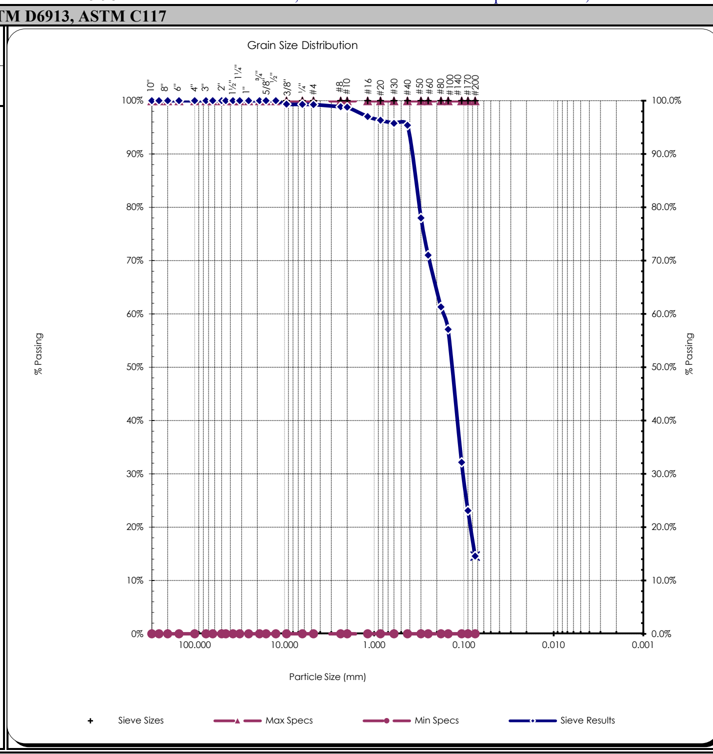
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.026 mm	% Gravel = 0.7%	Coeff. of Curvature, C_C = 1.19
$D_{(10)}$ = 0.051 mm	% Sand = 84.7%	Coeff. of Uniformity, C_U = 3.32
$D_{(15)}$ = 0.076 mm	% Silt & Clay = 14.6%	Fineness Modulus = 0.75
$D_{(30)}$ = 0.102 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.137 mm	Plasticity Index = n/a	Moisture %, as sampled = 39.5%
$D_{(60)}$ = 0.171 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.386 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 15/98	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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		99%	100.0%	0.0%
#4	4.75	99%	99%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		97%	100.0%	0.0%
#20	0.850		96%	100.0%	0.0%
#30	0.600		96%	100.0%	0.0%
#40	0.425	95%	95%	100.0%	0.0%
#50	0.300		78%	100.0%	0.0%
#60	0.250		71%	100.0%	0.0%
#80	0.180		61%	100.0%	0.0%
#100	0.150	57%	57%	100.0%	0.0%
#140	0.106		32%	100.0%	0.0%
#170	0.090		23%	100.0%	0.0%
#200	0.075	14.6%	14.6%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT48-GB-10-15 ft
Sample#: B21-2066

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 8-Oct-21
Tested By: A. Eifrig

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color:
dark brown

ACCREDITED
Certificate #: 1366.01

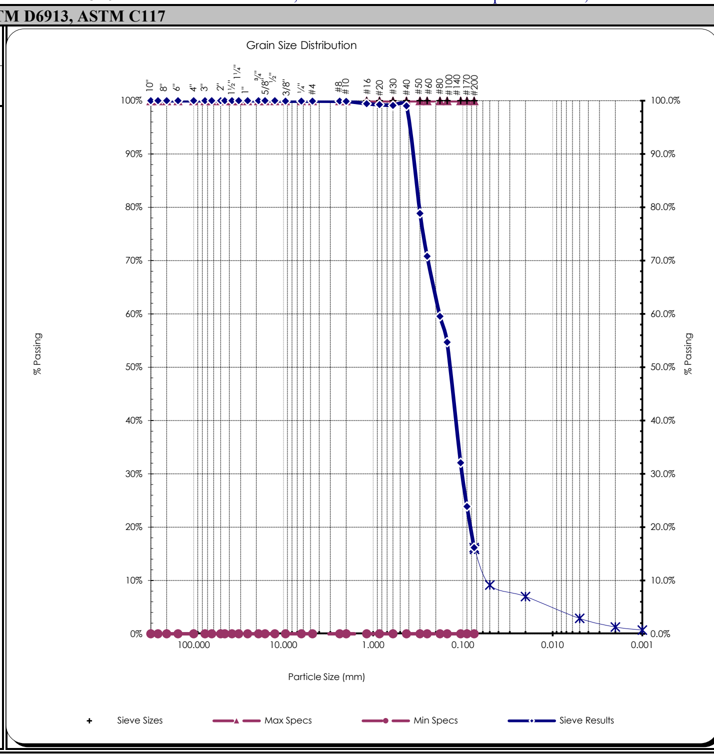
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.009 mm	% Gravel = 0.1%	Coeff. of Curvature, C_C = 1.02
$D_{(10)}$ = 0.056 mm	% Sand = 83.7%	Coeff. of Uniformity, C_U = 3.29
$D_{(15)}$ = 0.071 mm	% Silt & Clay = 16.2%	Fineness Modulus = 0.68
$D_{(30)}$ = 0.102 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.141 mm	Plasticity Index = n/a	Moisture %, as sampled = 30.7%
$D_{(60)}$ = 0.183 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.369 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 8/49	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		79%	100.0%	0.0%
#60	0.250		71%	100.0%	0.0%
#80	0.180		60%	100.0%	0.0%
#100	0.150	55%	55%	100.0%	0.0%
#140	0.106		32%	100.0%	0.0%
#170	0.090		24%	100.0%	0.0%
#200	0.075	16.2%	16.2%	100.0%	0.0%



All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	8-Oct-21
Source:	LDW21-GT48-GB-10-15 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2066		

Unified Soils Classification System, ASTM D-2487
SM, Silty Sand
Sample Color
dark brown

ASTM D7928, HYDROMETER ANALYSIS

Sp Gr :	2.62	
Sample Weight:	100.83	grams
Hydroscopic Moist.:	3.02%	
Adj. Sample Wgt :	97.87	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	9	9.3%	0.0533 mm
2	8	8.2%	0.0380 mm
5	7	7.2%	0.0242 mm
15	6.5	6.7%	0.0140 mm
30	5.5	5.7%	0.0100 mm
60	4	4.1%	0.0071 mm
240	2	2.1%	0.0036 mm
1440	1	1.0%	0.0015 mm

% Gravel:	0.1%	**Liquid Limit:**	n/a
% Sand:	83.7%	**Plastic Limit:**	n/a
% Silt:	13.3%	**Plasticity Index:**	n/a
% Clay:	2.9%		

ASTM D6913

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	100%	4.750 mm
#10	100%	2.000 mm
#20	99%	0.850 mm
#40	99%	0.425 mm
#100	55%	0.150 mm
#200	16.2%	0.075 mm
Silts	15.9%	0.074 mm
	9.1%	0.050 mm
	7.0%	0.020 mm
Clays	2.9%	0.005 mm
	1.3%	0.002 mm
Colloids	0.7%	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
Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	8-Oct-21
Source:	LDW21-GT48-GB-15-18.2 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2067		

Unified Soils Classification System, ASTM D-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
dark brown

ACCREDITED
Certificate #: 1366.01

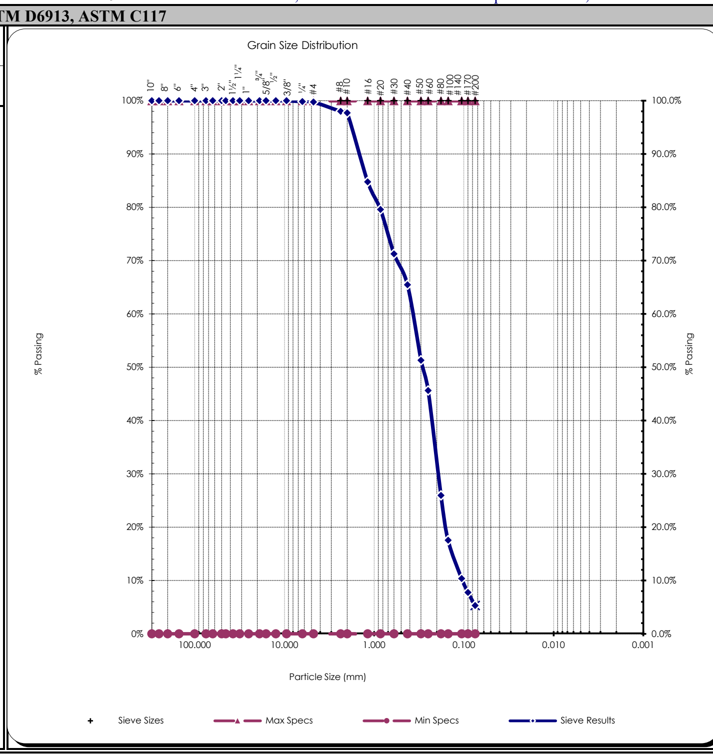
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.070 mm	% Gravel = 0.2%	Coeff. of Curvature, C_C = 0.97
$D_{(10)}$ = 0.104 mm	% Sand = 94.4%	Coeff. of Uniformity, C_U = 3.64
$D_{(15)}$ = 0.134 mm	% Silt & Clay = 5.3%	Fineness Modulus = 1.77
$D_{(30)}$ = 0.194 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.288 mm	Plasticity Index = n/a	Moisture %, as sampled = 21.9%
$D_{(60)}$ = 0.377 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.510 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 4/49	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		98%	100.0%	0.0%
#10	2.00	98%	98%	100.0%	0.0%
#16	1.18		85%	100.0%	0.0%
#20	0.850	80%	80%	100.0%	0.0%
#30	0.600		71%	100.0%	0.0%
#40	0.425	65%	65%	100.0%	0.0%
#50	0.300		51%	100.0%	0.0%
#60	0.250	46%	46%	100.0%	0.0%
#80	0.180		26%	100.0%	0.0%
#100	0.150	18%	18%	100.0%	0.0%
#140	0.106		10%	100.0%	0.0%
#170	0.090		8%	100.0%	0.0%
#200	0.075	5.3%	5.3%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	8-Oct-21
Source:	LDW21-GT48-GB-18.2-19.5 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2068		

Visual Identification
Sandy Silt
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

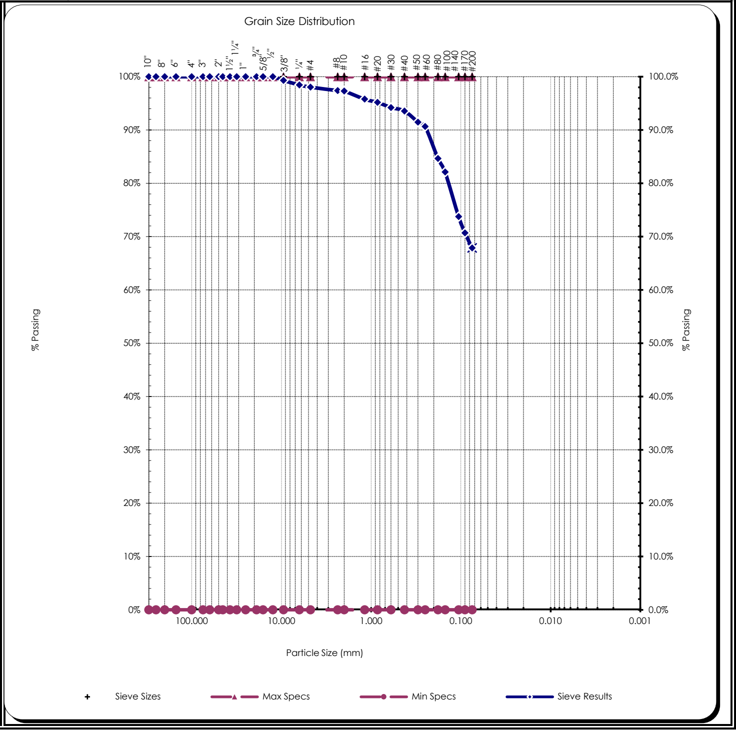
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.006	mm	% Gravel =	2.0%	Coeff. of Curvature, C_C =	1.50
$D_{(10)}$ =	0.011	mm	% Sand =	30.2%	Coeff. of Uniformity, C_U =	6.00
$D_{(15)}$ =	0.017	mm	% Silt & Clay =	67.9%	Fineness Modulus =	0.42
$D_{(30)}$ =	0.033	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.055	mm	Plasticity Index =	n/a	Moisture %, as sampled =	30.8%
$D_{(60)}$ =	0.066	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	0.242	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	37/51		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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		98%	100.0%	0.0%
#4	4.75	98%	98%	100.0%	0.0%
#8	2.36		97%	100.0%	0.0%
#10	2.00	97%	97%	100.0%	0.0%
#16	1.18		96%	100.0%	0.0%
#20	0.850	95%	95%	100.0%	0.0%
#30	0.600		94%	100.0%	0.0%
#40	0.425	94%	94%	100.0%	0.0%
#50	0.300		91%	100.0%	0.0%
#60	0.250	91%	91%	100.0%	0.0%
#80	0.180		85%	100.0%	0.0%
#100	0.150	82%	82%	100.0%	0.0%
#140	0.106		74%	100.0%	0.0%
#170	0.090		71%	100.0%	0.0%
#200	0.075	67.9%	67.9%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	8-Oct-21
Source:	LDW21-GT48-GB-20-21.6 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2069		

Unified Soils Classification System, ASTM D-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
dark brown

ACCREDITED
Certificate #: 1366.01

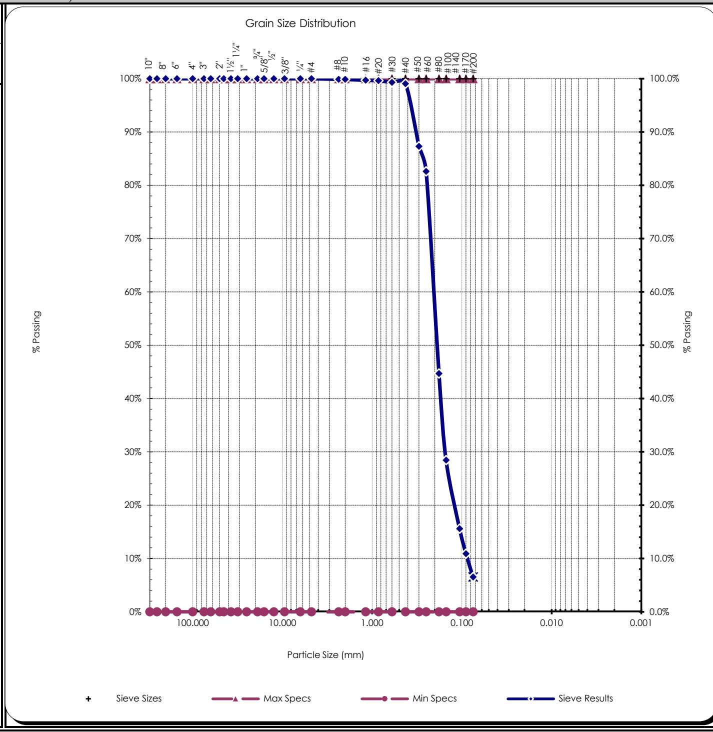
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.057 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.29
$D_{(10)}$ = 0.087 mm	% Sand = 93.5%	Coeff. of Uniformity, C_U = 2.40
$D_{(15)}$ = 0.104 mm	% Silt & Clay = 6.5%	Fineness Modulus = 0.85
$D_{(30)}$ = 0.153 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.190 mm	Plasticity Index = n/a	Moisture %, as sampled = 31.2%
$D_{(60)}$ = 0.208 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.329 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 6/91	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850	100%	100%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		87%	100.0%	0.0%
#60	0.250	83%	83%	100.0%	0.0%
#80	0.180		45%	100.0%	0.0%
#100	0.150	28%	28%	100.0%	0.0%
#140	0.106		16%	100.0%	0.0%
#170	0.090		11%	100.0%	0.0%
#200	0.075	6.5%	6.5%	100.0%	0.0%



Comments:

Reviewed by:

Meghan Blodgett-Carrillo

HWA GeoSciences Inc.
DBE/MWBE

October 19, 2021
HWA Project No. 2012-002-23 Task 51

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

Attention: Ms. Meghan Blodgett-Carrillo

Subject: **LABORATORY TESTING REPORT**
QC - Lower Duwamish Waterway
MTC Project Number: 21B233

Dear Ms. Blodgett-Carrillo;

In accordance with your request, HWA GeoSciences Inc. (HWA) performed laboratory testing for the above referenced project. Herein we present the results of our laboratory analyses, which are summarized on the attached Figures. The laboratory testing program was performed in general accordance with your instructions and appropriate ASTM Standards as outlined below.

SAMPLE DESCRIPTION: The subject samples were delivered to our laboratory on August 26, 2021 by MTC personnel. The samples were delivered in four Shelby tubes and were designated with exploration ID and depth of sampling. The soil samples were classified using visual-manual methods. The descriptions may be found on the attached Summary of Material Properties, Figure 1.

MOISTURE CONTENT OF SOIL: The moisture contents of the soil samples (percent by dry mass) were determined in general accordance with ASTM D2216. The results are shown on Figure 1.

SPECIFIC GRAVITY OF SOILS: The specific gravity of the selected samples was determined using method ASTM D854. The test results are shown on the attached Summary of Material Properties, Figure 1.

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS (ATTERBERG LIMITS): The plasticity index of each specified sample was tested using method ASTM D4318, multi-point method. The results are reported on the attached Liquid Limit, Plastic Limit, and Plasticity Index of Soils Report, Figure 2.

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION OF SOILS: Selected samples were tested in general accordance with method ASTM D4767 to determine the shear strength characteristics of the soil. The samples were extruded from Shelby tubes, and the test specimens were trimmed to obtain a cylindrical test sample with a length to diameter ratio between 2:1 and 2.5:1. The specimens were carefully weighed and measured prior to testing.

Three trials were run at varying confining stresses specified by the client. Each sample was run using a single specimen to perform a multi-stage shear test.

The multi-stage method was performed by first consolidating the sample at the lowest specified confining pressure. The sample was then sheared until the change in pore pressure was at or near its estimated peak. After reaching the peak change in pore pressure, the shear phase was terminated, and the specimen was reconsolidated at the middle consolidation pressure. Under the second consolidation pressure the sample was again sheared until the change in pore pressure was at or near its estimated peak, at which point the shear was terminated. The sample was reconsolidated a third and final time under the highest confining pressure and shearing was performed to sample failure, concluding the test.

For sample LDW21-GT33-GB at 6.0-8.0’, the test was terminated at 20.5% strain due to a spike in pore pressure caused by a perforation in the membrane encasing the sample. As a result, the final moisture content of the sample was affected due to the ingress of water from the surrounding water filled pressure cell. The final moisture content for this sample was determined to be 70.7%.

The Consolidated Undrained test results are summarized and plotted graphically in Figures 3-6.

ONE DIMENSIONAL CONSOLIDATION PROPERTIES OF SOIL: The consolidation properties of selected soil samples were measured in general accordance with ASTM D 2435. Saturation was maintained by inundation of the sample throughout the test. The samples were subjected to increasing increments of total stress, the duration of which was selected to exceed the time required for completion of primary consolidation as defined in the Standard, Method B. Unloading of the sample was carried out incrementally. The primary compression test results are presented on the attached Consolidation Test Reports, Figures 7-10.

CLOSURE: Experience has shown that test values on soil and other natural materials vary with each representative sample. As such, HWA has no knowledge as to the extent and quantity of material the tested samples may represent. HWA also makes no warranty as to how representative either the samples tested or the test results obtained are to actual field conditions. It is a well-established fact that sampling methods present varying degrees of disturbance that affect sample representativeness.

No copy should be made of this report except in its entirety.

We appreciate the opportunity to provide laboratory testing services on this project. Should you have any questions or comments, or if we may be of further service, please call.

Sincerely,

HWA GEOSCIENCES INC.

Greg Barker
Materials Laboratory Supervisor

Steven E. Greene, L.G., L.E.G.
Principal Engineering Geologist
Vice President

Attachments:

Figure 1	Summary of Material Properties
Figure 2	Liquid Limit, Plastic Limit and Plasticity Index of Soils
Figures 3-6	Consolidated Undrained Triaxial Compression Test for Cohesive Soils
Figures 7-10	Consolidation Test Report

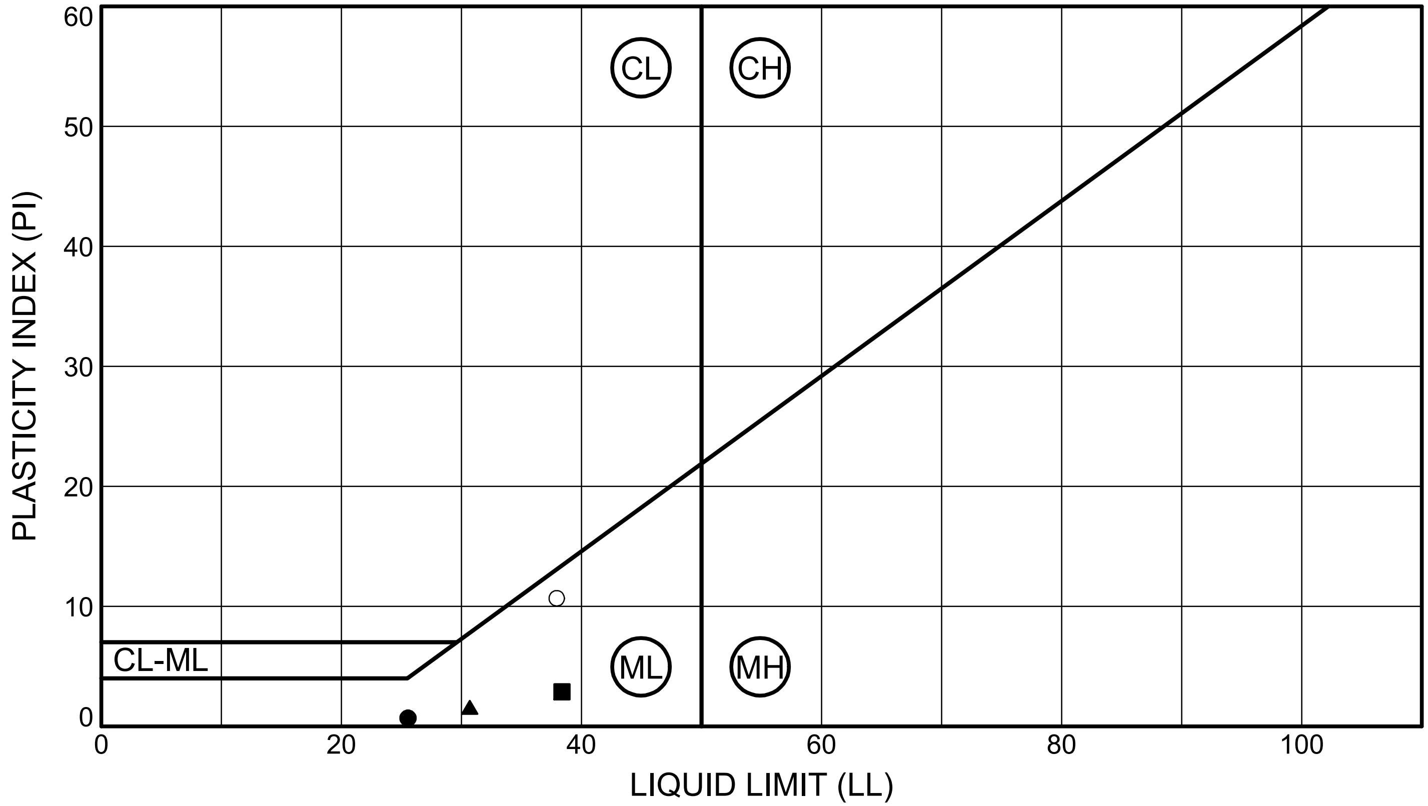
EXPLORATION DESIGNATION	TOP DEPTH (feet)	BOTTOM DEPTH (feet)	MOISTURE CONTENT (%)	ORGANIC CONTENT (%)	SPECIFIC GRAVITY	ATTERBERG LIMITS (%)			% GRAVEL	% SAND	% FINES	ASTM SOIL CLASSIFICATION	SAMPLE DESCRIPTION
						LL	PL	PI					
LDW21-GT23-GB,	28.5	30.5	33.3		2.617	26	25	1				SM	Dark grayish-brown, silty SAND
LDW21-GT33-GB,	6.0	8.0	58.6		2.612	38	36	2				ML	Very dark grayish-brown, SILT with sand
LDW21-GT33-GB,	21.0	23.0	35.3		2.643	31	29	2				SM	Very dark grayish-brown, silty SAND
LDW21-GT53-SPT,	30.0	32.0	43.6		2.627	38	27	11				ML	Very dark grayish-brown, SILT with sand

Notes: 1. This table summarizes information presented elsewhere in the report and should be used in conjunction with the report test, other graphs and tables, and the exploration logs.
2. The soil classifications in this table are based on ASTM D2487 and D2488 as applicable.

HWA GEOSCIENCES INC.

