REPORT

130th Avenue NE Station Area Park and Ride Geotechnical Report

Submitted to:

KPFF

1601 5th Avenue, Suite 1600
Seattle, WA 98101

Submitted by:

Golder Associates Inc.
18300 NE Union Hill Road, Suite 200 Redmond, Washington, USA 98052

+1 425 883-0777

20145996

April 14, 2021

Table of Contents

1.0 INTRODUCTION 1

1.1 Project Description 1

1.2 Purpose and Scope 1

2.0 SUBSURFACE EXPLORATION PROGRAM 1

2.1 Drilling and Sampling Methods 2

2.2 Slug Testing 2

2.3 Laboratory Testing 2

2.4 Previous Borehole Records 2

3.0 SITE CONDITIONS 2

3.1 Topography 2

3.2 Regional Geology 2

3.3 Hydrogeologic Setting 3

3.3.1 Regional Groundwater Systems 3

3.3.2 Regional Groundwater Flow 3

3.4 Subsurface Conditions 4

3.5 Geologic Hazards 4

3.5.1 Fault Rupture 4

3.5.2 Liquefaction Potential 4

3.5.3 Lateral Spreading 4

3.5.4 Landslides 5

4.0 EVALUATION AND RECOMMENDATIONS 5

4.1 Soil Parameters 5

4.2 Seismicity 5

4.2.1 International Building Code 5

4.2.2 AASHTO LRFD Bridge Design Specifications 6

4.3 Subgrade Preparation 7

4.4 Bearing Capacity 7

4.5 Soldier Pile Recommendations 9

4.6 Pole Foundations 10

4.7 Pavement 10

4.8 Slug Testing and Dewatering Evaluation 11

4.8.1 Slug Test Results 11

4.8.2 Dewatering Evaluation 11

5.0 CLOSING 13

6.0 REFERENCES 15

TABLES

Table 1: Engineering Properties by Soil Unit 5

Table 2: E340 AASHTO Based Two Level Seismic Design Parameters 6

Table 3: AASHTO LRFD Bridge Design Specifications, 8th Edition Based Seismic Design Parameters 7

Table 4: Strip Footings Bearing on Soil 8

Table 5: Square Footings Bearing on Soil 8

Table 6: Design parameters for Lateral Earth Loads 9

Table 7: Summary of Slug Test Results 11

Table 8: Summary of Input Parameters 12

Table 9: Summary of Estimated Steady-State Dewatering Rates 13

FIGURES

Figure 1: Borehole Location Map

Figure 2: Cantilever Soldier Pile Lateral Earth Pressure Diagram

APPENDICES

APPENDIX A
Boreholes

APPENDIX B
Slug Test Data

APPENDIX C
Laboratory Data

APPENDIX D
Historic Boreholes

1.0 INTRODUCTION

1.1 Project Description

A park-and-ride facility at the site, north of 130th Station between 130th Ave NE and 132nd Ave NE, was designed as part of the Sound Transit East Link project but was not constructed. The City of Bellevue is updating and advancing the previous design to construction. The proposed park-and-ride is located north of the Sound Transit Light Rail Station between 130th Avenue NE and 132nd Avenue NE in Bellevue, Washington (Figure 1) and will serve as the park-and-ride facility for the area. Design elements of the proposed park-and-ride include pavement and luminaires, a cantilever soldier pile retaining wall, and a storm water detention vault.

1.2 Purpose and Scope

This report presents the results of Golder Associates Inc. (Golder's) geotechnical investigation and provides recommendations for design and construction of the proposed 130th Park-and-Ride project. Recommendations also consider subsurface information collected as part of the East Link project (H-J-H 2016a). Golder's scope of service included the following:

- Documentation of our previous and current subsurface investigation.
- A summary of the topography and surface conditions.
- A summary of general geological conditions and subsurface conditions encountered in our boreholes.
- Results of laboratory soils testing.
- Summary of the slug test results and hydraulic conductivity estimates.
- Appendices containing borehole records, testing data, and output from the analysis.
- Pavement design and subgrade recommendations consistent with City of Bellevue Transportation Department Design Manual.
- Geotechnical design recommendations for pole foundations for use with Washington State Department of Transportation (WSDOT) Standard Plan J-28.30.
- Geotechnical design recommendations and construction considerations for cantilever soldier pile retaining wall design. The design recommendations will be consistent with methods and guidelines AASHTO LRFD Bridge Design Specifications, Eighth Edition.
- Bearing capacity and subgrade preparation recommendations for spread footings bearing on compacted structural fill to support the bike shelter. The design recommendations will be consistent with methods and guidelines AASHTO LRFD Bridge Design Specifications, Eighth Edition.
- Seismic response spectrum and seismic site class consistent with methods and guidelines AASHTO LRFD Bridge Design Specifications, Eighth Edition.

2.0 SUBSURFACE EXPLORATION PROGRAM

Golder drilled two boreholes and performed one slug test in each to characterize subsurface conditions within the proposed 130th Park-and-Ride location and confirm conditions expected from information collected previously. The boreholes and slug tests were conducted between December 23, 2020 and December 31, 2020. The boreholes were located near the north and south extents of the proposed storm water vault, respectively. Approximate locations of the boreholes are shown in Figure 1.

2.1 Drilling and Sampling Methods

Drilling and sampling was performed using sonic drilling methods with a Geoprobe 8140 drill rig. The sonic drilling method was used to obtain continuous samples of the subsurface stratigraphy to best characterize the site. Results of the sonic drilling boreholes are presented in Appendix A. A 2-inch diameter slotted PVC standpipe well was installed in both boreholes. The wells were installed with a 10 foot slotted section located between 10 and 20 feet below ground surface (bgs).

2.2 Slug Testing

Slug tests (rising and falling head tests) were completed in B-01 and B-02 on December 29, 2020. The slug tests were completed by rapidly either inserting or removing a 1.5-inch diameter slug rod to respectively raise or lower the water level in the well and allowing the water level to recover. The slug rod used for the tests was either 6 or 12 feet long. The tests were repeated 4 to 6 times in each well.

2.3 Laboratory Testing

Laboratory testing was performed on selected samples from the explorations to aid in classifying the soil type. The water content was determined in accordance with ASTM D2216 and grain size distribution was determined in accordance with ASTM D6913. Results of the laboratory tests are presented in Appendix C.

2.4 Previous Borehole Records

Golder previously performed boreholes at the project site for the Sound Transit East Link project (H-J-H 2016a). The location of these borings are shown in Figure 1. The stratigraphy encountered in boreholes B-01 and B-02 is generally consistent with the boreholes collected previously, presented in Appendix D.

3.0 SITE CONDITIONS

3.1 Topography

At present, the southern portion of the site was recently graded with a gravel surface as part of the Sound Transit East Link project, while the north west portion has a one-story building with a paved parking lot. There is a storm water detention pond currently located in the southeastern portion of the site.

3.2 Regional Geology

The project is located in the central portion of the Puget Lowland, an elongated, north-south topographic depression situated between the Olympic Mountains and the Cascade Range. Repeated glacial advances (glacial events) into this region strongly influenced present-day topography, geology, and groundwater conditions in the project area.

Geologists generally agree that the Puget Sound area was subjected to six or more major glacial events. The ice for these glaciations originated in the Coast Range and Rocky Mountains of British Columbia, Canada, and generally advanced (flowed) southward into the Puget Lowland. Each glaciation deposited new sediment and partially eroded previous sediments. During the intervening periods when glacial ice was not present, normal stream processes, wave action, weathering, bioturbation (soil disturbance resulting from faunal activity), and landsliding eroded and reworked some of the glacially derived sediment, further complicating the geologic setting.

Boreholes and geophysical surveys indicate that approximately 1,300 to 3,500 feet of sediment overlie the bedrock in this area (Yount et al. 1985). During the most recent glaciation that covered the central Puget Lowland, approximately 18,000 to 13,000 years before present (termed Fraser Glaciation) (Porter and Swanson 1998), the glacial ice is estimated to have been about 3,000 feet thick in the project area (Thorson 1989). The weight of the glacial ice resulted in compaction (overconsolidation) of the glacial and nonglacial soils beneath the ice. As the last ice to reach the Puget Lowland (Vashon stade of the Fraser Glaciation) retreated to the north, deposits of sand, gravel, silt, and clay, commonly containing cobbles and boulders, were laid down by meltwater streams issuing from the glacial ice front. These deposits are termed glacial recessional soils and are not glacially consolidated.

The glacial and interglacial deposits are overlain by younger (Holocene epoch), relatively loose and soft, post-glacial soils that include alluvial, lake, and fill deposits.

3.3 Hydrogeologic Setting

The stratigraphy created by the repeated glacial and interglacial depositional processes in the Seattle area has influenced the hydrogeologic regime and the nature of the groundwater flow in the region. The following sections discuss the regional groundwater system and regional groundwater flow.

3.3.1 Regional Groundwater Systems

The main groundwater systems in the alignment vicinity are typically located within relatively coarser grained normally consolidated post-glacial deposits (upper groundwater zone) and lower glacially consolidated deposits (lower groundwater zone). Both the upper and lower groundwater zones are widespread throughout the project area. The upper groundwater zone in the area is discontinuous and groundwater is usually perched on less permeable units. The upper groundwater zone includes fill, recent alluvium and lacustrine, recessional lacustrine, recessional outwash, and ablation till. The lower groundwater zone is generally continuous throughout the area and regionally and includes advance outwash and pre-Vashon nonglacial fluvial deposits.

Separating the upper and lower groundwater zones are fine-grained soil deposits that do not readily transmit groundwater and impede the vertical movement of groundwater. These fine-grained layers, referred to as aquitards, include recent lacustrine deposits, nonglacial lacustrine deposits, till and till-like deposits, ice-contact deposits, glaciolacustrine deposits, and other fine-grained sediments. The aquitards are not continuous on an area-wide basis and, where absent, the upper and lower groundwater zones may be in direct contact with each other. For example, some parts of the project area have recessional outwash directly overlying advance outwash and pre-Vashon nonglacial fluvial deposits. In this case, the glacial till aquitard, that is often part of the geologic sequence, is not present.

3.3.2 Regional Groundwater Flow

Groundwater flow in the project vicinity is influenced by the distribution of fine- and coarse-grained deposits, local topography, precipitation recharge area, groundwater connections with surface water bodies, and groundwater discharge. Groundwater recharge typically occurs in the upland areas located north of SR 520. Groundwater movement from these recharge areas is predominantly downward or laterally toward discharge areas, typically surface water bodies. The Kelsey Creek wetlands, west of the project site, are a major discharge zone in the project vicinity.

In the upper part of the soil profile, shallow groundwater is generally unconfined (water table conditions) and flows laterally to discharge at springs or seeps on hillsides and into creeks or wetlands. The shallow groundwater is typically perched above finer-grained aquitards. Consequently, where aquitards are present, only a small portion of the shallow groundwater water is able to move vertically downward through the aquitards to the deeper groundwater system.

Groundwater flow in deeper zones is primarily governed by the hydraulic gradient, or difference in piezometric head, between groundwater and surface water. The hydraulic gradient determines the potential for groundwater to move in a particular direction, with groundwater moving from high piezometric head levels to low piezometric head levels.

Vertical hydraulic gradients in unconfined groundwater (water table conditions) are often downward. When surface water bodies are groundwater discharge areas, groundwater flow is often upward in the area.

3.4 Subsurface Conditions

This section presents subsurface conditions encountered at the site in Golder's recent boreholes investigation and during Golder's field program for the Sound Transit East Link project (H-J-H 2016a).

Fill was encountered in each of the boreholes and ranged in thickness from under a foot up to 7 feet thick. In general, the fill ranged from 4 to 6 feet thick across the site. Fill material consisted generally of medium dense sand to silty sand and/or stiff clayey silt. Recessional outwash and lacustrine deposits were encountered beneath the fill. Recessional deposits consisted generally of loose to medium dense sand and silty sand to stiff clayey silt.

The depth of glacially overridden material ranged from 7 to 42 feet bgs, increasing in depth from the north to the south. Glacially overridden material generally consisted of very dense sand and gravel with silt.

Groundwater levels were measured in boreholes B-01 and B-02 using an electric water level tape prior to slug testing. The depth to water in B-01 was 6.70 feet below the top of the PVC casing, and the depth to water in B-02 was 7.58 feet below the top of the PVC casing. The wells are installed in flush monuments and the tops of the PVC casings are slightly below ground surface, estimated to be 194 feet. Therefore, the groundwater elevations are estimated to be about 186.3 to 187.4 feet at the time of measurement. These values are relatively consistent with groundwater elevation estimates from the Sound Transit East Link project.

3.5 Geologic Hazards

3.5.1 Fault Rupture

The nearest known fault system to the project site is the Seattle Fault Zone (SFZ) located approximately 3.5 miles south of the site. Therefore, fault rupture is not anticipated to be a hazard at the project site.

3.5.2 Liquefaction Potential

Loose to medium dense, granular soils located below the water table are generally considered to be susceptible to liquefaction. Soft, fine grained soils with low plasticity and high water contents may also be susceptible to liquefaction. Based on review of the soil and groundwater conditions encountered in the boreholes advanced onsite, the liquefaction risk is low to moderate. Localized areas of ground surface settlement resulting from liquefaction are likely to occur.

3.5.3 Lateral Spreading

Liquefaction-induced lateral spreading occurs predominantly within sloping sites or sites situated near water bodies. The potential for lateral spreading at the project site is low.

3.5.4 Landslides

The potential for landslides under static and seismic loading at the project site is low based on surrounding site topography.

4.0 EVALUATION AND RECOMMENDATIONS

4.1 Soil Parameters

The soil properties used for each soil unit are presented in this section. Soil properties were determined based on laboratory test results, soil characteristics noted in borehole records, correlations with SPT blow counts and prior experience in the area with soils of the same geologic origins. Soil units were selected based on general soil characteristics. Recommended values for soil properties by soil unit are presented below in Table 1.

Table 1: Engineering Properties by Soil Unit

Description	Geologic Unit	Total Unit Weight γ (pcf)	Effective Unit Weight γ ‘ (pcf)	Friction Angle Φ (degrees)	Cohesion c’ (psf)
Fill	Hf	120	58	32	0
Recessional Lacustrine and Outwash	Qvrl, Qvro	120	58	32	0
Glacially Overridden Deposits	Qvt, Qva, Qpnf	130	68	38	0

Notes:
pcf = pounds per cubic foot.
psf= pounds per square foot

4.2 Seismicity

4.2.1 International Building Code

Golder understands the bike shelter structure will be designed based on the International Building Code, 2015 Edition. If required and for reference, IBC based seismic parameters are provided.

Section 1613 of the 2015 IBC provides information on earthquake loads and site class. Section 1613.3.2 of 2015 IBC states “[b]ased on the site soil properties, the site shall be classified as Site Class A, B, C, D, E or F in accordance with Chapter 20 of ASCE 7.” Based on the SPT N-values recorded in the boreholes, it is our opinion that the Site should be classified as Site Class D.

Ground motion parameters used for design per the 2015 IBC include the site coefficient and mapped spectral accelerations, which can be found in Section 1613.3. The mapped spectral accelerations correspond to Class B conditions. Accordingly, the spectral response accelerations should be adjusted for the site-specific Class D soil conditions. The following design parameters are based on the IBC Maximum Considered Earthquake (MCE) Ground Motion, the 0.2-second spectral acceleration (Ss), and the 1.0-second spectral acceleration (S1) for the Project Site. The interpolated probabilistic ground motion values in percent gravity were obtained from the ASCE 7 Hazard Tool (https://asce7hazardtool.online/). The following results were obtained for latitude 47.625 and longitude -122.166 (a point located near the center of the Site):

- Peak Ground Acceleration
  - PGA = 0.525 g
  - PGA_M = 0.525 g
  - S_{D0} = 0.345 g
- Short (0.2 second) Spectral Response
  - S_S: 1.295 g
  - S_{MS}: 1.295 g
  - S_{DS}: 0.836 g
- Long (1.0 second) Spectral Response
  - S_1: 0.497 g
  - S_{M1}: 0.747 g
  - S_{D1}: 0.498 g

4.2.2 AASHTO LRFD Bridge Design Specifications

Golder understands the cantilever solider pile wall was previously designed based on the Sound Transit Design Criteria Manual Revision 3, August 2013, AASHTO LRFD Bridge Design Specifications, 6th Edition, and WSDOT Bridge Design Manual, M23-50.12, August 2012. The design evaluated two levels of earthquakes. Design parameters for the two earthquakes from the E340 Geotechnical Recommendations Report (H-J-H 2016b) are summarized in Table 2.

Table 2: E340 AASHTO Based Two Level Seismic Design Parameters

Design Event	PGA	S_S	S_1	Site Class	A_S	S_{DS}	S_{D1}
ODE	0.180	0.395	0.126	D	0.260	0.586	0.289
MDE	0.590	1.335	0.540	D	0.590	1.335	0.811

Notes:

1. PGA = peak ground acceleration, i.e., spectral acceleration at zero period for Site Class B.
2. S_S = short-period (0.2-second) spectral acceleration for Site Class B.
3. S_1 = 1-second spectral acceleration for Site Class B.
4. A_S, S_{DS}, and S_{D1} are PGA, S_S, and S_1 (respectively) adjusted for site class.
5. ODE = Operating Design Earthquake.
6. MDE = Maximum Design Earthquake (includes near-fault effects).

For comparison, seismic design parameters consistent with AASHTO LRFD Bridge Design Specifications, 8th Edition are included in Table 3. The values in Table 3 are less than the MDE values in Table 2.

