APPENDIX A

GEOTECHNICAL REPORT

GEOTECHNICAL ENGINEERING REPORT

Scriber Creek Trail
Lynnwood, Washington

HWA Project No. 2018-102-21

Prepared for
Parametrix

June 28, 2024

HWA GEOSCIENCES INC.
DBE/MWBE

Geotechnical Engineering
Pavement Engineering
Geoenvironmental
Hydrogeology
Inspection & Testing

HWA GeoSciences Inc.
DBE/MWBE

June 28, 2024
HWA Project No. 2018-102-21

Parametrix
719 2nd Avenue, Suite 200
Seattle, Washington 98104

Attention: Jenny Bailey, P.E.

Subject: **Geotechnical Engineering Report**
Scriber Creek Trail
Lynnwood, Washington

Ms. Bailey:

As requested, HWA GeoSciences Inc. (HWA) has completed a geotechnical site investigation and related geotechnical engineering evaluations for the Scriber Creek Trail located in Lynnwood, Washington. The attached geotechnical report summarizes the results of our work and our geotechnical engineering recommendations.

We appreciate the opportunity to provide geotechnical engineering services on this project. If you have any questions regarding this report or require additional information or services, please contact the undersigned at your convenience.

Sincerely,

HWA GeoSciences Inc.

Bryan Hawkins, P.E.
Geotechnical Engineer

TABLE OF CONTENTS

LIST OF FIGURES (FOLLOWING TEXT)

APPENDICES

Appendix A: Field Explorations

Appendix B: Laboratory Test Results

GEOTECHNICAL ENGINEERING REPORT
SCRIBER CREEK TRAIL
LYNNWOOD, WASHINGTON

1. INTRODUCTION

1.1 General

This report summarizes the results of a geotechnical engineering investigation undertaken by HWA GeoSciences Inc. (HWA) for the Scriber Creek Trail project. Our work included a field investigation program and geotechnical analyses associated with the proposed trail. The approximate location of the alignment is shown on the Site and Vicinity Map, Figure 1.

1.2 Project Description

It is our understanding that the City of Lynnwood proposes to upgrade the Scriber Creek Trail, which runs approximately 0.75 miles from Wilcox Park to the Lynnwood Transit Center. The City would like to address issues of flooding and improve trail conditions and pedestrian accessibility. This will include widening the trail along the alignment and the construction of new boardwalks, retaining walls and bridge crossings. The trail alignment is shown in the Site and Exploration Plans, Figures 2A through 2C.

2. FIELD EXPLORATION AND LABORATORY TESTING

2.1 Field Exploration

HWA conducted a subsurface exploration program that consisted of drilling nineteen borings, designated BH-1 through BH-19, between July 1 and 10, 2019. All borings were drilled by Geologic Drill Partners, Inc. of Bellevue, Washington, under subcontract to HWA. Borings BH-1 through BH-11 and BH-14 through BH-19 were drilled using a Bobcat-mounted Mini Drill Rig and ranged in depth from 10.75 to 41.5 feet below ground surface. Borings BH-12 and BH-13 were drilled using a Deep Rock XL drill rig and extended to depths of 9 and 15.5 feet, respectively. The locations of the borings are shown on the Site and Exploration Plans, Figures 2A through 2C.

In each of the boreholes, Standard Penetration Test (SPT) sampling was performed using a 2-inch outside diameter split-spoon sampler driven by a 140-pound hammer raised using a rope and cathead system. During the SPT, samples were obtained by driving the sampler 18 inches into the soil with the hammer free-falling 30 inches. The numbers of blows required for each 6 inches of penetration were recorded. The Standard Penetration Resistance ("N-value") of the soil is calculated as the number of blows required for the final 12 inches of penetration. This resistance, or N-value, provides an indication of relative density of granular soils and the relative consistency of cohesive soils; both indicators of soil strength.

A geotechnical engineer from HWA recorded all pertinent information including soil sample depths, stratigraphy, soil engineering characteristics, and ground water occurrence. Soil samples obtained from the boreholes were classified in the field and representative portions were sealed in plastic bags. These soil samples were then taken to our Bothell, Washington, laboratory for further examination and testing. The stratigraphic contacts shown on the individual exploration logs represent the approximate boundaries between soil types; actual transitions may be more gradual. The soil and groundwater conditions depicted are only for the specific date and locations reported and, therefore, are not necessarily representative of other locations and times. A legend of the terms and symbols used on the exploration logs is presented in Figure A-1. Summary logs of the borehole explorations are presented in Figures A-2 through A-20.

2.2 Laboratory Testing

Representative soil samples obtained from the explorations were placed in plastic bags to prevent loss of moisture and transported to our Bothell, Washington, laboratory for further examination and testing. Laboratory tests were conducted on selected soil samples to characterize relevant engineering and index properties of the soils. The tests include visual classifications, natural moisture and organic content determinations, grain size distribution analyses and Atterberg Limits (plasticity characteristics). The tests were conducted in general accordance with appropriate American Society of Testing and Materials (ASTM) standards and are discussed in further detail in Appendix B. The test results are also presented in Appendix B, and/or displayed on the exploration logs in Appendix A, as appropriate.