MLT for MTC, Inc.
QC - Lower Duwamish Waterway
Client Project No.: 21B233

SUMMARY OF MATERIAL PROPERTIES



SYMBOL	SAMPLE	DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Fines
●	LDW21-GT23-GB	28.5 - 30.5	(SM) Dark grayish-brown, silty SAND	33	26	25	1	
■	LDW21-GT33-GB	6.0 - 8.0	(ML) Very dark grayish-brown, SILT with sand	59	38	36	2	
▲	LDW21-GT33-GB	21.0 - 23.0	(SM) Very dark grayish-brown, silty SAND	35	31	29	2	
○	LDW21-GT53-SPT	30.0 - 32.0	(ML) Very dark grayish-brown, SILT with sand	44	38	27	11	

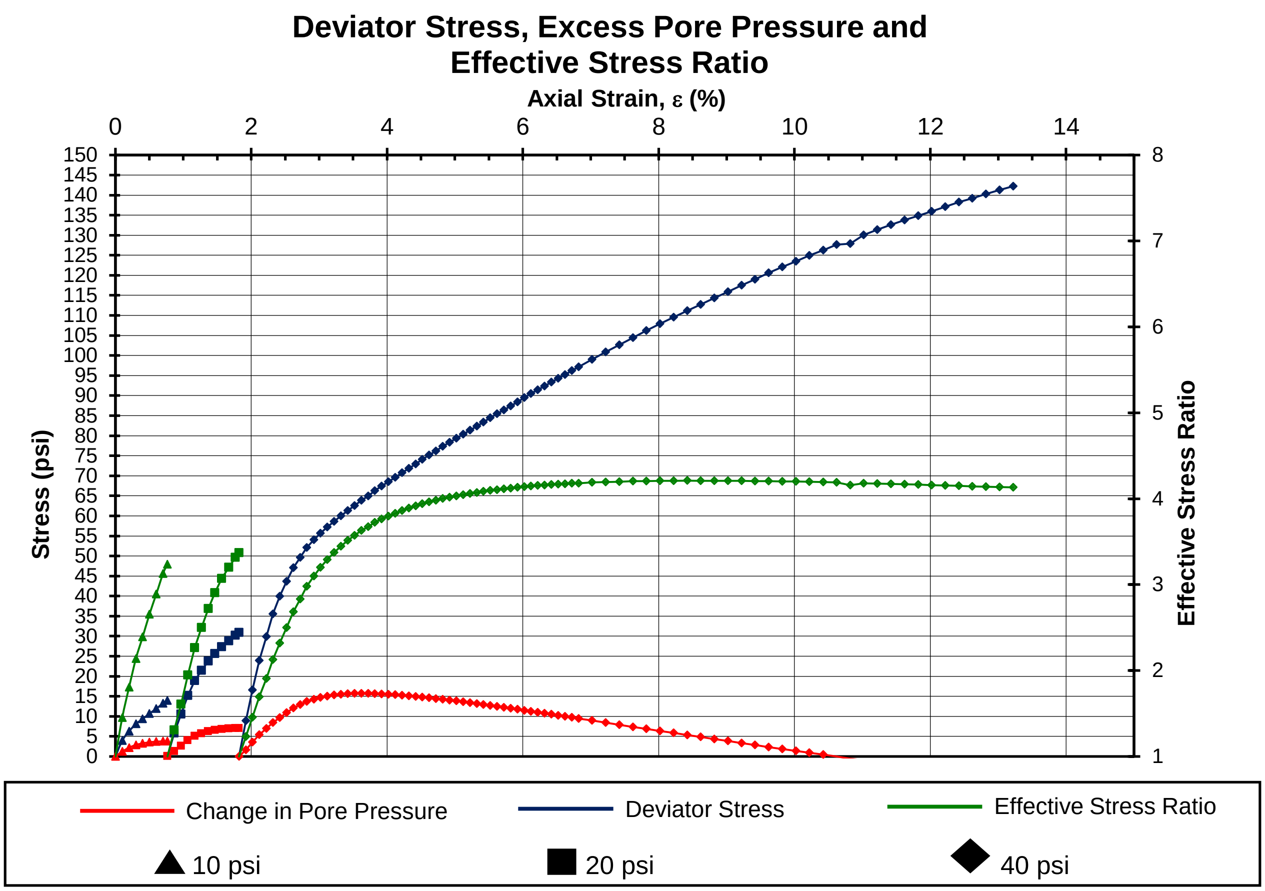
HWA GEOSCIENCES INC.

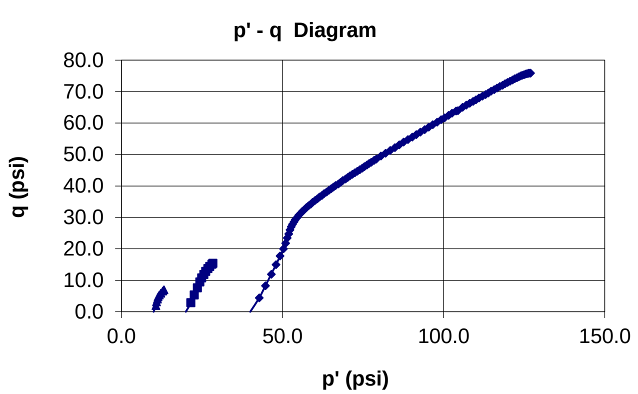
MLT for MTC, Inc.
QC - Lower Duwamish Waterway
Client Project No.: 21B233

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS METHOD ASTM D4318

PROJECT NO.: 2012-002 T51 FIGURE: 2

HWA GeoSciences Inc - Materials Testing Laboratory					
Consolidated-Undrained Triaxial Compression Test for Cohesive Soils (ASTM D 4767)					
Project Name:	Lower Duwamish Waterway		Date:	8/27/2021	
Project No.:	2012-002-23 T51	Exploration ID:		LDW21-GT23-GB	
Technician:	DW	Sample No:		n/a	
Sample Description:	Dark grayish-brown, silty SAND (SM)		Sample Depth, ft:	28.5-30.5'	
Confining Pressures:	**10 psi** **20 psi** **40 psi**		Consolidation T50 Values (minutes)		
Initial Moisture:	33.4%	Final Moisture: 32.4%	10 psi	20 psi	40 psi
Initial Wet Density, pcf:	115.2		0.6	0.6	1.0
Initial Dry Density, pcf:	86.3				

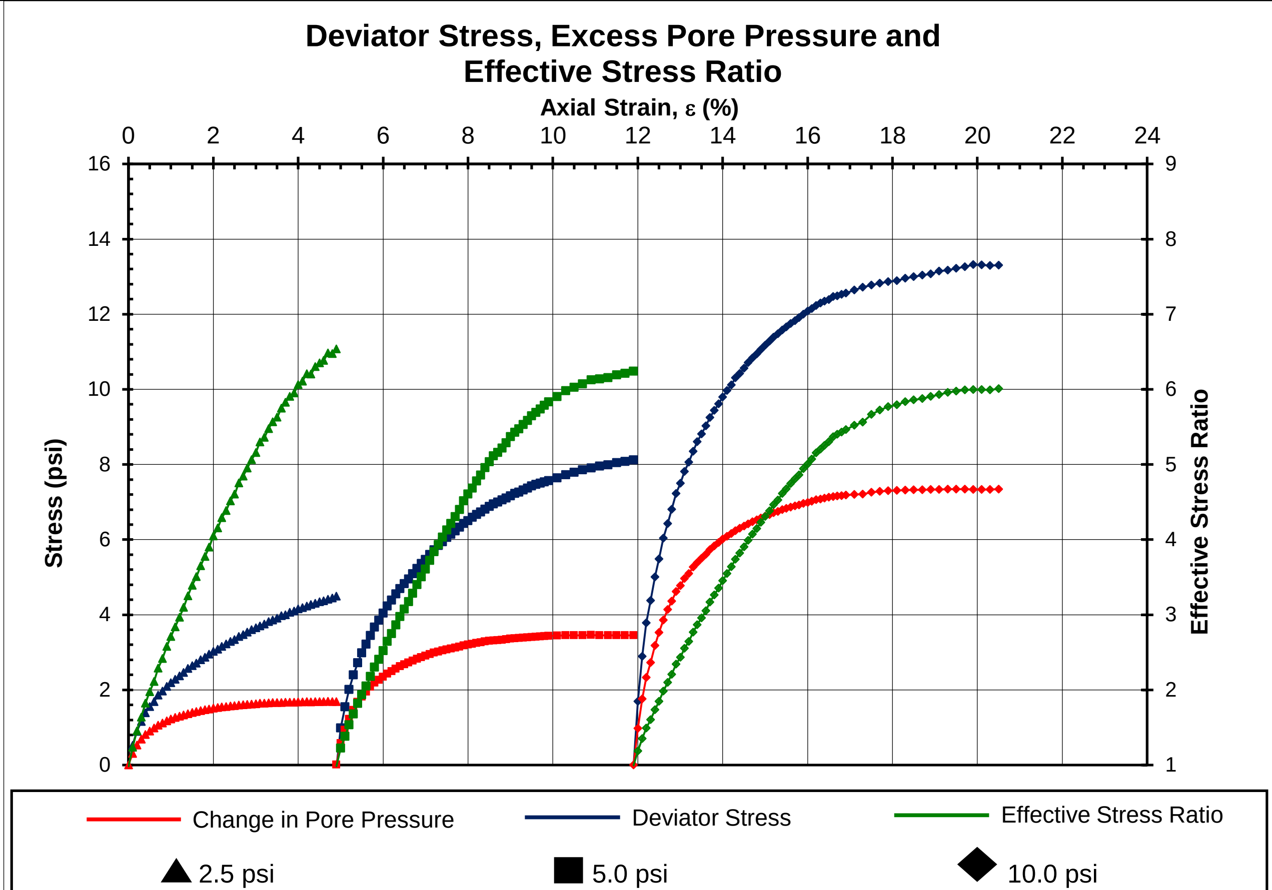


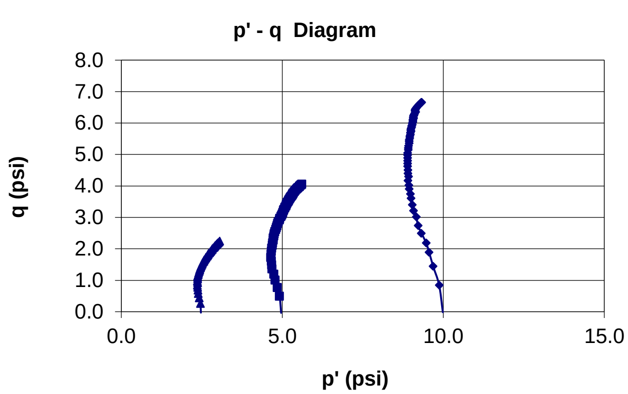


Reviewed by: SEG

Figure 3

HWA GeoSciences Inc - Materials Testing Laboratory					
Consolidated-Undrained Triaxial Compression Test for Cohesive Soils (ASTM D 4767)					
Project Name:	Lower Duwamish Waterway		Date:	8/28/2021	
Project No.:	2012-002-23 T51	Exploration ID:		LDW21-GT33-GB	
Technician:	GB	Sample No:		n/a	
Sample Description:	Very dark grayish-brown, SILT with sand (ML)		Sample Depth, ft:		6.0 - 8.0
Confining Pressures:	**2.5 psi** **5.0 psi** **10.0 psi**		Consolidation T50 Values (minutes)		
Initial Moisture:	64.8%	Final Moisture: see report	2.5 psi	5.0 psi	10.0 psi
Initial Wet Density, pcf:	93.4		91.13	83.21	162.0
Initial Dry Density, pcf:	56.7				

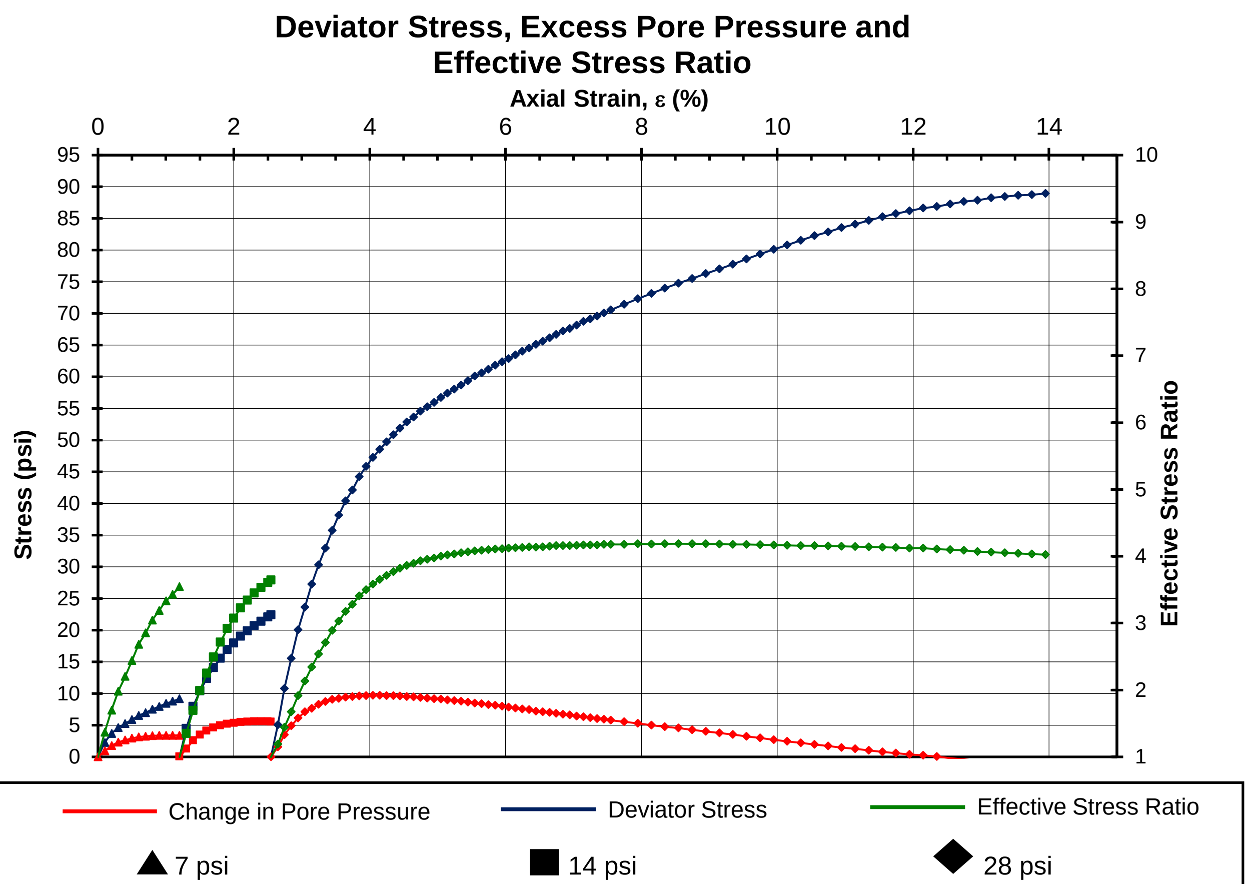


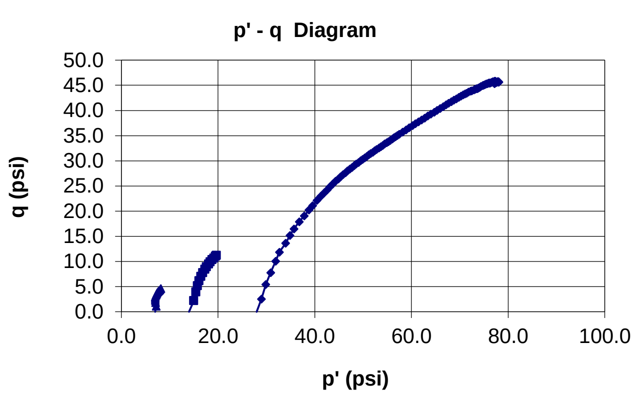


Reviewed by: SEG

Figure 4

HWA GeoSciences Inc - Materials Testing Laboratory						
Consolidated-Undrained Triaxial Compression Test for Cohesive Soils (ASTM D 4767)						
Project Name:	Lower Duwamish Waterway			Date:	9/7/2021	
Project No.:	2012-002-23 T51	Exploration ID:			LDW21-GT33-GB	
Technician:	GB	Sample No:			n/a	
Sample Description:	Very dark grayish-brown, silty SAND (SM)			Sample Depth, ft:		21.0-23.0
Confining Pressures:	**7 psi**	**14 psi**	**28 psi**	Consolidation T50 Values (minutes)		
Initial Moisture:	35.3%	Final Moisture:	34.7%	7 psi	14 psi	28 psi
Initial Wet Density, pcf:	109.6			144.5	23.8	0.3
Initial Dry Density, pcf:	81.0					





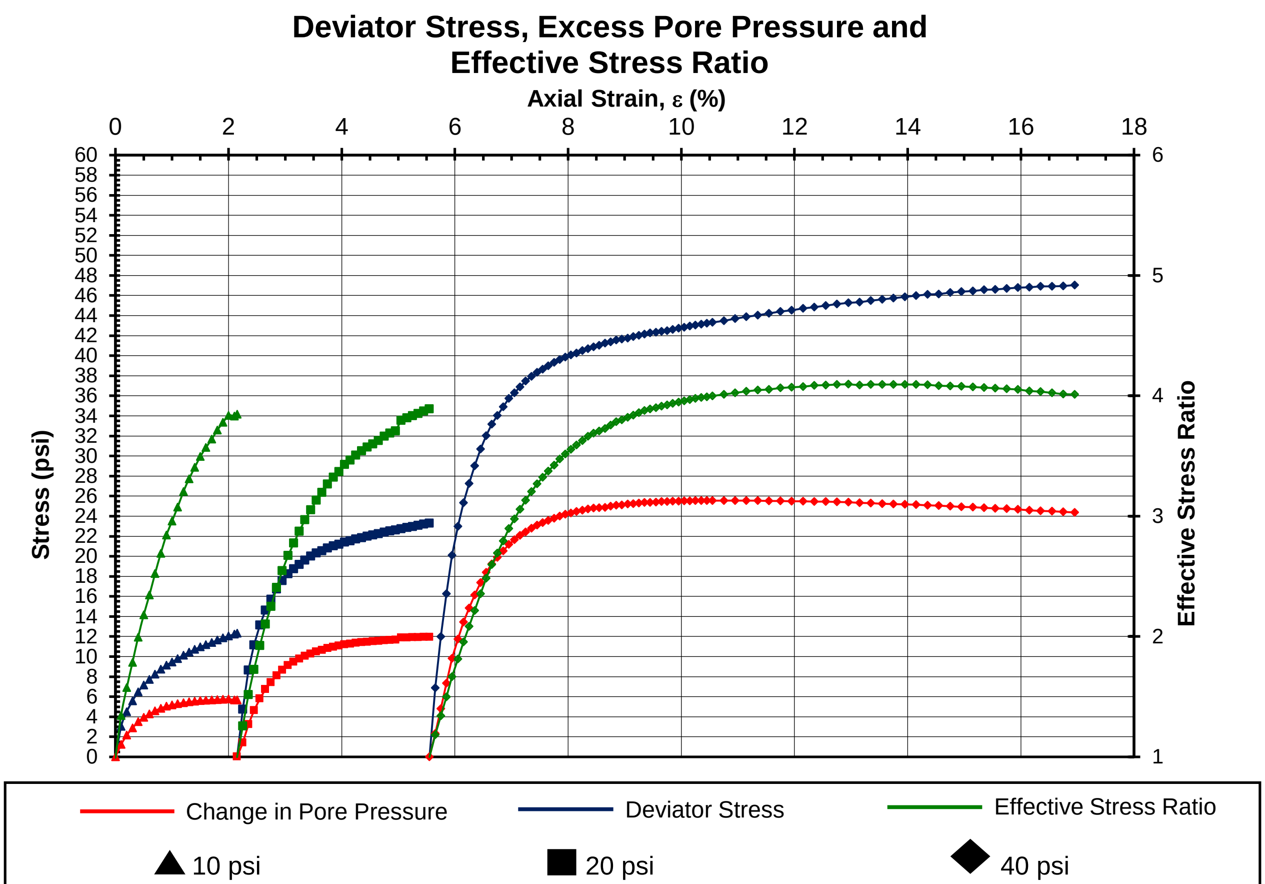
Reviewed by: SEG

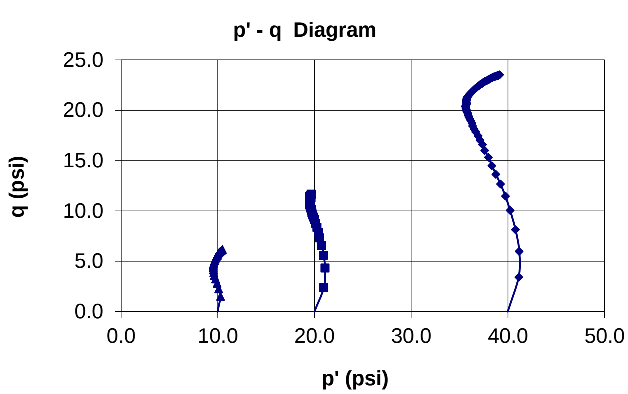
Figure 5

HWA GeoSciences Inc - Materials Testing Laboratory

Consolidated-Undrained Triaxial Compression Test for Cohesive Soils (ASTM D 4767)

Project Name:	Lower Duwamish Waterway			Date:	9/16/2021
Project No.:	2012-002-23 T51	Exploration ID:			LDW21-GT53-SPT
Technician:	GB	Sample No:			n/a
Sample Description:	Very dark grayish-brown, SILT with sand (ML)			Sample Depth, ft:	30.0-32.0
Confining Pressures:	**10 psi**	**20 psi**	**40 psi**	Consolidation T50 Values (minutes)	
Initial Moisture:	43.6%	Final Moisture:	36.3%	10 psi / 20 psi / 40 psi	
Initial Wet Density, pcf:	112.3			10.13 / 5.5 / 15.3	
Initial Dry Density, pcf:	78.2				

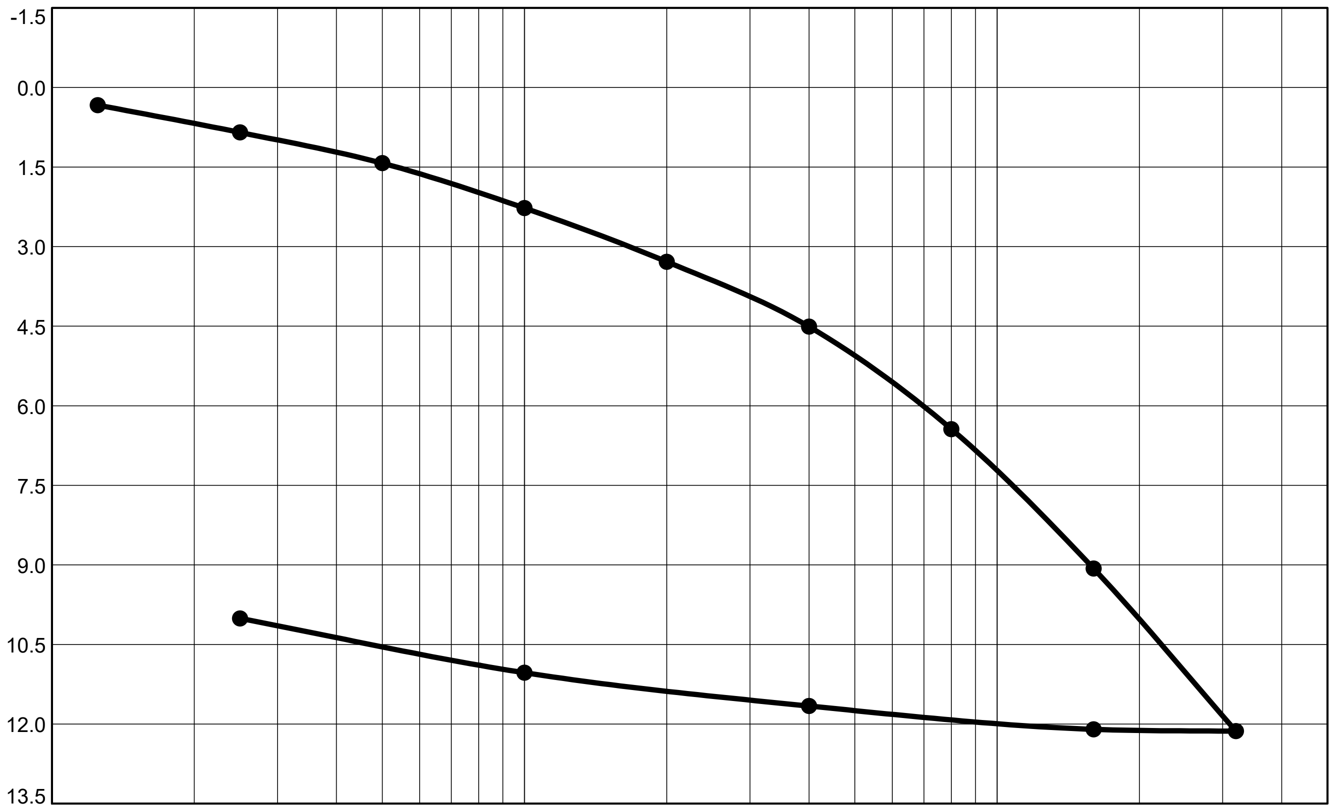


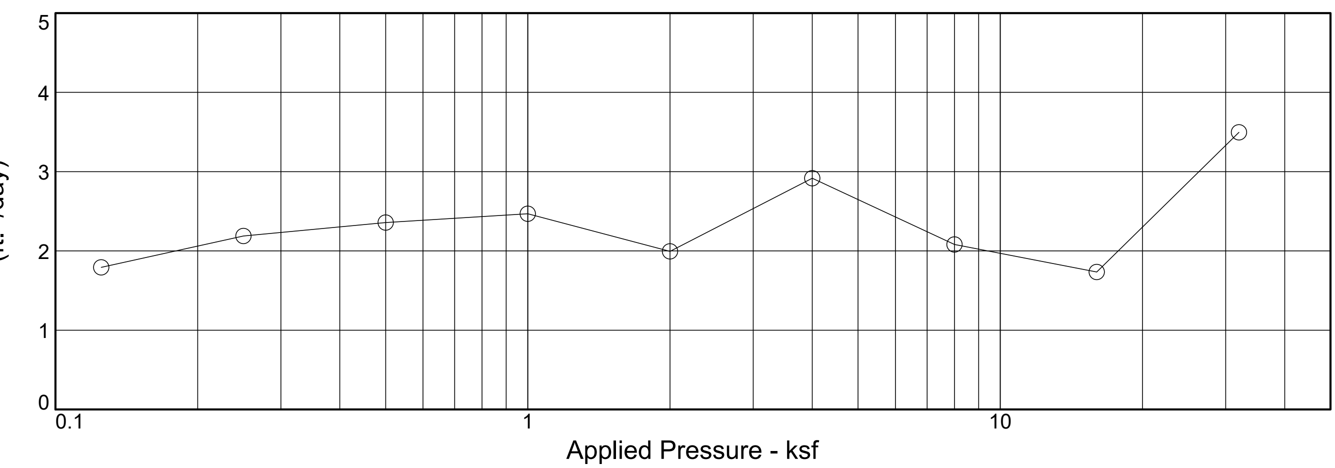


Reviewed by: SEG

Figure 6

CONSOLIDATION TEST REPORT





Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
89.4 %	33.3 %	82.8	26	1	2.617	SM		0.973