Table 3: AASHTO LRFD Bridge Design Specifications, 8th Edition Based Seismic Design Parameters

Design Event	PGA	S_S	S_1	Site Class	A_S	S_{DS}	S_{D1}
AASHTO	0.368	0.811	0.201	D	0.415	0.957	0.402

Notes:

1. PGA = peak ground acceleration, i.e., spectral acceleration at zero period for Site Class B.
2. S_S = short-period (0.2-second) spectral acceleration for Site Class B.
3. S_1 = 1-second spectral acceleration for Site Class B.
4. A_S, S_{DS}, and S_{D1} are PGA, S_S, and S_1 (respectively) adjusted for site class.
5. Zero-Period Site Factor, F_{pga} = 1.13 (AASHTO 2017 Table 3.10.3.2-1)
6. Short-Period Site Factor, F_a = 1.18 (AASHTO 2017 Table 3.10.3.2-2)
7. Long-Period Site Factor, F_v = 2.0 (AASHTO 2017 Table 3.10.3.2-3)

4.3 Subgrade Preparation

This section applies generally to subgrade preparation for foundations and pavement. Undisturbed soil subgrade should be observed by the geotechnical engineer (or their representative) prior to placement of structural fill, subbase, base, or concrete on the subgrade. We recommend that proof-rolling with a fully loaded dump truck (or other heavy equipment) be observed for pavement subgrade. Any soft or excessively yielding areas should be stabilized or removed and replaced. Similarly, any areas that are harder or stiffer than the surrounding area should be re-conditioned. Properly prepared subgrade will reduce differential settlement between footings. Subgrade soils should not contain topsoil, organic soils, loose native soils, or previously placed uncontrolled fills.

Over-excavation or other actions may be required where there are subgrade soils that do not have sufficient strength to support the planned improvements. Depending on the soil, it may be possible to recompact in place, remove and recompact, or remove and replace with imported material. Loose granular soils such as sand and gravel can often be compacted if they are at appropriate moisture content. Other soils such as soft / loose silt, clay, or organics will usually require over-excavation and replacement with imported material.

Structural fill beneath footings should be Gravel Borrow (WSDOT 2020b 9-03.14[1]) compacted to at least 95% of the ASTM D 1557 (ASTM 2012) maximum dry density value for the material. Structural fill should be compacted with equipment suitable to achieve proper compaction throughout each lift. We recommend that lift thickness not exceed 12 inches before compaction.

4.4 Bearing Capacity

The subgrade soil conditions largely consist of loose to compact sand (fill) over dense sand or very stiff silt. After excavation for the footing is completed, the subgrade should be observed by the geotechnical engineer (or their representative) prior to placement of concrete or rebar.

Based on the soil conditions encountered, up to 2 or 3 feet of over-excavation of subgrade soils and replacement with structural fill will likely be required to provide adequate bearing capacity to support structures. Inspection during construction will be necessary to confirm subgrade conditions and identify unsuitable soils for removal and replacement. The basic soil parameters used to develop recommendations for footings are described in Section 4.1 of this report. Footing subgrade is anticipated to be fill or recessional deposits.

General bearing pressure recommendations for shallow spread footings are shown in Tables 4 and 5.

Table 4: Strip Footings Bearing on Soil

B′ (feet)	q_n (ksf)	q_1 (ksf)
2	10.8	4.3
4	13.6	5.0
6	16.7	3.4
8	19.9	2.5
10	22.1	2.0

Notes:

1. B′ = effective footing width (accounting for load eccentricity).
2. q_n = un-factored bearing strength. Apply a resistance factor φ_b = 0.45 for AASHTO (2017) Strength load combinations or a minimum factor of safety of 2.5 for IBC allowable stress design combinations.
3. q_1 = static bearing pressure inducing approximately 1 inch of settlement.
4. Values are applicable for minimum footing embedment of 1.5 feet below adjacent ground surface, placed on a properly prepared subgrade.
5. ksf = kips per square foot.

Table 5: Square Footings Bearing on Soil

B′ (feet)	qn (ksf)	q1 (ksf)
2	9.0	8.9
4	10.5	7.0
6	12.0	4.75
8	12.75	3.5
10	13.5	2.75

Notes:

1. B′ = effective footing width (accounting for load eccentricity).
2. qn = un-factored bearing strength. Apply a resistance factor φb = 0.45 for AASHTO (2017) Strength load combinations or a minimum factor of safety of 2.5 for IBC allowable stress design combinations.
3. q_1 = static bearing pressure inducing approximately 1 inch of settlement.
4. Values are applicable for minimum footing embedment of 1.5 feet below adjacent ground surface, placed on a properly prepared subgrade.
5. ksf = kips per square foot.

Foundations can resist lateral loads with base friction and passive resistance acting on the sides of the footing. For design purposes, lateral loads can be resisted simultaneously by:

- **BASE FRICTION:** An ultimate base friction coefficient of 0.6 can be assumed between the soil and spread footings. Apply a resistance factor φ_τ = 0.80 for AASHTO (2017) Strength load combinations. Apply a factor of safety = 1.5 for IBC allowable stress design.
- **PASSIVE RESISTANCE ON SIDES OF SHALLOW FOOTINGS:** For design purposes, we recommend that the un-factored (i.e., “ultimate”) passive pressure be based on a fluid with a density of 500 pounds per

square foot (psf) for footings bearing on the dense native soils or structural fill. Apply a resistance factor φ_{ep} = 0.50 for AASHTO (2017) Strength load combinations. Apply a factor of safety = 2.0 for IBC allowable stress design. The upper 1 foot of calculated passive pressure should be ignored.

4.5 Soldier Pile Recommendations

A soldier pile retaining wall is proposed for the site. The wall has a maximum retained height of 10 feet over a length of approximately 200 feet.

The ground surface at the top of the wall slopes up at approximately three horizontal to one vertical (3H:1V) and has a vertical grade change of approximately 5 feet at the north end of the wall and approximately 10 feet near the south end of the wall. Boreholes drilled near the wall indicate the wall will be embedded in and retain mostly glacially overridden deposits.

Soil parameters used in design correspond to glacially overridden deposits, presented in Section 4.1. Earth pressure diagrams for cantilever soldier pile walls are provided in Figure 2. A groundwater elevation of 187.5 feet is recommended for design. The recommended lateral earth pressures provided assume that adequate drainage is provided behind the walls to prevent the buildup of hydrostatic pressures. Walls should be provided with backdrains to prevent the buildup of hydrostatic pressure behind the walls. Lateral earth pressure and design values are presented in Table 6.

Table 6: Design parameters for Lateral Earth Loads

Soil	K_a	K_p	AASHTO			MDE			IBC		
			K_{ae1}	K_{ae2}	K_{pe}	K_{ae1}	K_{ae2}	K_{pe}	K_{ae1}	K_{ae2}	K_{pe}
All	0.27	8.77	0.8	0.51	5.44	0.97	0.72	5.44	0.65	0.45	5.44

Notes:

1. Ka = active earth pressure coefficient, static loading.
2. $K_{ae,1}$ = full active earth pressure coefficient, seismic loading, seismic coefficient $k_h = A_S$ or S_{D0} assumes no permanent wall displacement.
3. $K_{ae,2}$ = reduced active earth pressure coefficient, seismic loading, seismic coefficient k_h = ½ A_S or ½ S_{D0} to account for permanent wall displacement, wave scattering, and apparent cohesion.
4. K_p = passive earth pressure coefficient, static loading.
5. K_{pe} = passive earth pressure coefficient, seismic loading, seismic coefficient $k_h = A_S$.
6. AASHTO = AASHTO LRFD Bridge Design Specifications, 8th Edition Based Seismic Design Parameters
7. MDE = Maximum Design Earthquake used in previous design.
8. IBC = Design earthquake to be used in conjunction with IBC 2015 based design.
9. Values for active earth pressure coefficients are based on a 3H:1V slope. Values for passive earth pressure coefficients are based on a level ground surface.
10. Values for all passive earth pressure coefficients are un-factored (i.e., “ultimate”) values. Apply a resistance factor φ_{ep}= 0.50 for AASHTO Strength load combinations, or a factor of safety = 2.0 for IBC allowable stress load combinations.

The following construction considerations apply for installation of solider piles in drilled shafts:

- Contractor should be prepared to deal with boulders and cobbles.
- Groundwater seepage should be expected during installation of soldier piles. Temporary casings may be required during the construction of soldier piles to prevent sloughing or caving of granular soils. Installation of casing should be done in such a way that disturbance of surrounding soils is minimized.

- If temporary casing is required, the casing should be withdrawn in conjunction with concrete placement, and care should be taken to ensure no reduction in shaft cross-sectional area or displacement of structural steel elements occurs.
- In areas where the soldier pile will be below the water table, the contractor should be prepared to use wet construction methods to prevent soils from heaving at the base of the excavation. This typically involves maintaining a fluid head inside the shaft. In addition, the concrete placed into the shaft excavation will require tremie pipe methods.
- Upon completion of drilling, remove loose material at the base of the excavation before soldier pile installation. The pile and concrete should not be placed until the excavations have been inspected by a qualified geotechnical engineering representative. Concrete should be poured immediately following inspection; excavations should not be left open for an extended amount of time.

4.6 Pole Foundations

Golder understands the foundation designs for the light poles are based on WSDOT Standard Plan J-28.30. Following review of boreholes in the area from the East Link E340 (H-J-H 2016a) project and our understanding of ongoing construction activities, the anticipated foundation bearing soils are medium dense to very dense granular soils and fills. Per Section 17.2.1 of the WSDOT GDM (WSDOT 2020a), an allowable lateral bearing pressure of 2,000 psf can be assumed for compacted common borrow fills and native soils with Standard Penetration Test Resistance (not corrected for overburden) of 13 blows or more. According to the WSDOT Standard Plan J-28.30 Type A standard foundations are suitable for areas flatter than 4:1 (H:V) and Type B Standard foundations are suitable for all areas up to 2:1 at this site based on the allowable lateral bearing pressure greater than 2,000 psf.

4.7 Pavement

We understand the parking areas will be limited to passenger cars, no buses or other heavy vehicles are anticipated to use the parking area on a regular basis. Limiting the parking areas to passenger cars will allow for a thinner pavement section than required by the City of Bellevue for a “Typical Local Street.”

Parking lot pavement performance will be dependent on proper subgrade preparation during construction. Undisturbed soil subgrade should be observed by the geotechnical engineer (or their representative) prior to placement of structural fill, subbase, base, or pavement on the subgrade. Subgrade preparation recommendations are summarized in Section 4.3 of this report.

Provided the subgrade is properly prepared, the subgrade should provide an adequate base for asphalt pavement support. In accordance with Washington Asphalt Pavement Association (WAPA 2009) guidelines and our local experience, we recommend a minimum 4 inches of Hot Mix Asphalt (HMA) over 4 inches of Crushed Surfacing Top Course.

If buses or vehicles other than passenger cars will use the parking lot on a regular basis, a thicker pavement section will likely be required. Access lanes for maintenance vehicles should be a minimum of 6 inches thick to support vehicles with heavier axle loads, such as vactor trucks.

4.8 Slug Testing and Dewatering Evaluation

4.8.1 Slug Test Results

Slug tests (rising and falling head tests) were completed in B-01 and B-02 on December 29, 2020. The slug tests were completed by rapidly either inserting or removing a 1.5-inch diameter slug rod to respectively raise or lower the water level in the well and allowing the water level to recover. The slug rod used for the tests was either 6 or 12 feet long. The tests were repeated 4 to 6 times in each well.

Groundwater levels were measured prior to the tests using an electric water level tape. The depth to water in B-01 was 6.70 feet below the top of the PVC casing, and the depth to water in B-02 was 7.58 feet below the top of the PVC casing. The wells are installed in flush monuments and the tops of the PVC casings are slightly below ground surface, estimated to be 194 feet. Therefore, the groundwater elevations are estimated to be about 186.3 to 187.4 feet at the time of measurement.

Pressure transducers and dataloggers were installed in each well to monitor water levels during the tests. The data loggers were programmed to collect readings every second throughout the tests.

The test data were analyzed using HydroBench version 7.0 (Golder 2019) to estimate the formation hydraulic conductivity. The results of the analyses are summarized in Table 7:

Table 7: Summary of Slug Test Results

Test Number	B-01 Hydraulic Conductivity (feet/day)	B-02 Hydraulic Conductivity (feet/day)
RHT 1	14.2	3.3
FHT 1	14.9	2.8
RHT 2	12.7	2.9
FHT 2	12.7	3.1
RHT 3	10.4	NA
FHT 3	12.0	NA

Note: RHT – rising head test, FHT – falling head test

The estimated hydraulic conductivities are consistent with the descriptions of the geological materials on the well logs.

4.8.2 Dewatering Evaluation

A stormwater vault will be installed at the facility. The vault dimensions are 16 by 48 feet (768 square feet). The base of the vault is at an elevation of 180.27 feet, and the base of the in-vault sump is 4 feet lower, or 176.27 feet. Therefore, the sump and base of the vault are below the groundwater level and dewatering will be required during excavation.

Steady-state dewatering rates were estimated using an analytical method (Marinelli and Niccoli 2000) implemented in an Excel spreadsheet. The analytical method assumes the following summarized in Table 8 (“Base Case” scenario):

- The groundwater elevation is the average of the measured groundwater elevations in B-01 and B-02 on December 29, 2020.
- The formation hydraulic conductivity is 8.3 feet/day (ft/d), based on the average hydraulic conductivity from the slug tests completed in B-01 and B-02.
- Precipitation at the site was assumed to be equal to measured precipitation at the King County Crossroads station (XRDS) over the period October 1, 2000 to September 30, 2020 (King County Hydrologic Information Center 2021). The average precipitation at the Crossroads station was 44.96 inches per year (in/yr) or 3.75 feet per year (ft/yr).
- Recharge was estimated using a precipitation-based regression equation developed for urban areas by the U.S. Geological Survey for the Puget Sound area (Bidlake and Payne 2021). The equation is:

  $$R = 0.194P - 2.13$$

  where:
  R is recharge (in/yr)
  P is precipitation (in/yr)
  0.194 and 2.13 are regression constants

  The estimated average recharge is 6.6 in/yr (0.55 ft/yr).
- The base of the vault is at elevation 176.27 feet (i.e., the entire base of the vault is at the elevation of the sump).

Table 8: Summary of Input Parameters

Scenario	Hydraulic Conductivity (feet/day)	Groundwater Elevation (feet)	Recharge (feet/year)	Description
1	8.3	187	0.47	Base
2a	8.3	189	0.47	High Groundwater Elevation (+2 feet)
2b	8.3	185	0.47	Low Groundwater Elevation (-2 feet)
3a	16.0	187	0.47	High Hydraulic Conductivity (B-01 analysis +25%)
3b	2.3	187	0.47	Low Hydraulic Conductivity (B-02 analysis -25%)
4a	8.3	187	0.64	High Recharge (maximum precipitation measured at Crossroads)
4b	8.3	187	0.33	Low Recharge (minimum precipitation measured at Crossroads)

To evaluate the sensitivity of the predicted dewatering rates to the model assumptions, the input parameters, including hydraulic conductivity of the advance outwash, groundwater elevation, and recharge were varied. Table 9 summarizes the range in model parameters evaluated as part of the sensitivity analysis.

The predicted steady-state Base Case (Scenario 1) dewatering rate is 14.2 gpm. The results of the sensitivity analysis are summarized as follows (Table 9):

- For a groundwater elevation of 189 feet, the predicted dewatering rate increases to 17.7 gpm. If the groundwater elevation is lower (185 feet) the predicted dewatering rate decreases to 11 gpm.
- If the hydraulic conductivity of the materials is higher (16 ft/d), the predicted dewatering rate is higher at 26.5 gpm. If the hydraulic conductivity of the materials is lower (2.3 ft/d), the predicted dewatering rate is lower (4.2 gpm).
- The model is less sensitive to changes in precipitation recharge. If the recharge is based on the maximum measured precipitation at the Crossroads station (recharge of 0.76 ft/yr), the predicted dewatering rate increases slightly to 14.5 gpm. If recharge is based on the minimum measured precipitation (recharge of 0.42 ft/yr), the predicted steady-state dewatering rate decreases slightly to 14 gpm.

Table 9: Summary of Estimated Steady-State Dewatering Rates

Scenario	Predicted Steady-State Dewatering Rate (gpm)	Description
1	14.2	Base case
2a	17.7	High Groundwater Elevation (+2 feet)
2b	11.0	Low Groundwater Elevation (-2 feet)
3a	26.5	High Hydraulic Conductivity (B-01 analysis +25%)
3b	4.2	Low Hydraulic Conductivity (B-02 analysis -25%)
4a	14.5	High Recharge (maximum precipitation measured at Crossroads)
4b	14.0	Low Recharge (minimum precipitation measured at Crossroads)

The predicted dewatering rates are for steady-state conditions. Higher rates will occur at dewatering system start-up, if the dewatering system has been temporarily offline as water is removed from storage within the radius of influence of the system, or if there is a significant precipitation event during construction. Higher rates may be required if there are other sources of recharge that are not accounted for in the model. Other sources of recharge could include leaking potable water or stormwater pipelines in the vicinity of the project.

5.0 CLOSING

This report has been prepared exclusively for the use of KPFF and the City of Bellevue for the Project Site. This report may be reviewed by bidders and/or contractors as it relates to factual data only. The conclusions and recommendations presented in this report are based on the explorations and observations completed for this study, conversations regarding the existing Site conditions, and our understanding of the planned project. The conclusions are not intended, nor should they be construed to represent, a warranty regarding the project. They are included to assist in the planning and design process.

Judgment has been applied in interpreting and presenting the results. The soil and groundwater conditions depicted are only for the specific dates and locations reported and, therefore, are not necessarily representative of other locations and times. Variations in subsurface conditions outside the exploration locations are common in glacial environments such as those encountered at the Site and in areas disturbed by human activities. Actual conditions encountered during construction may be different from those observed in and inferred from the explorations.

Golder Associates Inc.

ANTHONY MAX ROSSITER
20100769
4/14/2021

Max Rossiter, PE
Project Engineer

Hydrogeologist
339
Michael P. Klisch
4/14/2021
Michael Klisch

Michael Klish, LHg
Senior Project Hydrogeologist

JOSHUA L. HANSON
Josh Hanson
41816
4/14/2021

Josh Hanson, PE
Associate, Senior Consultant

AMR/MK/JLH/tp

Golder and the G logo are trademarks of Golder Associates Corporation

https://golderassociates.sharepoint.com/sites/129709/project files/6 deliverables/20145996-rev0-cob 130th park and ride geotechnical report-041421.docx

6.0 REFERENCES

American Association of State and Highway Transportation Officials (AASHTO). 2012. LRFD Bridge Design Specifications, Customary United States Units, 6th Edition, American Association of State Highway and Transportation Officials.

American Association of State and Highway Transportation Officials (AASHTO). 2017. LRFD Bridge Design Specifications, Customary United States Units, 8th Edition, American Association of State Highway and Transportation Officials.