3. SITE CONDITIONS

3.1 Existing Site Conditions

The existing Scriber Creek Trail extends approximately 0.75 miles from Wilcox Park to the Lynnwood Transit Center. The project alignment has been divided into three segments and are described below from north to south. Figure 2A through 2C show the locations of each segment. Flooding was observed in Segment 1 and Segment 3 of the trail alignment at the time of our explorations. Most of the trail alignment is located within existing wetlands.

Segment 1, Figure 2A, begins at the north and extends from Wilcox Park south towards 200th Street SW, through Scriber Lake Park. There are two proposed bridge crossings over Scriber Creek in this segment of the trail alignment. Various sections of elevated fiber grate boardwalk structures are also proposed.

Segment 2, Figure 2B, starts from the south end of Segment 1, north of Sprague Mini Pond, and follows the south side of 200th Street SW to the east. Segment 2 then crosses Cedar Valley Road and runs south to Scriber Creek Park. Approximately 350 feet of Hollowcore boardwalk are proposed along the south side of 200th Street SW.

Segment 3, Figure 2C, begins at the end of Segment 2 at Scriber Creek Park and extends eastward through the park and ends at the Lynnwood Transit Center. There is 1 bridge crossing proposed and approximately 550 feet of elevated fiber grate boardwalk proposed.

3.2 General Geologic Conditions

The site is located in the central portion of the Puget Sound Lowland, an elongated topographic and structural depression bordered by the Cascade Mountains on the east and the Olympic Mountains on the west. The Lowland is characterized by low-rolling relief with some deeply cut ravines. In general, the ground surface elevation is within 500 feet of sea level. The Puget Lowland was filled to significant depths by glacial and non-glacial sediments during the Pleistocene Epoch, although bedrock does outcrop in scattered locations throughout the area. Generally, the rock is deeply buried by Pleistocene and recent sediments.

Geologists have generally agreed that the Puget Sound area was subjected to four or more major glaciations during the Pleistocene Epoch. Ice for these glacial events originated in the Coastal Mountains and the Vancouver Range of British Columbia. The maximum southward advance of ice was about halfway between Olympia and Centralia. The Pleistocene stratigraphic record in the central portion of the Puget Lowland is a complex sequence of glacially-derived and interglacial sediments. Erosion of certain deposits, as well as local deposition of sediments, further complicate the geologic setting.

Geologic information for the project area was obtained from the *Geologic Map of the Edmonds East and Part of the Edmonds West Quadrangles, Washington* (Minard, 1983). According to this map, the project alignment is underlain by younger alluvium and this deposit is mapped as extending across the entire project alignment. Younger alluvium consists of mostly sands and gravels with some organic rich mud.

3.3 Subsurface Conditions

The soil conditions along the project alignment include varying amounts of fill soils underlain by peat, alluvium, and advance outwash deposits. Each major soil unit is described below, with materials interpreted as being youngest in origin and nearest to the surface described first.

- **Fill/Topsoil:** Layers of fill/topsoil were encountered in borings BH-1 through BH-14 and ranged in depths from 1.5 feet to 7.5 feet deep. The fill deposits generally consisted of very loose to medium dense, silty, fine to medium sand, with varying amounts of gravel. The fill in borings BH-2, BH-3, and BH-10 contained trace to abundant organics.

- **Peat:** Very soft to soft peat was encountered in all of the borings except in borings BH-14 and BH-15. In boring BH-11, stiff to very stiff peat was encountered. All borings with peat consisted of abundant organics such as intact roots, bark, and wood debris. In borings BH-1, BH-3, BH-11, and BH-13, where the sampler was driven through a piece of wood, blows are likely overstated. Peat thicknesses ranged from 2.5 to 29 feet and was greatest in borings BH-2 and BH-5, where the peat measured between 28 and 29 feet thick. This unit is highly compressible and large settlements should be anticipated if loads greater than existing are applied. In addition, ongoing secondary consolidation, resulting from organic decay, will also result in future settlements of this layer.

- **Alluvium**: An alluvium deposit was observed in borings BH-11 and BH-14 and consisted of medium stiff, sandy silt to medium dense silty sand and gravel. In boring BH-11, the alluvium was about 6 feet thick with moderate rust mottling and scattered organics and gravels. In boring BH-14, the alluvium was about 2.5 feet thick with a 2-inch lens of coarse sand. The alluvium is also somewhat compressible, though considerably less than the peat.

- **Advance Outwash**: Advance outwash was encountered in all of the borings and all borings were terminated in this deposit. In borings BH-13 through BH-15, the upper layer of advance outwash appeared weathered. The advance outwash layer was encountered at depths of 5 to 32 feet bgs. The advance outwash encountered consisted primarily of medium dense to very dense, slightly gravelly, silty to clean, fine to medium sand. Scattered organics and coarse sand were typically encountered. This unit was deposited ahead of the advancing glaciers and has been glacially overridden resulting in its dense configuration. The advance outwash will provide good bearing for foundation elements.