MATERIAL DESCRIPTION

Dark grayish-brown, Silty SAND

Project No. 2012-002 **Client:** MTC

Project: MLT for MTC
Lower Duwamish River

Source of Sample: LDW21-GT23-GB **Depth:** 28.5

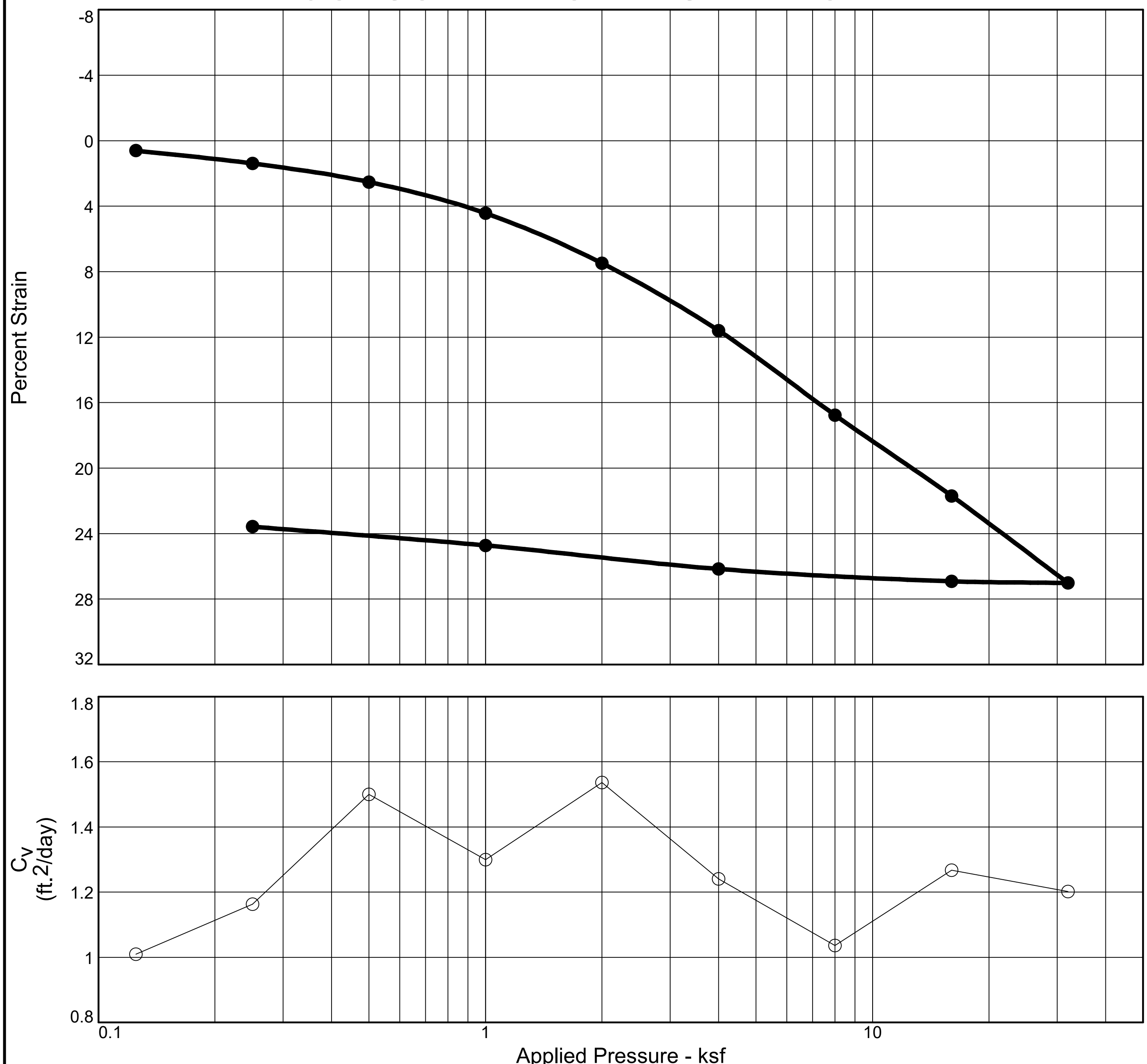
HWA GEOSCIENCES INC.
DBE/MWBE

Remarks:
Specific Gravity determined per ASTM D854

Figure 7

Tested By: AH/GB **Checked By:** SEG

CONSOLIDATION TEST REPORT



Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
97.9 %	58.6 %	64.3	38	2	2.612	ML		1.564

MATERIAL DESCRIPTION

Very dark grayish-brown, SILT with sand

Project No. 2012-002 **Client:** MTC

Project: MLT for MTC
Lower Duwamish River

Source of Sample: LDW21-GT33-GB **Depth:** 6.0

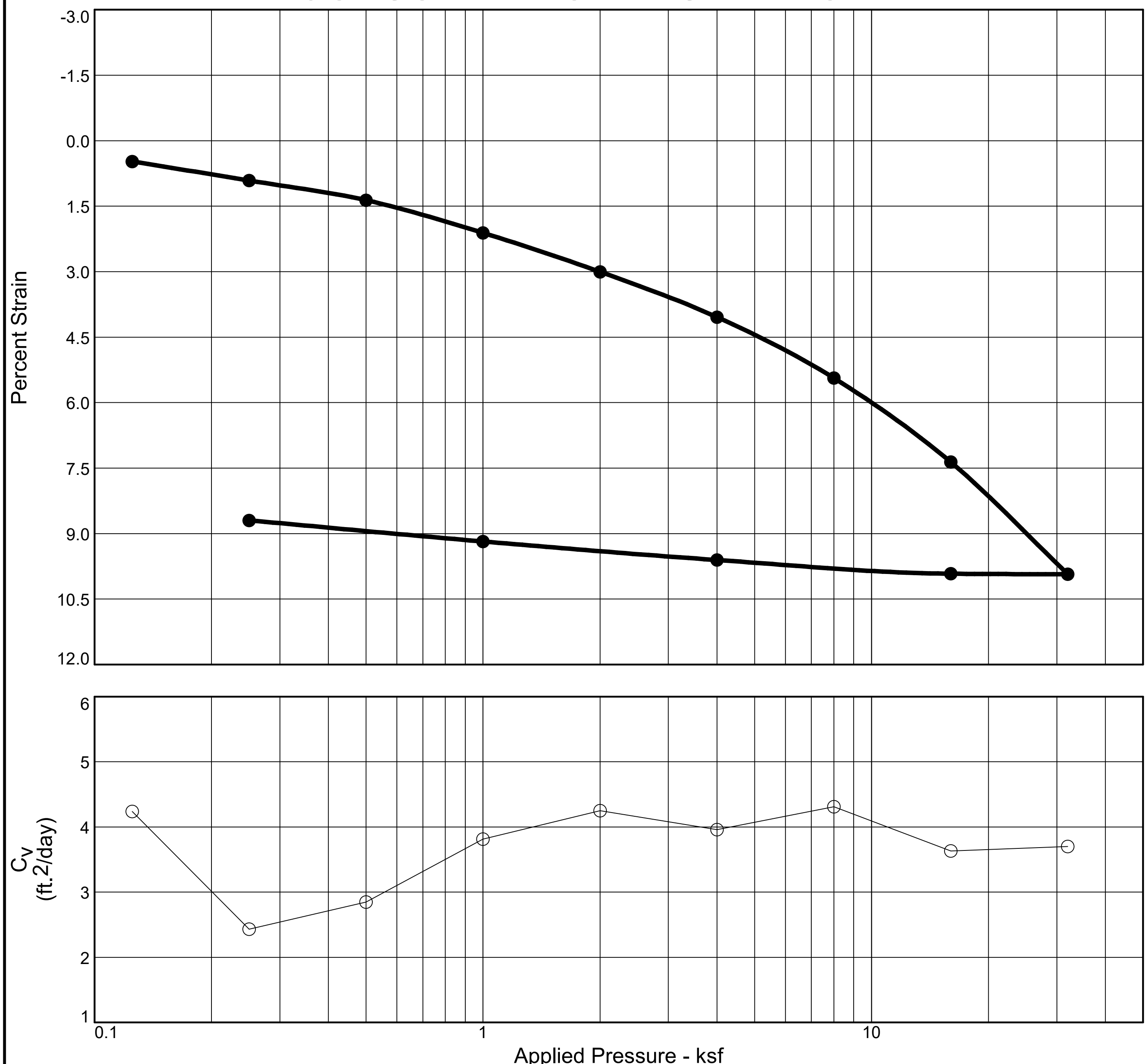
HWA GEOSCIENCES INC.
DBE/MWBE

Remarks:
Specific Gravity determined per ASTM D854

Figure 8

Tested By: GB

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
96.4 %	35.3 %	87.0	31	2	2.643	SM		0.968

MATERIAL DESCRIPTION

Very dark grayish-brown, silty SAND

Project No. 2012-002 **Client:** MTC

Project: MLT for MTC
Lower Duwamish River

Source of Sample: LDW21-GT33-GB **Depth:** 21.0

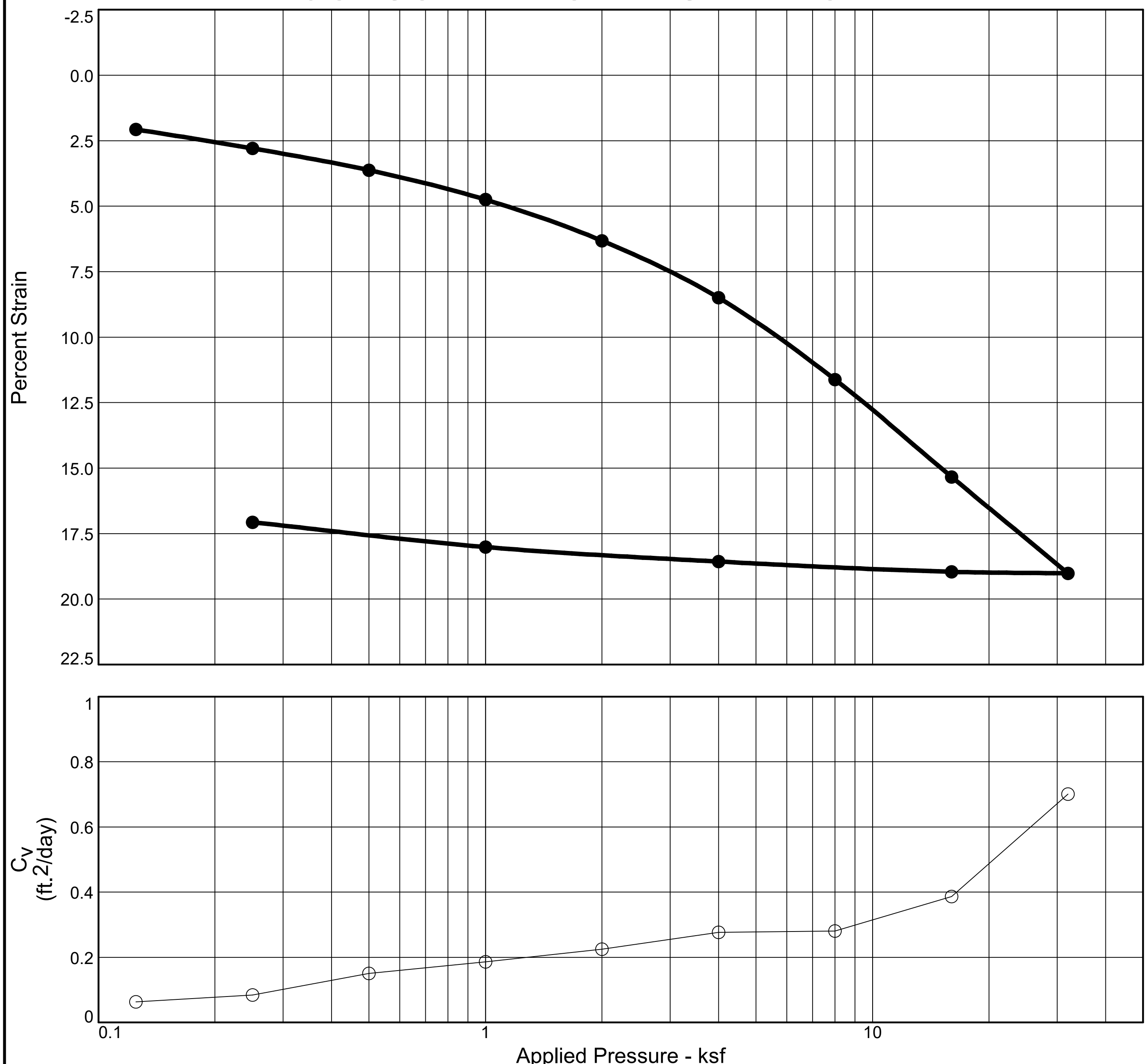
GEOSCIENCES INC.
DBE/MWBE

Remarks:
Specific Gravity determined per ASTM D854

Figure 9

Tested By: GB **Checked By:** SEG

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
108.4 %	43.6 %	82.0	38	11	2.627	ML		1.058

MATERIAL DESCRIPTION

Very dark grayish-brown, SILT wtih sand

Project No. 2012-002 **Client:** MTC

Project: MLT for MTC
Lower Duwamish River

Source of Sample: LDW21-GT53-SPT **Depth:** 30.0

HWA GEOSCIENCES INC.
DBE/MWBE

Remarks:
Specific Gravity determined per ASTM D854

Figure 10

Tested By: GB **Checked By:** SEG

MATERIALS TESTING & CONSULTING, INC.

Client:	Anchor QEA	**Date:**	October 22, 2021
Address:	21328 2nd Drive SE	**Project:**	Q.C. - Lower Duwamish Waterway
	Bothell, WA 98021	**Project #:**	21B233
Attn:	Garrett Timm	**Sample #:**	B21-2006 - 2020
Revised on:		**Date sampled:**	7-19-21 & 7-20-21

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	Please See Attached Reports		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count			LA Abrasion	
X	Moisture Content	Please See Attached Report	X	Direct Shear	Please See Attached Reports
	Specific Gravity, Coarse		X	Specific Gravity, Soils	Please See Attached Reports
	Specific Gravity, Fine				
X	Hydrometer Analysis	Please See Attached Reports			
X	Atterberg Limits	Please See Attached Reports			

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Respectfully Submitted,
Meghan Blodgett-Carrillo
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM C566, ASTM D2216

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: October 5, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: M. Carrillo

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B21-2006	LDW21-GT5-0-1.5 ft	233.4	758.3	626.0	132.3	392.6	33.7%
B21-2007	LDW21-GT5-0-7.5 ft	266.3	675.6	572.3	103.3	306.0	33.8%
B21-2008	LDW21-GT5-7.5-9 ft	270.2	918.2	773.3	144.9	503.1	28.8%
B21-2009	LDW21-GT5-7.5-17.2ft	215.7	960.7	862.1	98.6	646.4	15.3%
B21-2010	LDW21-GT5-17.2-17.5 ft	300.9	721.1	625.3	95.8	324.4	29.5%
B21-2011	LDW21-GT5-17.5-19 ft	346.3	836.3	746.0	90.3	399.7	22.6%
B21-2012	LDW21-GT5-17.5-27.5 ft	341.8	961.5	816.3	145.2	474.5	30.6%
B21-2013	LDW21-GT5-27.5-29 ft	356.9	833.5	719.1	114.4	362.2	31.6%
B21-2014	LDW21-GT35-0-1.5 ft	360.3	821.8	607.9	213.9	247.6	86.4%
B21-2015	LDW21-GT35-5-6.5 ft	354.1	572.7	469.6	103.1	115.5	89.3%
B21-2016	LDW21-GT35-10-11.5 ft	359.4	882.4	671.2	211.2	311.8	67.7%
B21-2017	LDW21-GT35-15-16.5 ft	236.6	466.5	417.1	49.4	180.5	27.4%
B21-2018	LDW21-GT35-20-21.5 ft	237.4	947.7	793.9	153.8	556.5	27.6%
B21-2019	LDW21-GT35-25-26.5 ft	224.2	733.1	614.5	118.6	390.3	30.4%
B21-2020	LDW21-GT35-30-31.5 ft	225.1	669.4	560.4	109.0	335.3	32.5%

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM D854

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: October 5, 2021
Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B21-2009	LDW21-GT5-7.5-17.2ft	601.79	703.81	102.0	TSA-022	198.0	499.5	0.99865	760.54	696.77	17.7	2.6674865	1.00045	2.6686868
B21-2012	LDW21-GT5-17.5-27.5 ft	497.70	600.26	102.6	TSA-021	183.4	499.4	0.99869	744.61	682.18	17.6	2.5559632	1.00048	2.5571901
B21-2017	LDW21-GT35-15-16.5 ft	509.68	611.88	102.2	TSA-023	163.9	498.7	0.99865	724.72	661.99	17.7	2.5895248	1.00045	2.5906901

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.
Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT5-GB-0-7.5 ft
Sample #: B21-2007

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 14-Oct-21
Tested By: A. Eifrig

Visual Identification
Sand with Silt
Sample Color
brown

Liquid Limit Determination

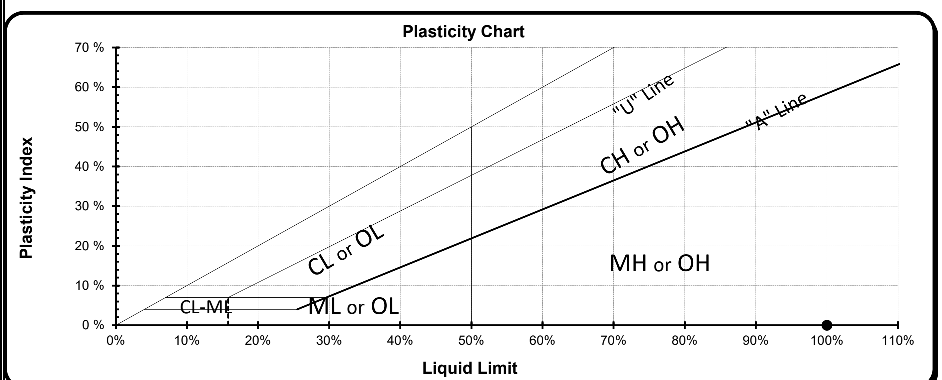
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

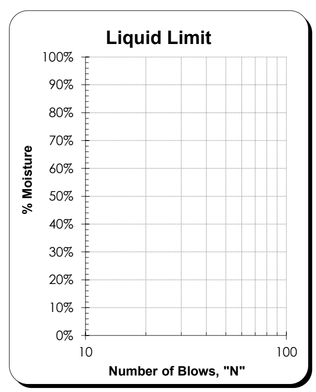
Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumblind. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	6-Oct-21
Source:	LDW21-GT5-GB-7.5-17.2 ft	**Tested By:**	K. Mendez
Sample#:	B21-2009		

Unified Soil Classification System, ASTM-2487
SW-SM, Well-graded Sand with Silt and Gravel
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

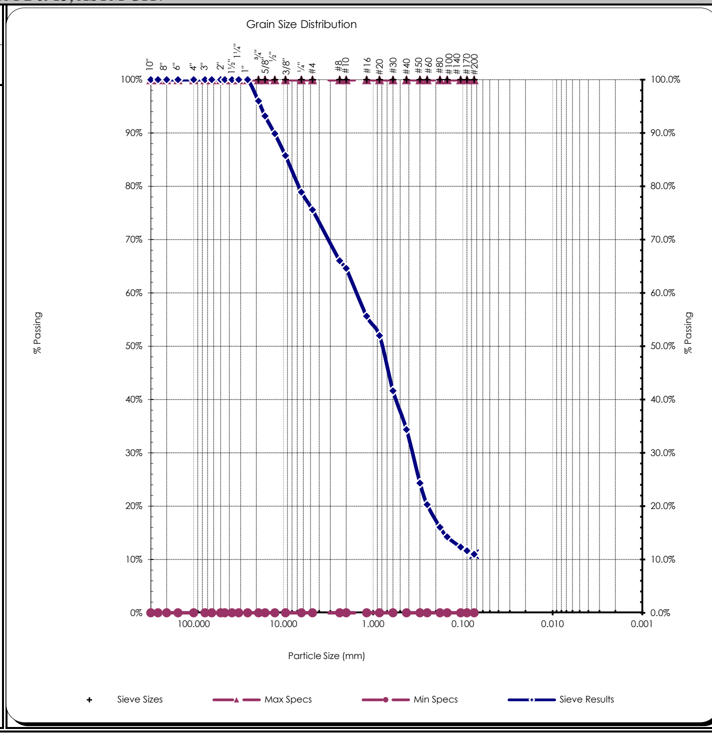
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.034 mm	% Gravel =	24.4%	Coeff. of Curvature, C_C =	1.27
$D_{(10)}$ =	0.068 mm	% Sand =	64.6%	Coeff. of Uniformity, C_U =	23.13
$D_{(15)}$ =	0.162 mm	% Silt & Clay =	11.0%	Fineness Modulus =	3.41
$D_{(30)}$ =	0.370 mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.801 mm	Plasticity Index =	n/a	Moisture %, as sampled =	15.3%
$D_{(60)}$ =	1.580 mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	12.641 mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	23/72	Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	96%	96%	100.0%	0.0%
5/8"	16.00		93%	100.0%	0.0%
1/2"	12.50	90%	90%	100.0%	0.0%
3/8"	9.50	86%	86%	100.0%	0.0%
1/4"	6.30		79%	100.0%	0.0%
#4	4.75	76%	76%	100.0%	0.0%
#8	2.36		66%	100.0%	0.0%
#10	2.00	65%	65%	100.0%	0.0%
#16	1.18		56%	100.0%	0.0%
#20	0.850	52%	52%	100.0%	0.0%
#30	0.600		42%	100.0%	0.0%
#40	0.425	34%	34%	100.0%	0.0%
#50	0.300		24%	100.0%	0.0%
#60	0.250	20%	20%	100.0%	0.0%
#80	0.180		16%	100.0%	0.0%
#100	0.150	14%	14%	100.0%	0.0%
#140	0.106		12%	100.0%	0.0%
#170	0.090		12%	100.0%	0.0%
#200	0.075	11.0%	11.0%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

MATERIALS TESTING & CONSULTING, INC.