American Society of Testing and Materials (ASTM). 2012. Coshohocken, PA. Verification of latest standards at www.astm.org (accessed February 16, 2021).
D 1557-12e1 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.
D 2216-19 Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
D6913 / D6913M - 17 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Bidlake, W.R. and K.L. Payne. 2001. Estimating Recharge to Ground Water from Precipitation at Naval Base Bangor and Vicinity, Kitsap County, Washington. U.S. Geological Survey Water-Resources Investigations Report 2001-4110.

Golder Associates Inc. (Golder). 2019. Hydrobench, Version 7.

H-J-H Final Design Partners (H-J-H). 2016a. East Link: South Bellevue to Overlake Transit Center: Contract E340 Geotechnical Data Report IFB Submittal. March 28.

H-J-H Final Design Partners. (H-J-H). 2016b. East Link: South Bellevue to Overlake Transit Center: Contract E340 Final Geotechnical Recommendations Report IFB Submittal. March 28.

ICC (International Code Council). 2015. 2015 International Building Code.

King County Hydrologic Information Center. 2021. Crossroads Precipitation Gage XRDS Daily Precipitation, https://green2.kingcounty.gov/hydrology/gaugemap.aspx. Downloaded January 20.

Marinelli, F., and W. L. Niccoli. 2000. Simple analytical equations for estimating ground water inflow to a mine pit. Ground Water 38, no. 2: 311-314.

Porter, S.C., and Swanson, T.W. 1998. Radiocarbon age constraints on rates of advance and retreat of the Puget lobe of the Cordilleran Ice Sheet during the last glaciations: Quaternary Research, v. 50, p. 205-213.

Sound Transit. 2013. Design Criteria Manual, Revision 3, Sound Transit Link. August.

Thorson, R.M. 1989. Glacio-isostatic response of the Puget Sound area, Washington: Geological Society of America Bulletin, v. 101, no. 9, p. 1163 1174.

Washington Asphalt Pavement Association (WAPA). 2009. WAPA Asphalt Pavement Guide, Design Catalog – Parking Lots, 724 Columbia Street NW Suite #245, Olympia, Washington, (http://www.asphaltwa.com/wapa_web/modules/10_design_catalog/10_parking_lots.htm) downloaded November 25, 2009.

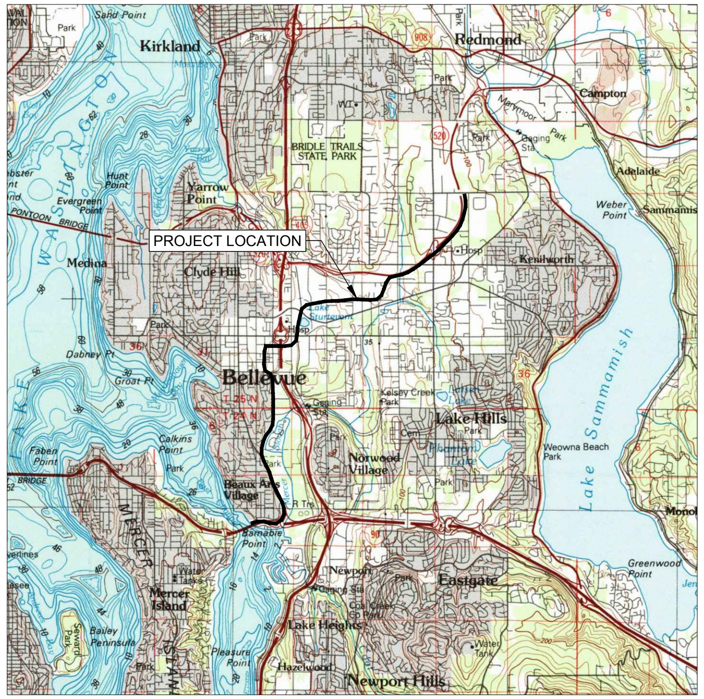
Washington State Department of Transportation (WSDOT). 2012. Geotechnical Design Manual. Publication no. M 23-50.12. August.

Washington State Department of Transportation (WSDOT). 2020a. Geotechnical Design Manual. Publication no. M 46-03. December.

Washington State Department of Transportation (WSDOT). 2020b. Standard Specifications for Road, Bridge, and Municipal Construction 2021, M 41-10, Washington State Department of Transportation. September.

Yount, J.C., Dembroff, G.R., and Barats, G.M. 1985. Map showing depth to bedrock in the Seattle 30' by 60' quadrangle, Washington: US Geological Survey Miscellaneous Field Studies Map MF-1692, scale 1:100,000.

Figures



VICINITY MAP
(NOT TO SCALE)

LEGEND

⊕ BORING COMPLETED BY H-J-H - EAST LINK RAIL PHASE II

⊕ PRELIMINARY ENGINEERING BORINGS BY CH2M HILL

⊕ BORING COMPLETED BY GOLDER

0 100 200
1" = 100' FEET

CLIENT
KPFF

PROJECT
CONSTRUCTION SUPPORT
CITY OF BELLEVUE 130TH PARK & RIDE
BELLEVUE, WA

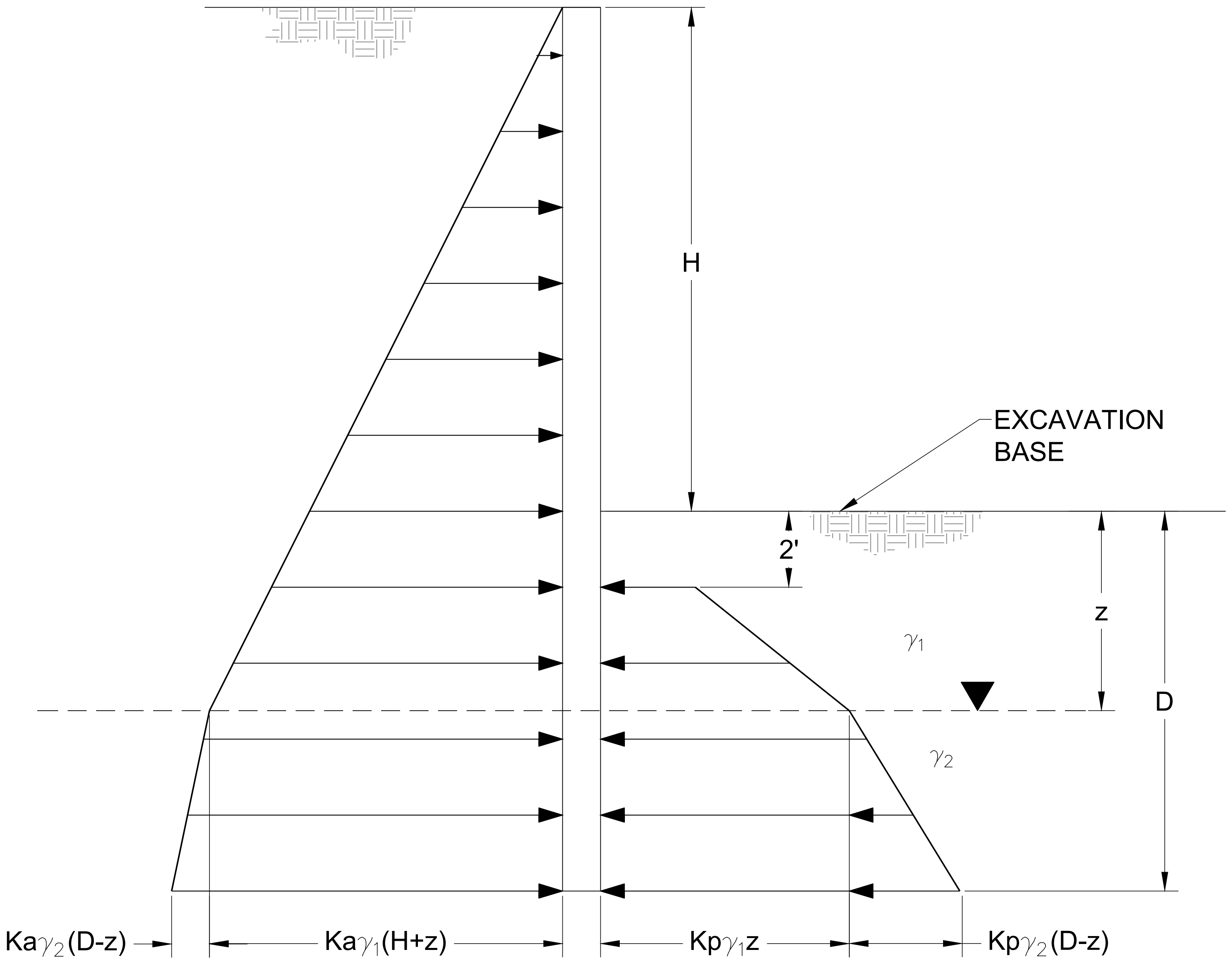
TITLE
BOREHOLE LOCATION MAP

CONSULTANT

GOLDER

YYYY-MM-DD	2021-02-11
DESIGNED	MR
PREPARED	REDMOND
REVIEWED	MR
APPROVED	JH

PROJECT NO.	PHASE	REV.	FIGURE
20145996	200	A	1



LEGEND

H = WALL HEIGHT
D = EMBEDMENT DEPTH
z = DEPTH TO GROUNDWATER
γ_1 = TOTAL UNIT WEIGHT OF SOIL
γ_2 = SUBMERGED UNIT WEIGHT OF SOIL
Ka = ACTIVE EARTH PRESSURE COEFFICIENT
Kp = PASSIVE EARTH PRESSURE COEFFICIENT
Kae = SEISMIC ACTIVE EARTH PRESSURE COEFFICIENT
Kpe = SEISMIC PASSIVE EARTH PRESSURE COEFFICIENT

NOTES

1. ALL DIMENSIONS IN FEET.
2. ALL PRESSURES IN POUNDS PER SQUARE FOOT (PSF).
3. ACTIVE PRESSURE ACTS OVER ENTIRE WALL FACE ABOVE EXCAVATION BASE AND OVER ONE CONCRETED SOLDIER PILE DIAMETER BELOW EXCAVATION BASE.
4. PASSIVE PRESSURE ACTS OVER THREE TIMES CONCRETED SOLDIER PILE DIAMETER OR THE PILE SPACING, WHICHEVER IS LESS.
5. IGNORE THE UPPER 2 FEET OF EMBEDMENT FOR PASSIVE RESISTANCE.
6. SURCHARGE LOADS ARE NOT INCLUDED ON THE DIAGRAM.
7. PASSIVE PRESSURE SHOWN IS UN-FACTORED. APPLY RESISTANCE FACTOR OR FACTOR OF SAFETY IN ACCORDANCE WITH DESIGN STANDARD (I.E., AASHTO OR IBC).
8. EARTH PRESSURE DIAGRAM BASED ON FIGURE 3.11.5.6-1 OF AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS 2012.
9. FOR SEISMIC CASE ABOVE EXCAVATION BASE REPLACE VALUES OF Ka WITH Kae, BELOW BASE OF EXCAVATION REPLACE VALUES OF Kp WITH Kpe

CLIENT
KPFF

PROJECT
CONSTRUCTION SUPPORT
CITY OF BELLEVUE 130TH PARK & RIDE
BELLEVUE, WA

TITLE
CANTILEVER SOLDIER PILE LATERAL EARTH PRESSURE DIAGRAM

CONSULTANT
GOLDER

YYYY-MM-DD	2021-02-11
DESIGNED	MR
PREPARED	REDMOND
REVIEWED	MR
APPROVED	JH

PROJECT NO.	PHASE	REV.	FIGURE
20145996	200	A	2

APPENDIX A

Boreholes

RECORD OF BOREHOLE: B-01

CLIENT:	City of Bellevue	START DATE:	December 23, 2020	ELEVATION:	192.0 ft (Ground)
PROJECT:	130th Park and Ride	END DATE:	December 31, 2020		
PROJECT NO:	20145996	INCLINATION:	90.0°	COORD SYS:	Geographical Coordinates
LOCATION:		CONTRACTOR:	Holocene Drilling, Inc.	HORZ DATUM:	WGS 84
				HOLE LOC:	North end of proposed vault location

DRILL RIG: Geoprobe 8140

DRILL METHOD: Sonic Drilling - 5-in Hole Dia.

MATERIAL PROFILE

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)
0.0 – 4.0	FILL - (SP) Poorly graded sand with gravel, mostly fine to coarse SAND, little fine to coarse subrounded to subangular gravel, trace non plastic fines; brown, iron oxide staining; moist.	SP	0.0
4.0 – 12.0	(SM) Silty SAND, mostly fine to medium sand, little nonplastic fines; mottled gray and orangish brown, iron oxide staining, OUTWASH; moist.	SM	188.0 4.0
12.0 – 22.0	(ML) SILT, mostly nonplastic fines, few fine sand, trace organics (charcoal); gray; moist.	ML	180.0 12.0
22.0 – 25.0	(SP) Poorly graded SAND, mostly fine to medium sand, trace nonplastic fines; light gray; moist.	SP	170.0 22.0

Continued on Next Page

SAMPLES

Hammer: N/A
ASTM D1586, Blows per 6 in
140-lb hammer, 30-in drop

WATER CONTENT PERCENT: H Plastic & Liquid Limits (%); ○ Water Content (%); NP Nonplastic (scale 0–50)

NUMBER	TYPE	REC %	BLOWS	N-VALUE	WATER CONTENT	GRAVEL	SAND	FINES
S-1a	SC	80						
S-1b								
S-2	SC	100			○	0	72	28
S-3a	SC	90						
S-3b					○	0	11	89
S-4	SC	80			○	0	11	89
S-5a	SC	80						
S-5b					○	0	97	3

GROUNDWATER OBSERVATIONS

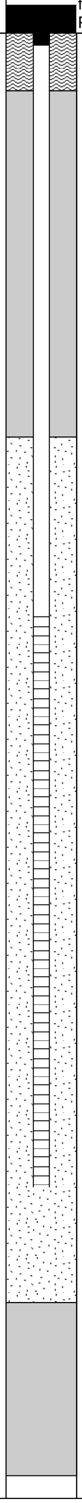
▼ 23Dec20 09:23 (approx. 9 ft)

▽ 23Dec20 08:56 (approx. 13.4 ft)

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 0.00 ft

Pipe Elev: 192.0 ft



0.0 - 1.0 ft bgs: Cement Seal and Flush Mount Monument

Well Tag: BMR845

1.0 - 7.0 ft bgs: Bentonite Chips

7.0 - 22.0 ft bgs: 10/20 Silica Sand

DEPTH SCALE: 1:131

REV: A

GOLDER

LOGGED: Amelia McMillin — DATE: Dec 23, 2020

CHECKED: Max Rossiter — DATE: Feb 9, 2021

RECORD OF BOREHOLE: B-01

CLIENT: City of Bellevue
PROJECT: 130th Park and Ride
PROJECT NO: 20145996
LOCATION:

START DATE: December 23, 2020
END DATE: December 31, 2020
INCLINATION: 90.0°
CONTRACTOR: Holocene Drilling, Inc.

ELEVATION: 192.0 ft (Ground)
COORD SYS: Geographical Coordinates
HORZ DATUM: WGS 84
HOLE LOC: North end of proposed vault location

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE DESCRIPTION	USCS	STRATA PLOT	ELEV. --------- DEPTH (ft)	SAMPLES (Hammer: N/A ASTM D1586, Blows per 6 in 140-lb hammer, 30-in drop) NUMBER	TYPE	REC %	BLOWS	N-VALUE	WATER CONTENT PERCENT H Plastic & Liquid Limits (%) ○ Water Content (%) NP Nonplastic 0 10 20 30 40 50	GRADATION % GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS Pipe Stickup: 0.00 ft Pipe Elev: 192.0 ft
26	Geoprobe 8140	Sonic Drilling - 5-in Hole Dia.	(SP) Poorly graded SAND, mostly fine to medium sand, trace nonplastic fines; light gray; moist.	SP		165.0	S-6a													22.0 - 30.0 ft bgs: Bentonite Chips
27			(SM) Silty SAND, mostly fine to medium sand, little nonplastic fines; gray, iron oxide staining; moist.	SM		27.0 164.0	S-6b	SC	76											
28 29			(SP-SM) Poorly graded SAND with SILT, mostly fine to medium, few nonplastic fines; light tan; moist.	SP-SM		28.0 162.0	S-6c													
30			End of hole at 30.0 ft.																	

31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

DEPTH SCALE: 1:131

REV: A

GOLDER

LOGGED: Amelia McMillin
CHECKED: Max Rossiter

DATE: Dec 23, 2020
DATE: Feb 9, 2021

RECORD OF BOREHOLE: B-02

Sheet 1 of 2

CLIENT: City of Bellevue
PROJECT: 130th Park and Ride
PROJECT NO: 20145996
LOCATION:

DATE: December 23, 2020
INCLINATION: 90.0°
CONTRACTOR: Holocene Drilling, Inc.

ELEVATION: 192.0 ft (Ground)
COORD SYS: Geographical Coordinates
HORZ DATUM: WGS 84
HOLE LOC: South end of proposed vault

DRILL RIG: Geoprobe 8140
DRILL METHOD: Sonic Drilling - 5-in Hole Dia.