3.4 Groundwater

Groundwater was observed in nearly all borings and is typically within 5 to 10 feet below ground surface. In borings BH-2, BH-6, BH-17, BH-18 and BH-19, perched groundwater was encountered from ground surface to 2.5 feet below ground surface. We anticipate that groundwater levels vary seasonally, with the highest water levels in the wet winter months.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 General

The proposed trail alignment site is primarily underlain by a sequence of fill over compressible wetland deposits (peat) and alluvium over dense advance outwash. In general, the dense advance outwash deposit will provide adequate support for the proposed trail boardwalks, bridges, and retaining walls.

The very soft to soft peat and alluvium deposits compressible soils are subject to consolidation settlements with the application of additional loads. Small diameter piles (pin piles) are recommended for support of the proposed boardwalks and bridges. HWA recommends the implementation of mitigation measures to reduce anticipated settlements for the proposed retaining walls. Recommended mitigation measures could include over-excavation of compressible soils and replacement with structural fill, preloading, deep foundation supported structures and placement of lightweight fill. Given the highly moisture sensitive nature of the soils encountered, we recommend all earthwork related to retaining walls occur during the dry summer months. Significant construction problems associated with groundwater levels and wet soils conditions should be anticipated if earthwork is performed during wet weather.

4.2 Seismic Considerations

The contribution of potential earthquake-induced ground motion from known sources is included in the probabilistic ground motion maps developed by the USGS. Design data seismic site characterization and design recommendations based on USGS mapping and analysis are implemented in the 2018 International Building Code (IBC). As part of this code, the design of structures must consider dynamic forces resulting from seismic events. These forces are dependent upon the magnitude of the earthquake event as well as the properties of the soils that underlie the site.

As part of the procedure to evaluate seismic forces, the 2018 IBC requires the evaluation of the Seismic Site Class, which categorizes the site based upon the characteristics of the subsurface profile 100 feet below the proposed foundations. As a result, the Site Class to be determined in accordance with Section 20.3 and the corresponding values of F_a and F_v can be determined from Tables 11.4-1 and 11.4-2 of ASCE 7-16. Much of the site is underlain by 10 feet or more of organic peat, as identified in our geotechnical explorations, these sections of the site should be considered Site Class E. However, the areas around Boardwalks 1, 2 and 3 were observed to have less than 10 feet of peat below them and based on blow counts obtained from the site explorations should be considered Site Class D. In Section 11.4.8 of ASCE 7-16, it is stated that a site-specific ground motions hazard analysis is required on sites with three additional conditions.

1. Seismically isolated structures and structures with dampening systems on site with S_1 greater than or equal to 0.6.
2. Structures on Site Class E sites with S_s greater than or equal to 1.0.
3. Structures on Site Class D and E sites with S_1 greater than or equal to 0.2.

Condition 1 should be determined by the project structural engineer but is assumed to not apply to the proposed site improvements. Conditions 2 and 3 would necessitate performing a site-specific ground motions hazard analysis on this site; however, three exceptions are provided, in Section 11.4.8 of ASCE 7-16, to determine seismic design parameters without performing a site-specific ground motions hazard analysis. These exceptions are:

1. Structures on site Class E site with S_S greater than or equal to 1.0, provided the site coefficient F_a is taken to be equal to that of Site Class C.
2. Structures of Site Class D sites with S_1 greater than or equal to 0.2, provided the value of the seismic response coefficient (Cs) is determined by Eq 12.8-2 of ASCE 7-16 for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either Equation 12.8-3 of ASCE 7-16 for $T_L \geq T > 1.5T_s$, or Equation 12.8-4 of ASCE 7-16 for $T > T_L$.
3. Structures on Site Class E sites with S_1 greater than or equal to 0.2, provided that T is less than or equal to T_s and the equivalent static force procedure is used for design.

Please note that unless a site-specific ground motions hazard analysis is performed, the requirements in exception 2 for boardwalks 1, 2 and 3, and exception 1 and 3, for other parts of the site will need to be followed.

Should the information used as a basis for this design be incorrect, HWA should be notified to provide appropriate recommendations. The associated probabilistic ground acceleration values and site coefficients for the general site area were obtained from the Applied Technology Council Seismic Hazard Maps. The risk targeted seismic values and coefficients for boardwalks 1, 2 and 3 and the remainder of the site are presented in Tables 1 and 2 below.