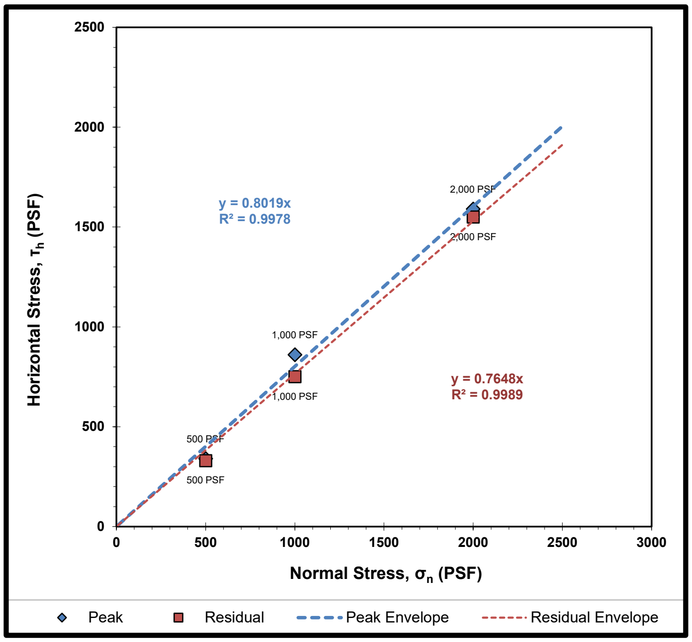
Project: Q.C. - Lower Duwamish Waterway

Project Number:	21B233	**Sample Source:**	LDW21-GT5-GB-7.5-17.2 ft
Laboratory Sample ID:	B21-2009	**Visual Soil Description:**	brown sand
Sample Date:	7/19/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	10/12/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	25.3	
	Initial	**Post-Consolidation**
Dry Density (PCF):	106.6	108.7
Void Ratio:	0.580	0.549
Porosity (%):	36.7	35.5
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	25.2	
	Initial	**Post-Consolidation**
Dry Density (PCF):	107.2	109.2
Void Ratio:	0.571	0.543
Porosity (%):	36.3	35.2
Degree of Saturation (%):	saturated	saturated

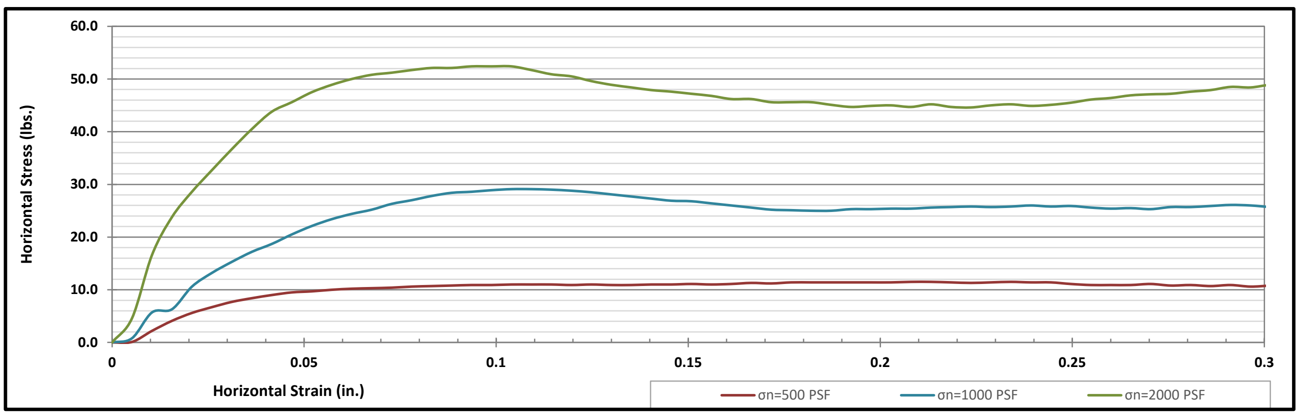
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	25.8	
	Initial	**Post-Consolidation**
Dry Density (PCF):	106.6	109.4
Void Ratio:	0.581	0.540
Porosity (%):	36.7	35.1
Degree of Saturation (%):	saturated	saturated

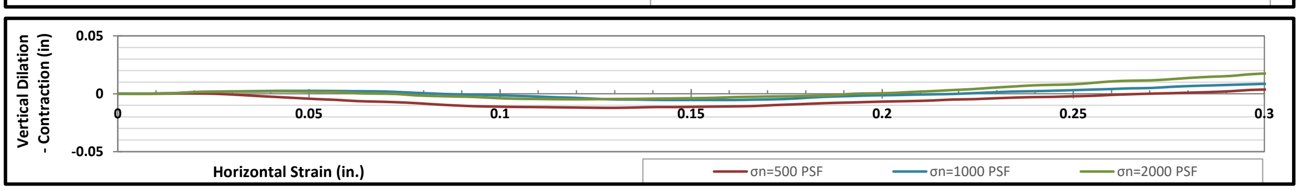


ESTIMATED STRENGTH PARAMETERS

	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	39	37
Cohesion (PSF):	0	0

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	340	860	1590
Residual Horizontal Stress, τ_h (PSF):	330	750	1550





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

Materials Testing & Consulting, Inc.
Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	14-Oct-21
Source:	LDW21-GT5-GB-17.2-17.5 ft	**Tested By:**	A. Eifrig
Sample #:	B21-2010		

Visual Identification
Sand with Silt
Sample Color
brown

Liquid Limit Determination

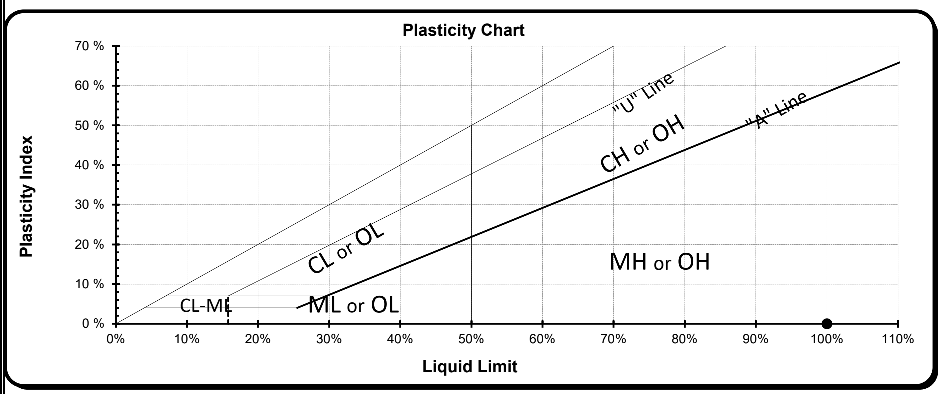
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

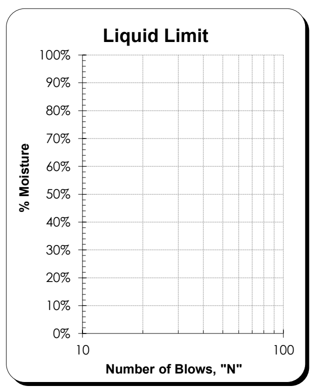
Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumblind. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT5-GB-17.5-27.5 ft
Sample#: B21-2012

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 6-Oct-21
Tested By: K. Mendez

Unified Soil Classification System, ASTM-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

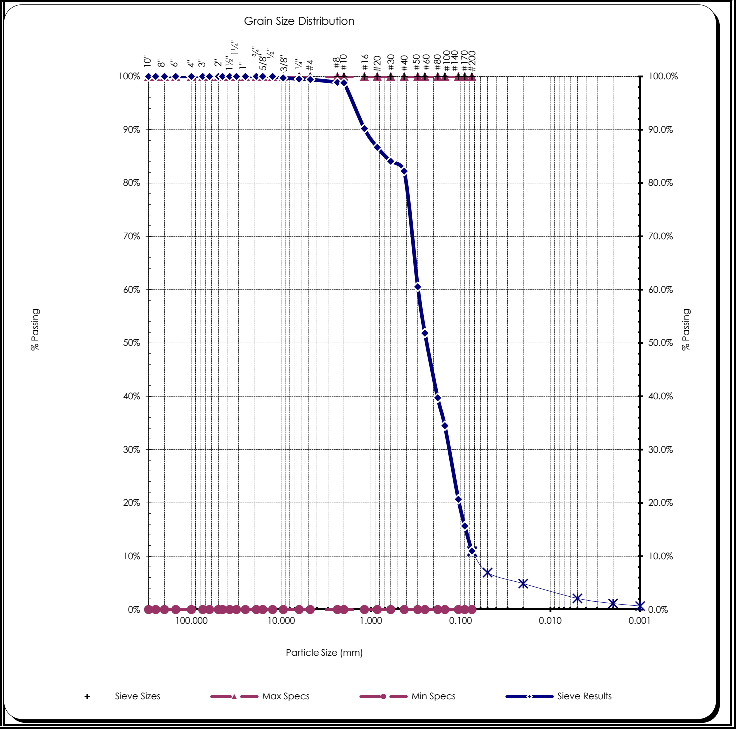
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.022	mm	% Gravel = 0.6%		Coeff. of Curvature, C_C = 0.91	
$D_{(10)}$ = 0.068	mm	% Sand = 88.5%		Coeff. of Uniformity, C_U = 4.38	
$D_{(15)}$ = 0.088	mm	% Silt & Clay = 11.0%		Fineness Modulus = 1.33	
$D_{(30)}$ = 0.136	mm	Liquid Limit = n/a		Plastic Limit = n/a	
$D_{(50)}$ = 0.239	mm	Plasticity Index = n/a		Moisture %, as sampled = 30.6%	
$D_{(60)}$ = 0.297	mm	Sand Equivalent = n/a		Req'd Sand Equivalent =	
$D_{(90)}$ = 1.161	mm	Fracture %, 1 Face = n/a		Req'd Fracture %, 1 Face =	
Dust Ratio = 2/15		Fracture %, 2+ Faces = n/a		Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	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		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		90%	100.0%	0.0%
#20	0.850		87%	100.0%	0.0%
#30	0.600		84%	100.0%	0.0%
#40	0.425	82%	82%	100.0%	0.0%
#50	0.300		61%	100.0%	0.0%
#60	0.250		52%	100.0%	0.0%
#80	0.180		40%	100.0%	0.0%
#100	0.150	35%	35%	100.0%	0.0%
#140	0.106		21%	100.0%	0.0%
#170	0.090		16%	100.0%	0.0%
#200	0.075	11.0%	11.0%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	6-Oct-21
Source:	LDW21-GT5-GB-17.5-27.5 ft	**Tested By:**	K. Mendez
Sample#:	B21-2012		

Unified Soil Classification System, ASTM-2487
SP-SM, Poorly graded Sand with Silt
Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Sp Gr.	2.56	
Sample Weight:	100.01	grams
Hydroscopic Moist.:	1.52%	
Adj. Sample Wgt :	98.51	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	8	8.2%	0.0545 mm
2	6	6.1%	0.0389 mm
5	5	5.1%	0.0248 mm
15	4.5	4.6%	0.0144 mm
30	4	4.1%	0.0102 mm
60	3	3.1%	0.0072 mm
240	1.5	1.5%	0.0036 mm
1440	1	1.0%	0.0015 mm

% Gravel:	0.6%	**Liquid Limit:**	n/a
% Sand:	88.5%	**Plastic Limit:**	n/a
% Silt:	8.9%	**Plasticity Index:**	n/a
% Clay:	2.1%		

ASTM D6913

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	99%	2.000 mm
#20	87%	0.850 mm
#40	82%	0.425 mm
#100	35%	0.150 mm
#200	11.0%	0.075 mm
Silts	10.8%	0.074 mm
	6.9%	0.050 mm
	4.9%	0.020 mm
Clays	2.1%	0.005 mm
	1.1%	0.002 mm
Colloids	0.7%	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
Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21	**Visual Identification**
Project #:	21B233	**Sampled By:**	Client	Clay
Client:	Anchor QEA	**Date Tested:**	14-Oct-21	**Sample Color**
Source:	LDW21-GT35-GB-5-6.5 ft	**Tested By:**	K. Mendez	brown
Sample #:	B21-2015			

Liquid Limit Determination

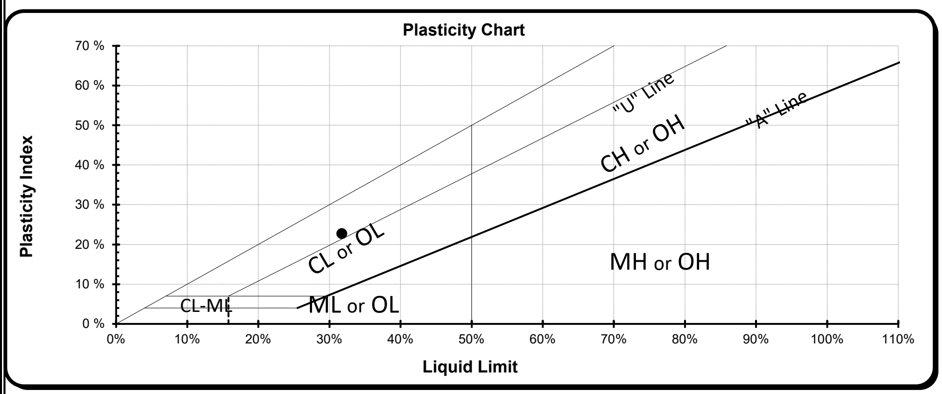
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	30.42	27.71	26.95			
Weight of Dry Soils + Pan:	27.89	24.44	23.66			
Weight of Pan:	19.88	15.05	14.81			
Weight of Dry Soils:	8.01	9.39	8.85			
Weight of Moisture:	2.53	3.27	3.29			
% Moisture:	31.6 %	34.8 %	37.2 %			
Number of Blows:	25	20	15			

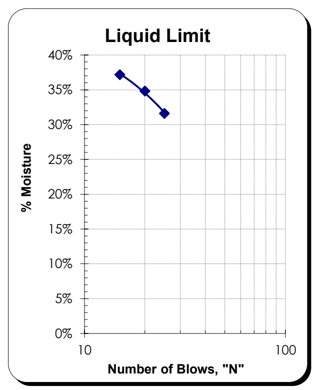
Liquid Limit @ 25 Blows:	32 %
Plastic Limit:	9 %
Plasticity Index, I_P:	23 %

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	37.34	36.36				
Weight of Dry Soils + Pan:	36.82	35.86				
Weight of Pan:	31.03	30.33				
Weight of Dry Soils:	5.79	5.53				
Weight of Moisture:	0.52	0.50				
% Moisture:	9.0 %	9.0 %				

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Sieve Report

Project: Q.C. - Lower Duwamish Waterway	**Date Received:** 29-Jul-21	**Unified Soil Classification System, ASTM-2487**	
Project #: 21B233	**Sampled By:** Client	SM, Silty Sand	
Client: Anchor QEA	**Date Tested:** 6-Oct-21	**Sample Color:**	
Source: LDW21-GT35-GB-15-16.5 ft	**Tested By:** K. Mendez	gray	ACCREDITED Certificate #: 1366.01
Sample#: B21-2017			

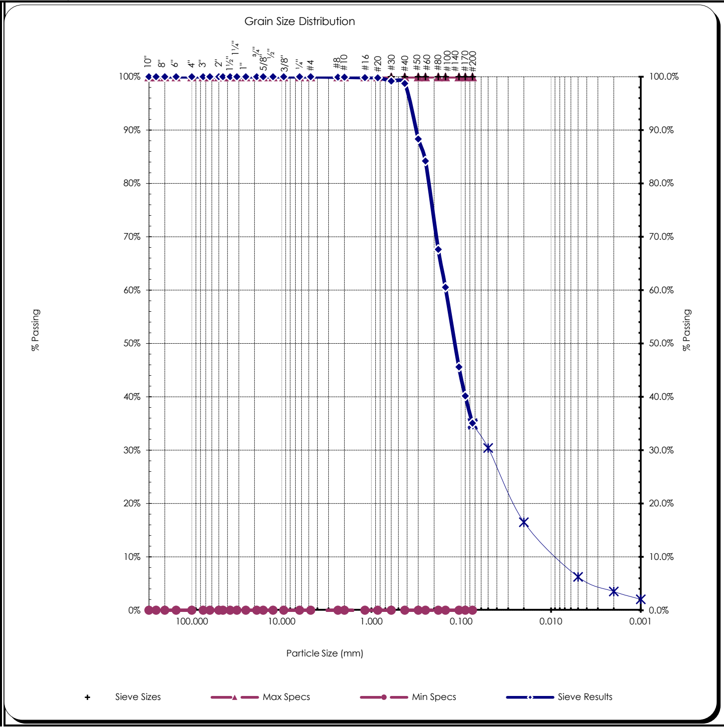
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.004 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 2.36
$D_{(10)}$ = 0.009 mm	% Sand = 64.9%	Coeff. of Uniformity, C_U = 16.11
$D_{(15)}$ = 0.017 mm	% Silt & Clay = 35.1%	Fineness Modulus = 0.52
$D_{(30)}$ = 0.057 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.119 mm	Plasticity Index = n/a	Moisture %, as sampled = 27.4%
$D_{(60)}$ = 0.148 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.320 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 11/31	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850	100%	100%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		88%	100.0%	0.0%
#60	0.250	84%	84%	100.0%	0.0%
#80	0.180		68%	100.0%	0.0%
#100	0.150	61%	61%	100.0%	0.0%
#140	0.106		46%	100.0%	0.0%
#170	0.090		40%	100.0%	0.0%
#200	0.075	35.1%	35.1%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21	**Unified Soil Classification System, ASTM-2487**
Project #:	21B233	**Sampled By:**	Client	SM, Silty Sand
Client :	Anchor QEA	**Date Tested:**	6-Oct-21	**Sample Color**
Source:	LDW21-GT35-GB-15-16.5 ft	**Tested By:**	K. Mendez	gray
Sample#:	B21-2017			

ASTM D7928, HYDROMETER ANALYSIS

Sp Gr.	2.59	
Sample Weight:	102.29	grams
Hydroscopic Moist.:	1.10%	
Adj. Sample Wgt :	101.18	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	27.5	27.7%	0.0486 mm
2	23	23.2%	0.0352 mm
5	18	18.1%	0.0230 mm
15	13	13.1%	0.0137 mm
30	10.5	10.6%	0.0099 mm
60	8	8.1%	0.0070 mm
240	5	5.0%	0.0036 mm
1440	3	3.0%	0.0015 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	64.9%	**Plastic Limit:**	n/a
% Silt:	28.8%	**Plasticity Index:**	n/a
% Clay:	6.3%		

ASTM D6913

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	100%	4.750 mm
	#10	100%	2.000 mm
	#20	100%	0.850 mm
	#40	99%	0.425 mm
	#100	61%	0.150 mm
	#200	35.1%	0.075 mm
Silts		34.8%	0.074 mm
		30.4%	0.050 mm
		16.5%	0.020 mm
Clays		6.3%	0.005 mm
		3.5%	0.002 mm
Colloids		2.0%	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: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

MATERIALS TESTING & CONSULTING, INC.

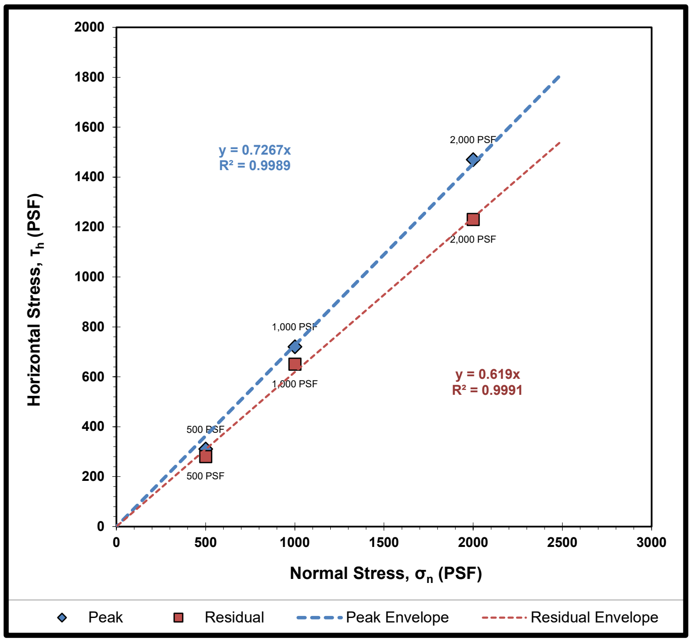
Project: Q.C. - Lower Duwamish Waterway

Project Number:	21B233	**Sample Source:**	LDW21-GT35-GB-15-16.5 ft
Laboratory Sample ID:	B21-2017	**Visual Soil Description:**	gray sand
Sample Date:	7/20/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	10/6/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	29.5	
	Initial	Post-Consolidation
Dry Density (PCF):	109.5	110.5
Void Ratio:	0.539	0.525
Porosity (%):	35.0	34.4
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	30.1	
	Initial	Post-Consolidation
Dry Density (PCF):	108.1	110.4
Void Ratio:	0.559	0.527
Porosity (%):	35.8	34.5
Degree of Saturation (%):	saturated	saturated

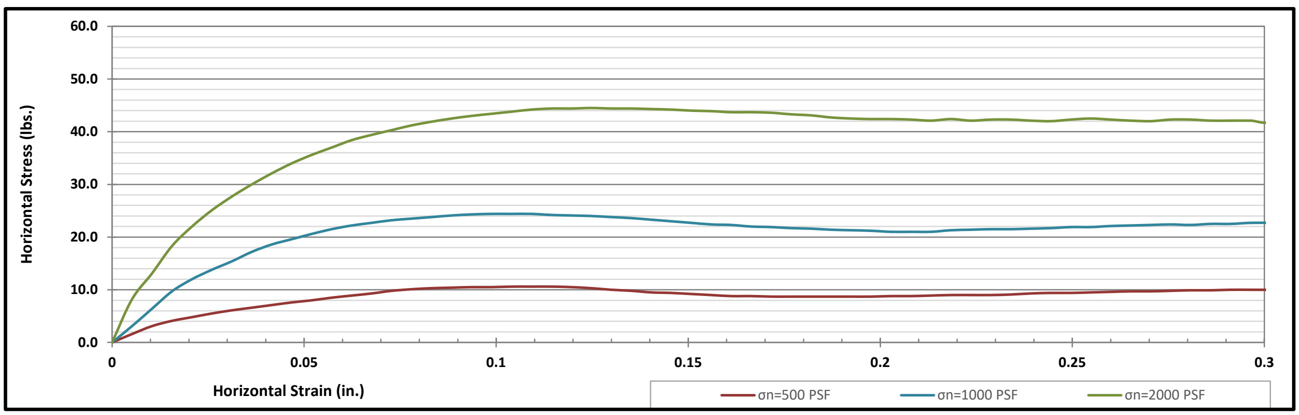
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	32.2	
	Initial	Post-Consolidation
Dry Density (PCF):	107.5	110.7
Void Ratio:	0.567	0.522
Porosity (%):	36.2	34.3
Degree of Saturation (%):	saturated	saturated

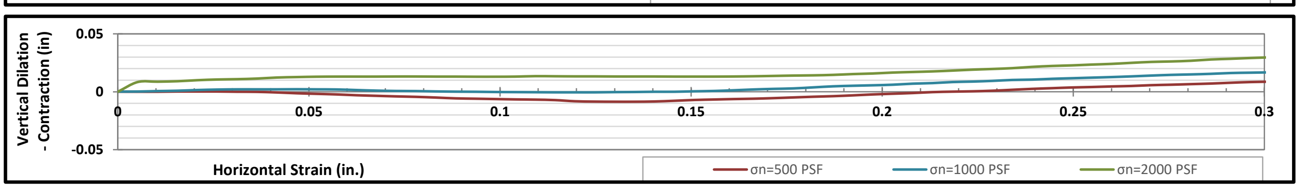


ESTIMATED STRENGTH PARAMETERS

	PEAK	RESIDUAL
Angle of Internal Friction, ϕ (°):	36	32
Cohesion (PSF):	0	0

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	310	720	1470
Residual Horizontal Stress, τ_h (PSF):	280	650	1230





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	6-Oct-21
Source:	LDW21-GT35-GB-20-21.5 ft	**Tested By:**	K. Mendez
Sample#:	B21-2018		

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

ACCREDITED
Certificate #: 1366.01

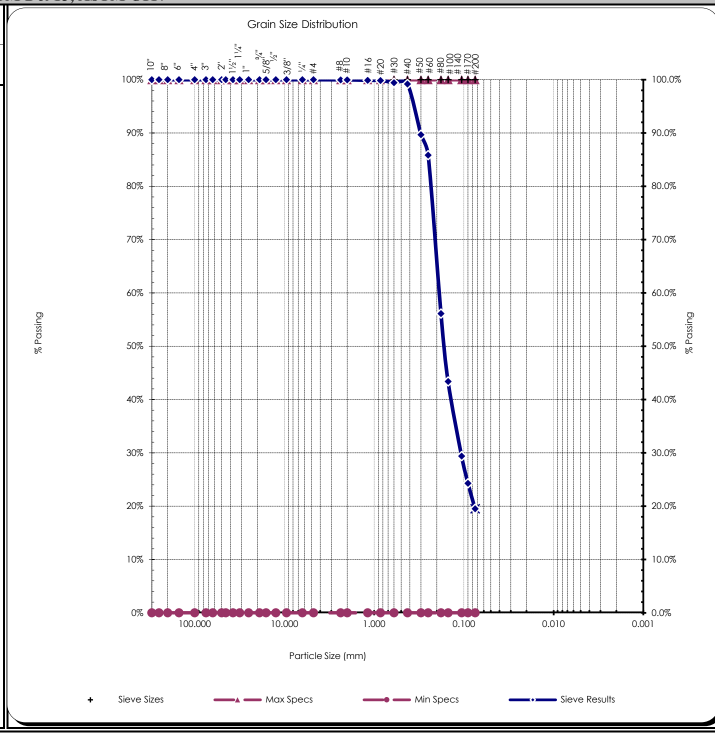
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.019 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.60
$D_{(10)}$ = 0.038 mm	% Sand = 80.5%	Coeff. of Uniformity, C_U = 4.92
$D_{(15)}$ = 0.058 mm	% Silt & Clay = 19.5%	Fineness Modulus = 0.68
$D_{(30)}$ = 0.108 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.166 mm	Plasticity Index = n/a	Moisture %, as sampled = 27.6%
$D_{(60)}$ = 0.189 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.304 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 13/66	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850	100%	100%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		90%	100.0%	0.0%
#60	0.250	86%	86%	100.0%	0.0%
#80	0.180		56%	100.0%	0.0%
#100	0.150	43%	43%	100.0%	0.0%
#140	0.106		29%	100.0%	0.0%
#170	0.090		24%	100.0%	0.0%
#200	0.075	19.5%	19.5%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT35-GB-30-31.5 ft
Sample #: B21-2020

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 14-Oct-21
Tested By: A. Eifrig

Visual Identification
Silty Sand
Sample Color
brown

Liquid Limit Determination

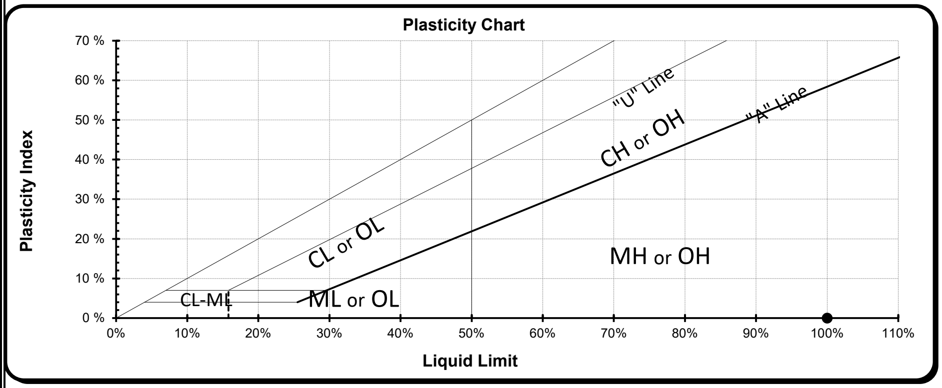
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Liquid limit cannot be established				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

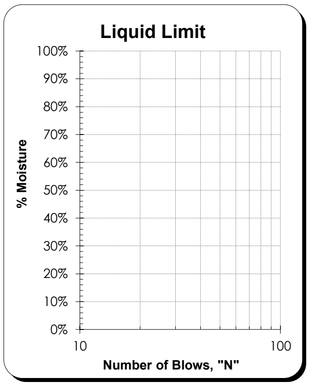
Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Plastic limit cannot be determined				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments: Liquid limit cannot be established as the material displays rapid dilation upon spreading into the cup. At lower moistures the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the material does not roll down to 1/8" threads before cracking or crumblind. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Client:	Anchor QEA	**Date:**	October 25, 2021
Address:	21328 2nd Drive SE	**Project:**	Q.C. - Lower Duwamish Waterway
	Bothell, WA 98021	**Project #:**	21B233
Attn:	Garrett Timm	**Sample #:**	B21-2143-2162
Revised on:		**Date sampled:**	August 5, 2021

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	Please See Attached Reports		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count			LA Abrasion	
X	Moisture Content	Please See Attached Report	X	Direct Shear	Please See Attached Reports
	Specific Gravity, Coarse		X	Specific Gravity, Soils	Please See Attached Reports
	Specific Gravity, Fine				
X	Hydrometer Analysis	Please See Attached Reports			
X	Atterberg Limits	Please See Attached Reports			