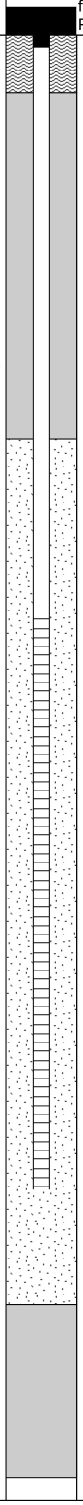
SAMPLES: Hammer: N/A ASTM D1586, Blows per 6 in 140-lb hammer, 30-in drop

WATER CONTENT PERCENT: H Plastic & Liquid Limits (%); ○ Water Content (%); NP Nonplastic (scale 0 10 20 30 40 50)

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE	WATER CONTENT	GRAVEL	SAND	FINES	GROUNDWATER OBSERVATIONS
0.0 – 3.0	FILL - (SP) Poorly graded SAND with gravel, mostly fine to coarse sand, little fine to coarse subrounded to subangular gravel, trace nonplastic fines; brown and gray; moist.	SP	0.0 189.0	S-1a	SC	80							
3.0 – 4.0	(OL) Organic SILT with sand, mostly nonplastic fines, little fine to medium sand, trace gravel; dark brown; moist.	OL	3.0 188.0	S-1b									
4.0 – 9.0	(SM) Silty SAND, mostly fine to medium sand, little nonplastic fines, trace gravel; gray and tan, iron oxide staining; moist to wet.	SM	4.0 183.0	S-1c S-2a	 SC	 80			 ○	 0	 77	 23	23Dec20 11:18 23Dec20 10:58
9.0 – 13.0	(ML) SILT with sand, mostly nonplastic fines, little fine sand; tan, iron oxide staining, moist.	ML	9.0 179.0	S-2b S-3a	 SC	 80			○	0	21	79	
13.0 – 20.0	(SM) Silty SAND, mostly fine sand, some nonplastic fines; gray; moist to wet. - 17.5 to 18.0 ft: lens of low plasticity silt	SM	13.0 172.0	S-3b S-4	 SC	 80			 ○	 0	 42	 58	23Dec20 12:16 23Dec20 11:58
20.0 – 24.0	(ML) Sandy SILT, mostly nonplastic fines, some fine to medium sand; gray; moist to wet.	ML	20.0 168.0	S-5a	SC	90			○	0	59	41	23Dec20 11:45
24.0 – 25	(ML) SILT, mostly nonplastic FINES, few fine sand, trace gravel; gray; moist.		24.0	S-5b									

Continued on Next Page

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 0.00 ft
Pipe Elev: 192.0 ft

0.0 - 1.0 ft bgs: Cement Seal and Flush Mount Monument

Well Tag: BMR846

1.0 - 7.0 ft bgs: Bentonite Chips

7.0 - 22.0 ft bgs: 10/20 Silica Sand

DEPTH SCALE: 1:131

REV: A

LOGGED: Amelia McMillin DATE: Dec 23, 2020
CHECKED: Max Rossiter DATE: Feb 9, 2021

Golder - 3 Imperial US / ASTM D2487 Auto / 2021-02-09

RECORD OF BOREHOLE: B-02

CLIENT:	City of Bellevue	DATE:	December 23, 2020	ELEVATION:	192.0 ft (Ground)
PROJECT:	130th Park and Ride				
PROJECT NO:	20145996	INCLINATION:	90.0°	COORD SYS:	Geographical Coordinates
LOCATION:		CONTRACTOR:	Holocene Drilling, Inc.	HORZ DATUM:	WGS 84
				HOLE LOC:	South end of proposed vault

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE DESCRIPTION	USCS	STRATA PLOT	ELEV. --------- DEPTH (ft)	SAMPLES (Hammer: N/A ASTM D1586, Blows per 6 in 140-lb hammer, 30-in drop) NUMBER	TYPE	REC %	BLOWS	N-VALUE	WATER CONTENT PERCENT (H Plastic & Liquid Limits (%); ○ Water Content (%); NP Nonplastic) 0 10 20 30 40 50	GRADATION % GRAVEL	SAND	FINES	ORGANIC CONTENT %	ADDITIONAL LAB TESTING	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS Pipe Stickup: 0.00 ft Pipe Elev: 192.0 ft
26	Geoprobe 8140	Sonic Drilling - 5-in Hole Dia.	(ML) SILT, mostly nonplastic FINES, few fine sand, trace gravel; gray; moist.	ML		165.0	S-6a													22.0 - 30.0 ft bgs: Bentonite Chips
27 28 29			(SM) Silty SAND, mostly fine to medium SAND, little nonplastic fines; gray; moist.	SM		27.0 162.0	S-6b	SC	80			○	0	84	16					
30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50			End of hole at 30.0 ft.																	

DEPTH SCALE: 1:131

REV: A

GOLDER

LOGGED: Amelia McMillin

DATE: Dec 23, 2020

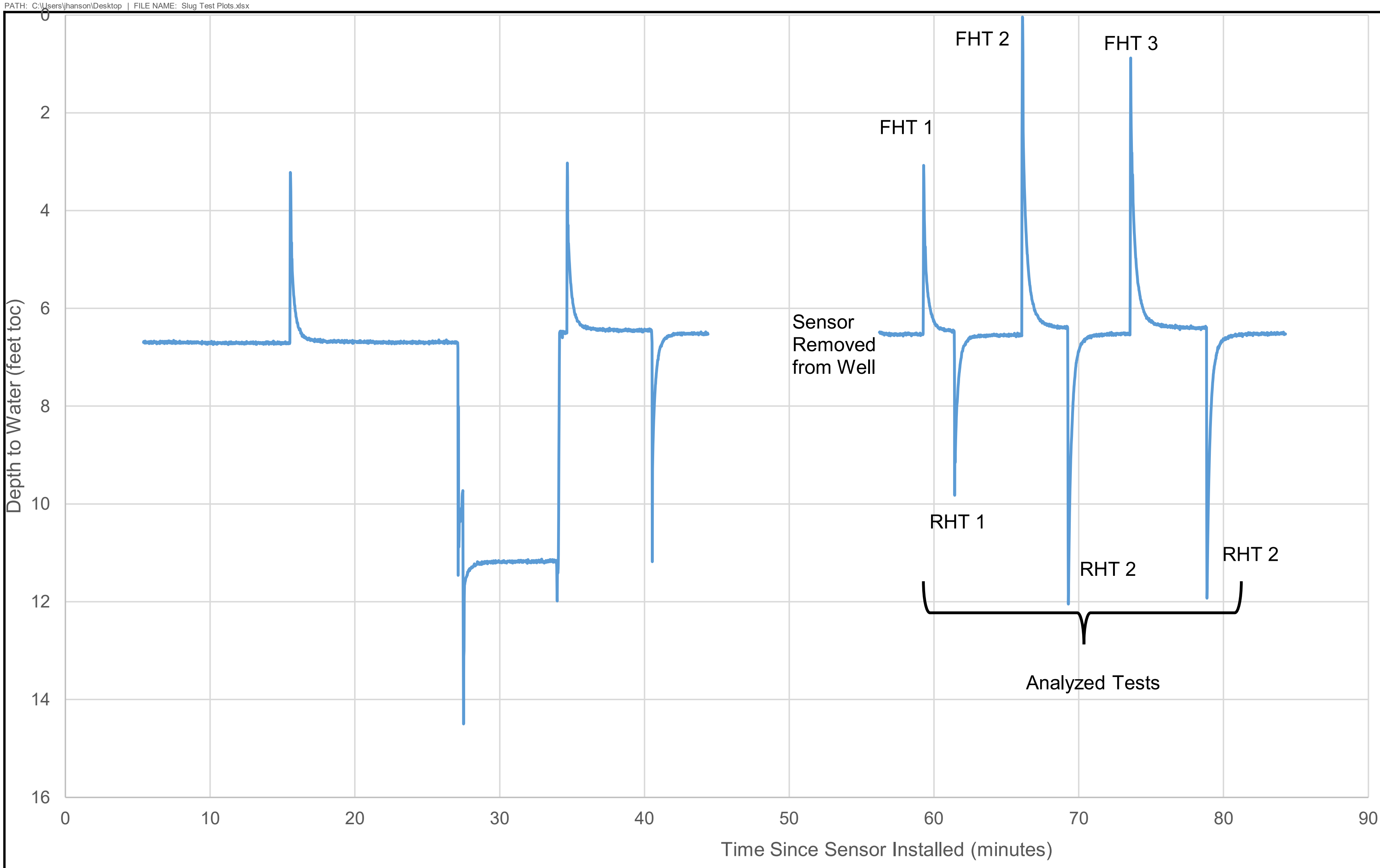
CHECKED: Max Rossiter

DATE: Feb 9, 2021

APPENDIX B

Slug Test Data

PATH: C:\Users\jhanson\Desktop | FILE NAME: Slug Test Plots.xlsx



LEGEND

Note: Readings collected every second using InSitu Rugged TROLL 100 pressure transducer/datalogger

CLIENT
KPPF

CONSULTANT

GOLDER

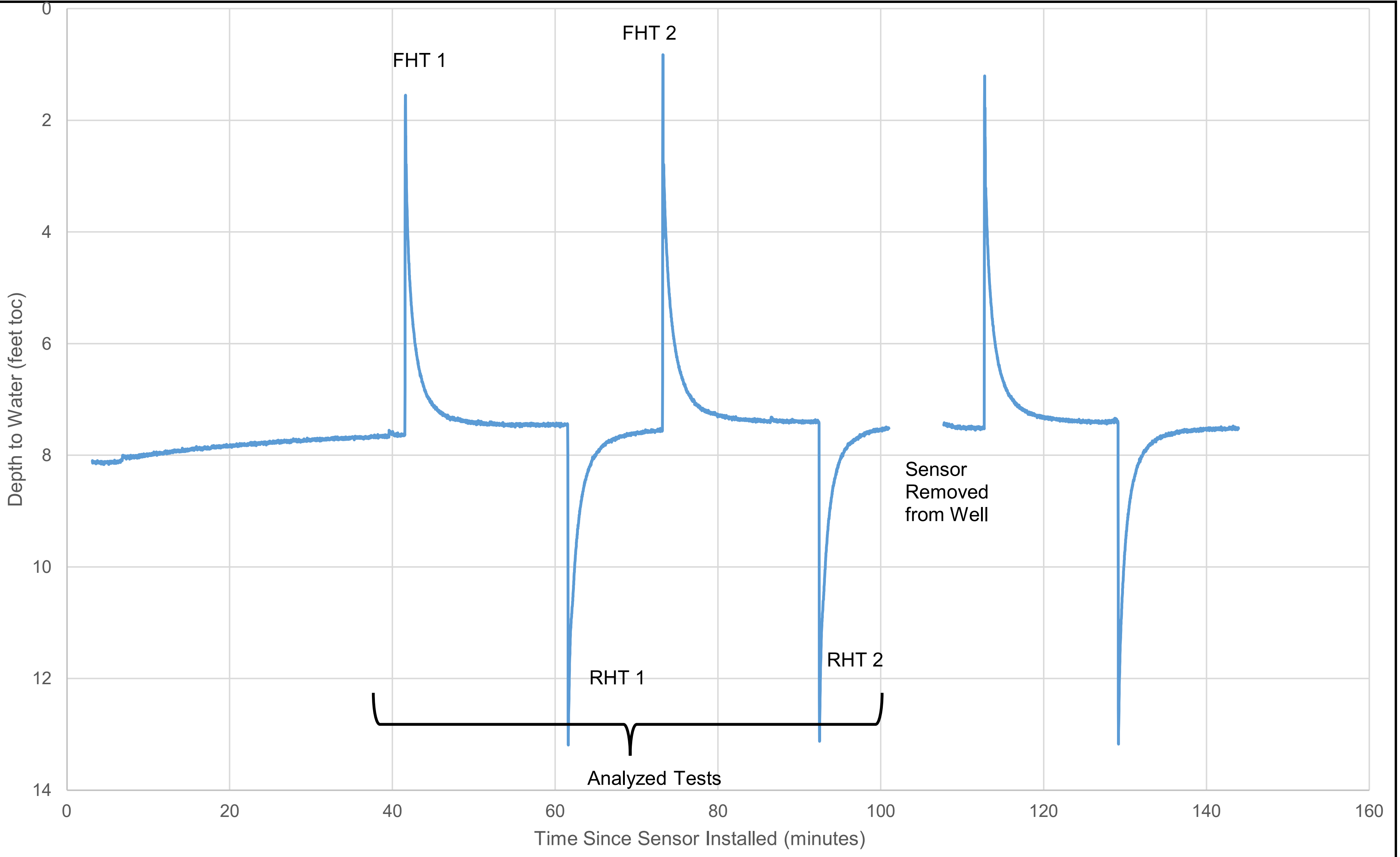
YYYY-MM-DD	2/18/2021
DESIGNED	MPK
PREPARED	MPK
REVIEWED	DH
APPROVED	----

PROJECT
130th AVENUE NE STATION
PARK AND RIDE DESIGN
BELLEVUE WASHINGTON

TITLE
SLUG TEST HYDROGRAPH
B-01

PROJECT NO.	PHASE	REV.	FIGURE
20145996	200.1	00	B-1

PATH: C:\Users\jhanson\Desktop | FILE NAME: Slug Test Plots.xlsx



LEGEND

Note: Readings collected every second using InSitu Rugged TROLL 100 pressure transducer/datalogger

CLIENT
KPPF

CONSULTANT

GOLDER

YYYY-MM-DD 2/18/2021
DESIGNED MPK
PREPARED MPK
REVIEWED DH
APPROVED ----

PROJECT
130th AVENUE NE STATION
PARK AND RIDE DESIGN
BELLEVUE WASHINGTON

TITLE
SLUG TEST HYDROGRAPH
B-02

PROJECT NO.	PHASE	REV.	FIGURE
20145996	200.1	00	B-2

APPENDIX C

Laboratory Data

AAR TESTING AND INSPECTION, INC.

7126 180th Avenue NE, Suite C101
Redmond, Washington 98188
www.aartesting.com
425.881.5812 | O

January 11, 2021
AAR Project Number: 20-717

Amelia McMillin
Golder
18300 NE Union Hill Road, Suite 200
Redmond, WA 98052

SUBJECT: **130th Park and Ride**
Bellevue, WA

Ms. McMillin:

In accordance with your request, AAR Testing and Inspection, Inc. (AAR) has performed ASTM D2216: Moisture Content of Soils, and ASTM D6913: Gradation Analysis of soils as delivered from the above referenced project. Soil descriptions are based on sieve results and visual determination of fine material type.

The results of the testing can be found on the following page.

We hope this will answer any questions you may have, if any should arise or we if can be of further assistance please do not hesitate to give us a call.

Sincerely,

AAR TESTING & INSPECTION, INC.

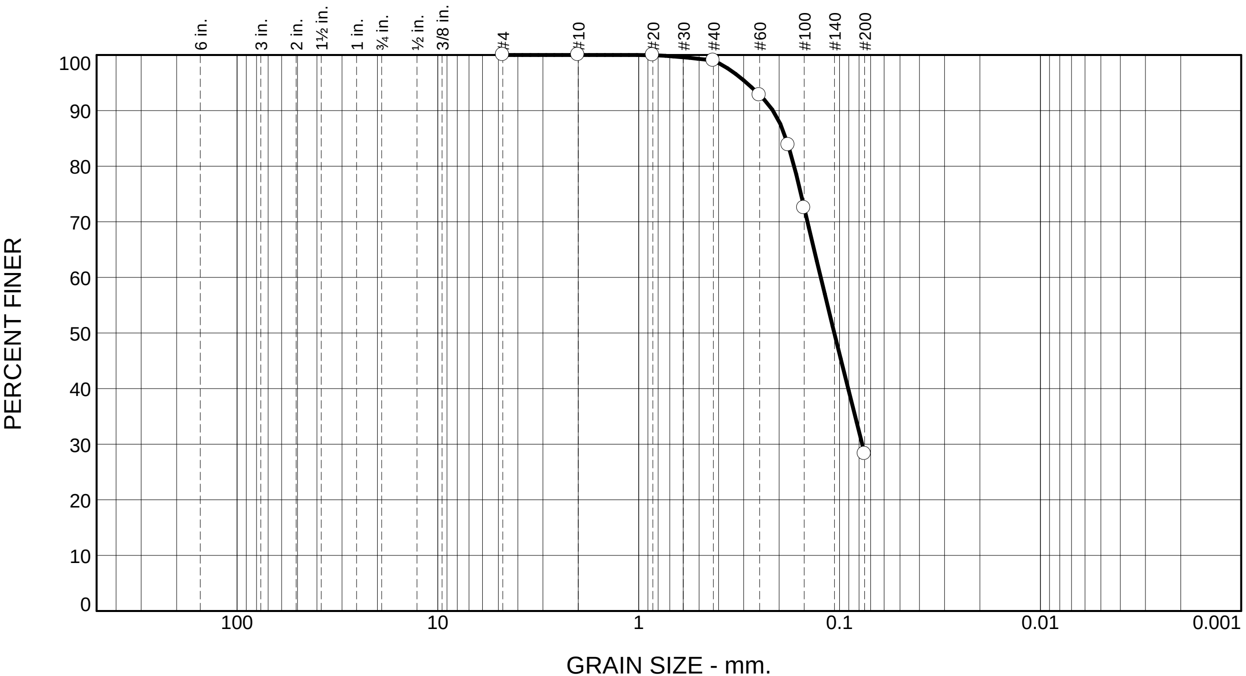
Stu Swenson, CET
Laboratory Manager

AAR TESTING AND INSPECTION, INC.
7126 180th Avenue NE, Suite C101
Redmond, Washington 98188
www.aartesting.com
425.881.5812 | O

SUMMARY TABLE
124TH PARK AND RIDE

AAR SAMPLE ID	SOURCE	GOLDER SAMPLE ID	DEPTH (FT)	MOISTURE CONTENT %	SIEVE ANAYLSIS							SAMPLE DESCRIPTION
					Fines Content	Gravel %	Sand %	D10	D30	D60	D90	
20930	B-01	2	5-10	28	28	0	72		0.077	0.124	0.215	Silty fine sand (SM)
20931	B-01	3B	12-15	30	89	0	11				0.080	Silt with occasional sand (ML)
20932	B-01	4	15-20	27	89	0	11				0.082	Silt with occasional sand (ML)
20933	B-01	5B	22-25	27	7	0	93	0.089	0.157	0.287	0.517	Fine to medium sand with silt (SP-SM)
20934	B-02	2A	5-9	25	23	0	77		0.096	0.173	0.317	Silty fine sand (SM)
20935	B-02	2B	9-10	29	79	0	21				0.113	Silt with sand (ML)
20936	B-02	4	15-20	26	58	0	42			0.079	0.155	Sandy silt (ML)
20937	B-02	5A	20-24	25	41	0	59			0.121	0.215	Silty fine sand (SM)
20938	B-02	6B	27-30	18	16	0	84		0.181	0.332	0.572	Silty fine to medium sand (SM)

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	1	71	28	

TEST RESULTS (ASTM D6913)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100		
#10	100		
#20	100		
#40	99		
#60	93		
#80	84		
#100	73		
#200	28		

* (no specification provided)

Material Description

Silty fine sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=**

Coefficients

D_{90}= 0.2146 D_{85}= 0.1846 D_{60}= 0.1241
D_{50}= 0.1061 D_{30}= 0.0771 D_{15}=
D_{10}= C_u= C_c=

Remarks

As Received Moisture: 28%

Date Received: 01/04/2021 **Date Tested:** 01/11/2021
Tested By: Tama Lewis
Checked By: Stu Swenson, CET
Title: Laboratory Manager