Table 1: Ground Motion Values, Site Class D* for Boardwalks 1, 2 and 3

Period (sec)	Mapped MCE Spectral Response Acceleration (g)		Site Coefficients		Adjusted MCE Spectral Response Acceleration (g)		Design Spectral Response Acceleration (g)	
0.0	PGA	0.558	F_{PGA}	1.100	PGA_M	0.614	-	-
0.2	S_s	1.302	F_a	1.000	S_{Ms}	1.302	S_{Ds}	0.868
1.0	S_1	0.460	F_v	1.840	S_{M1}	0.846	S_{D1}	0.564

Transition Point	Period (sec)
T_0	0.130
T_s	0.650
T_L	6

Notes: **2% Probability of Exceedance in 50 years for Latitude 47.8204° and Longitude -122.3070°*
Northern most portion of the alignment had slightly higher ground motion values than the southern portion and but are appropriate for the entire alignment.
PGA = Peak ground acceleration FPGA = PGA site coefficient
PGA_M = Maximum considered earthquake geometric mean peak ground acceleration adjusted for Site Class effects
S_S = Short period (0.2 second) Mapped Spectral Acceleration
S_1 = 1.0 second period Mapped Spectral Acceleration
S_{MS} = Spectral Response adjusted for site class effects for short period = Fa • SS
S_{M1} = Spectral Response adjusted for site class effects for 1-second period = Fv • S1
S_{DS} = Design Spectral Response Acceleration for short period =2/3 • SMS
S_{D1} = Design Spectral Response Acceleration for 1-second period =2/3 • SM1
Fa = Short Period Site Coefficients
Fv = Long Period Site Coefficients
T_0 = 0.2•SD1/SDs
T_s = SD1/SDs
T_L = Long Period Transition period

Table 2: Ground Motion Values, Site Class E* for Remainder of Site

Period (sec)	Mapped MCE Spectral Response Acceleration (g)		Site Coefficients		Adjusted MCE Spectral Response Acceleration (g)		Design Spectral Response Acceleration (g)	
0.0	PGA	0.558	F_{PGA}	1.142	PGA_M	0.637	-	-
0.2	S_s	1.302	F_a	1.200	S_{Ms}	1.562	S_{Ds}	1.042
1.0	S_1	0.460	F_v	2.280	S_{M1}	1.049	S_{D1}	0.699

Transition Point	Period (sec)
T_0	0.134
T_S	0.671
T_L	6

Based on Tables 11.6-1 and 11.6-2 (of ASCE 7-16), the Seismic Design Category for both site class areas is "D".

4.2.1 Liquefaction

The potential for soil liquefaction effects must be considered during the design of any soil-supported structure. Soil liquefaction is a phenomenon where loose, saturated, granular deposits temporarily lose strength and behave as a liquid in response to moderate to strong earthquake shaking.

The proposed site is primarily underlain by wetland deposits (peat) over advance outwash. The deposits of peat underlying the site will not undergo liquefaction given its fibrous composition. The underlying advance outwash deposit encountered was typically dense to very dense. Given the density of these soils, liquefaction is unlikely and will not be a design consideration.

4.3 CONSOLIDATION SETTLEMENTS

The trail alignment is susceptible to consolidation settlement of the underlying compressible soils. Consolidation settlement results from the application of static loading on compressible soil deposits that are saturated and have not previously experienced similar loading conditions. Consolidation settlement occurs as both primary consolidation (short term consolidation) and secondary consolidation (long term consolidation). Both mechanisms are described below.

Primary consolidation initiates immediately upon the application of load and is a result of pore water being expelled from the void space within the soil unit. As load is applied, the pore water pressure increases within the soil unit and slowly decreases as the pore water is expelled from the soil. As this process continues the void space is reduced and the volume of the soil deposit decreases. This decrease in the volume results in a reduction in the thickness of the soil unit which manifests as settlement at the ground surface. The magnitude of primary consolidation is dependent on the geometry of the compressible soil unit, with respect to the applied load, and the compressibility properties of the soils.

Secondary compression is a settlement phenomenon that occurs in soil deposits after completion of the primary consolidation stage and can continue for many years. The magnitude of the secondary compression settlement is difficult to predict but is typically a small fraction (5 to 10%) of the settlement that occurs as primary consolidation for most mineral soils. For peat, on the other hand, secondary compression has been observed to be a significant amount of the total settlement.

Given the time that has elapsed since placement of fill in the area, we expect that primary consolidation is complete and a significant amount of the secondary consolidation has occurred. Therefore, as long as the load on the subsurface soils is not increased, we do not expect any additional primary consolidation to occur. However, given the organic nature of the subsurface soils we do expect that secondary consolidation settlements will continue to occur through the design life of the trail.

We were not aware of grade increases and the necessity for retaining walls at the time our explorations and laboratory tests were performed; hence no consolidation laboratory testing was conducted, as we assumed all structures would be supported on piles bearing in the advance outwash soils. If estimates of settlements for grade supported structures (walls) are required, additional borings should be completed, and Shelby tube sampling be performed in the peat deposits so that this testing can be performed.

4.4 Retaining Wall Design

We understand that various walls will be required along the project alignment due to trail widening and bridge approaches. The proposed wall locations for Phase 1 of Scriber Creek Trail (Sta 200+00 to 218+15) were provided by Parametrix in their 30% Plan Submittals. We understand that there are no walls planned for Phase 2 (Sta 100+00 to 120+62). Table 3 provides a summary of the walls for Phase 1, including the approximate wall locations, whether the wall is a cut or fill wall, estimated maximum wall height, and relevant borings.