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Respectfully Submitted,
Meghan Blodgett-Carrillo
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM C566, ASTM D2216

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: October 15, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B21-2143	LDW21-GT48-GB-21.6-25 ft	234.6	512.3	437.5	74.8	202.9	36.9%
B21-2144	LDW21-GT48-GB-25-30 ft	221.6	1232.1	959.0	273.1	737.4	37.0%
B21-2145	LDW21-GT48-GB-30-35 ft	215.3	1034.5	826.3	208.2	611.0	34.1%
B21-2146	LDW21-GT48-GB-35-36.5 ft	235.3	1073.2	832.7	240.5	597.4	40.3%
B21-2147	LDW21-GT53-GB-0-1.5 ft	228.9	845.1	638.7	206.4	409.8	50.4%
B21-2148	LDW21-GT53-GB-0-5 ft	208.5	682.6	526.4	156.2	317.9	49.1%
B21-2149	LDW21-GT53-GB-5-6.5 ft	222.9	1006.1	801.8	204.3	578.9	35.3%
B21-2150	LDW21-GT53-GB-5-10 ft	229.4	762.5	595.5	167.0	366.1	45.6%
B21-2151	LDW21-GT53-GB-10-15 ft	221.1	1092.3	749.6	342.7	528.5	64.8%
B21-2152	LDW21-GT53-GB-15-20 ft	220.4	805.0	678.3	126.7	457.9	27.7%
B21-2153	LDW21-GT53-GB-20-23.5 ft	222.9	998.0	819.4	178.6	596.5	29.9%
B21-2154	LDW21-GT53-GB-23.5-25 ft	217.3	990.1	795.4	194.7	578.1	33.7%
B21-2155	LDW21-GT53-GB-25-28.6 ft	222.6	807.8	656.4	151.4	433.8	34.9%
B21-2156	LDW21-GT53-GB-28.6-30 ft	224.3	929.6	800.4	129.2	576.1	22.4%
B21-2157	LDW21-GT48-SPT-0-0.7 ft	268.9	742.1	658.8	83.3	389.9	21.4%
B21-2158	LDW21-GT48-SPT-0.7-1.5 ft	310.9	685.1	612.8	72.3	301.9	23.9%
B21-2159	LDW21-GT48-SPT-10-11.5 ft	319.8	870.6	717.8	152.8	398.0	38.4%
B21-2160	LDW21-GT48-SPT-15-16.5 ft	301.0	852.0	723.3	128.7	422.3	30.5%
B21-2161	LDW21-GT48-SPT-20-20.6 ft	302.0	675.6	567.7	107.9	265.7	40.6%
B21-2162	LDW21-GT48-SPT-20.6-21.5 ft	303.2	829.7	715.1	114.6	411.9	27.8%

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MTC
MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM D854

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: October 16, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B21-2143	LDW21-GT48-GB-21.6-25 ft	420.68	495.04	74.4	TSA-010	180.3	499.5	0.99854	725.29	679.12	18.3	2.6377506	1.00034	2.6386475
B21-2148	LDW21-GT53-GB-0-5 ft	413.74	512.57	98.8	TSA-011	190.3	499.5	0.99856	747.85	689.15	18.3	2.4627054	1.00035	2.4635674
B21-2152	LDW21-GT53-GB-15-20 ft	379.63	483.20	103.6	TSA-017	187.9	499.4	0.99841	751.03	686.50	19.1	2.6531994	1.00020	2.65373
B21-2155	LDW21-GT53-GB-25-28.6 ft	394.13	472.87	78.7	TSA-022	198.0	499.5	0.99856	743.69	696.72	18.3	2.478377	1.00035	2.4792444

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT48-GB-21.6-25 ft
Sample#: B21-2143

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 15-Oct-21
Tested By: A. Eifrig

Visual Identification
Silt with Sand and Clay
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

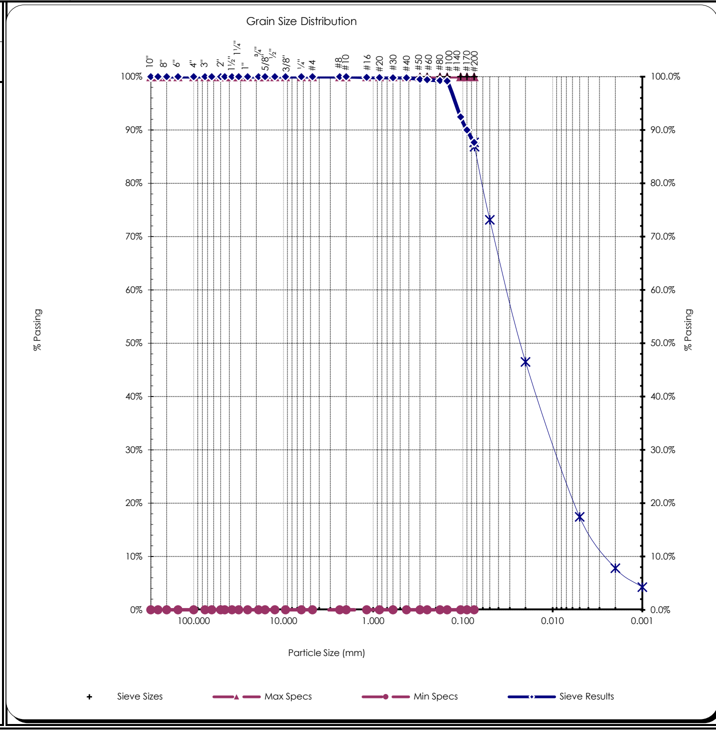
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.001 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 0.94
$D_{(10)}$ = 0.003 mm	% Sand = 12.3%	Coeff. of Uniformity, C_U = 14.64
$D_{(15)}$ = 0.004 mm	% Silt & Clay = 87.7%	Fineness Modulus = 0.02
$D_{(30)}$ = 0.010 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.023 mm	Plasticity Index = n/a	Moisture %, as sampled = 36.9%
$D_{(60)}$ = 0.040 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.090 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 29/33	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		100%	100.0%	0.0%
#30	0.600		100%	100.0%	0.0%
#40	0.425	100%	100%	100.0%	0.0%
#50	0.300		100%	100.0%	0.0%
#60	0.250		99%	100.0%	0.0%
#80	0.180		99%	100.0%	0.0%
#100	0.150	99%	99%	100.0%	0.0%
#140	0.106		92%	100.0%	0.0%
#170	0.090		90%	100.0%	0.0%
#200	0.075	87.7%	87.7%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	15-Oct-21
Source:	LDW21-GT48-GB-21.6-25 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2143		

Visual Identification
Silt with Sand and Clay

Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Sp. Gr	2.64	
Sample Weight:	50.35	grams
Hydroscopic Moist.:	2.46%	
Adj. Sample Wgt :	49.14	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	31	63.7%	0.0464 mm
2	27.5	56.5%	0.0338 mm
5	24	49.3%	0.0218 mm
15	17.5	36.0%	0.0131 mm
30	14	28.8%	0.0095 mm
60	11.5	23.6%	0.0068 mm
240	6	12.3%	0.0035 mm
1440	3	6.2%	0.0015 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	12.3%	**Plastic Limit:**	n/a
% Silt:	70.2%	**Plasticity Index:**	n/a
% Clay:	17.5%		

ASTM D6913

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	100%	4.750 mm
#10	100%	2.000 mm
#20	100%	0.850 mm
#40	100%	0.425 mm
#100	99%	0.150 mm
#200	87.7%	0.075 mm
Silts	86.8%	0.074 mm
	73.1%	0.050 mm
	46.5%	0.020 mm
Clays	17.5%	0.005 mm
	7.8%	0.002 mm
Colloids	4.2%	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
Silt Loam

Comments:

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT48-GB-21.6-25 ft
Sample #: B21-2143

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 15-Oct-21
Tested By: A. Eifrig

Visual Identification
Silt with Sand and Clay
Sample Color
brown

Liquid Limit Determination

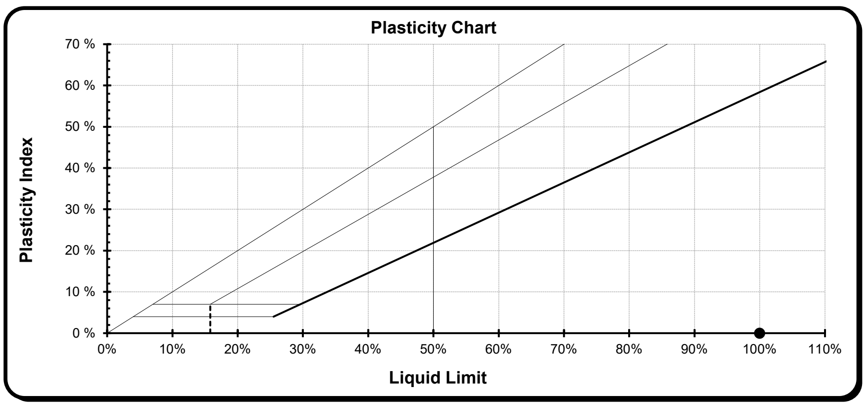
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to establish liquid limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

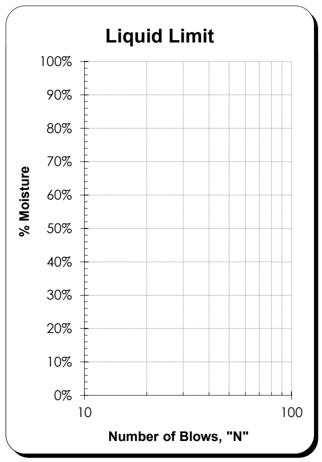
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_P: N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Cannot determined plastic limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation. At lower moistures, the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the sample does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by:
Meghan Blodgett-Carrillo

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	15-Oct-21
Source:	LDW21-GT48-GB-25-30 ft	**Tested By:**	A. Eifrig
Sample #:	B21-2144		

Visual Identification
Silt with Sand and Clay
Sample Color
brown

Liquid Limit Determination

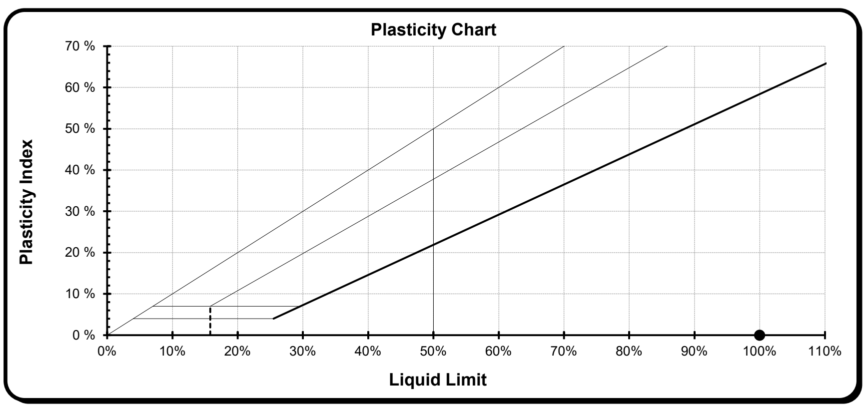
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to establish liquid limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

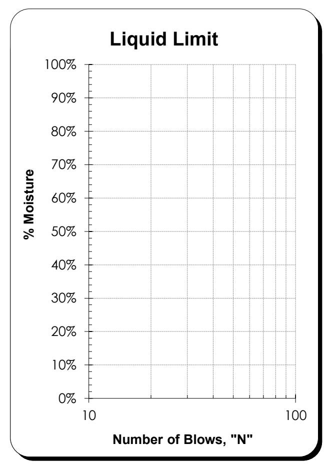
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Cannot determined plastic limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation. At lower moistures, the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the sample does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspections • Materials Testing • Environmental Consulting

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA, LLC
Source: LDW21-GT48-GB-30-35 ft
Sample #: B21-2145

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 18-Oct-21
Tested By: C. Kirk-Patterson

Visual Identification
Silt with Clay
Sample Color
brown

Liquid Limit Determination

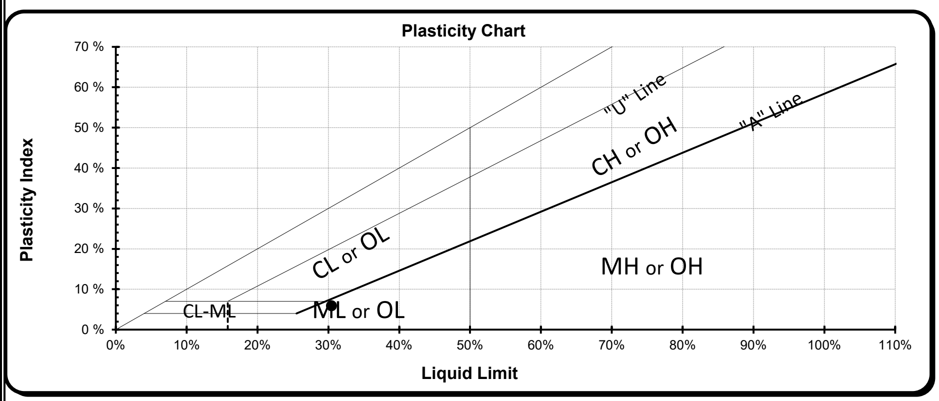
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.11	30.59	34.12			
Weight of Dry Soils + Pan:	25.96	26.90	30.59			
Weight of Pan:	15.19	14.77	19.81			
Weight of Dry Soils:	10.77	12.13	10.78			
Weight of Moisture:	3.15	3.69	3.53			
% Moisture:	29.3 %	30.4 %	32.8 %			
Number of Blows:	30	23	18			

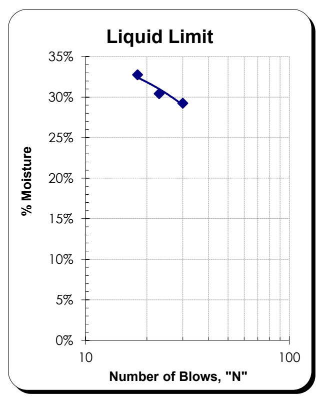
Liquid Limit @ 25 Blows: 30 %
Plastic Limit: 24 %
Plasticity Index, I_P: 6 %

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	34.58	35.80				
Weight of Dry Soils + Pan:	33.37	34.35				
Weight of Pan:	28.28	28.60				
Weight of Dry Soils:	5.09	5.75				
Weight of Moisture:	1.21	1.45				
% Moisture:	23.8 %	25.2 %				

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04





Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Corporate ~ 777 Chrysler Drive • Burlington, WA 98233 • Phone (360) 755-1990 • Fax (360) 755-1980

Regional Offices: Olympia ~ 360.534.9777 Bellingham ~ 360.647.6111 Silverdale ~ 360.698.6787 Tukwila ~ 206.241.1974

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT53-GB-0-5 ft
Sample #: B21-2148

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 15-Oct-21
Tested By: A. Eifrig

Visual Identification
Silt with Clay
Sample Color
brown

Liquid Limit Determination

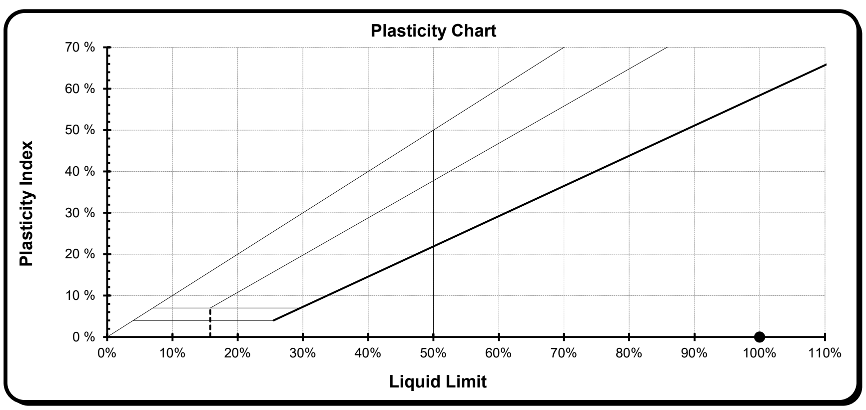
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to establish liquid limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

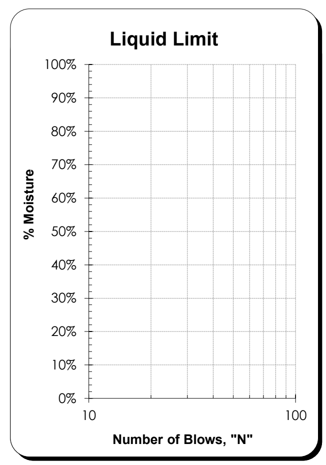
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Cannot determined plastic limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation. At lower moistures, the material does not spread into the liquid limit device without tearing the soil cake. Plastic limit cannot be determined as the sample does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT53-GB-5-10 ft
Sample#: B21-2150

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 15-Oct-21
Tested By: A. Eifrig

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

ACCREDITED
Certificate #: 1366.01

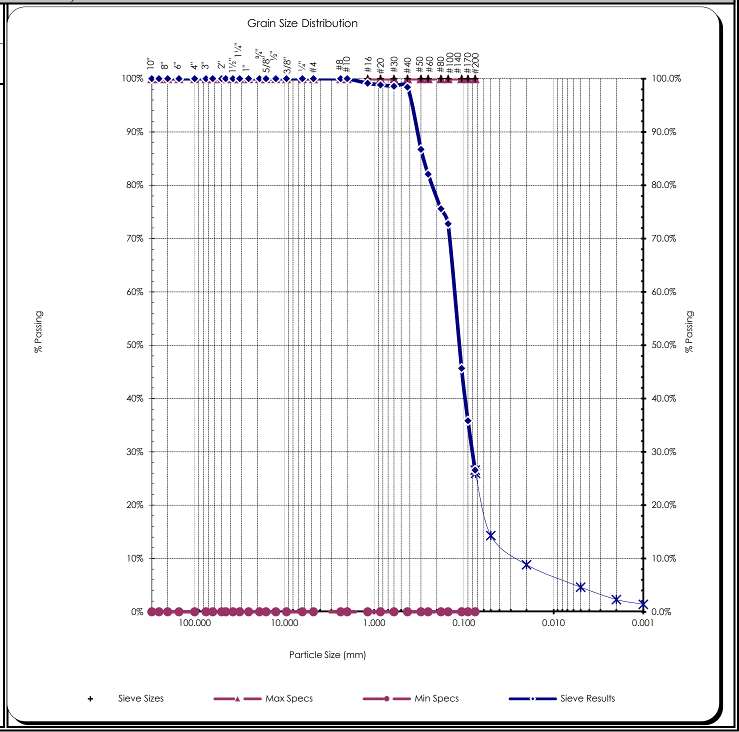
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.005 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.81
$D_{(10)}$ = 0.028 mm	% Sand = 73.4%	Coeff. of Uniformity, C_U = 4.67
$D_{(15)}$ = 0.056 mm	% Silt & Clay = 26.6%	Fineness Modulus = 0.43
$D_{(30)}$ = 0.081 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.113 mm	Plasticity Index = n/a	Moisture %, as sampled = 45.6%
$D_{(60)}$ = 0.129 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.335 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 10/37	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	98%	98%	100.0%	0.0%
#50	0.300		87%	100.0%	0.0%
#60	0.250		82%	100.0%	0.0%
#80	0.180		76%	100.0%	0.0%
#100	0.150	73%	73%	100.0%	0.0%
#140	0.106		46%	100.0%	0.0%
#170	0.090		36%	100.0%	0.0%
#200	0.075	26.6%	26.6%	100.0%	0.0%



Comments:

Reviewed by:
Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	15-Oct-21
Source:	LDW21-GT53-GB-5-10 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2150		

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

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp. Gr	2.65	
Sample Weight:	100.03	grams
Hydroscopic Moist.:	2.23%	
Adj. Sample Wgt :	97.85	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	12	12.3%	0.0516 mm
2	11.5	11.8%	0.0368 mm
5	9	9.2%	0.0235 mm
15	8	8.2%	0.0137 mm
30	7	7.2%	0.0097 mm
60	6.5	6.6%	0.0069 mm
240	3	3.1%	0.0035 mm
1440	2	2.0%	0.0014 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	73.4%	**Plastic Limit:**	n/a
% Silt:	22.0%	**Plasticity Index:**	n/a
% Clay:	4.6%		

ASTM D6913

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	100%	4.750 mm
#10	100%	2.000 mm
#20	99%	0.850 mm
#40	98%	0.425 mm
#100	73%	0.150 mm
#200	26.6%	0.075 mm
Silts	26.0%	0.074 mm
	14.3%	0.050 mm
	8.8%	0.020 mm
Clays	4.6%	0.005 mm
	2.3%	0.002 mm
Colloids	1.4%	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
Loamy Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway		
Project Number:	21B233	**Sample Source:**	LDW21-GT53-GB-5-10 ft
Laboratory Sample ID:	B21-2150	**Visual Soil Description:**	brown silty sand with gravel
Sample Date:	8/5/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	10/18/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

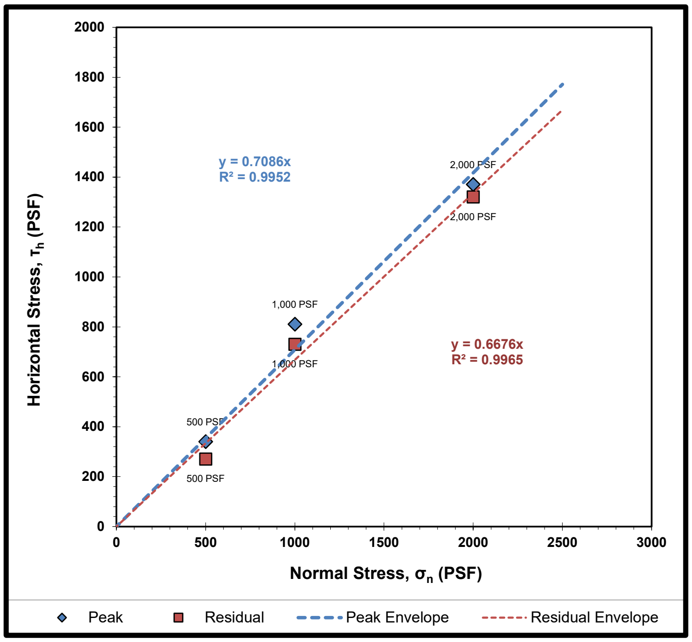
Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	30.0	
	Initial	Post-Consolidation
Dry Density (PCF):	109.7	110.6
Void Ratio:	0.536	0.523
Porosity (%):	34.9	34.3
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	29.9	
	Initial	Post-Consolidation
Dry Density (PCF):	110.2	112.7
Void Ratio:	0.529	0.495
Porosity (%):	34.6	33.1
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	29.3	
	Initial	Post-Consolidation
Dry Density (PCF):	110.5	114.2
Void Ratio:	0.524	0.475
Porosity (%):	34.4	32.2
Degree of Saturation (%):	saturated	saturated

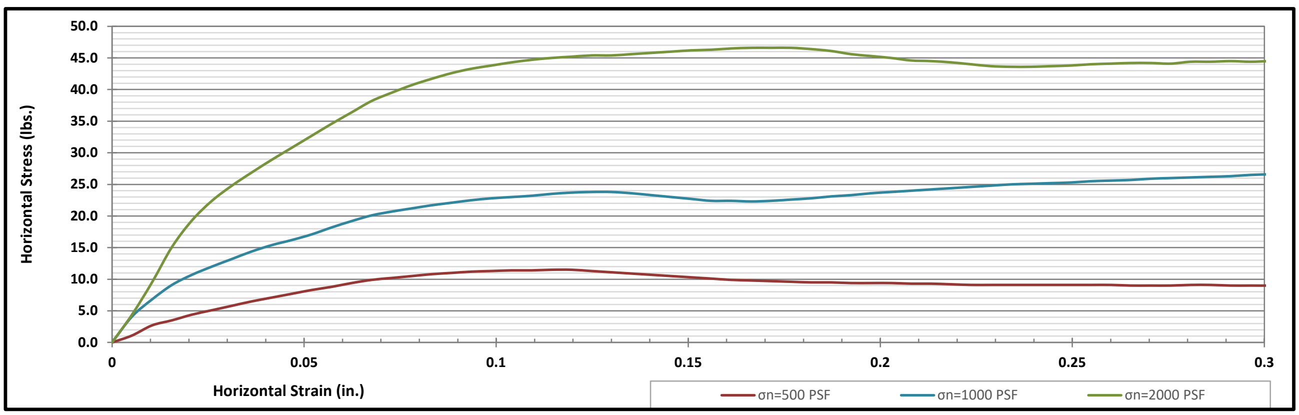
ESTIMATED STRENGTH PARAMETERS

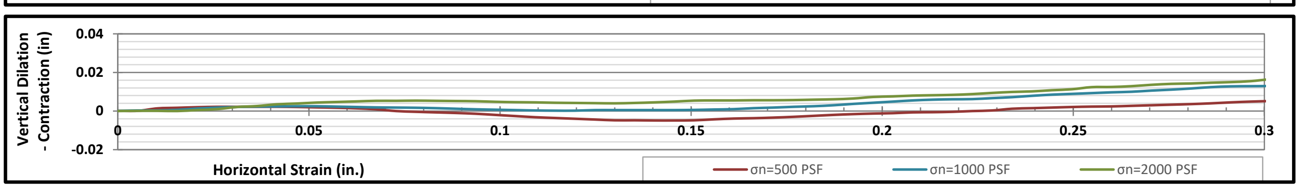
	PEAK	RESIDUAL
Angle of Internal Friction, ϕ (°):	35	34
Cohesion (PSF):	0	0



Failure Envelope Test Values:

Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	340	810	1370
Residual Horizontal Stress, τ_h (PSF):	270	730	1320





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	15-Oct-21
Source:	LDW21-GT53-GB-10-15 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2151		