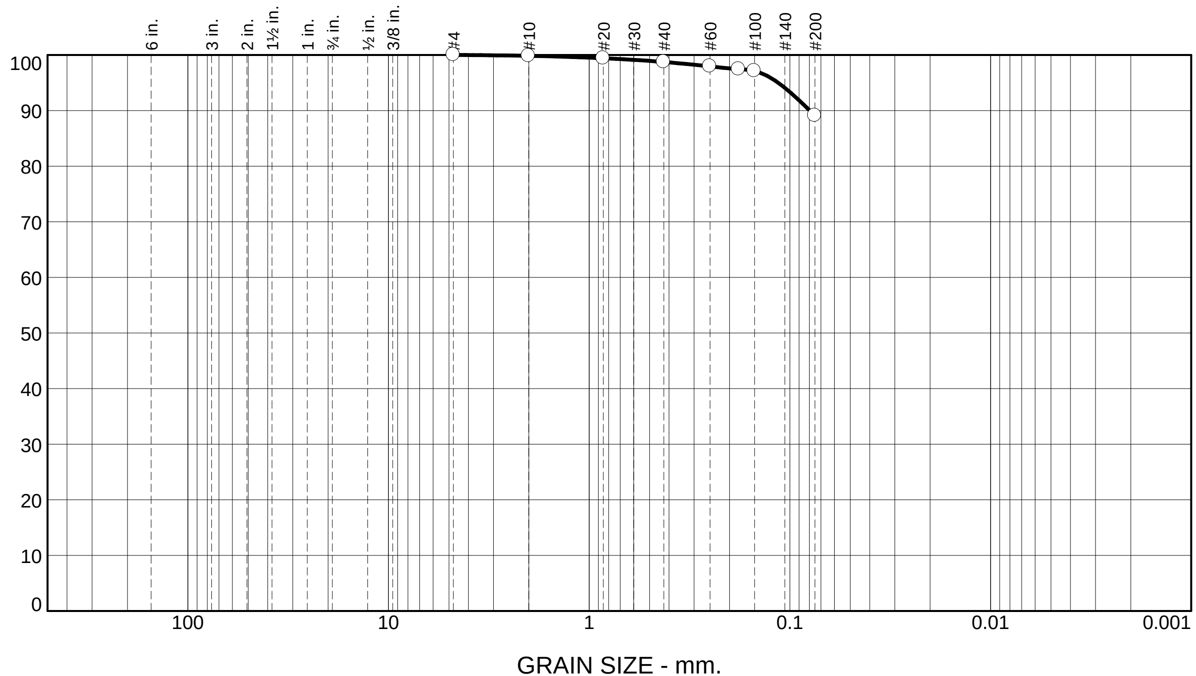
Source of Sample: B-01 S02 **Depth:** 5-10' **Date Sampled:** 12/23/2020
Sample Number: 20930

A.A.R.
Testing
Laboratory, Inc.

Client: Golder Associates; Inc.
Project: 130th Park and Ride

Project No: 20-717 .

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	1	10	89	

TEST RESULTS (ASTM D6913)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100		
#10	100		
#20	99		
#40	99		
#60	98		
#80	97		
#100	97		
#200	89		

* (no specification provided)

Material Description

Silt with occasional sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=**

Coefficients

D_{90}= 0.0796 D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

As Received Moisture: 30%

Date Received: 01/04/2021 **Date Tested:** 01/11/2021
Tested By: Tama Lewis
Checked By: Stu Swenson, CET
Title: Laboratory Manager

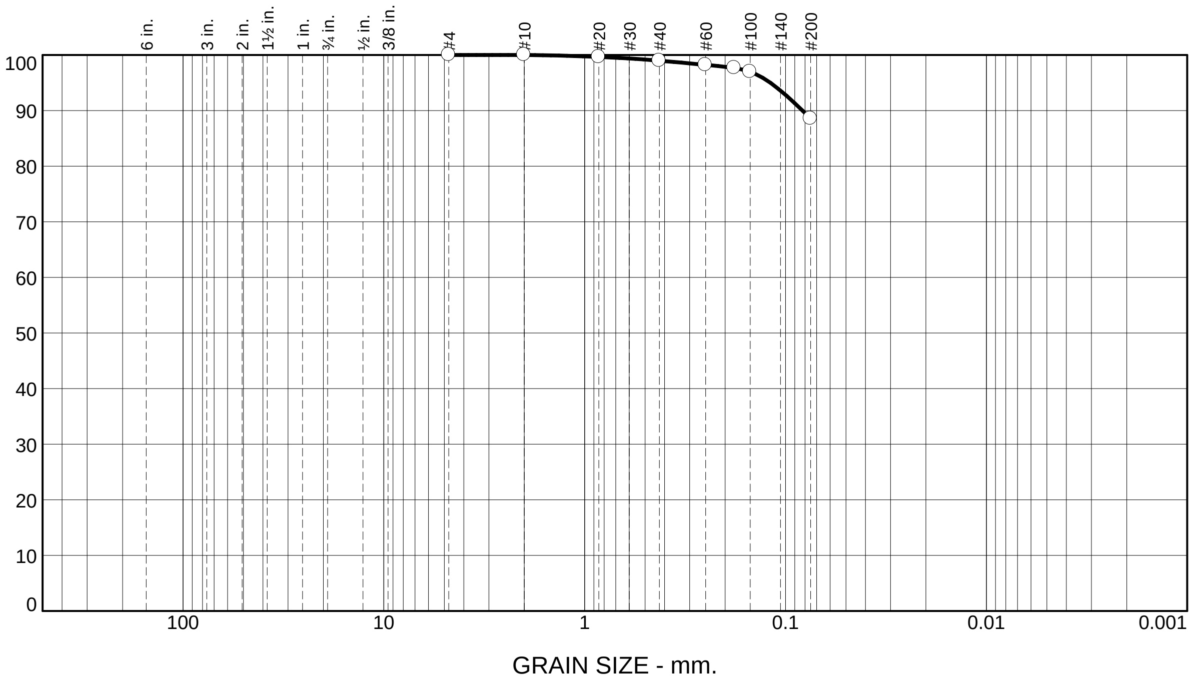
Source of Sample: B-01 S03B **Depth:** 12-15' **Date Sampled:** 12/23/2020
Sample Number: 20931

A.R.
Testing
Laboratory, Inc.

Client: Golder Associates; Inc.
Project: 130th Park and Ride

Project No: 20-717 .

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	1	10	89	

TEST RESULTS (ASTM D6913)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100		
#10	100		
#20	100		
#40	99		
#60	98		
#80	98		
#100	97		
#200	89		

* (no specification provided)

Material Description

Silt with occasional sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=**

Coefficients

D_{90}= 0.0824 D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

As Received Moisture: 27%

Date Received: 01/04/2021 **Date Tested:** 01/11/2021
Tested By: Tama Lewis
Checked By: Stu Swenson, CET
Title: Laboratory Manager

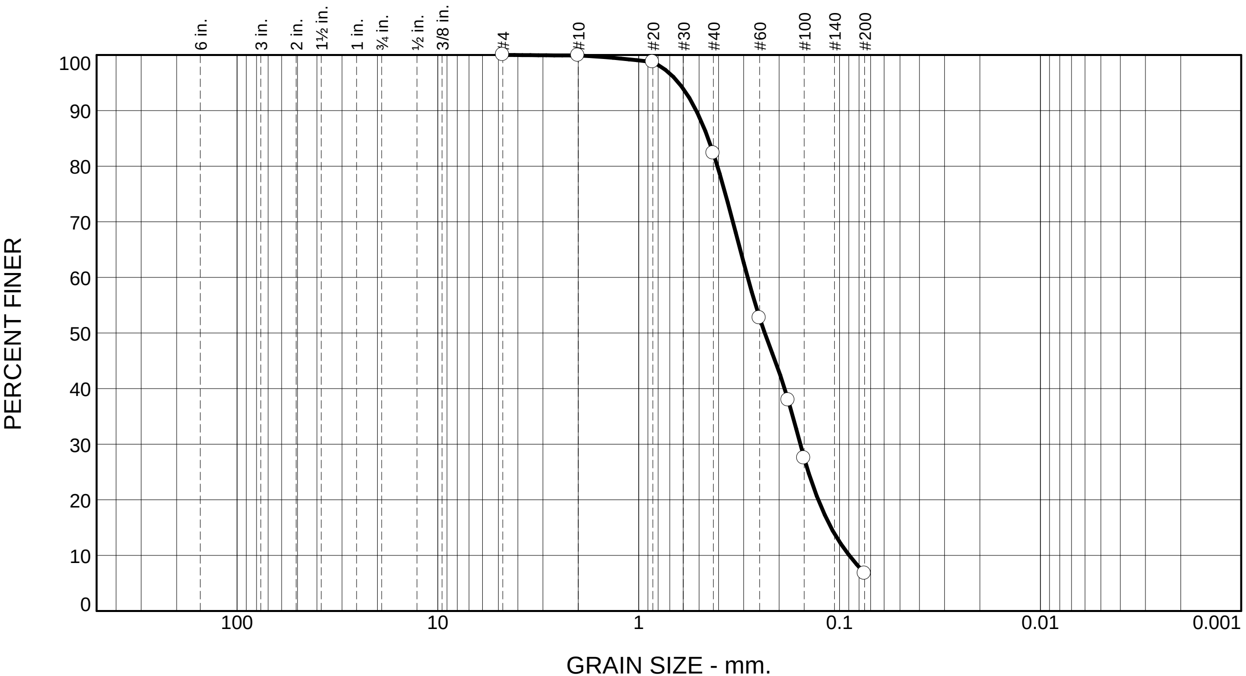
Source of Sample: B-01 S04 **Depth:** 15-20' **Date Sampled:** 12/23/2020
Sample Number: 20932

A.A.R.
Testing
Laboratory, Inc.

Client: Golder Associates; Inc.
Project: 130th Park and Ride

Project No: 20-717 .

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	18	75	7	

TEST RESULTS (ASTM D6913)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100		
#10	100		
#20	99		
#40	82		
#60	53		
#80	38		
#100	27		
#200	6.8		

* (no specification provided)

Material Description

Fine to medium sand with silt

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=**

Coefficients

D_{90}= 0.5169 D_{85}= 0.4511 D_{60}= 0.2868

D_{50}= 0.2358 D_{30}= 0.1568 D_{15}= 0.1102

D_{10}= 0.0894 C_u= 3.21 C_c= 0.96

Remarks

As Received Moisture: 27%

Date Received: 01/04/2021 **Date Tested:** 01/11/2021

Tested By: Tama Lewis

Checked By: Stu Swenson, CET

Title: Laboratory Manager

Source of Sample: B-01 S05B **Depth:** 22-25' **Date Sampled:** 12/23/2020

Sample Number: 20933

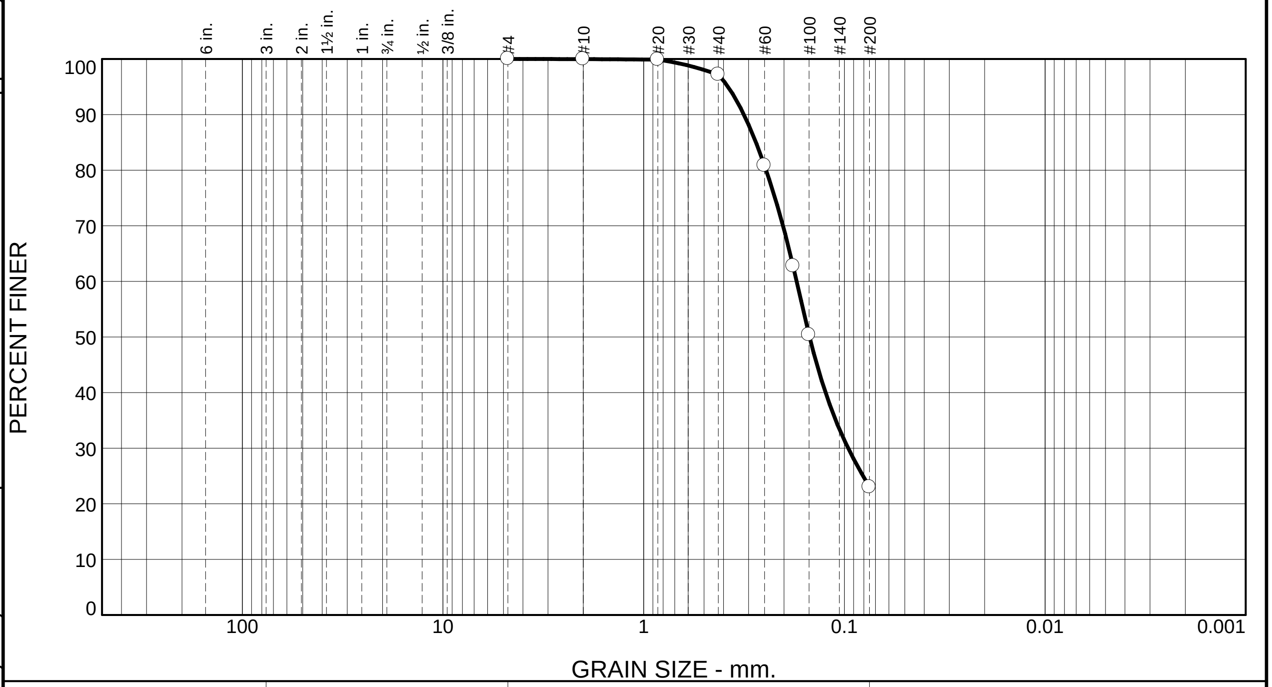
A.A.R.
Testing
Laboratory, Inc.

Client: Golder Associates; Inc.

Project: 130th Park and Ride

Project No: 20-717 .

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	3	74	23	

TEST RESULTS (ASTM D6913)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100		
#10	100		
#20	100		
#40	97		
#60	81		
#80	63		
#100	50		
#200	23		

* (no specification provided)

Material Description

Silty fine sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=**

Coefficients

D_{90}= 0.3168 D_{85}= 0.2759 D_{60}= 0.1728
D_{50}= 0.1491 D_{30}= 0.0957 D_{15}=
D_{10}= C_u= C_c=

Remarks

As Received Moisture: 25%

Date Received: 01/04/2021 **Date Tested:** 01/11/2021
Tested By: Tama Lewis
Checked By: Stu Swenson, CET
Title: Laboratory Manager

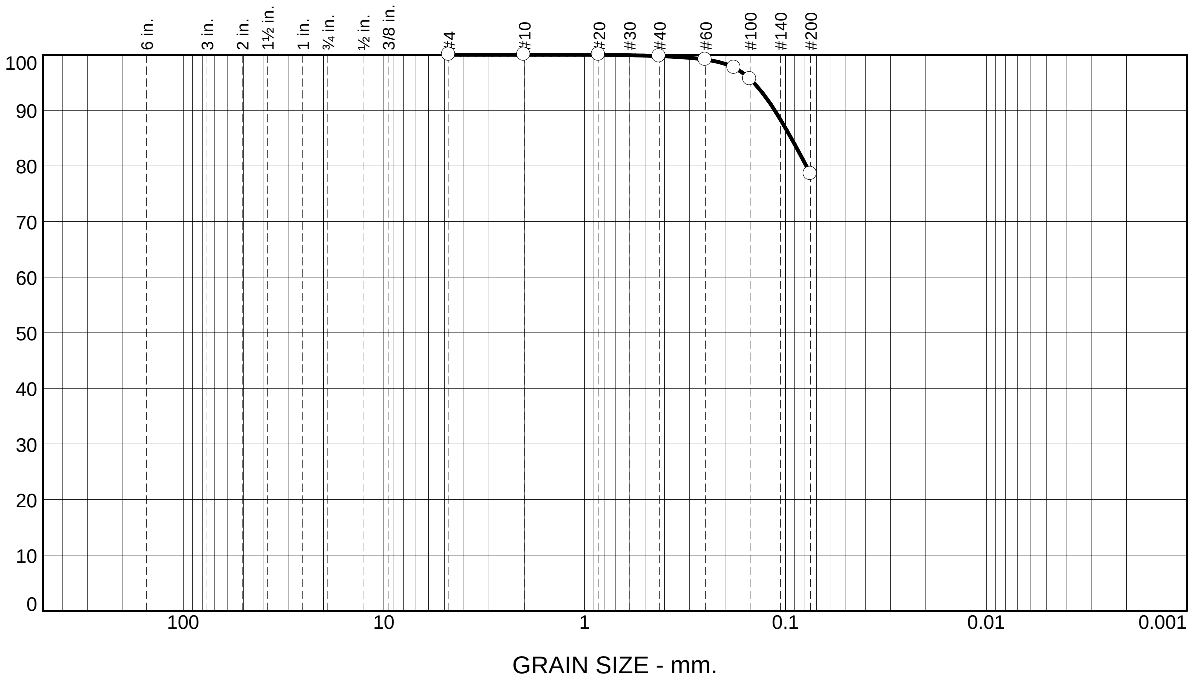
Source of Sample: B-02 S02A **Depth:** 5-9' **Date Sampled:** 12/23/2020
Sample Number: 20934

A.A.R.
Testing
Laboratory, Inc.

Client: Golder Associates; Inc.
Project: 130th Park and Ride

Project No: 20-717 .