Table 3. Summary of Wall Types and Locations

Wall No.	Approximate Wall Stationing and Location	Cut or Fill	Estimated Exposed Wall Height (ft)	Relevant Boring
6	203+50 (East Side)	Fill	4.5	BH-10
7	203+00 (West Side)	Fill	3	BH-10
8	209+10 (West Side)	Fill	2	BH-4
9	209+10 (East Side)	Fill	2.5	BH-4
10	210+50 (West Side)	Fill	3.5	BH-4
11	210+50 (East Side)	Fill	4	BH-1
12	213+50 (West Side)	Fill	4	BH-1
13	215+00 (South Side)	Cut	2.5	BH-1
14	216+00 (South Side)	Fill	1	BH-1

4.4.1 Block Wall Design

We recommend gravity block walls be used for walls with retained heights of less than 3 feet of exposed wall height. The gravity block wall type recommended consists of blocks with dimensions of the order of 18 inches wide by 12 to 21 inches deep, by 8 inches tall, such as Keystone® blocks, and are referred to as "Modular Block" walls. Modular block walls consist of small, relatively light blocks and are suitable for all walls except Walls 6, 10, 11 and 12. We assume that the proposed walls will consist of a proprietary wall system and that the wall supplier will design the walls for internal stability. The walls should be designed in accordance with AASHTO Standard Specifications for Highway Bridges. We recommend the walls be designed using the parameters presented in Table 4. For the Extreme Event I Limit State, the wall should be designed for a horizontal seismic acceleration coefficient kh of one-half the peak ground acceleration or 0.222 g and a vertical seismic acceleration coefficient ky of 0.0 g (assuming the wall is free to move during a seismic event).

Table 4. Recommended Design Parameters for Block Walls

Soil Properties	Wall Backfill*	Retained Soil*	Foundation Soil
Unit Weight (pcf)	135	135	100
Friction Angle (deg)	38	36	28
Cohesion (psf)	0	0	0
		AASHTO Load Group 1	**AASHTO Load Group 2**
Allowable Bearing Capacity (psf)		1,000	1,300
Horizontal Seismic Acceleration Coefficient (k_h)		N/A	0.318

* *Gravel Borrow*, as specified in Section 9-03.14(1) of WSDOT *Standard Specifications*

An unfactored coefficient of friction of 0.5 times the effective stress at the base of the wall can be used for sliding resistance. Embedment depths of the blocks should be at least 6 inches for cut walls and 1 foot for fill walls with slopes above and below the walls no steeper than 2H:1V.

Given the compressible soils below the wall locations, settlement of these walls is expected. Settlement values for walls less than 3 feet are likely to be small, on the order of several inches. However, this may require periodic maintenance in the future. If some level of settlement is not tolerable, one of the methods presented below should be used to mitigate this.

4.4.2 Block Wall Subgrade Preparation

Subgrade preparation for the modular block gravity walls is important to limit differential settlement and maintain global stability. Proper wall construction and drainage are essential to prevent premature failure of the wall system. The wall should also be constructed on a properly prepared subgrade to limit deformation of the wall. We recommend all earthwork occur during the dry summer months. We expect the soil conditions at the locations of most of the walls to consist of loose to medium dense, silty sand.

Prior to placement of blocks the subgrade soils should be thoroughly compacted to at least 95% of modified Proctor maximum dry density. As indicated above, this may require over-excavation and placement of separator fabric and geogrid to stabilize subgrade soils prior to placement of fill. Subgrade preparation should include placement of a leveling pad to support the block wall. We recommend the bottom course of blocks be placed on a 6-inch-thick leveling pad consisting of Crushed Surfacing Top Course (CSTC), as specified in Section 9-03.9(3) of the *Standard Specifications* (WSDOT, 2020). The CSTC should be compacted to at least 95 percent of the modified Proctor maximum dry density, as determined by ASTM D 1557. This leveling pad should be graded to establish the proper wall batter.

4.4.3 Block Wall Drainage

A 4- to 6-inch-diameter perforated drainpipe should be installed behind the base of the block wall to collect and convey seepage from behind the wall. The drainpipe should be bedded and backfilled with Gravel Backfill for Drains, as specified in Section 9-03.12(4) of the *Standard Specifications* (WSDOT, 2020). The drainpipe should be sloped to drain and routed to an appropriate discharge location.

4.4.4 Retaining Wall Settlement Mitigation Options

For walls greater than 3 feet in height, or if settlement is not tolerable for shorter walls, we recommend that options to mitigate settlements be evaluated, as settlement values are likely to be excessive. There are several options that could be implemented to reduce or eliminate settlement issues. These options include over-excavation and replacement, preloading, lightweight fill and deep foundation supported structures. A description of each of these options is provided below.