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

ACCREDITED
Certificate #: 1366.01

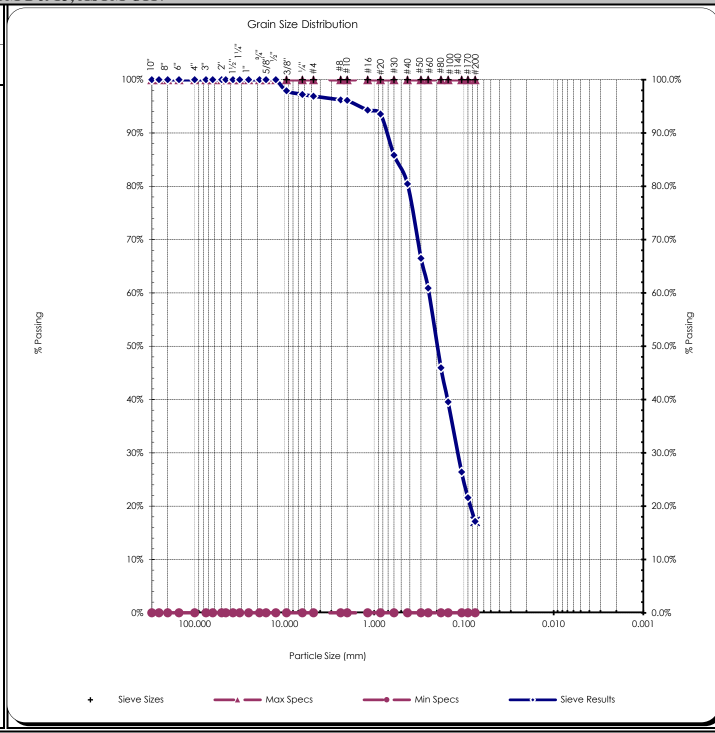
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.022	mm	% Gravel =	3.1%	Coeff. of Curvature, C_C =	1.30
$D_{(10)}$ = 0.044	mm	% Sand =	79.8%	Coeff. of Uniformity, C_U =	5.62
$D_{(15)}$ = 0.066	mm	% Silt & Clay =	17.1%	Fineness Modulus =	1.23
$D_{(30)}$ = 0.118	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ = 0.199	mm	Plasticity Index =	n/a	Moisture %, as sampled =	64.8%
$D_{(60)}$ = 0.246	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ = 0.735	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio = 13/61		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	98%	98%	100.0%	0.0%
1/4"	6.30		97%	100.0%	0.0%
#4	4.75	97%	97%	100.0%	0.0%
#8	2.36		96%	100.0%	0.0%
#10	2.00	96%	96%	100.0%	0.0%
#16	1.18		94%	100.0%	0.0%
#20	0.850	94%	94%	100.0%	0.0%
#30	0.600		86%	100.0%	0.0%
#40	0.425	80%	80%	100.0%	0.0%
#50	0.300		66%	100.0%	0.0%
#60	0.250	61%	61%	100.0%	0.0%
#80	0.180		46%	100.0%	0.0%
#100	0.150	40%	40%	100.0%	0.0%
#140	0.106		26%	100.0%	0.0%
#170	0.090		22%	100.0%	0.0%
#200	0.075	17.1%	17.1%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	15-Oct-21
Source:	LDW21-GT53-GB-15-20 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2152		

Unified Soil Classification System, ASTM-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

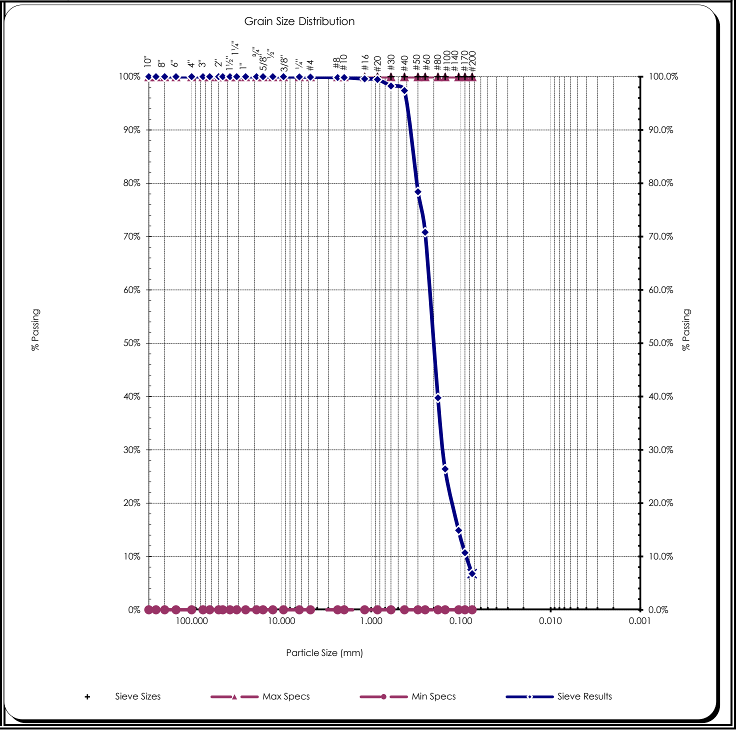
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ =	0.055	mm	% Gravel =	0.1%	Coeff. of Curvature, C_C =	1.27
$D_{(10)}$ =	0.087	mm	% Sand =	93.2%	Coeff. of Uniformity, C_U =	2.59
$D_{(15)}$ =	0.106	mm	% Silt & Clay =	6.8%	Fineness Modulus =	0.98
$D_{(30)}$ =	0.158	mm	Liquid Limit =	n/a	Plastic Limit =	n/a
$D_{(50)}$ =	0.203	mm	Plasticity Index =	n/a	Moisture %, as sampled =	27.7%
$D_{(60)}$ =	0.226	mm	Sand Equivalent =	n/a	Req'd Sand Equivalent =	
$D_{(90)}$ =	0.376	mm	Fracture %, 1 Face =	n/a	Req'd Fracture %, 1 Face =	
Dust Ratio =	3/43		Fracture %, 2+ Faces =	n/a	Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850	99%	99%	100.0%	0.0%
#30	0.600		98%	100.0%	0.0%
#40	0.425	97%	97%	100.0%	0.0%
#50	0.300		78%	100.0%	0.0%
#60	0.250	71%	71%	100.0%	0.0%
#80	0.180		40%	100.0%	0.0%
#100	0.150	26%	26%	100.0%	0.0%
#140	0.106		15%	100.0%	0.0%
#170	0.090		11%	100.0%	0.0%
#200	0.075	6.8%	6.8%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT53-GB-20-23.5 ft
Sample#: B21-2153

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 15-Oct-21
Tested By: A. Eifrig

Unified Soil Classification System, ASTM-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
brown

ACCREDITED
Certificate #: 1366.01

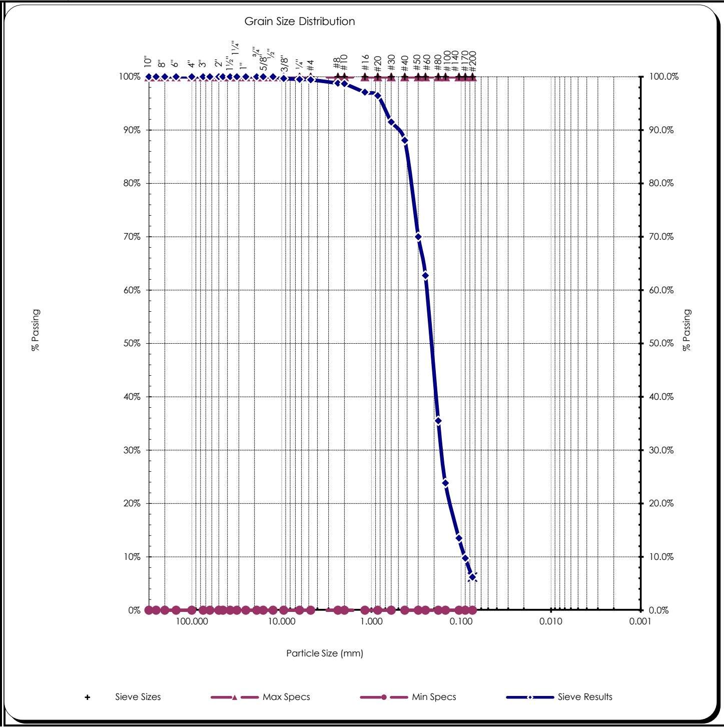
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.060 mm	% Gravel = 0.6%	Coeff. of Curvature, C_C = 1.24
$D_{(10)}$ = 0.091 mm	% Sand = 93.2%	Coeff. of Uniformity, C_U = 2.67
$D_{(15)}$ = 0.112 mm	% Silt & Clay = 6.2%	Fineness Modulus = 1.20
$D_{(30)}$ = 0.166 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.217 mm	Plasticity Index = n/a	Moisture %, as sampled = 29.9%
$D_{(60)}$ = 0.243 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.522 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 7/99	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	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		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		97%	100.0%	0.0%
#20	0.850	96%	96%	100.0%	0.0%
#30	0.600		92%	100.0%	0.0%
#40	0.425	88%	88%	100.0%	0.0%
#50	0.300		70%	100.0%	0.0%
#60	0.250	63%	63%	100.0%	0.0%
#80	0.180		36%	100.0%	0.0%
#100	0.150	24%	24%	100.0%	0.0%
#140	0.106		14%	100.0%	0.0%
#170	0.090		10%	100.0%	0.0%
#200	0.075	6.2%	6.2%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT53-GB-23.5-25 ft
Sample#: B21-2154

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 15-Oct-21
Tested By: A. Eifrig

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

ACCREDITED
Certificate #: 1366.01

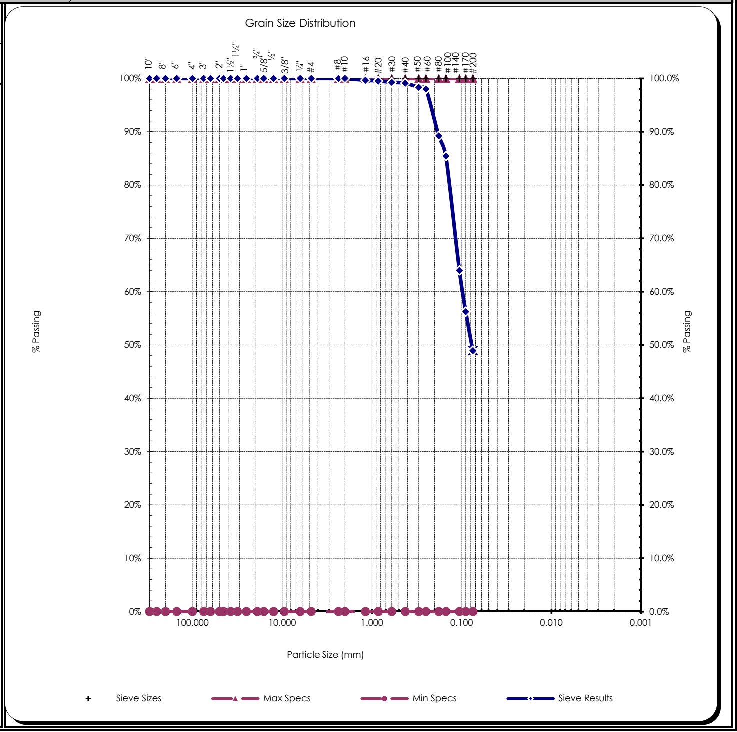
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.008 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.41
$D_{(10)}$ = 0.015 mm	% Sand = 51.1%	Coeff. of Uniformity, C_U = 6.38
$D_{(15)}$ = 0.023 mm	% Silt & Clay = 48.9%	Fineness Modulus = 0.17
$D_{(30)}$ = 0.046 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.077 mm	Plasticity Index = n/a	Moisture %, as sampled = 33.7%
$D_{(60)}$ = 0.098 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.186 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 39/79	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850	100%	100%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		98%	100.0%	0.0%
#60	0.250	98%	98%	100.0%	0.0%
#80	0.180		89%	100.0%	0.0%
#100	0.150	85%	85%	100.0%	0.0%
#140	0.106		64%	100.0%	0.0%
#170	0.090		56%	100.0%	0.0%
#200	0.075	48.9%	48.9%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	15-Oct-21
Source:	LDW21-GT53-GB-25-28.6 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2155		

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

ACCREDITED
Certificate #: 1366.01

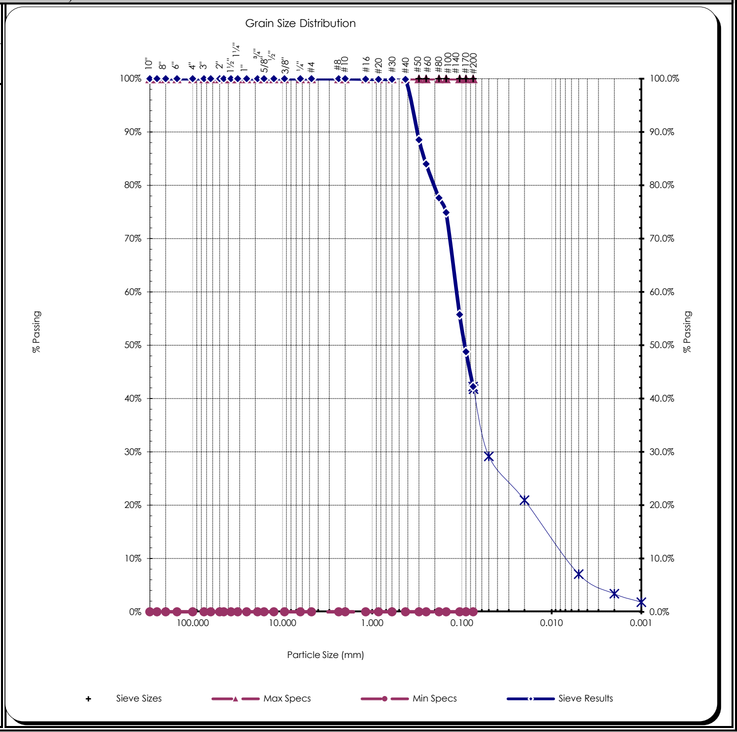
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.003 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 2.78
$D_{(10)}$ = 0.008 mm	% Sand = 57.7%	Coeff. of Uniformity, C_U = 15.33
$D_{(15)}$ = 0.013 mm	% Silt & Clay = 42.3%	Fineness Modulus = 0.37
$D_{(30)}$ = 0.049 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.093 mm	Plasticity Index = n/a	Moisture %, as sampled = 34.9%
$D_{(60)}$ = 0.116 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.316 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 11/26	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		100%	100.0%	0.0%
#30	0.600		100%	100.0%	0.0%
#40	0.425	100%	100%	100.0%	0.0%
#50	0.300		89%	100.0%	0.0%
#60	0.250		84%	100.0%	0.0%
#80	0.180		78%	100.0%	0.0%
#100	0.150	75%	75%	100.0%	0.0%
#140	0.106		56%	100.0%	0.0%
#170	0.090		49%	100.0%	0.0%
#200	0.075	42.3%	42.3%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	15-Oct-21
Source:	LDW21-GT53-GB-25-28.6 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2155		

Unified Soil Classification System, ASTM-2487

SM, Silty Sand

Sample Color

brown

ASTM D7928, HYDROMETER ANALYSIS

Sp. Gr	2.48	
Sample Weight:	75.36	grams
Hydroscopic Moist.:	0.35%	
Adj. Sample Wgt :	75.10	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	22	30.8%	0.0519 mm
2	19	26.6%	0.0374 mm
5	17	23.8%	0.0239 mm
15	12	16.8%	0.0142 mm
30	9	12.6%	0.0102 mm
60	7	9.8%	0.0073 mm
240	4	5.6%	0.0037 mm
1440	2	2.8%	0.0015 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	57.7%	**Plastic Limit:**	n/a
% Silt:	35.2%	**Plasticity Index:**	n/a
% Clay:	7.1%		

ASTM D6913

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	100%	4.750 mm
#10	100%	2.000 mm
#20	100%	0.850 mm
#40	100%	0.425 mm
#100	75%	0.150 mm
#200	42.3%	0.075 mm
Silts	41.8%	0.074 mm
	29.2%	0.050 mm
	20.9%	0.020 mm
Clays	7.1%	0.005 mm
	3.4%	0.002 mm
Colloids	1.8%	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: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client:	Anchor QEA	**Date Tested:**	15-Oct-21
Source:	LDW21-GT53-GB-28.6-30 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2156		

Unified Soil Classification System, ASTM-2487
SP-SM, Poorly graded Sand with Silt
Sample Color:
grayish-brown

ACCREDITED
Certificate #: 1366.01

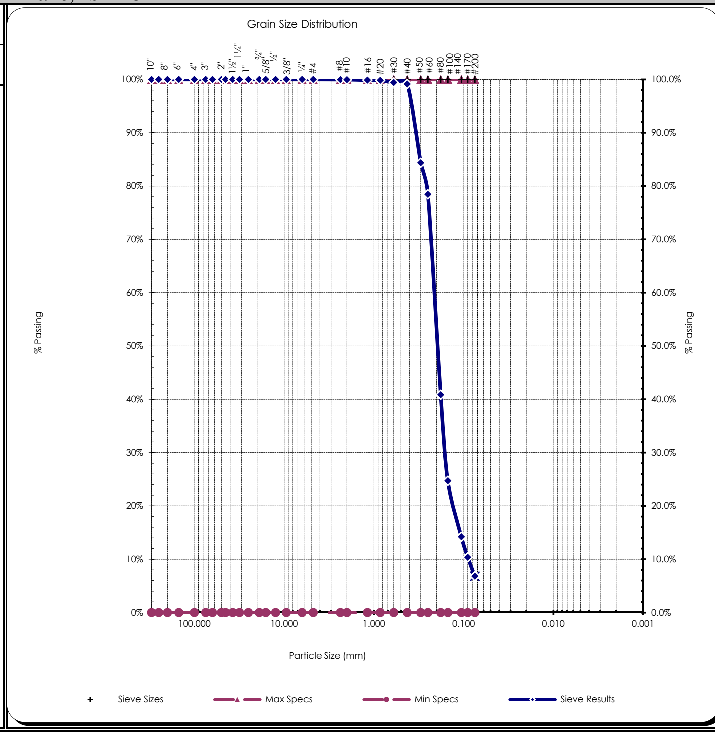
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.055 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.34
$D_{(10)}$ = 0.088 mm	% Sand = 93.2%	Coeff. of Uniformity, C_U = 2.44
$D_{(15)}$ = 0.109 mm	% Silt & Clay = 6.8%	Fineness Modulus = 0.92
$D_{(30)}$ = 0.160 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.197 mm	Plasticity Index = n/a	Moisture %, as sampled = 22.4%
$D_{(60)}$ = 0.216 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.348 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 2/29	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850	100%	100%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		84%	100.0%	0.0%
#60	0.250	78%	78%	100.0%	0.0%
#80	0.180		41%	100.0%	0.0%
#100	0.150	25%	25%	100.0%	0.0%
#140	0.106		14%	100.0%	0.0%
#170	0.090		10%	100.0%	0.0%
#200	0.075	6.8%	6.8%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Client:	Anchor QEA	**Date:**	October 25, 2021
Address:	21328 2nd Drive SE	**Project:**	Q.C. - Lower Duwamish Waterway
	Bothell, WA 98021	**Project #:**	21B233
Attn:	Garrett Timm	**Sample #:**	B21-2164-2174
Revised on:		**Date sampled:**	8-3-21 & 8-5-21

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

	Test(s) Performed:	Test Results		Test(s) Performed:	Test Results
X	Sieve Analysis	Please See Attached Reports		Sulfate Soundness	
	Proctor			Bulk Density & Voids	
	Sand Equivalent			WSDOT Degradation	
	Fracture Count			LA Abrasion	
X	Moisture Content	Please See Attached Report	X	Direct Shear	Please See Attached Reports
	Specific Gravity, Coarse		X	Specific Gravity, Soils	Please See Attached Reports
	Specific Gravity, Fine				
X	Hydrometer Analysis	Please See Attached Reports			
X	Atterberg Limits	Please See Attached Reports			

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Respectfully Submitted,
Meghan Blodgett-Carrillo
WABO Supervising Laboratory Technician

MATERIALS TESTING & CONSULTING, INC.

Moisture Content - ASTM C566, ASTM D2216

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: October 18, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B21-2164	LDW21-GT48-SPT-25-26.5 ft	233.1	1048.4	832.6	215.8	599.5	36.0%
B21-2165	LDW21-GT48-SPT-30-31.5 ft	182.3	1308.3	1004.2	304.1	821.9	37.0%
B21-2166	LDW21-GT53-SPT-10-11.5 ft	260.3	653.6	537.2	116.4	276.9	42.0%
B21-2167	LDW21-GT53-SPT-15-16.5 ft	270.1	1295.8	1089.8	206.0	819.7	25.1%
B21-2168	LDW21-GT53-SPT-20-21.5 ft	266.3	1049.6	853.9	195.7	587.6	33.3%
B21-2169	LDW21-GT53-SPT-25-26.5 ft	360.2	1271.6	1074.8	196.8	714.6	27.5%
B21-2170	LDW21-GT41-GH-0-1.3 ft	359.4	527.4	488.8	38.6	129.4	29.8%
B21-2171	LDW21-GT41-GH-1.3-2 ft	354.2	2105.6	1668.8	436.8	1314.6	33.2%
B21-2172	LWD21-GT42-GH-0-0.3 ft	341.5	409.5	366.7	42.8	25.2	169.8%
B21-2173	LWD21-GT42-GH-0.3-1.5 ft	356.9	581.1	525.1	56.0	168.2	33.3%
B21-2174	LWD21-GT42-GH-1.5-2.3 ft	224.0	439.0	407.7	31.3	183.7	17.0%

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Environmental ● Geotechnical Engineering ● Special Inspection ● Non-Destructive Testing ● Materials Testing
Burlington | Olympia | Bellingham | Silverdale | Tukwila
360.755.1990
www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Specific Gravity - ASTM D854

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Date Received: July 29, 2021
Date Tested: October 18, 2021

Client: Anchor QEA
Sampled by: Client
Tested by: A. Eifrig

Sample #	Location	Tare	Dry Soil + Tare	Mass of Dry Soil	Pycno ID	Mass of Pycno	Volume of Pycno	Density of Water @ Tx	Mass of Pycno filled w/ water & soils	Mass of Pycno filled w/ water	Temp. of Water, 0.1 *C	SpG of Soils	Temp. Correction Factor	Corrected SpG
B21-2170	LDW21-GT41-GH-0-1.3 ft	416.85	491.39	74.5	TSA-020	195.0	499.5	0.99850	738.69	693.77	18.5	2.516483	1.00030	2.5172379
B21-2174	LDW21-GT42-GH-1.5-2.3 ft	415.34	491.53	76.2	TSA-015	187.6	499.5	0.99835	733.52	686.28	19.4	2.632154	1.00014	2.6325225

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway
Project #: 21B233
Client: Anchor QEA
Source: LDW21-GT41-GH-0-1.3 ft
Sample#: B21-2170

Date Received: 29-Jul-21
Sampled By: Client
Date Tested: 18-Oct-21
Tested By: A. Eifrig

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

ACCREDITED
Certificate #: 1366.01

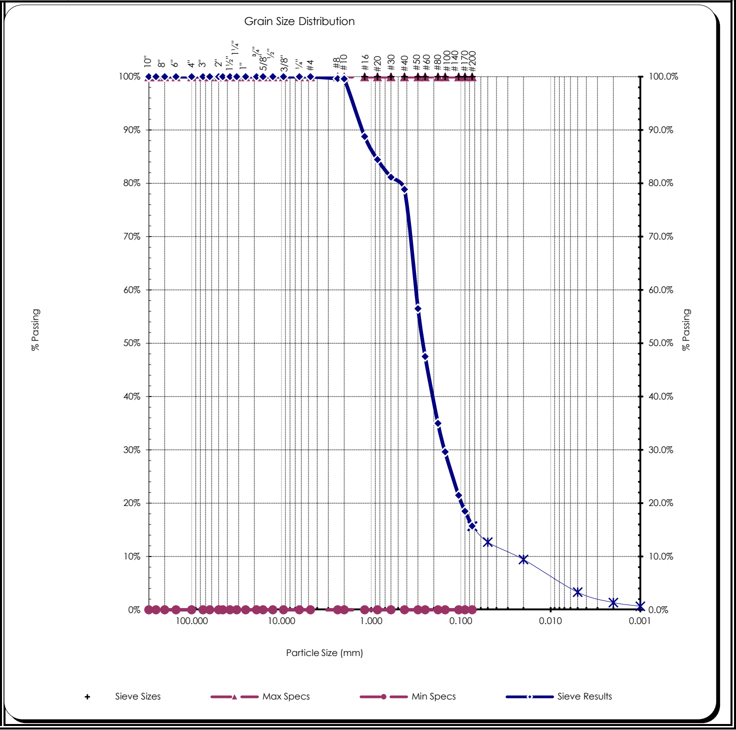
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.008 mm		% Gravel = 0.0%		Coeff. of Curvature, C_C = 3.31	
$D_{(10)}$ = 0.022 mm		% Sand = 84.3%		Coeff. of Uniformity, C_U = 14.63	
$D_{(15)}$ = 0.068 mm		% Silt & Clay = 15.7%		Fineness Modulus = 1.44	
$D_{(30)}$ = 0.152 mm		Liquid Limit = n/a		Plastic Limit = n/a	
$D_{(50)}$ = 0.264 mm		Plasticity Index = n/a		Moisture %, as sampled = 29.8%	
$D_{(60)}$ = 0.320 mm		Sand Equivalent = n/a		Req'd Sand Equivalent =	
$D_{(90)}$ = 1.271 mm		Fracture %, 1 Face = n/a		Req'd Fracture %, 1 Face =	
Dust Ratio = 1/5		Fracture %, 2+ Faces = n/a		Req'd Fracture %, 2+ Faces =	

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		89%	100.0%	0.0%
#20	0.850		84%	100.0%	0.0%
#30	0.600		81%	100.0%	0.0%
#40	0.425	79%	79%	100.0%	0.0%
#50	0.300		56%	100.0%	0.0%
#60	0.250		48%	100.0%	0.0%
#80	0.180		35%	100.0%	0.0%
#100	0.150	30%	30%	100.0%	0.0%
#140	0.106		21%	100.0%	0.0%
#170	0.090		19%	100.0%	0.0%
#200	0.075	15.7%	15.7%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	18-Oct-21
Source:	LDW21-GT41-GH-0-1.3 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2170		