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	21	79	

TEST RESULTS (ASTM D6913)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100		
#10	100		
#20	100		
#40	100		
#60	99		
#80	98		
#100	96		
#200	79		

* (no specification provided)

Material Description

Silt with sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=**

Coefficients

D_{90}= 0.1131 **D_{85}=** 0.0936 **D_{60}=**
D_{50}= **D_{30}=** **D_{15}=**
D_{10}= **C_u=** **C_c=**

Remarks

As Received Moisture: 29%

Date Received: 01/04/2021 **Date Tested:** 01/11/2021
Tested By: Tama Lewis
Checked By: Stu Swenson, CET
Title: Laboratory Manager

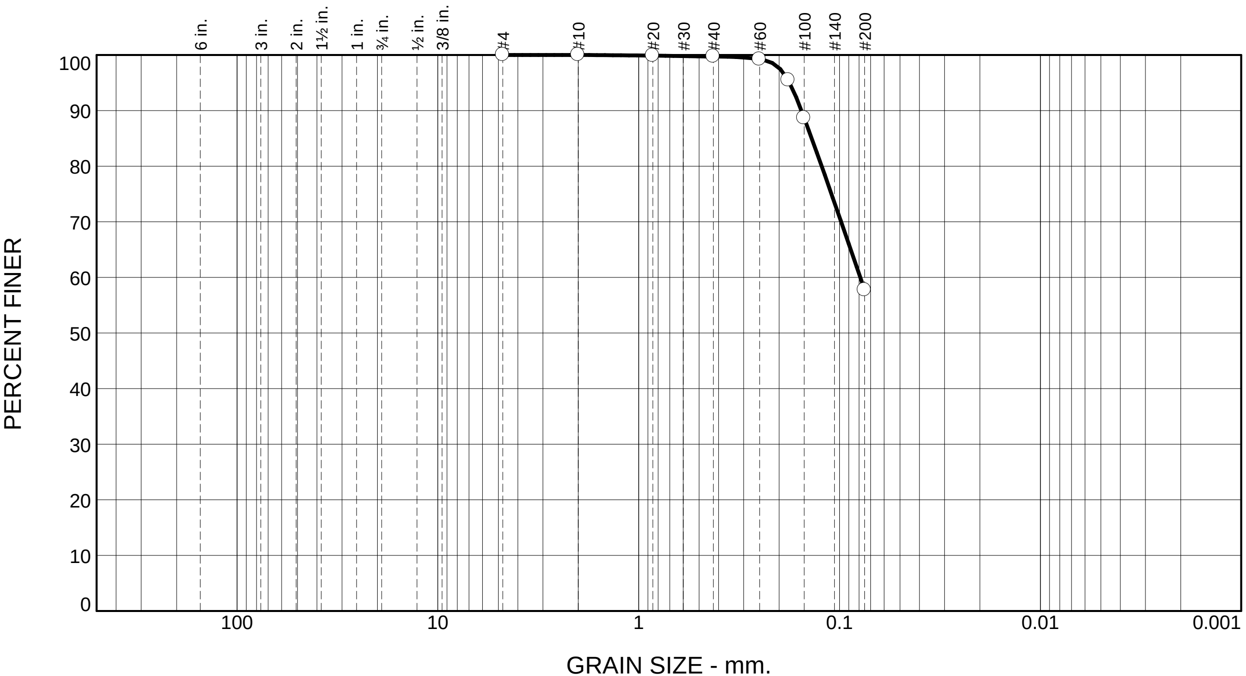
Source of Sample: B-02 S02B **Depth:** 9-10' **Date Sampled:** 12/23/2020
Sample Number: 20935

A.A.R.
Testing
Laboratory, Inc.

Client: Golder Associates; Inc.
Project: 130th Park and Ride

Project No: 20-717 .

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	42	58	

TEST RESULTS (ASTM D6913)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100		
#10	100		
#20	100		
#40	100		
#60	99		
#80	95		
#100	89		
#200	58		

* (no specification provided)

Material Description

Sandy silt

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=**

Coefficients

D_{90}= 0.1549 D_{85}= 0.1377 D_{60}= 0.0788
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

As Received Moisture: 26%

Date Received: 01/04/2021 **Date Tested:** 01/11/2021
Tested By: Tama Lewis
Checked By: Stu Swenson, CET
Title: Laboratory Manager

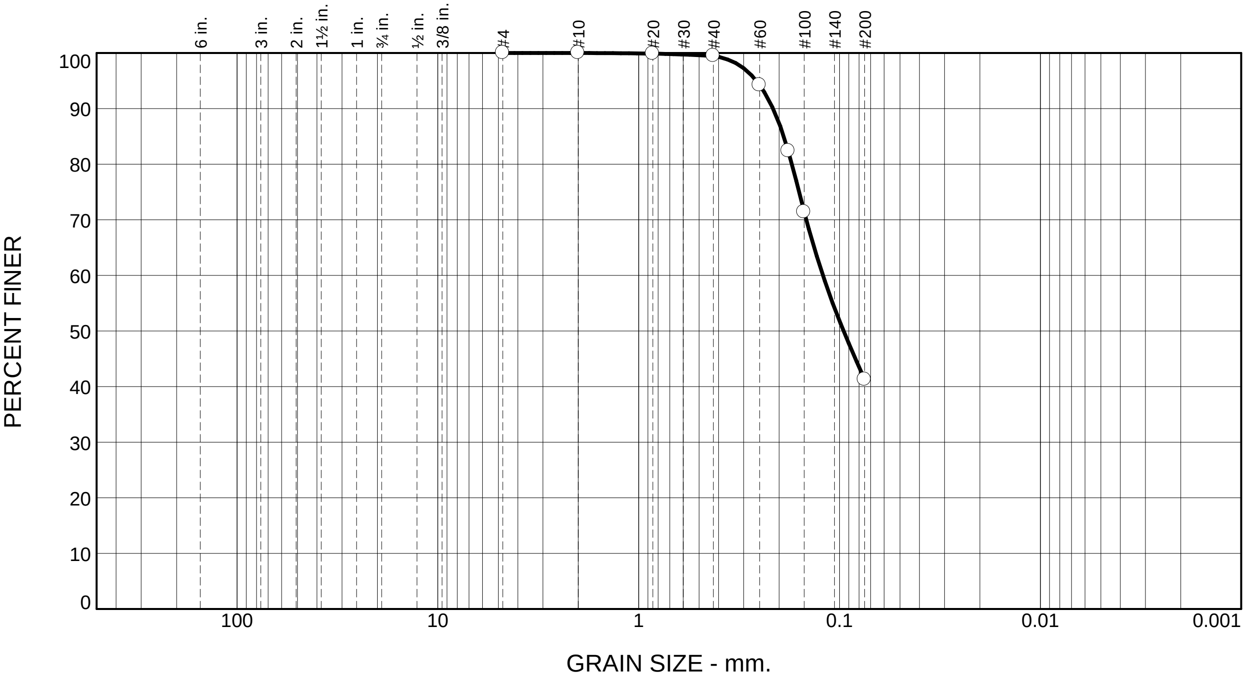
Source of Sample: B-02 S04 **Depth:** 15-20' **Date Sampled:** 12/23/2020
Sample Number: 20936

**A.A.R.
Testing
Laboratory, Inc.**

Client: Golder Associates; Inc.
Project: 130th Park and Ride

Project No: 20-717 .

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	1	58	41	

TEST RESULTS (ASTM D6913)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100		
#10	100		
#20	100		
#40	99		
#60	94		
#80	82		
#100	71		
#200	41		

* (no specification provided)

Material Description

Silty fine sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=**

Coefficients

D_{90}= 0.2145	D_{85}= 0.1895	D_{60}= 0.1210
D_{50}= 0.0954	D_{30}=	D_{15}=
D_{10}=	C_u=	C_c=

Remarks

As Received Moisture: 25%

Date Received: 01/04/2021 **Date Tested:** 01/11/2021

Tested By: Tama Lewis

Checked By: Stu Swenson, CET

Title: Laboratory Manager

Source of Sample: B-02 S05A **Depth:** 20-24' **Date Sampled:** 12/23/2020

Sample Number: 20937

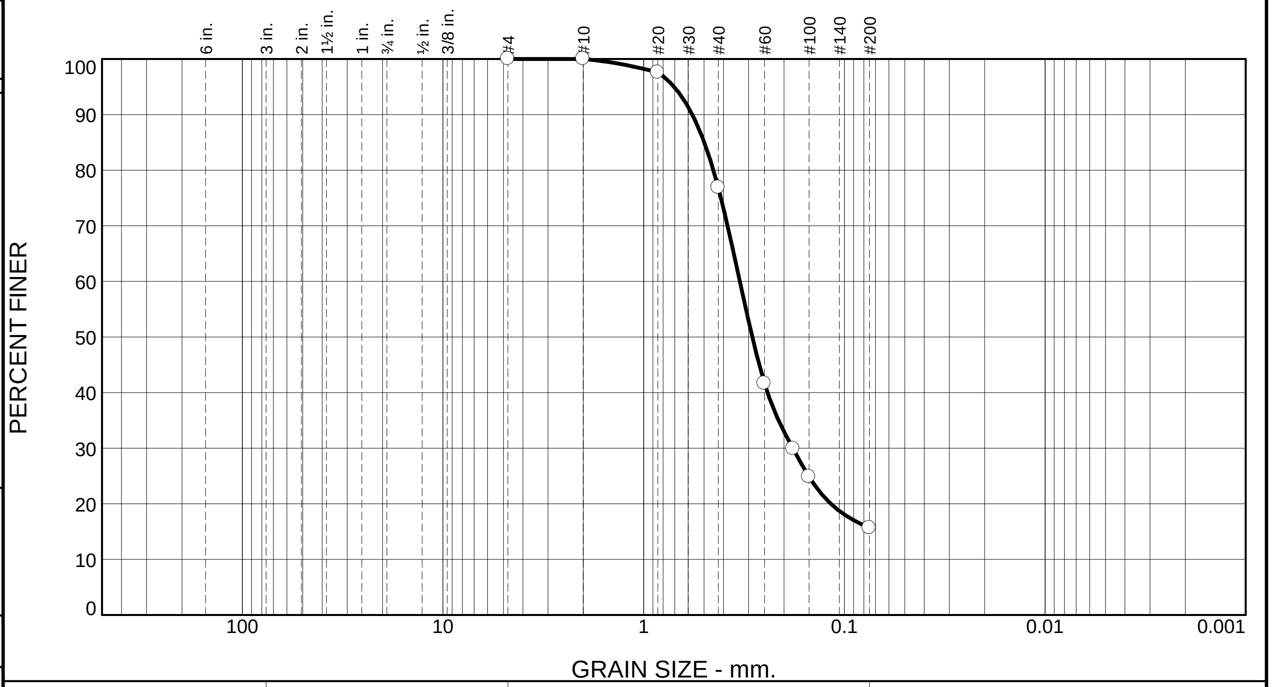
**A.A.R.
Testing
Laboratory, Inc.**

Client: Golder Associates; Inc.

Project: 130th Park and Ride

Project No: 20-717 .

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	23	61	16	

TEST RESULTS (ASTM D6913)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100		
#10	100		
#20	98		
#40	77		
#60	42		
#80	30		
#100	25		
#200	16		

* (no specification provided)

Material Description

Silty fine to medium sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=**

Coefficients

D_{90}= 0.5720	D_{85}= 0.4990	D_{60}= 0.3317
D_{50}= 0.2876	D_{30}= 0.1806	D_{15}=
D_{10}=	C_u=	C_c=

Remarks

As Received Moisture: 18%

Date Received: 01/04/2021 **Date Tested:** 01/11/2021

Tested By: Tama Lewis

Checked By: Stu Swenson, CET

Title: Laboratory Manager

Source of Sample: B-02 S06B **Depth:** 27-30' **Date Sampled:** 12/23/2020

Sample Number: 20938

A.A.R.
Testing
Laboratory, Inc.

Client: Golder Associates; Inc.

Project: 130th Park and Ride

Project No: 20-717 .

APPENDIX D

Historic Boreholes

RECORD OF BOREHOLE E340-B-019

SHEET 1 of 5

PROJECT: Sound Transit East Link/WA
PROJECT NUMBER: 113-93533.0320
LOCATION: 130th AVE NE and NE 15th Pl

DRILLING METHOD: Mud Rotary
DRILLING DATE: 2/22/2013
DRILL RIG: B-60 Mobile Drill Truck

DATUM: Sound Transit East Coordinate System
COORDINATES: N: 558,712.25 E: 1,639,657.32

ELEVATION: 190.04
INCLINATION: -90
WELL TAG#:BHU516

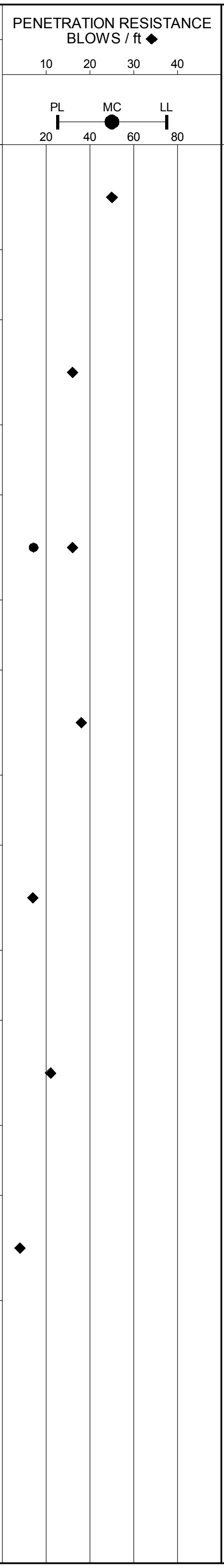
BORING METHOD: 6.0-inch Diameter Bit, Mud Rotary

DEPTH (Ft): 0, 5, 10, 15, 20

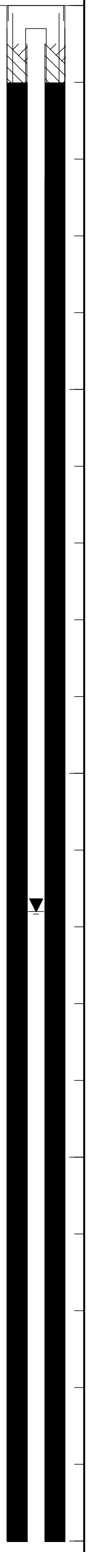
SOIL PROFILE			
DESCRIPTION	USCS	ELEV.	DEPTH (Ft)
0.0 - 0.4 Asphalt Pavement.		189.6	0.4
0.4 - 2.0 Compact, brown, (SM), moist, gravelly, silty, fine to coarse SAND and Asphalt, [FILL, Hf].	SM	188.0	2.0
2.0 - 12.0 Loose to compact, brown, (SP-SM), moist, fine to coarse SAND, some gravel, little silt, [RECESSIONAL OUTWASH, Qvro].	SP-SM	178.0	12.0
12.0 - 16.5 Loose to compact, brown, (SP), wet, fine to coarse SAND, little gravel, trace silt, [RECESSIONAL OUTWASH, Qvro].	SP	173.5	16.5
16.5 - 21.0 Dense, gray, (SP-SM), wet, fine to coarse SAND, little silt and gravel, fine organics, [RECESSIONAL OUTWASH, Qvro].	SP-SM		

Log continued on next page

SAMPLES					NOTES WATER LEVELS
NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	
S-1	SS	25-15-10	25	0.8 / 1.5	8-inch diameter flush mount steel monument, cemented to 1 ft bgs. 2-inch diameter PVC riser from 0.3 to 78 ft bgs. Backfilled with bentonite chips from 1 to 75 ft bgs.
S-2	SS	4-7-9	16	0.8 / 1.5	
S-3	SS	5-10-6	16	0.8 / 1.5	S-3@5ft %G-14.1 %S-74.2 %F-11.7
S-4	SS	6-11-7	18	1.0 / 1.5	
S-5	SS	8-4-3	7	0.0 / 1.5	No recovery Sample S-5 at 10 ft bgs.
S-6	SS	7-6-5	11	0.4 / 1.5	
S-7	SS	4-2-2	4	0.2 / 1.5	



WELL INSTALLATION



Groundwater measured 11.8 ft bgs on 4/18/2013.

1 in to 3 ft
DRILLING CONTRACTOR: Holt Services Inc.
DRILLER: Derek Patsey

LOGGED: Mike Wolczko
CHECKED: David P. Findley
DATE: 10/14/2013

FINAL DESIGN PARTNERS.

RECORD OF BOREHOLE E340-B-019

SHEET 2 of 5

PROJECT: Sound Transit East Link/WA
PROJECT NUMBER: 113-93533.0320
LOCATION: 130th AVE NE and NE 15th Pl
DRILLING METHOD: Mud Rotary
DRILLING DATE: 2/22/2013
DRILL RIG: B-60 Mobile Drill Truck
DATUM: Sound Transit East Coordinate System
COORDINATES: N: 558,712.25 E: 1,639,657.32
ELEVATION: 190.04
INCLINATION: -90
WELL TAG#:BHU516

DEPTH (Ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (Ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	NOTES WATER LEVELS / WELL INSTALLATION
20	6.0-inch Diameter Bit, Mud Rotary	16.5 - 21.0 Dense, gray, (SP-SM), wet, fine to coarse SAND, little silt and gravel, fine organics, [RECESSIONAL OUTWASH, Qvro].	SP-SM	169.0 21.0	S-8	SS	11-20-20	40	1.2 / 1.5	
		21.0 - 30.2 Hard, gray to greenish gray, (ML), wet, sandy, clayey SILT, some fine micaceous particles, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl].	ML							
25					S-9	SS	10-19-20	39	1.5 / 1.5	S-9@25ft %G-0.0 %S-27.5 %F-72.5
30				159.8 30.2	S-10	SS	50/6"	>50	0.3 / 0.5	>> Gravelly drilling from 30 to 43 ft bgs.
		30.2 - 33.0 Very dense, gray, (SM), moist, gravelly, silty, fine to coarse SAND, diamict structure, [TILL, Qvt].	SM	157.0 33.0						
		33.0 - 38.0 Very dense, gray, (GM), wet, sandy, silty GRAVEL, [TILL, Qvt].	GM							
35					S-11	SS	6-29-50/4"	>50	0.5 / 1.3	>>
				152.0 38.0						
		38.0 - 43.0 Very dense, gray, (GP), wet, GRAVEL, [PRE-VASHON FLUVIAL DEPOSITS, Qpnf].	GP							
40										

PENETRATION RESISTANCE BLOWS / ft ◆ (10, 20, 30, 40); PL, MC ●, LL (20, 40, 60, 80)

Log continued on next page

1 in to 3 ft
DRILLING CONTRACTOR: Holt Services Inc.
DRILLER: Derek Patsey
LOGGED: Mike Wolczko
CHECKED: David P. Findley
DATE: 10/14/2013

FINAL DESIGN PARTNERS.