- **Over-Excavation and Replacement:** The weak and compressible deposits below the trail could be over-excavated and replaced with compacted structural fill to eliminate the potential for future settlements. This could be feasible for walls in Segment 3, near the Lynnwood Transit Center, where excavations of 5 to 10 feet would likely be required. However, for the remaining walls subsurface investigations indicate that the base of the compressible soils varies from 11 to 15 feet below ground surface. Therefore, over-excavation and replacement would require deep exactions that would require shoring. Additionally, the groundwater level along the trail alignment is such that over-excavation and replacement would most likely require dewatering. Consideration could be given to the use of quarry spalls as backfill for the lower portion of fill, as the spalls could be placed in wet conditions (underwater) and would not require compaction.
- **Preloading:** Preloading is often a viable way to reduce future settlements and increase the shear strength of underlying compressible soils. Preloading involves placing a specified amount of soil or weight over a given area and allowing the weight to consolidate the

underlying compressible or weak soils prior to construction of the proposed improvements. Preloading has been used successfully on similar projects in the past. However, the viability of preloading requires time and space. We anticipate the peat soils would take several months to a year to consolidate sufficiently to reduce future settlements and increase the shear strength properties of the soil. We recommend additional borings be conducted to obtain Shelby tube samples of the peat soils and that laboratory consolidation testing be performed to estimate the duration of required preload and expected magnitude of settlements.

- **Deep Foundation Supported Structures:** Consideration could also be given to the use of small diameter pipe (pin) piles to support taller retaining walls. The foundations would need to extend below the soft deposits of peat and alluvium and bear in the advance outwash below. A grade beam would need to be constructed over the piles on which to construct the wall. Lightweight fill could then be used to raise grade.
- **Lightweight Backfill:** Lightweight materials could be used to reduce the load on the underlying compressible soils, reducing anticipated future settlements. This would be achieved by excavating existing fill soils and replacing them with lightweight materials. The depth of excavation would depend on the type of lightweight materials to be used and the anticipated loads. The new loads associated with the walls and grade changes (including the lightweight fill) would need to be less than the weight of soils excavated. The use of lightweight materials could be used to achieve the grade changes proposed.

  Several lightweight fill materials are available and have been used on past projects with success. These materials include Geofoam and lightweight cellular concrete (Cell-Crete). Geofoam consists of proprietary lightweight Styrofoam blocks that are readily available to contractors and have been used successfully on numerous road projects. Geofoam can be obtained in a variety of unit weights, typically 1 to 3 pcf. Lightweight cellular concrete is a proprietary product that can be manufactured onsite to a wide range of unit weights (36 to 120 pcf) and compressive strengths.

  Lightweight fill could be designed to reduce anticipated future settlements. The facings of the light-weight fill will need to be protected and this can be achieved by various methods such as shotcrete or block walls (but these also add weight). The lightweight fill will need to be designed to resist potential buoyancy forces under the extreme high-water level. It is our understanding that the ground water level across the site is currently at 5 to 10 feet bgs with occasional perched water at the surface. Sufficient soil cover should be provided to ensure an adequate factor of safety for buoyancy.

4.5 BOARDWALK & BRIDGE FOUNDATION RECOMMENDATIONS

It is our understanding a fiber grate boardwalk and several bridges are proposed at various locations along the trail alignment and a Hollowcore boardwalk is proposed along the south side of 200th Street SW. Figures 2A through 2C show the locations of the bridges and boardwalks.

To mitigate anticipated settlements due to the presence of soft, compressible soils we recommend these boardwalks and bridges be supported on small diameter pipe piles (pin piles). The piles will need to be galvanized due to the presence of peat soils.

4.5.1 Small Diameter Piles (Pin Piles)

Pin piles can be installed using a vibratory impact hammer operating on the boom of an excavator or articulating forklift. The pin piles are driven into the ground until they reach a 'refusal criteria' that varies with hammer weight and pile diameter and is typically provided by the pile driving contractor. It is our understanding that nominal 6-inch and 8-inch diameter, galvanized, Schedule 80 (extra strong), steel pipe piles will be used for all boardwalk and bridge sections. The pin piles must penetrate all existing fill, peat and alluvial soils and bear in the underlying dense advance outwash soils.

We anticipate that the pin piles will develop sufficient load-carrying capacity with about 10 feet of penetration into the dense advance outwash soils. Given the varying depths to the advance outwash deposit, different lengths of pile will be required. The fiber grate boardwalks and bridges in Segment 1, south of Wilcox Park, will require pile lengths of approximately 20 to 40 feet. The fiber grate boardwalks and bridge in Segment 3 near the Lynnwood Transit Center will require approximate pile lengths of 15 to 20 feet. We anticipate that the pin piles used to support the Hollowcore Boardwalk section along 200th Street SW will require approximate pile lengths of 20 to 30 feet. Figure 3 shows the allowable pile capacities for an 8-inch diameter pin pile at varying depths.

Each pin pile should be driven to "refusal," which is defined as a minimum penetration during a specified time period of driving (e.g., less than 1 inch of penetration during 60 seconds of driving). The driving criteria are determined based on the impact hammer used, pile size, site soil conditions, and load testing. Based on our experience and available design guidelines, 8-inch diameter pin piles driven to refusal will be capable of developing allowable axial compressive loads of 45 to 60 kips and 6-inch diameter pin piles driven to refusal will be capable of developing allowable axial compressive loads of 30 kips. We recommend load testing be performed on a minimum of 3% of the piles up to 5 piles maximum (1 minimum), to verify axial capacity and to establish an acceptable driving criterion. The test piles should be tested in accordance with the Quick Load Test Method described in test method ASTM D 1143-81, under the direction of a qualified geotechnical engineer. All pin piles should be driven under the observation of the geotechnical engineer.