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

ASTM D7928, HYDROMETER ANALYSIS

Sp Gr :	2.52	
Sample Weight:	100.37	grams
Hydroscopic Moist.:	0.83%	
Adj. Sample Wgt :	99.54	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	13	13.4%	0.0539 mm
2	11.5	11.9%	0.0385 mm
5	10.5	10.8%	0.0245 mm
15	7.5	7.7%	0.0144 mm
30	6.5	6.7%	0.0102 mm
60	4.5	4.6%	0.0073 mm
240	2.5	2.6%	0.0037 mm
1440	1	1.0%	0.0015 mm

% Gravel:	0.0%	**Liquid Limit:**	n/a
% Sand:	84.3%	**Plastic Limit:**	n/a
% Silt:	12.4%	**Plasticity Index:**	n/a
% Clay:	3.3%		

ASTM D6913

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	100%	4.750 mm
#10	100%	2.000 mm
#20	84%	0.850 mm
#40	79%	0.425 mm
#100	30%	0.150 mm
#200	15.7%	0.075 mm
Silts	15.6%	0.074 mm
	12.7%	0.050 mm
	9.4%	0.020 mm
Clays	3.3%	0.005 mm
	1.4%	0.002 mm
Colloids	0.7%	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
Sand

Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

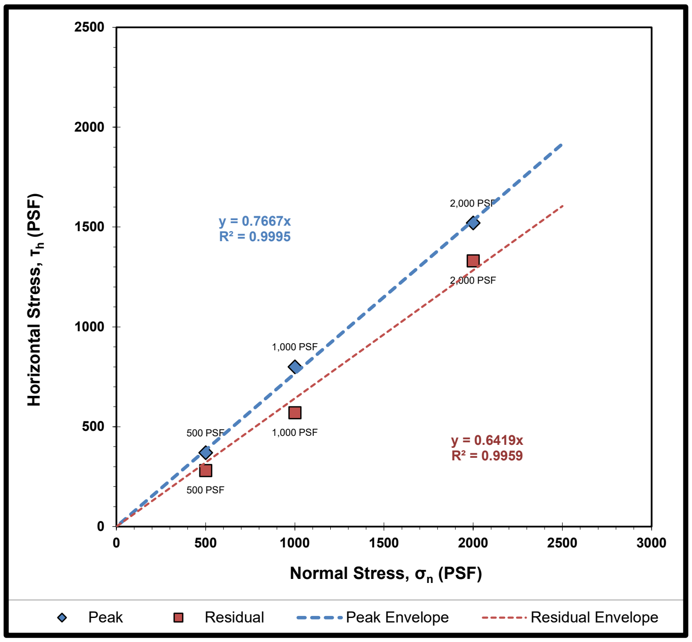
MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway		
Project Number:	21B233	**Sample Source:**	LDW21-GT41-GH-0-1.3 ft
Laboratory Sample ID:	B21-2170	**Visual Soil Description:**	brown sand with silt and gravel
Sample Date:	8/3/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	10/18/2021	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0208
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		σ_n=500 PSF
Initial Moisture Content (%):	28.1	
	Initial	Post-Consolidation
Dry Density (PCF):	109.2	111.5
Void Ratio:	0.543	0.510
Porosity (%):	35.2	33.8
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		σ_n=1000 PSF
Initial Moisture Content (%):	27.3	
	Initial	Post-Consolidation
Dry Density (PCF):	110.2	115.1
Void Ratio:	0.529	0.464
Porosity (%):	34.6	31.7
Degree of Saturation (%):	saturated	saturated

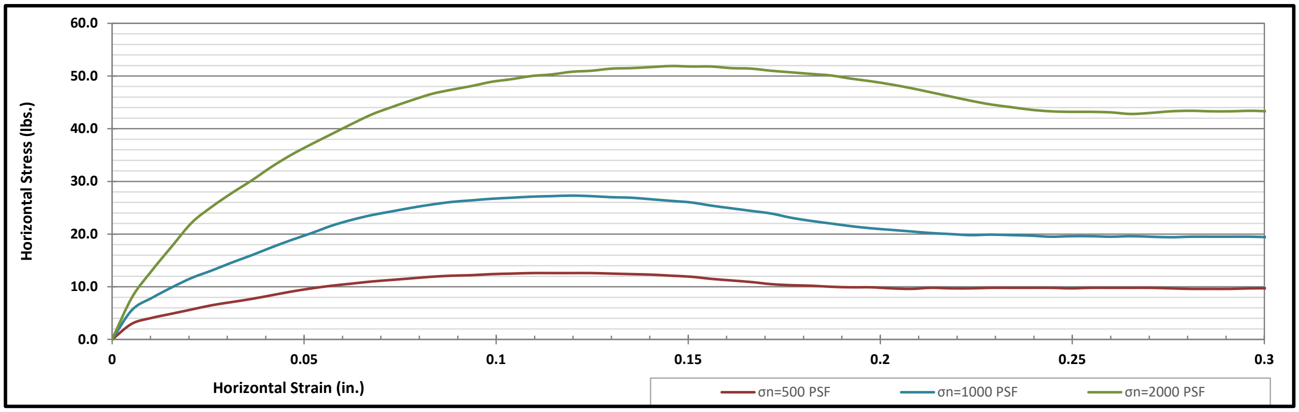
Summary of Sample Data:		σ_n=2000 PSF
Initial Moisture Content (%):	28.4	
	Initial	Post-Consolidation
Dry Density (PCF):	109.1	119.9
Void Ratio:	0.545	0.405
Porosity (%):	35.3	28.8
Degree of Saturation (%):	saturated	saturated

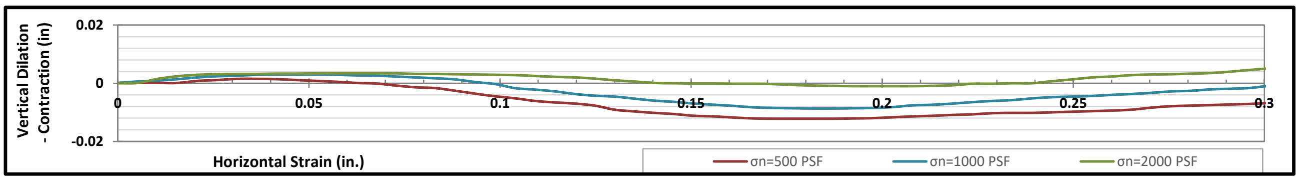


ESTIMATED STRENGTH PARAMETERS

	PEAK	RESIDUAL
Angle of Internal Friction, ϕ (°):	37	33
Cohesion (PSF):	0	0

Failure Envelope Test Values:			
Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	370	800	1520
Residual Horizontal Stress, τ_h (PSF):	280	570	1330





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway	**Date Received:** 29-Jul-21	**Unified Soil Classification System, ASTM-2487**	
Project #: 21B233	**Sampled By:** Client	SM, Silty Sand	
Client: Anchor QEA	**Date Tested:** 18-Oct-21	**Sample Color:**	
Source: LDW21-GT41-GH-1.3-2.0 ft	**Tested By:** A. Eifrig	brown	ACCREDITED Certificate #: 1366.01
Sample#: B21-2171			

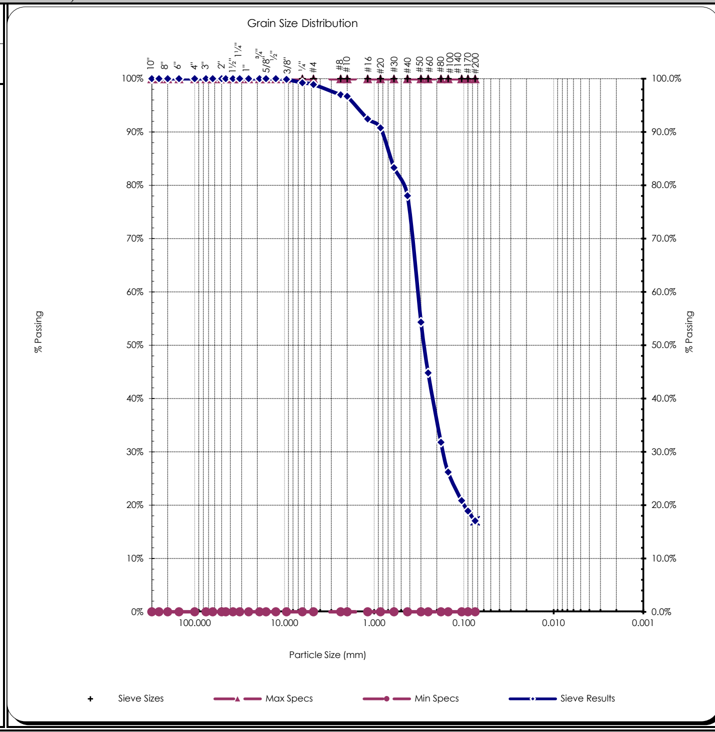
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.022 mm	% Gravel = 1.1%	Coeff. of Curvature, C_C = 2.00
$D_{(10)}$ = 0.044 mm	% Sand = 81.8%	Coeff. of Uniformity, C_U = 7.51
$D_{(15)}$ = 0.066 mm	% Silt & Clay = 17.1%	Fineness Modulus = 1.48
$D_{(30)}$ = 0.170 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.277 mm	Plasticity Index = n/a	Moisture %, as sampled = 33.2%
$D_{(60)}$ = 0.330 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.824 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 7/32	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		99%	100.0%	0.0%
#4	4.75	99%	99%	100.0%	0.0%
#8	2.36		97%	100.0%	0.0%
#10	2.00	97%	97%	100.0%	0.0%
#16	1.18		92%	100.0%	0.0%
#20	0.850	91%	91%	100.0%	0.0%
#30	0.600		83%	100.0%	0.0%
#40	0.425	78%	78%	100.0%	0.0%
#50	0.300		54%	100.0%	0.0%
#60	0.250	45%	45%	100.0%	0.0%
#80	0.180		32%	100.0%	0.0%
#100	0.150	26%	26%	100.0%	0.0%
#140	0.106		21%	100.0%	0.0%
#170	0.090		19%	100.0%	0.0%
#200	0.075	17.1%	17.1%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

MATERIALS TESTING & CONSULTING, INC.

ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: Q.C. - Lower Duwamish Waterway **Project #:** 21B233 **Client:** Anchor QEA **Source:** LDW21-GT42-GH-0-0.3 ft **Sample #:** B21-2172	**Date Received:** 29-Jul-21 **Sampled By:** Client **Date Tested:** 18-Oct-21 **Tested By:** A. Eifrig	**Visual Identification** Silt with Organics **Sample Color** brown

Liquid Limit Determination

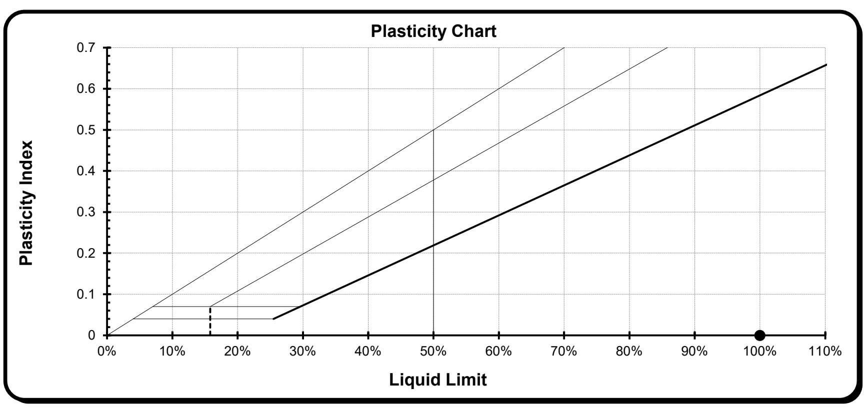
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Unable to establish liquid limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

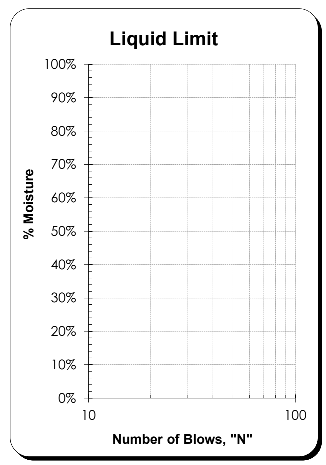
ACCREDITED
Certificate #: 1366.01

Liquid Limit @ 25 Blows:	N/A
Plastic Limit:	N/A
Plasticity Index, I_P:	N/A

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:		Cannot determined plastic limit				
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						





Comments: Liquid limit cannot be established as the material displays rapid dilation. At lower moistures the material does not spread into the cup without tearing the soil cake. Plastic limit cannot be determined as the sample does not roll down to 1/8" threads before cracking or crumbling. Non-plastic.

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Sieve Report

Project: Q.C. - Lower Duwamish Waterway	**Date Received:** 29-Jul-21	**Visual Identification**	
Project #: 21B233	**Sampled By:** Client	Sandy Silt with Clay	
Client: Anchor QEA	**Date Tested:** 18-Oct-21	**Sample Color:**	
Source: LDW21-GT42-GH-0.3-1.5 ft	**Tested By:** A. Eifrig	brown	ACCREDITED Certificate #: 1366.01
Sample#: B21-2173			

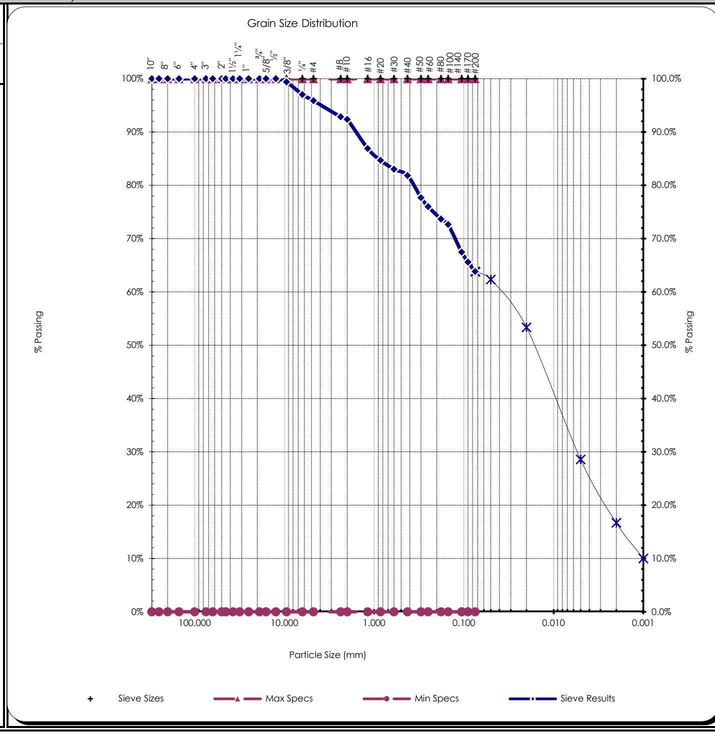
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.000	mm	% Gravel = 4.1%	Coeff. of Curvature, C_C = 0.79
$D_{(10)}$ = 0.001	mm	% Sand = 32.0%	Coeff. of Uniformity, C_U = 37.10
$D_{(15)}$ = 0.002	mm	% Silt & Clay = 63.8%	Fineness Modulus = 0.92
$D_{(30)}$ = 0.005	mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.017	mm	Plasticity Index = n/a	Moisture %, as sampled = 33.3%
$D_{(60)}$ = 0.037	mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.643	mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 39/50		Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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		87%	100.0%	0.0%
#20	0.850		85%	100.0%	0.0%
#30	0.600		83%	100.0%	0.0%
#40	0.425	82%	82%	100.0%	0.0%
#50	0.300		78%	100.0%	0.0%
#60	0.250		76%	100.0%	0.0%
#80	0.180		74%	100.0%	0.0%
#100	0.150	73%	73%	100.0%	0.0%
#140	0.106		67%	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: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Hydrometer Report

Project:	Q.C. - Lower Duwamish Waterway	**Date Received:**	29-Jul-21
Project #:	21B233	**Sampled By:**	Client
Client :	Anchor QEA	**Date Tested:**	18-Oct-21
Source:	LDW21-GT42-GH-0.3-1.5 ft	**Tested By:**	A. Eifrig
Sample#:	B21-2173		

Visual Identification
Sandy Silt with Clay
Sample Color
brown

ASTM D7928, HYDROMETER ANALYSIS

Assumed Sp Gr :	2.65	
Sample Weight:	75.38	grams
Hydroscopic Moist.:	1.68%	
Adj. Sample Wgt :	74.13	grams

ACCREDITED
Certificate #: 1366.01

Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter
1	49	61.1%	0.0393 mm
2	45	56.1%	0.0288 mm
5	42.5	53.0%	0.0187 mm
15	34.5	43.0%	0.0115 mm
30	30.5	38.0%	0.0084 mm
60	26	32.4%	0.0061 mm
240	18	22.4%	0.0032 mm
1440	11	13.7%	0.0014 mm

% Gravel:	4.1%	**Liquid Limit:**	n/a
% Sand:	32.0%	**Plastic Limit:**	n/a
% Silt:	35.2%	**Plasticity Index:**	n/a
% Clay:	28.6%		

ASTM D6913

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"	99%	9.500 mm
1/4"	97%	6.300 mm
#4	96%	4.750 mm
#10	92%	2.000 mm
#20	85%	0.850 mm
#40	82%	0.425 mm
#100	73%	0.150 mm
#200	63.8%	0.075 mm
Silts	63.8%	0.074 mm
	62.3%	0.050 mm
	53.4%	0.020 mm
Clays	28.6%	0.005 mm
	16.7%	0.002 mm
Colloids	10.0%	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
Loam

Comments:

Reviewed by: Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

Direct Shear Test Results:

ASTM D-3080

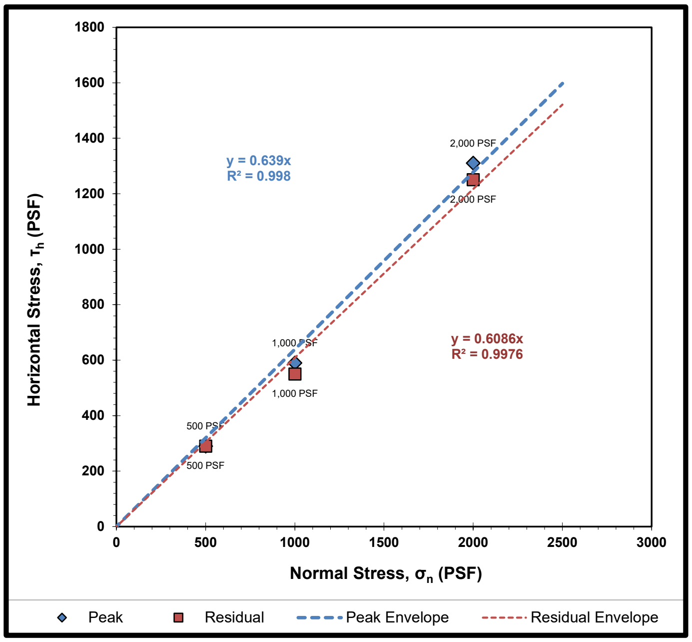
MATERIALS TESTING & CONSULTING, INC.

Project:	Q.C. - Lower Duwamish Waterway		
Project Number:	21B233	**Sample Source:**	LDW21-GT42-GH-0.3-1.5 ft
Laboratory Sample ID:	B21-2173	**Visual Soil Description:**	brown clay with silt
Sample Date:	8/3/2021	**Type of Specimen:**	Remolded Cylindrical Shear Box
Test Date:	10-19-21 through 10-21-21	**Specimen Diameter (in):**	2.5
Technician:	M. Carrillo	**Specimen Height (in):**	1
		Rate of Strain (in/min):	0.0012
		Estimated Specific Gravity of Solids:	2.65

Summary of Sample Data:		**σ_n=500 PSF**
Initial Moisture Content (%):	34.0	
	Initial	**Post-Consolidation**
Dry Density (PCF):	102.5	106.8
Void Ratio:	0.644	0.578
Porosity (%):	39.2	36.6
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		**σ_n=1000 PSF**
Initial Moisture Content (%):	31.5	
	Initial	**Post-Consolidation**
Dry Density (PCF):	104.6	114.9
Void Ratio:	0.611	0.467
Porosity (%):	37.9	31.8
Degree of Saturation (%):	saturated	saturated

Summary of Sample Data:		**σ_n=2000 PSF**
Initial Moisture Content (%):	28.9	
	Initial	**Post-Consolidation**
Dry Density (PCF):	107.0	120.1
Void Ratio:	0.574	0.403
Porosity (%):	36.5	28.7
Degree of Saturation (%):	saturated	saturated

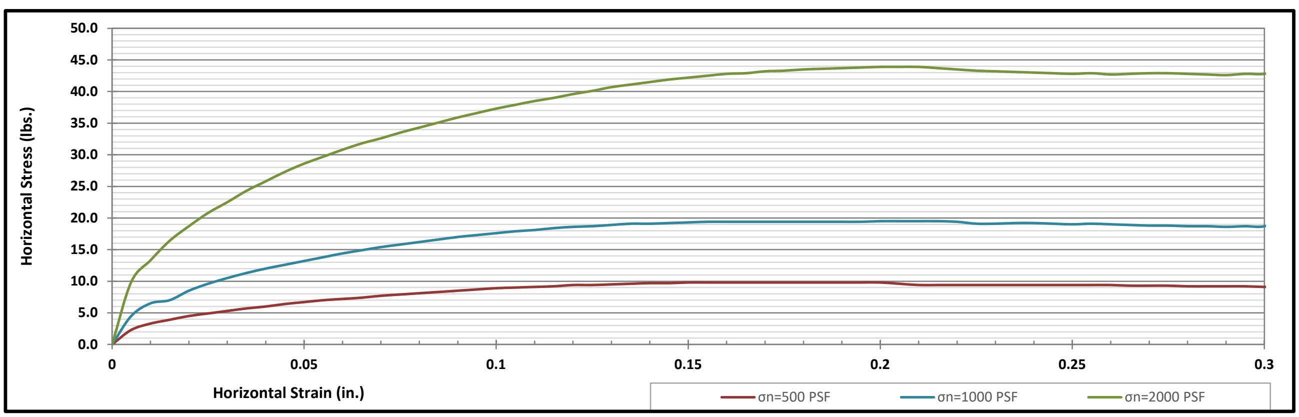


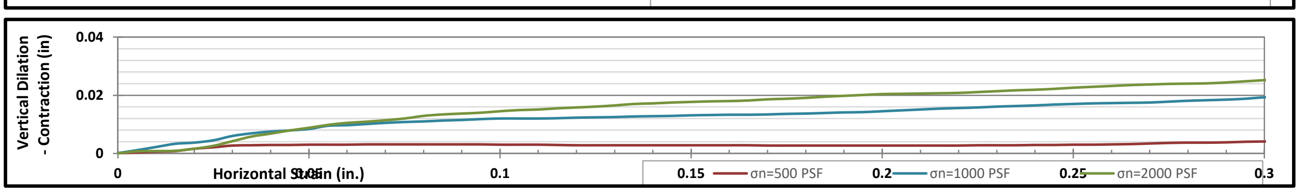
ESTIMATED STRENGTH PARAMETERS

	PEAK	**RESIDUAL**
Angle of Internal Friction, ϕ (°):	**33**	**31**
Cohesion (PSF):	**0**	**0**

Failure Envelope Test Values:

Normal Stress, σ_n (PSF):	500	1000	2000
Peak Horizontal Stress, τ_h (PSF):	290	590	1310
Residual Horizontal Stress, τ_h (PSF):	290	550	1250





Corporate • 777 Chrysler Drive • Burlington, WA 98233 • Phone 360.755.1990 • Fax 360.755.1980
SW Region • 2118 Black Lake Blvd. S.W.• Olympia, WA 98512 • Phone 360.534.9777 • Fax 360.534.9779
NW Region • 805 Dupont, Suite #5 • Bellingham, WA 98225 • Phone 360.647.6061 • Fax 360.647.8111
Kitsap Region • 5451 N.W. Newberry Hill Road, Suite 101 • Silverdale, WA 98383 • Phone/Fax 360.698.6787

Visit our website: www.mtc-inc.net

MATERIALS TESTING & CONSULTING, INC.