RECORD OF BOREHOLE E340-B-019

SHEET 3 of 5

PROJECT: Sound Transit East Link/WA
PROJECT NUMBER: 113-93533.0320
LOCATION: 130th AVE NE and NE 15th Pl
DRILLING METHOD: Mud Rotary
DRILLING DATE: 2/22/2013
DRILL RIG: B-60 Mobile Drill Truck
DATUM: Sound Transit East Coordinate System
COORDINATES: N: 558,712.25 E: 1,639,657.32
ELEVATION: 190.04
INCLINATION: -90
WELL TAG#:BHU516

DEPTH (Ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (Ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ◆ (10 20 30 40); PL MC LL (20 40 60 80)	NOTES WATER LEVELS / WELL INSTALLATION
40	6.0-inch Diameter Bit, Mud Rotary	38.0 - 43.0 Very dense, gray, (GP), wet, GRAVEL, [PRE-VASHON FLUVIAL DEPOSITS, Qpnf].	GP	147.0 43.0	S-12	SS	12-20-50/6"	>50	0.3 / 1.5	>>◆	
		43.0 - 45.1 Very dense, greenish gray, (ML), moist to wet, sandy SILT, [PRE-VASHON FLUVIAL DEPOSITS, Qpnf].	ML	144.9 45.1							Smoother drilling at 43 ft bgs.
45		45.1 - 48.0 Very dense, gray, (SP), moist to wet, fine to coarse SAND, [PRE-VASHON FLUVIAL DEPOSITS, Qpnf].	SP	142.0 48.0	S-13	SS	4-29-41	>50	0.8 / 1.5	>>◆	
50		48.0 - 53.0 Very dense, gray, (SP-SM), wet, fine to medium SAND, little silt, piece of wood and fibrous peat, fine micaceous particles, [PRE-VASHON FLUVIAL DEPOSITS, Qpnf].	SP-SM	137.0 53.0	S-14	SS	12-25-28	>50	0.8 / 1.5	>>◆	
55		53.0 - 56.0 Very dense, gray, (SM), wet, silty, fine to coarse SAND, trace fine organics, piece of wood, [PRE-VASHON FLUVIAL DEPOSITS, Qpnf].	SM	134.0 56.0	S-15	SS	22-43-48	>50	1.2 / 1.5	● >>◆	S-15@55ft %G-0.3 %S-71.2 %F-28.5
		56.0 - 58.0 Very dense, gray, (SP), wet, fine to coarse SAND, [PRE-VASHON FLUVIAL DEPOSITS, Qpnf].	SP	132.0 58.0							
60		58.0 - 90.8 Very dense, gray, (GP), wet, sandy GRAVEL, trace silt, [PRE-VASHON FLUVIAL DEPOSITS, Qpnf].	GP								Gravelly drilling from 58 to 90 ft bgs.

Log continued on next page

1 in to 3 ft
DRILLING CONTRACTOR: Holt Services Inc.
DRILLER: Derek Patsey
LOGGED: Mike Wolczko
CHECKED: David P. Findley
DATE: 10/14/2013

FINAL DESIGN PARTNERS.

RECORD OF BOREHOLE E340-B-019

SHEET 4 of 5

PROJECT: Sound Transit East Link/WA
PROJECT NUMBER: 113-93533.0320
LOCATION: 130th AVE NE and NE 15th Pl
DRILLING METHOD: Mud Rotary
DRILLING DATE: 2/22/2013
DRILL RIG: B-60 Mobile Drill Truck
DATUM: Sound Transit East Coordinate System
COORDINATES: N: 558,712.25 E: 1,639,657.32
ELEVATION: 190.04
INCLINATION: -90
WELL TAG#:BHU516

DEPTH (Ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (Ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ◆ (10 20 30 40); PL MC LL (20 40 60 80)	NOTES WATER LEVELS / WELL INSTALLATION
60	6.0-inch Diameter Bit, Mud Rotary	58.0 - 90.8 Very dense, gray, (GP), wet, sandy GRAVEL, trace silt, [PRE-VASHON FLUVIAL DEPOSITS, Qpnf].				S-16	SS	66/6"	>50	0.2 / 0.5	>>◆	
65						S-17	SS	16-57/6"	>50	1.0 / 1.0	>>◆	
70			GP			S-18	SS	60/6"	>50	0.3 / 0.5	>>◆	
75						S-19	SS	50/4"	>50	0.1 / 0.3	>>◆	Backfilled with 10x20 silica sand from 75 to 88 ft bgs. Very poor recovery Sample S-19 at 75 ft bgs.
												2-inch diameter 0.010 slotted PVC with cap from 78 to 88 ft bgs.
80		Log continued on next page										

1 in to 3 ft
DRILLING CONTRACTOR: Holt Services Inc.
DRILLER: Derek Patsey

LOGGED: Mike Wolczko
CHECKED: David P. Findley
DATE: 10/14/2013

FINAL DESIGN PARTNERS.

RECORD OF BOREHOLE E340-B-019

SHEET 5 of 5

PROJECT: Sound Transit East Link/WA
PROJECT NUMBER: 113-93533.0320
LOCATION: 130th AVE NE and NE 15th Pl
DRILLING METHOD: Mud Rotary
DRILLING DATE: 2/22/2013
DRILL RIG: B-60 Mobile Drill Truck
DATUM: Sound Transit East Coordinate System
COORDINATES: N: 558,712.25 E: 1,639,657.32
ELEVATION: 190.04
INCLINATION: -90
WELL TAG#:BHU516

DEPTH (Ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (Ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	PENETRATION RESISTANCE BLOWS / ft ◆ 10 20 30 40; PL MC LL 20 40 60 80	NOTES WATER LEVELS WELL INSTALLATION
80	6.0-inch Diameter Bit, Mud Rotary	58.0 - 90.8 Very dense, gray, (GP), wet, sandy GRAVEL, trace silt, [PRE-VASHON FLUVIAL DEPOSITS, Qpnf].				S-20	SS	9-54/6"	>50	0.3/1.0	>>◆	
85			GP			S-21	SS	50/4"	>50	0.2/0.3	>>◆	
												Slough at bottom of hole.
90					99.2	S-22	SS	16-50/4"	>50	0.3/0.8	>>◆	
		Borehole completed at 90.8 ft.			90.8							
95												
100												

1 in to 3 ft
DRILLING CONTRACTOR: Holt Services Inc.
DRILLER: Derek Patsey

LOGGED: Mike Wolczko
CHECKED: David P. Findley
DATE: 10/14/2013

FINAL DESIGN PARTNERS.

RECORD OF BOREHOLE E340-B-020

SHEET 1 of 3

PROJECT: Sound Transit East Link/WA
PROJECT NUMBER: 113-93533.0320
LOCATION: 1625 132nd Ave NE
DRILLING METHOD: Hollow Stem Auger
DRILLING DATE: 3/4/2013
DRILL RIG: B-59 Mobile Drill Truck
DATUM: Sound Transit East Coordinate System
COORDINATES: N: 558,718.77 E: 1,640,163.97
ELEVATION: 193.85
INCLINATION: -90

BORING METHOD: 4.25-inch Inner Diameter Hollow Stem Auger

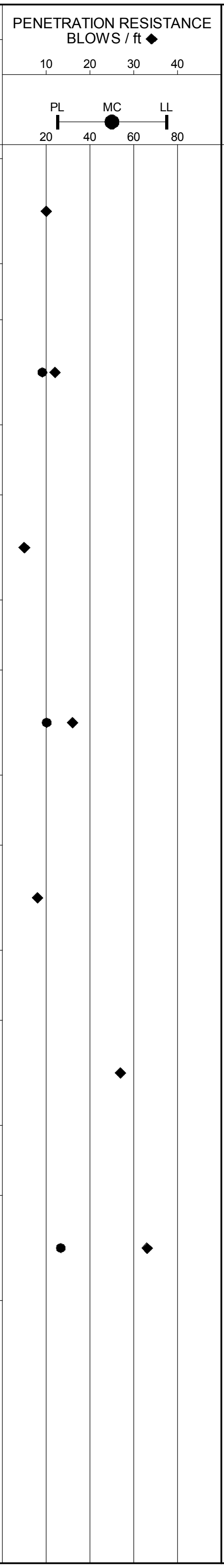
SOIL PROFILE

DEPTH (Ft)	DESCRIPTION	USCS	ELEV. / DEPTH (Ft)
0.0 - 0.2	Asphalt Pavement.		
0.2 - 0.5	Loose to compact, brown, (GP-GM), moist, fine to coarse GRAVEL, some sand, little silt, 1-1/4 in minus crushed rock, [FILL, Hf].	GP-GM	193.4 0.5
0.5 - 3.0	Stiff, dark gray, (ML), moist, low plasticity SILT, little sand, little fine gravel, trace organic material, [FILL, Hf].	ML	190.9 3.0
3.0 - 7.5	Loose to compact, mottled light gray and reddish yellow, (SM), moist, fine to coarse SAND and clayey SILT, little fine gravel, trace organic material, [FILL, Hf].	SM	186.4 7.5
7.5 - 13.5	Loose to compact, grayish brown, (SM/SP-SM), moist to wet, fine to medium SAND, little to some silt, rhythmic color stratification, horizontal oxidized layers, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl]. 1/2-inch thick layer of reddish brown silt at about 11 ft bgs.	SM /SP-SM	180.4 13.5
13.5 - 22.5	Hard, gray, (ML), moist, low plasticity SILT and fine SAND, interbedded, rhythmic dark gray stratification, trace organics, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl].	ML	

Log continued on next page

SAMPLES

NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	NOTES WATER LEVELS
S-1	SS	6-5-5	10	1.2 / 1.5	
S-2	SS	6-4-8	12	1.5 / 1.5	S-2@2.5ft %G-8.8 %S-46.6 %F-44.6
S-3	SS	1-2-3	5	0.7 / 1.5	
S-4	SS	5-6-10	16	1.2 / 1.5	S-4@7.5ft %G-0.0 %S-87.3 %F-12.7 Wet soil sampled at 7.5 ft bgs.
S-5	SS	3-3-5	8	0.6 / 1.5	
S-6	SS	3-12-15	27	1.5 / 1.5	Cuttings wet at 12.5 ft bgs.
S-7	SS	3-12-21	33	1.2 / 1.5	S-7@15ft %G-0.0 %S-30.2 %F-69.8 Groundwater measured 15.1 ft bgs with 30 ft of auger in the ground.



1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling Inc.
DRILLER: Dave Puckett
LOGGED: Jeff Schwartz
CHECKED: David P. Findley
DATE: 10/14/2013

RECORD OF BOREHOLE E340-B-020

SHEET 2 of 3

PROJECT: Sound Transit East Link/WA
PROJECT NUMBER: 113-93533.0320
LOCATION: 1625 132nd Ave NE
DRILLING METHOD: Hollow Stem Auger
DRILLING DATE: 3/4/2013
DRILL RIG: B-59 Mobile Drill Truck
DATUM: Sound Transit East Coordinate System
COORDINATES: N: 558,718.77 E: 1,640,163.97
ELEVATION: 193.85
INCLINATION: -90

DEPTH (Ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (Ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ◆ (10 20 30 40) PL MC LL (20 40 60 80)	NOTES WATER LEVELS
20	4.25-inch Inner Diameter Hollow Stem Auger	13.5 - 22.5 Hard, gray, (ML), moist, low plasticity SILT and fine SAND, interbedded, rhythmic dark gray stratification, trace organics, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl].	ML	171.4	S-8	SS	7-12-21	33	1.5 / 1.5	◆	
25		22.5 - 27.5 Dense/hard, gray, (SM/ML), wet, silty, fine SAND and sandy SILT, low plasticity, interbedded, trace fine gravel, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl].	SM /ML	22.5 166.4	S-9	SS	9-17-21	38	1.5 / 1.5	◆	
30		27.5 - 31.0 Compact, gray, (SP-SM), wet, fine SAND, little silt, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl].	SP-SM	27.5 162.9	S-10	SS	3-5-20	25	1.3 / 1.5	◆	3-inches of heave observed in top of Sample S-10 at 30 ft bgs. Gravel observed in bottom of Sample S-10 at 30 ft bgs.
		31.0 - 33.0 Compact, gray, (SP), wet, fine to medium SAND, trace silt, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl].	SP	31.0 160.9							
35		33.0 - 38.0 Very dense, gray, (GP), wet, fine to coarse GRAVEL, some sand, trace silt, [RECESSIONAL OUTWASH, Qvro]. Some cobbles at 35 ft bgs.	GP	33.0 155.9	S-11	SS	23-50/4"	>50	0.3 / 0.8	>>◆	Rock in sampler, blow counts may not be representative, Sample S-11 at 35 ft bgs. Very hard drilling from 35 to 40 ft bgs.
40		38.0 - 42.5 Very dense, gray, (GM), wet, fine to coarse GRAVEL and fine to coarse SAND, some cobbles, some silt, [RECESSIONAL OUTWASH, Qvro].	GM	38.0							

Log continued on next page

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling Inc.
DRILLER: Dave Puckett
LOGGED: Jeff Schwartz
CHECKED: David P. Findley
DATE: 10/14/2013

FINAL DESIGN PARTNERS.

RECORD OF BOREHOLE E340-B-020

SHEET 3 of 3

PROJECT: Sound Transit East Link/WA
PROJECT NUMBER: 113-93533.0320
LOCATION: 1625 132nd Ave NE
DRILLING METHOD: Hollow Stem Auger
DRILLING DATE: 3/4/2013
DRILL RIG: B-59 Mobile Drill Truck
DATUM: Sound Transit East Coordinate System
COORDINATES: N: 558,718.77 E: 1,640,163.97
ELEVATION: 193.85
INCLINATION: -90

DEPTH (Ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (Ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ◆ (10 20 30 40); PL MC LL (20 40 60 80)	NOTES WATER LEVELS
40	4.25-inch Inner Diameter Hollow Stem Auger	38.0 - 42.5 Very dense, gray, (GM), wet, fine to coarse GRAVEL and fine to coarse SAND, some cobbles, some silt, [RECESSIONAL OUTWASH, Qvro].	GM		151.4 42.5	S-12	SS	11-45-50/3"	>50	0.8 / 1.3	● >>◆	S-12@40ft %G-44.3 %S-43.6 %F-12.1
45		42.5 - 50.0 Very dense, gray, (GP), wet, fine to coarse GRAVEL and SAND, some cobbles, trace silt, [TILL, Qvt].	GP		143.9 50.0	S-13	SS	23-50/5"	>50	0.9 / 0.9	>>◆	
50		50.0 - 51.0 Very dense, gray, (GP-GM), wet, fine to coarse GRAVEL and fine to coarse SAND, little silt and cobbles, [TILL, Qvt].	GP-GM		142.9 51.0	S-14	SS	10-50/6"	>50	1.0 / 1.0	>>◆	3-inch diameter sampler driven after Sample S-14 at 50 ft bgs for sample recovery.
55		Borehole completed at 51.0 ft. Backfilled with 3/8-inch bentonite chips.										
60												

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling Inc.
DRILLER: Dave Puckett

LOGGED: Jeff Schwartz
CHECKED: David P. Findley
DATE: 10/14/2013

FINAL DESIGN PARTNERS.

RECORD OF BOREHOLE E340-B-022

SHEET 1 of 1

PROJECT: Sound Transit East Link/WA
PROJECT NUMBER: 113-93533.0320
LOCATION: 1625 132nd Ave NE

DRILLING METHOD: Hollow Stem Auger
DRILLING DATE: 3/4/2013
DRILL RIG: B-59 Mobile Drill Truck

DATUM: Sound Transit East Coordinate System
COORDINATES: N: 558,790.48 E: 1,640,129.82

ELEVATION: 193.62
INCLINATION: -90
WELL TAG#:BHU162

BORING METHOD: 4.25-inch Inner Diameter Hollow Stem Auger

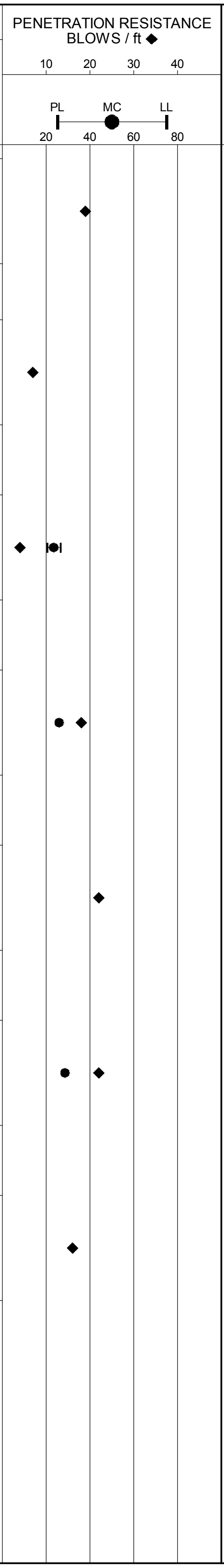
SOIL PROFILE

DESCRIPTION	USCS	ELEV. DEPTH (Ft)
0.0 - 0.2 Asphalt Pavement.		
0.2 - 0.5 Compact, brown, (GP-GM), moist, fine to coarse GRAVEL and SAND, little silt, 1-1/4 inch minus crushed rock, [FILL, Hf].	GP-GM	193.1 0.5
0.5 - 2.0 Compact, brown, (SP-SM), moist, fine to coarse SAND and fine GRAVEL, little silt, [FILL, Hf].	SP-SM	191.6 2.0
2.0 - 4.5 Loose, dark brown, (ML), moist, SILT, some fine to medium sand, little to some fine roots and organics, [Buried Topsoil Horizon].	ML	189.1 4.5
4.5 - 7.0 Soft to firm, greenish gray some brown mottling, (CL-ML), moist, silty CLAY, low plasticity, some fine to medium sand, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl].	CL-ML	186.6 7.0
7.0 - 9.5 Compact, yellowish brown, (SM), moist, fine to medium SAND and SILT, horizontal rhythmic stratification, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl].	SM	184.1 9.5
9.5 - 12.0 Compact, grayish brown, (SP-SM), wet, fine SAND, little silt, rhythmic stratification, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl].	SP-SM	181.6 12.0
12.0 - 14.5 Compact, brown, (ML), wet, interbedded, low plasticity SILT and fine to coarse SAND, some rhythmic oxidized laminations, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl].	ML	179.1 14.5
14.5 - 15.5 Compact, gray, (ML), moist, low plasticity SILT and fine SAND, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl].	ML	178.1 15.5
15.5 - 16.5 Compact, gray, (SM), moist to wet, silty, fine SAND and SILT, organic lenses, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl].	SM	177.1 16.5

Borehole completed at 16.5 ft.