It is possible that obstructions, possibly logs or large woody debris, which cannot be penetrated, may be encountered. In borings BH-1, BH-3, BH-11, and BH-13 pieces of wood or logs were encountered. If such an obstruction is encountered, the pin pile should be removed or abandoned in place, and a new pin pile should be installed at least 6 inches away. Alternatively, if sufficiently shallow, the obstruction in the location of the pile could be excavated and the pile redriven. If it is necessary to move a pile, the structural engineer should check and revise the boardwalk design and pile location as necessary.

Typically, the steel pipe piles will be delivered to the site in 21-foot (maximum) sections. If required, force-fit pin connections are typically used to splice sections together during installation. The uplift capacity of the pin piles should be neglected, unless the pile consists of a single section of pipe, or the connection is welded.

4.6 Pavement Design

4.6.1 New HMA Pavement Design

We understand that portions of the trail will be paved with Hot Mix Asphalt (HMA) and that the heaviest traffic will consist of infrequent maintenance vehicles. Table 5 provides our minimum HMA design recommendations.

Table 5. Structure Requirements for New HMA Pavement

Material Description	Minimum Layer Thickness (inches)	WSDOT Standard Specification
HMA	3	5-04
CSTC	6	9-03.9(3)

HMA: Hot Mix Asphalt
CSTC: Crushed Surfacing Top Course

We recommend that the asphaltic layers consist of HMA Class 3/8-inch. Recommendations are presented below for subgrade preparation and structural fill placement and compaction for pavement reconstruction.

The pavement will likely require periodic maintenance. Cracks larger than 1/4 -inch in width should be sealed periodically and some re-leveling/reconstruction may be required due to settlement given the presence of peat soils below the pavement.

4.6.2 HMA Binder Selection

The selection of the optimum asphalt binder type for the prevailing climate is critical to ensure long-term pavement performance. Use of the wrong binder can result in low temperature cracking or permanent deformation at high temperatures.

Based on the climate in the project vicinity, we recommend Superpave Performance Grade binder PG 58S-22 be used.

4.6.3 Placement of HMA

Placement of HMA should be in accordance with Section 5-04 of the WSDOT Standard Specifications (WSDOT, 2020). Particular attention should be paid to the following:

- HMA should not be placed until the engineer has accepted the previously constructed pavement layers.
- HMA should not be placed on any frozen or wet surface.
- HMA should not be placed when precipitation is anticipated before the pavement can be compacted, or before any other weather conditions which could prevent proper handling and compaction of HMA.
- HMA should not be placed when the average surface temperatures are less than 45^o F.
- HMA temperature behind the paver should be in excess of 240^o F. Compaction should be completed before the mix temperature drops below 180^o F. Comprehensive temperature records should be kept during the HMA placement.
- For cold joints, tack coat should be applied to the edge to be joined and the paver screed should be set to overlap the first mat by 1 to 2 inches.

4.6.4 Drainage

It is essential to the satisfactory performance of the pavement that good drainage is provided to prevent water ponding on or alongside or accumulating beneath. Water ponding can cause saturation of the pavement and subgrade layers and lead to premature failure. The base layers and subgrade surface should be graded to prevent water being trapped within the layer. The surface of the pavement should be sloped to convey water from the pavement to appropriate drainage facilities.

4.7 LUMINAIRE & SIGNAL POLE FOUNDATION RECOMMENDATIONS

We understand that project includes new luminaires and traffic signals. We recommend that all foundations extend below the peat soils and bear in the dense to very dense advance outwash soils in order to prevent settlement/tilting of the new poles. Table 17-2 of the *WSDOT Geotechnical Design Manual* (WSDOT, 2019), provides allowable lateral bearing pressures based on Standard Penetration Test (SPT) Resistance N-values (blows/foot). Table 6 summarizes the proposed design allowable lateral bearing pressures by depth for each borehole location.

Table 6. Recommended Allowable Lateral Bearing Pressure for Signal Pole Foundations

Relevant Boring	Depth (ft)	Average SPT N-Value in Depth Interval	Design Allowable Lateral Bearing Pressure (psf)
BH-1	0-30	0	0
BH-1	30+	20	3,500
BH-2	0-35	0	0
BH-2	35+	35	4,500
BH-3	0-15	0	0
BH-3	15+	25	4,200
BH-4	0-15	0	0
BH-4	15+	35	4,500
BH-5	0-30	0	0
BH-5	30+	20	3,500
BH-6	0-30	0	0
BH-6	30+	25	4,200
BH-7	0-15	0	0
BH-7	15+	35	4,500
BH-8	0-12	0	0
BH-8	12+	35	4,500
BH-9	0-20	0	0
BH-9	20+	35	4,500
BH-10	0-20	0	0