Sieve Report

Project: Q.C. - Lower Duwamish Waterway	**Date Received:** 29-Jul-21	**Unified Soil Classification System, ASTM-2487**	
Project #: 21B233	**Sampled By:** Client	SP, Poorly graded Sand	
Client: Anchor QEA	**Date Tested:** 18-Oct-21	**Sample Color:**	
Source: LDW21-GT42-GH-1.5-2.3 ft	**Tested By:** A. Eifrig	brown	ACCREDITED Certificate #: 1366.01
Sample#: B21-2174			

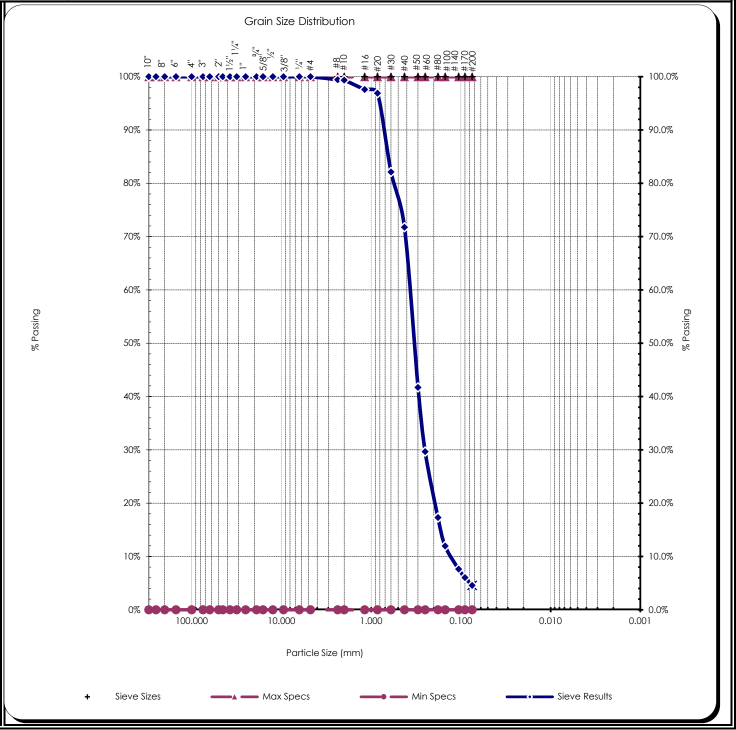
ASTM D2216, ASTM D2419, ASTM D4318, ASTM D5281

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.079 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.29
$D_{(10)}$ = 0.130 mm	% Sand = 95.4%	Coeff. of Uniformity, C_U = 2.90
$D_{(15)}$ = 0.167 mm	% Silt & Clay = 4.6%	Fineness Modulus = 1.67
$D_{(30)}$ = 0.251 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.334 mm	Plasticity Index = n/a	Moisture %, as sampled = 17.0%
$D_{(60)}$ = 0.376 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.733 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 3/47	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C136, ASTM D6913, ASTM C117

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	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		98%	100.0%	0.0%
#20	0.850	97%	97%	100.0%	0.0%
#30	0.600		82%	100.0%	0.0%
#40	0.425	72%	72%	100.0%	0.0%
#50	0.300		42%	100.0%	0.0%
#60	0.250	30%	30%	100.0%	0.0%
#80	0.180		17%	100.0%	0.0%
#100	0.150	12%	12%	100.0%	0.0%
#140	0.106		8%	100.0%	0.0%
#170	0.090		6%	100.0%	0.0%
#200	0.075	4.6%	4.6%	100.0%	0.0%



Comments:

Reviewed by: Meghan Blodgett-Carrillo

Meghan Blodgett-Carrillo

Attachment G.3
Supplemental Geotechnical Information by Others

Table G.3-1
Historical Geotechnical Investigations and Geologic Information

File Title	Identification No.[1]	River Mile	Document Title	Document type	Date Document Creation	Project Location	Sample Types/Report Info	Author
RM 2.9_Boeing_east bank	1	2.9	n/a	partial report/figures	9.11.1990	1135 S. Webster Street (Boeing Company), east bank	CPT logs, MW logs, grain size analysis, boring logs	Geoengineers
Boeing Plant 2_east bank	2, 8, 9, 10	3.1-3.5	Appendix C: Geotechnical Engineering Report, Habitat Project	report	10.2012	Boeing Plant 2 (Seattle/Tukwila)	Subsurface conditions, seismic conditions, liquefaction and lateral spreading analysis, slope stability analysis, shoreline excavation and dredging	AMEC, Floyd Snider, Dalton Olmsted & Fuglevand
RM 3.1-3.3 Boeing Technology Complex_east bank	3	3.1-3.3	Report of Geotechnical Investigation, Proposed Boeing Materials Technology Complex	report	8.13.1992	Boeing North Duwamish Campus, East Bank	Site conditions, subsurface/groundwater conditions, CPT logs, grain size, excavations, pile foundations, seismic aspects	Dames & Moore
RM 3.02_S Monroe St_west bank	4	3.12	Site plan	figures	8.22.1986	South Monroe Street, southwest side Duwamish	Site plan, 2 boring logs with blow counts, observation well install	Geoengineers
RM 3.3-3.6_Boeing Plant 2_east bank	5	3.3-3.6	Boeing Plant 2 RFI	figures (site thickness map, boring logs)	07.3.1997	Boeing Plant 2 (E Marginal Way S and 16th Ave S)	Boring logs, silt thickness and till units	Weston
RM 3_South Park Neighborhood_west bank	6	3.3	South Park Neighborhood Development Program Subsurface Investigations	report	8.1973	South Park Neighborhood	11 test boings (HSA), SPTs, 2 observation well installs, cross sections	Shannon & Wilson
RM 3.33-South Park Bridge	7	3.3	South Park Bridge Replacement Volume 3: Geotechnical Report	compiled reports	8.2007	South Park Bridge	Full geotechnical study (boring logs, seismic, liquefaction, soil motion, soil surface response spectra, shear wave velocity, rock input, etc.)	PB Americas, Shannon & Wilson
Terminal 117 Site Restoration GT Report - Rev 1	11	3.55	Terminal 117 Site Restoration	report	05.07.2014	Terminal 117: Duwamish waterway to the east, Dallas Avenue to the south. South Park marina to the north, parking lot to the west. (Flat around 15 ft)	Subsurface/surface conditions, GW, SPTs, earthquake engineering, liquefaction, design soil parameters, slope stability, ground improvement, shallow foundations, pile design, retaining walls, site development and earthwork	Geoengineers
RM 4.4_Transmission Towers	12	3.5-3.6	Geotechnical and Environmental Engineering Design Study Proposed Duwamish Transmission Towers	report	9.19.2003	Boeing Plant 2. Each bank of the Duwamish River south of the 14th Street bridge (south park bridge)	2 borings, existing geotechnical data, soil/GW subsurface, engineering analysis: seismic, foundations, deep foundations, SPTs	Hart Crowser
RM 3.6 Basin Oil_west bank	13	3.6	Geotechnical Engineering Study for Basin Oil	partial report/logs	02.07.1994	Basin Oil: 8661 Dallas Avenue South, Seattle	Site map and log	Lorilla Engineering
RM 3.6 _Dallas Ave S_west bank	14	3.6	Geotechnical Memorandum	memo	06.10.2014	Dallas Avenue South	10 test pits, 10 pilot infiltration tests, includes figures and logs, grain size	Seattle Public Utilities Geotechnical Engineering
RM 3.6_Jorgensen Forge MWs_east bank	15	3.6	Jorgensen Forge Boring Logs	figure/logs	12.05.1994	8531 E. Marginal Way, Seattle	2 HSA borings to 30 ft	SECOR
Final Inv Data Summ Rpt_021306	16	3.65	Final Investigation Data Summary Report Jorgensen Forge Facility	report	2.13.2006	Jorgenson: 8531 East Marginal Way South	Surface/subsurface samples analyzed for grain size (no deviations)	Farallon Consulting and Anchor Environmental

File Title	Identification No.[1]	River Mile	Document Title	Document type	Date Document Creation	Project Location	Sample Types/Report Info	Author
RM 3.7_Boeing S Park Facility_west bank	17	3.7	Report of Foundation Investigation	figures/logs	06.17.1980	1420 S. Trenton Street	7 boring logs and figures	Dames & Moore
Boeing Plant 2 CPT Locations	18	3.7	CPT Locations	figure	02.09.2015	POS Parcel Boeing Isaacson	CPTs (up to 60 feet bgs)	Kennedy/Jenks
RM 3.8_1600 S Henderson St_west bank	19	3.8	Supplemental Laboratory Testing	figures/logs	09.20.1984	South Park Site: 1600 S. Henderson St.	7 boring logs	Dames & Moore
RM 4.25_Delta Boat Lift Pier_west bank	20	4.25	Limited Geotechnical Engineering Report	report	5.8.2002	Boat Lift Pier 1608 S 96th Street	1 bore hole, two grain size, 200-wash analysis, Atterberg limits	AMEC
RM_4.4_Duwamish Substation_west bank	21	4.4	Geotechnical Report Duwamish Substation Bank 79 Foundation Retrofit	report	2.28.2003	Bank 79 Transformer: (near west marginal way)	1 PCPT, 2 geophysical surveys, 3 soil borings and analysis, borings completed for MWs	Earth Technology Corporation
RM_4.4_Duwamish Substation_west bank2	22	4.4	n/a	figures/logs	10.07.1969	Duwamish Substation	47 borings (logs with coordinates)	Seattle Engineering Department
Draft Duwamish Substation Geotech Rpt	23	4.45	Draft Geotechnical Report Seattle Substation Evaluation	draft report	11.2012	Duwamish Substation	Surface/subsurface conditions, environmentally critical areas, seismic considerations, foundations, earthwork	Seattle Public Utilities Geotechnical Engineering
RM 4.4-4.6_Boeing_east bank	24	4.4-4.6	Boeing Developmental Center Logs	figures/logs	2.1.2001	East Marginal Way South (Boeing Developmental Center)	MW well as-builts, site map, lithology logs (about 30 wells)	Landau Associates
USACE Dredging 2018	25	4.0-4.7	Memorandum For Record: DMMP Suitability Determination	report	05.24.2018	Duwamish River: Stations 242+00 and 275+56 (turning basin and navigation channel)	Vibracore samples (grain size/conventional) page 18	USACE
RM 4.6-7.7_Hwy 99_west bank	26	4.6-7.7	Report on Geotechnical Exploration	report	05.30.1985	Renton Effluent Transfer System. West Marginal Way Southwest, extending from about 1,500 south of South 102nd Street to 800 feet north of Des Moines Way South	Plan and profile maps, 21 exploration borings, trench excavation, chemical testing, GW conditions, geotechnical impacts	Converse Consultants
RM 5_Oxbow bridge	27	5.0	Geotechnical Design Report	report	4.1988	North Oxbow Bridge, Boeing Developmental Center	Surface/subsurface conditions, SPTs, GW, seismic considerations, vertical/lateral pile capacity, liquefaction potential, excavation	Rittenhouse-Zeman & Associates
RM +5_Boeing Oxbow Parking Lot_west bank	South of study area	5.1	Report of Geotechnical Investigation	report	7.23.1985	Boeing Developmental Center Oxbow Parking lot (west side Duwamish)	2 CPT, 5 borings, deepest boring 54.0 ft	Converse Consultants
LDW-Final-FS-Sections-8-13_october-31-2012_ADA	n/a	n/a	Lower Duwamish Waterway Final Feasibility Study (sections 8-13)	report	10.2012	Duwamish River	Table 8-6: prior geotechnical analyses from projects in the LDW, around Harbor Island, and adjacent Elliott Bay	LDWG
LDW-Final-FS-Sections-1-7_october-31-2012_ADA	n/a	n/a	Lower Duwamish Waterway Final Feasibility Study (sections 1-7)	report	10.2012.	Duwamish River	Section 2.6: additional considerations, sediment physical properties: grain size, Atterberg limits, TOC, porosity, bulk density, etc.	LDWG

File Title	Identification No.[1]	River Mile	Document Title	Document type	Date Document Creation	Project Location	Sample Types/Report Info	Author
Final_LDW-RI	n/a	n/a	Lower Duwamish Waterway Remedial Investigation Report	report	7.9.2010	Duwamish River	Section 2.5.4: sediment lithology: geotechnical parameter tests and results (moisture, specific gravity, Atterberg limits, bulk density, porosity). Also physical properties. Section 9.1.6: bank erosion	LDWG
2015_11_POS_Silver_DSR_Ecology	28	3.8	Boeing Isaacson-Thompson Site, Port of Seattle Sliver Data Summary Report	report	11.12.2015	Port of Seattle Sliver Property located west of the Boeing Isaacson Property	10 soil borings (direct push) to 25 ft bgs. 41 soil samples collected. No geotechnical analysis. Includes section on lithologic conditions of site and borings logs, page 5.	Kennedy/Jenks Consultants
Boeing_I-T_Landau_042114_Final_RI	29	3.8	Final Remedial Investigation Report Boeing Isaacson-Thompson Site	report	4.21.2014	Boeing Isaacson-Thompson Site	No geotechnical analysis. Descriptions of Geologic Conditions on page 107. Discuss soil conditions at 50 exploratory locations. Summary of depth to alluvium documented in Table 9 page 290	Landau Associates, AMEC
AppJ_Basin of Design Report_08162012	30	3.5 - 3.7	Appendix J Geotechnical Basis of Design Report (Terminal 117 Cleanup Design Sediment and Upland Areas)	report	8.1.2012	Port of Seattle, Terminal 117	Six borings and 8 CPTs. 3 completed on barge, 3 completed upland. 5 SPTs completed on barge, 3 completed in upland (locations figure 1 page 23). Geologic soil units described page 10. Engineering soil properties section 3 page 14. Subsurface profile figures begin page 25.	Crete Consulting, Jacobs Associates
2012_12-19_Final Shoreline Investigation	31	4.1-4.2	Shoreline Soil and Groundwater Characterization Report	report	3.12.2012	Former Rhone-Poulenc Site, Tukwila Washington: 9229 East Marginal Way	15 direct push upland borings for soil/GW from shoreline areas. 5 areas collected geotechnical samples between 11 and 15 feet. Section 3.1 soil lithology (page 14). Section 3.5 geotechnical analysis (moisture, density, grain size, atterberg). Results table 8 page 43. Geotech locations figure 3 page 47.	AMEC
Final Interm Measures Contruction Work Plan V1/V2	32	4.1-4.2	Final Interm Measures Contruction Work Plan V1/V2	report	10.25.2002	Former Rhone-Poulenc Site, Tukwila Washington: 9229 East Marginal Way	Samples to confirm depth and characterisics of uppermost aquitard. CPTs for soil strength at 3 locations alongside borings GT-5, B-1-02, B-7-02 (Section 2.4 Geotech Characterization page 15). Figures page 21. Table 2-1 summarizes analytical. V2: Appendix B: Geotechnical Data	URS
2021.03.05 Figures AppA-1_B-Boeing DC Thompson Geotech Report-01052021_Final_reduced	33	3.7; 4.6; 4.9	Boeing DC Thompson Geotech Report	figures/logs	1.5.2021	Boeing Thompson Site	3 CPTs at Thompson site; 3 CPTs at Boeing Development Center; 3 CPTs near Norfolk outfall	Golder
8801 Final FS July 27, 2020	34	3.9-4.0	Final Feasibility Study 8801 East Marginal Way S., Tukwila, Washington	report	7.27.2020	Centerpoint Properties	Geologic cross sections perpendicular and parallel to the river bank through Centerpoint Properties	Shannon & Wilson

Notes:
1. The study identification number is shown on Maps 5-2a and 5-2b. Studies with "n/a" in this field are site-wide studies.
CPT: cone penetration testing
DMMP: Dredged Material Management Program
GW: groundwater
HSA: hollow stem auger
LDW: Lower Duwamish Waterway
MW: monitoring well

n/a: not applicable
RFI: request for information
RI: remedial investigation
RM: river mile
SPT: standard penetration test
USACE: US Army Corps of Engineers

Attachment G.4
Calculations

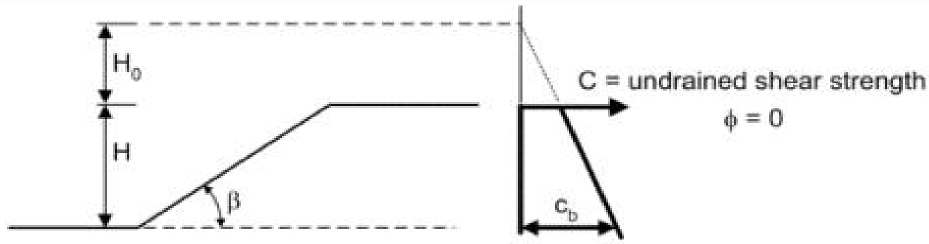
Slope Stability Chart Solution
LDW Upper Reach 60% Design

Ref: EM 1110-2-1902 Appendix E

J. Laplante
12/7/2022

	H_o	0.26	ft	Slope	2	H:1V	
	H	5.00	ft	β	**26.57**	degrees	
	M	**0.05**		c_b	200.00	psf	
submerged	γ	38	pcf	N	6.5		
intertidal	γ	69	pcf				
submerged	F	6.50					
intertidal	F	3.58					

EM 1110-2-1902
31 Oct 03



Steps

1. Extrapolate strength profile upward to determine value of H_0, where strength profile intersects zero.
2. Calculate $M = H_0/H$.
3. Determine stability number from chart below.
4. Determine c_b = strength at elevation of toe of slope.
5. Calculate $F = N \dfrac{c_b}{\gamma(H + H_o)}$

Use $\gamma = \gamma_{buoyant}$ for submerged slope

Use $\gamma = \gamma_{total}$ for no water outside slope

Use average γ for partly submerged slope

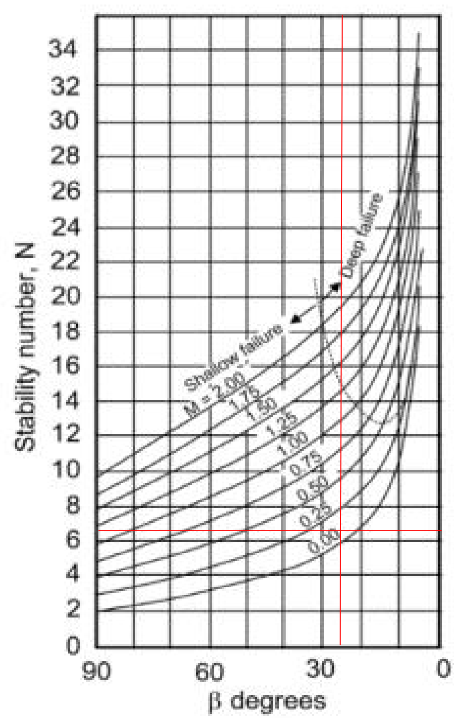


Figure E-8. Slope stability chart for $\phi = 0$ soils, with strength increasing with depth (after Hunter and Schuster 1968)

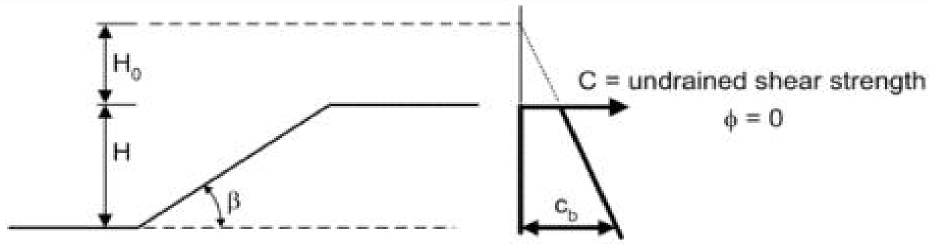
Slope Stability Chart Solution
LDW Upper Reach 60% Design

Ref: EM 1110-2-1902 Appendix E

J. Laplante
12/7/2022

	H_o	0.26	ft	Slope	2	H:1V
	H	7.00	ft	β	**26.57**	degrees
	M	**0.04**		c_b	200.00	psf
submerged	γ	38	pcf	N	6.25	
intertidal	γ	69	pcf			
submerged	F	4.53				
intertidal	F	2.49				

EM 1110-2-1902
31 Oct 03



Steps

1. Extrapolate strength profile upward to determine value of H_0, where strength profile intersects zero.
2. Calculate $M = H_0/H$.
3. Determine stability number from chart below.
4. Determine c_b = strength at elevation of toe of slope.
5. Calculate $F = N \frac{c_b}{\gamma(H + H_o)}$

Use $\gamma = \gamma_{buoyant}$ for submerged slope

Use $\gamma = \gamma_{total}$ for no water outside slope

Use average γ for partly submerged slope

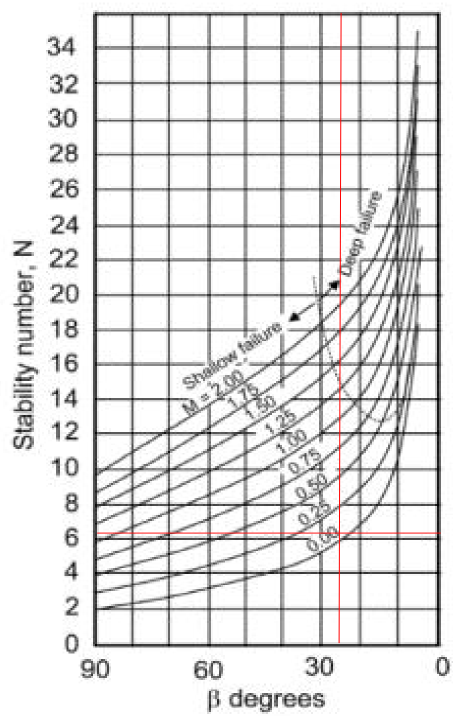


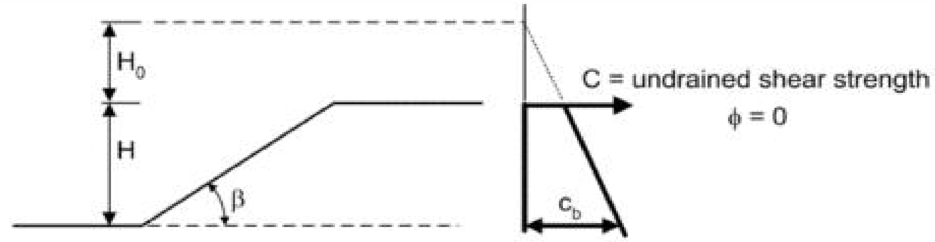
Figure E-8. Slope stability chart for φ = 0 soils, with strength increasing with depth (after Hunter and Schuster 1968)

Slope Stability Chart Solution — J. Laplante
LDW Upper Reach 60% Design — 12/7/2022

Ref: EM 1110-2-1902 Appendix E

	H_o	0.26	ft	Slope	3	H:1V
	H	5.00	ft	β	**18.43**	degrees
	M	**0.05**		c_b	200.00	psf
submerged	γ	38	pcf	N	8.5	
intertidal	γ	69	pcf			
submerged	F	8.50				
intertidal	F	4.68				

EM 1110-2-1902
31 Oct 03



Steps

1. Extrapolate strength profile upward to determine value of H_0, where strength profile intersects zero.
2. Calculate $M = H_0/H$.
3. Determine stability number from chart below.
4. Determine c_b = strength at elevation of toe of slope.
5. Calculate $F = N \dfrac{c_b}{\gamma(H + H_o)}$

Use $\gamma = \gamma_{buoyant}$ for submerged slope

Use $\gamma = \gamma_{total}$ for no water outside slope

Use average γ for partly submerged slope

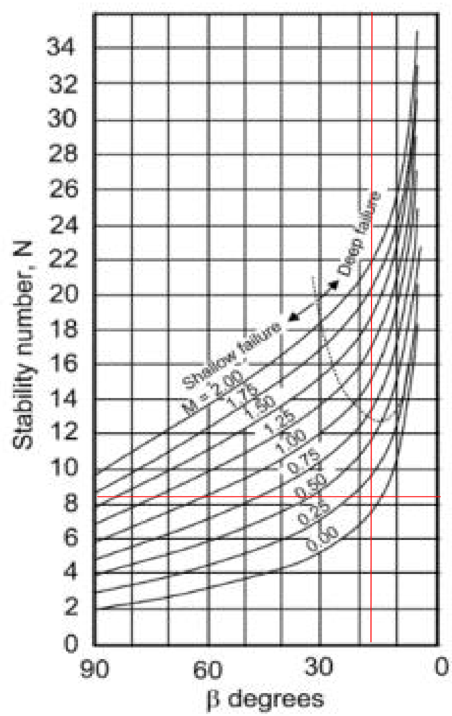
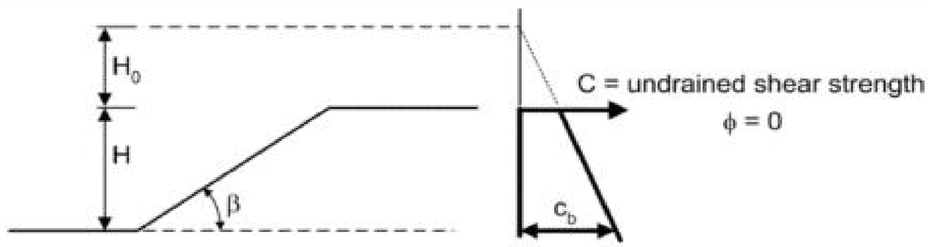


Figure E-8. Slope stability chart for $\phi = 0$ soils, with strength increasing with depth (after Hunter and Schuster 1968)

Slope Stability Chart Solution								J. Laplante
LDW Upper Reach 60% Design		H_o	0.26	ft	Slope	3	H:1V	12/7/2022
		H	7.00	ft	β	**18.43**	degrees	
Ref: EM 1110-2-1902 Appendix E		M	**0.04**		c_b	200.00	psf	
	submerged	γ	38	pcf	N	8		
	intertidal	γ	69	pcf				
	submerged	F	5.80					
	intertidal	F	3.19					

EM 1110-2-1902
31 Oct 03



Steps

1. Extrapolate strength profile upward to determine value of H_0, where strength profile intersects zero.
2. Calculate $M = H_0/H$.
3. Determine stability number from chart below.
4. Determine c_b = strength at elevation of toe of slope.
5. Calculate $F = N \dfrac{c_b}{\gamma(H + H_o)}$

Use $\gamma = \gamma_{buoyant}$ for submerged slope

Use $\gamma = \gamma_{total}$ for no water outside slope

Use average γ for partly submerged slope

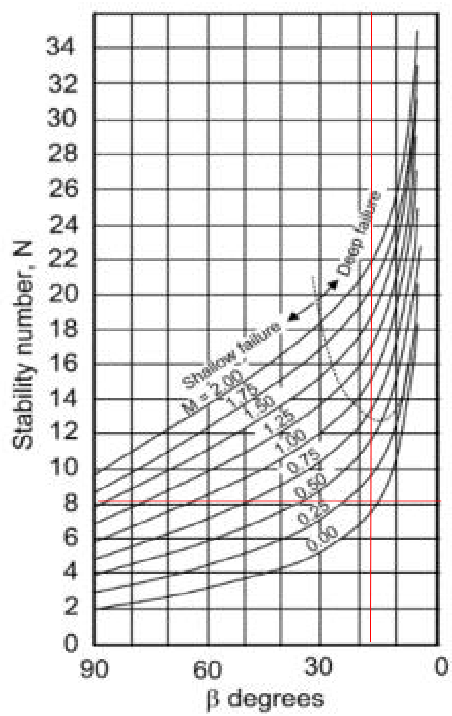


Figure E-8. Slope stability chart for ϕ = 0 soils, with strength increasing with depth (after Hunter and Schuster 1968)