SAMPLES

NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT
S-1	SS	8-8-11	19	1.5 1.5
S-2	SS	6-2-5	7	0.5 1.5
S-3	SS	5-2-2	4	0.8 1.5
S-4	SS	4-7-11	18	0.8 1.5
S-5	SS	3-9-13	22	0.8 1.5
S-6	SS	4-7-15	22	1.5 1.5
S-7	SS	3-5-11	16	0.7 1.5



NOTES WATER LEVELS

8-inch diameter flush mount monument, cemented to 2 ft bgs.

2-inch diameter PVC riser from 0.4 to 5 ft bgs.

Backfilled with bentonite chips from 2 to 3 ft bgs.

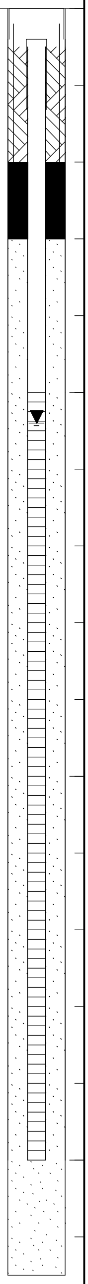
Backfilled with 10x20 silica sand from 3 to 16.5 ft bgs.

2-inch diameter 0.010 slotted PVC from 5 to 15 ft bgs.
Groundwater measured 5.5 ft bgs on 3/11/2013.

S-4@7.5ft
%G-0.3
%S-66.7
%F-33.0

S-6@12.5ft
%G-0.0
%S-32.7
%F-67.3

WELL INSTALLATION



Groundwater measured 5.4 ft bgs on 4/22/2013.

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling Inc.
DRILLER: Dave Puckett

LOGGED: Jeff Schwartz
CHECKED: David P. Findley
DATE: 10/14/2013

FINAL DESIGN PARTNERS.

RECORD OF BOREHOLE E340-B-023

SHEET 1 of 1

PROJECT: Sound Transit East Link/WA
PROJECT NUMBER: 113-93533.0320
LOCATION: 1606 130th Ave NE

DRILLING METHOD: Hollow Stem Auger
DRILLING DATE: 3/6/2013
DRILL RIG: B-59 Mobile Drill Truck

DATUM: Sound Transit East Coordinate System
COORDINATES: N: 558,869.09 E: 1,639,684.3

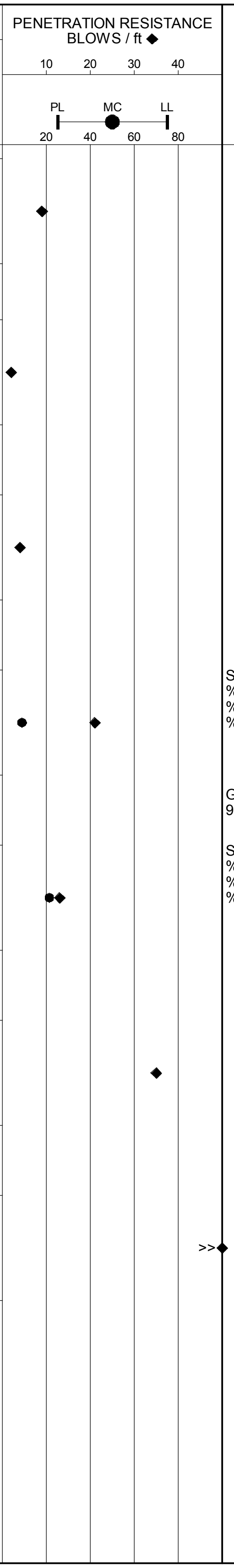
ELEVATION: 194.44
INCLINATION: -90

BORING METHOD: 4.25-inch Inner Diameter Hollow Stem Auger

SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (Ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC ATT	NOTES WATER LEVELS
0.0 - 0.2 Asphalt Pavement.									
0.2 - 0.5 Loose, gray, (GP-GM), moist, fine to coarse GRAVEL and SAND, little silt, [FILL, Hf].	GP-GM		193.9 0.5	S-1	SS	6-5-4	9	1.5 1.5	
0.5 - 5.5 Very loose, brown to dark brown, (SP-SM), moist, fine to coarse SAND, little silt, little gravel, [FILL, Hf].	SP-SM		188.9 5.5	S-2	SS	1-1-1	2	1.3 1.5	
5.5 - 7.0 Very loose to loose, brown, (SM), wet, silty, fine to coarse SAND, trace fine gravel, dark brown-black organics at contact, [RECESSIONAL OUTWASH, Qvro].	SM		187.4 7.0	S-3	SS	1-2-2	4	1.2 1.5	
7.0 - 14.5 Compact to dense, brown to grayish brown, (SP/SP-SM), moist to wet, fine to coarse SAND, trace to little silt, trace to some gravel, [RECESSIONAL OUTWASH, Qvro].	SP /SP-SM			S-4	SS	6-10-11	21	1.5 1.5	S-4@7.5ft %G-8.0 %S-86.7 %F-5.3
									Groundwater encountered 9.2 ft bgs during drilling.
				S-5	SS	5-5-8	13	1.5 1.5	S-5@10ft %G-2.3 %S-93.2 %F-4.5
Becomes dark reddish brown.									
Some fine to coarse gravel.				S-6	SS	7-13-22	35	0.7 1.5	
			179.9 14.5						
14.5 - 16.2 Very dense, gray, (SM), moist to wet, silty, fine to coarse SAND, little fine gravel, [RECESSIONAL OUTWASH, Qvro].	SM		178.2	S-7	SS	21-32-33	>50	1.5 1.5	
16.2 - 16.5 Very dense, gray, (ML), moist, SILT, low plasticity, few laminations, [RECESSIONAL OUTWASH, Qvro].	ML		177.9 16.5						

Borehole completed at 16.5 ft.

Backfilled with 3/8-inch bentonite chips, surfaced with coldpatch asphalt.



1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling Inc.
DRILLER: Dave Puckett

LOGGED: Jeff Schwartz
CHECKED: David P. Findley
DATE: 10/14/2013

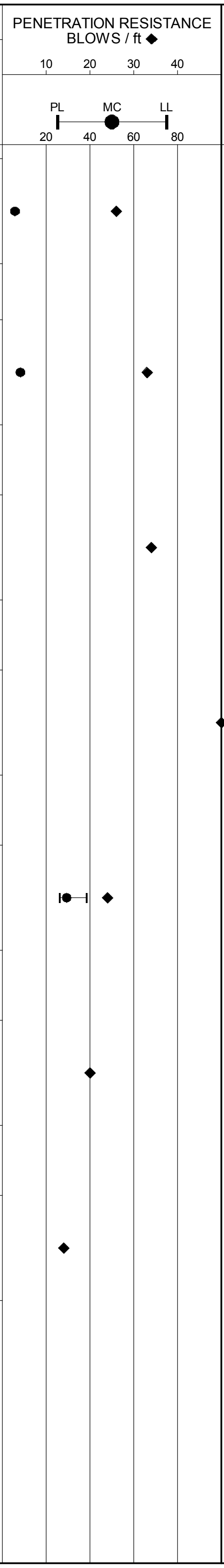
FINAL DESIGN PARTNERS.

RECORD OF BOREHOLE E340-B-024

SHEET 1 of 1

PROJECT: Sound Transit East Link/WA
PROJECT NUMBER: 113-93533.0320
LOCATION: 1606 130th Ave NE
DRILLING METHOD: Hollow Stem Auger
DRILLING DATE: 3/6/2013
DRILL RIG: B-59 Mobile Drill Truck
DATUM: Sound Transit East Coordinate System
COORDINATES: N: 558,900.63 E: 1,639,907.07
ELEVATION: 194.87
INCLINATION: -90

DEPTH (Ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (Ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	NOTES WATER LEVELS
0	4.25-inch Inner Diameter Hollow Stem Auger	0.0 - 0.2 Asphalt Pavement.		0.2						
		0.2 - 6.0 Compact to dense, brown, (SP-SM), moist, fine to coarse SAND, trace to some fine to coarse gravel, little silt, [FILL, Hf].	SP-SM		S-1	SS	7-11-15	26	1.0 / 1.5	S-1@0.2ft %G-20.0 %S-69.8 %F-10.2
					S-2	SS	5-11-22	33	1.2 / 1.5	S-2@2.5ft %G-4.3 %S-84.8 %F-10.9
5				188.9	S-3	SS	10-11-23	34	1.0 / 1.5	
		6.0 - 7.0 Dense, brown, (SP), moist to wet, fine to medium SAND, trace silt, [RECESSIONAL OUTWASH, Qvro].	SP	6.0 187.9						
		7.0 - 8.0 Dense to very dense, brown, (SP-SM), wet, fine SAND, little silt, interbedded with thin layers of yellowish brown, silty, fine SAND, [RECESSIONAL OUTWASH, Qvro].	SP-SM	7.0 186.9						Groundwater encountered 7.3 ft bgs after drilling. Blows may be over stated on gravel, Sample S-4 at 7.5 ft bgs.
		8.0 - 9.5 Dense to very dense, brown, (GP-GM), wet, fine to coarse GRAVEL and SAND, little silt, [RECESSIONAL OUTWASH, Qvro].	GP-GM	8.0 185.4	S-4	SS	10-18-32	50	0.8 / 1.5	
10		9.5 - 12.0 Compact, light gray and reddish yellow, (ML), moist, SILT, low plasticity, pockets of grayish brown fine sand, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl].	ML	9.5 182.9	S-5	SS	5-9-15	24	0.8 / 1.5	
		12.0 - 16.3 Compact, brown, (SP-SM), wet, fine to medium SAND, little silt, subtle stratification, [RECESSIONAL OUTWASH, Qvro].	SP-SM	12.0	S-6	SS	5-5-15	20	1.5 / 1.5	
15				178.6	S-7	SS	5-5-9	14	1.0 / 1.5	2 to 3-inches of heave observed in sample.
		16.3 - 16.5 Compact, brown, (ML), wet, non-plastic SILT and fine SAND, [RECESSIONAL LACUSTRINE DEPOSITS, Qvrl].	ML	16.5						
20		Borehole completed at 16.5 ft. Backfilled with 3/8-inch bentonite chips, surfaced with coldpatch asphalt.								



1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling Inc.
DRILLER: John Bennet
LOGGED: Jeff Schwartz
CHECKED: David P. Findley
DATE: 10/14/2013

FINAL DESIGN PARTNERS.

RECORD OF BOREHOLE E340-B-025

SHEET 1 of 1

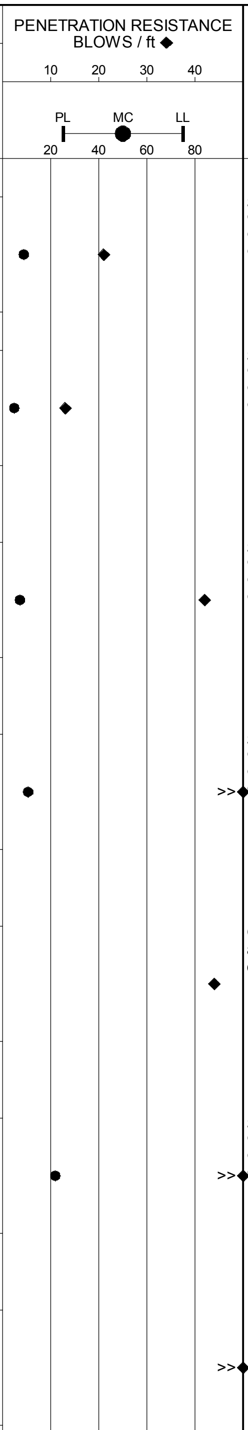
PROJECT: Sound Transit East Link/WA
PROJECT NUMBER: 113-93533.0320
LOCATION: 1700 130th NE

DRILLING METHOD: Hollow Stem Auger
DRILLING DATE: 5/2/2013
DRILL RIG: BK-81 Mobile Drill Truck

DATUM: Sound Transit East Coordinate System
COORDINATES: N: 559,044.82 E: 1,639,856.71

ELEVATION: 204.41
INCLINATION: -90

DEPTH (Ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (Ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	NOTES WATER LEVELS
0	4.25-inch Inner Diameter Hollow Stem Auger	0.0 - 0.2 Asphalt Pavement.		0.2						
		0.2 - 2.3 Compact, gray-brown to orange-brown, (SM), moist, silty, fine to coarse SAND, little gravel, 4-inch seam of dark brown soil with organics in middle of sample, [FILL, Hf].	SM	202.2 2.3	S-1	SS	9-9-12	21	1.3 1.5	S-1@0.5ft %G-6.3 %S-80.1 %F-13.6
		2.3 - 4.5 Compact, gray-brown, (SP-SM), moist, fine to medium SAND, little silt, [FILL, Hf].	SP-SM	199.9 4.5	S-2	SS	5-6-7	13	1.4 1.5	S-2@2.5ft %G-1.3 %S-93.7 %F-5.0
5		4.5 - 7.0 Dense, gray-brown, (SP-SM), moist, fine to coarse SAND, some gravel, little silt, small roots, [RECESSIONAL OUTWASH, Qvro]. Becomes gravelly at 6 ft bgs.	SP-SM	197.4 7.0	S-3	SS	4-18-24	42	1.3 1.5	S-3@5ft %G-20.2 %S-71.8 %F-8.0
		7.0 - 9.5 Very dense, gray-brown, (SM), moist, fine to coarse SAND and SILT, little gravel, 2-inch lens of fine to medium sand [TILL, Qvt].	SM	194.9 9.5	S-4	SS	25-36-40	>50	1.5 1.5	S-4@7.5ft %G-5.5 %S-51.5 %F-43.0
10		9.5 - 16.5 Dense to very dense, gray-brown to gray, (SM), wet, silty, fine to medium SAND, thin iron oxide stained bands, 2-inch lens of dark brown organics, abundant micaceous particles, [PRE-VASHON FLUVIAL DEPOSITS, Qpnf].	SM		S-5	SS	16-18-26	44	1.4 1.5	Groundwater encountered about 10 ft bgs during drilling.
					S-6	SS	15-25-31	>50	1.5 1.5	S-6@12.5ft %G-0.0 %S-76.1 %F-23.9
15				187.9 16.5	S-7	SS	16-28-23	>50	1.5 1.5	
20		Borehole completed at 16.5 ft. Backfilled with 3/8-inch bentonite chips, surfaced with coldpatch asphalt.								



1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling Inc.
DRILLER: Jerrod Thompson

LOGGED: Mike Wolczko
CHECKED: David P. Findley
DATE: 10/14/2013

FINAL DESIGN PARTNERS.

RECORD OF BOREHOLE E340-B-026

SHEET 1 of 1

PROJECT: Sound Transit East Link/WA
PROJECT NUMBER: 113-93533.0320
LOCATION: 1700 130th NE
DRILLING METHOD: Hollow Stem Auger
DRILLING DATE: 5/2/2013
DRILL RIG: BK-81 Mobile Drill Truck
DATUM: Sound Transit East Coordinate System
COORDINATES: N: 559,106.39 E: 1,639,699.82
ELEVATION: 202.11
INCLINATION: -90

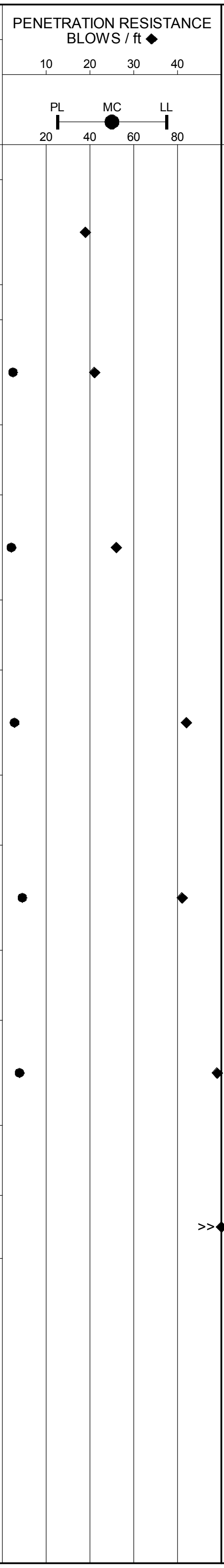
BORING METHOD: 4.25-inch Inner Diameter Hollow Stem Auger

SOIL PROFILE

DESCRIPTION	USCS	ELEV. / DEPTH (Ft)
0.0 - 0.3 Asphalt Pavement.		201.8 0.3
0.3 - 7.0 Compact, yellowish-brown, (SP), moist, fine to coarse SAND, trace silt, trace gravel, [RECESSIONAL OUTWASH, Qvro]. Becomes gray-brown to brownish-gray, oxide stained bands.	SP	195.1 7.0
7.0 - 12.0 Dense, orange-brown to gray-brown, (GW), wet, GRAVEL and SAND, trace silt, [RECESSIONAL OUTWASH, Qvro]. Becomes wet at 8.5 ft bgs.	GW	190.1 12.0
12.0 - 15.9 Dense to very dense, gray-brown, (GP-GM), wet, fine to coarse GRAVEL and SAND, little silt, iron oxide staining, [PRE-VASHON FLUVIAL DEPOSITS, Qpnf].	GP-GM	186.2 15.9
Borehole completed at 15.9 ft. Backfilled with 3/8-inch bentonite chips, surfaced with coldpatch asphalt.		

SAMPLES

NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	NOTES WATER LEVELS
S-1	SS	8-9-10	19	1.2 / 1.5	
S-2	SS	6-10-11	21	1.5 / 1.5	S-2@2.5ft %G-0.1 %S-98.3 %F-1.6
S-3	SS	7-11-15	26	1.5 / 1.5	S-3@5ft %G-2.8 %S-95.0 %F-2.2
S-4	SS	18-21-21	42	1.0 / 1.5	S-4@7.5ft %G-58.4 %S-37.2 %F-4.4
S-5	SS	15-18-23	41	0.7 / 1.5	Groundwater encountered about 9.5 ft bgs during drilling. S-5@10ft %G-60.3 %S-37.5 %F-2.2
S-6	SS	18-25-24	49	1.0 / 1.5	S-6@12.5ft %G-50.0 %S-39.2 %F-10.8
S-7	SS	26-50/5"	>50	0.8 / 0.9	



DEPTH (Ft): 0, 5, 10, 15, 20

1 in to 3 ft
DRILLING CONTRACTOR: Holocene Drilling Inc.
DRILLER: Jerrod Thompson
LOGGED: Mike Wolczko
CHECKED: David P. Findley
DATE: 10/14/2013

FINAL DESIGN PARTNERS.

GOLDER

golder.com