BH-10	20+	35	4,500
BH-11	0-20	0	0
BH-11	20+	35	4,500
BH-12	0-15	0	0
BH-12	15+	35	4,500
BH-13	0-8	0	0
BH-13	8+	35	4,500
BH-14	0-10	10	1,500
BH-14	10+	35	4,500
BH-15	0-8	15	2,500
BH-15	8+	35	4,500
BH-16	0-5	0	0
BH-16	5+	15	2,500
BH-17	0-10	0	0
BH-17	10+	35	4,500
BH-18	0-10	0	0
BH-18	10+	30	3,500
BH-19	0-8	0	0
BH-19	8+	20	3,500

4.8 General Earthwork

4.8.1 Subgrade Preparation

Subgrade preparation is important to limit differential settlement of the proposed trail. Where possible and to depths feasible, soft and organic material should be removed from below the alignment prior to placement of fill. We recommend provisions be made to include the use of geogrid below any structural fill. This will help limit future distresses and provide better support for placing and compacting fill soils above. We recommend an HWA geotechnical engineer, or their representative, be present during construction to verify proper subgrade preparation is completed.

4.8.2 Structural Fill Material

Structural fill materials should consist of clean, free-draining, granular soils free from organic matter or other deleterious materials. Such materials should be less than 4 inches in maximum particle dimension, with less than 7 percent fines (portion passing the U. S. Standard No. 200 sieve), as specified for “Gravel Borrow” in Section 9-03.14(1) of the WSDOT *Standard Specifications* (WSDOT, 2020). The fine-grained portion of structural fill soils should be non-plastic. The native soils possess high fines content and will be moisture sensitive and difficult to place and compact during wet weather. Therefore, we do not recommend that the native soils be reused as structural fill.

4.8.3 Compaction

Structural fill soils should be moisture conditioned and compacted to the requirements specified in Section 2-03.3(14)C, Method C, of the WSDOT *Standard Specifications* (WSDOT, 2020); except the standard of compaction achieved should not be less than 95% of the maximum dry density (MDD) determined for the fill material by test method ASTM D 1557 (Modified Proctor). Structural fill should be placed and compacted in loose, horizontal lifts of not more than 8 inches in thickness. Subgrade compaction in areas under proposed trail pavement should conform to the requirements of Section 2-06.3(1) of the WSDOT *Standard Specifications* (WSDOT, 2020).

At the time of placement, the moisture content of structural fill should be at or near optimum. Achievement of proper density of a compacted fill depends on the size and type of compaction equipment, the number of passes, thickness of the layer being compacted, and soil moisture-density properties. In areas where limited space restricts the use of heavy equipment, smaller equipment can be used, but the soil must be placed in thin enough layers and at the proper moisture content to achieve the required relative compaction. Generally, loosely compacted soils result from poor construction technique and/or improper soil moisture content. Soils with high fines contents are particularly susceptible to becoming too wet and coarse-grained materials easily become too dry for proper compaction.

4.8.4 Wet Weather Earthwork

The onsite soils are considered to be highly moisture sensitive, and we do not recommend earthwork occur during wet weather. General recommendations relative to earthwork performed in wet weather or in wet conditions are presented below. These recommendations should be incorporated into the contract specifications.

- Earthwork should be performed in small areas to minimize exposure to wet weather. Excavation of unsuitable and/or softened soil should be followed promptly by placement and compaction of clean structural fill. The size and type of construction equipment used may need to be limited to prevent soil disturbance.
- For wet weather conditions, the allowable fines content of the structural fill should be reduced to no more than 5 percent by weight of the portion of the fill material passing the ¾-inch sieve. The fines should be non-plastic. The ground surface within the construction area should be graded to promote surface water run-off and to prevent ponding.
- Within the construction area, the ground surface should be sealed on completion of each shift by a smooth drum vibratory roller, or equivalent, and under no circumstances should soil be left uncompacted and exposed to moisture infiltration.
- Bales of straw and/or geotextile silt fences should be strategically located to control erosion and the movement of soil.

4.8.5 Temporary Excavations

Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the contractor. In accordance with Part N of Washington Administrative Code (WAC) 296-155, all temporary cuts in excess of 4 feet in height must be either sloped or shored prior to entry by personnel. The existing fill soils are generally classified as Type C soils per WAC 296-155. Where shoring is not used, temporary cuts in Type C soils should be sloped no steeper than 1.5H:1V (horizontal: vertical). The recommended maximum slope is applicable to temporary excavations above the water table only; flatter side slopes would be required for excavations below the water table.

The contractor should monitor the stability of the temporary excavations and adjust the construction schedule and slope inclination accordingly. The contractor should be responsible for control of ground and surface water and should employ sloping, slope protection, ditching, sumps, dewatering, and other measures, as necessary, to prevent sloughing of soils.

5. CONDITIONS AND LIMITATIONS

We have prepared this report for the City of Lynnwood and Parametrix for use in design of this project. The conclusions and interpretations presented in this report should not be construed as our warranty of subsurface conditions at the site. Experience has shown that soil and ground water conditions can vary significantly over small distances and with time. Inconsistent conditions can occur between explorations that may not be detected by a geotechnical study of this scope and nature. If, during future site operations, subsurface conditions are encountered which vary appreciably from those described herein, HWA should be notified for review of the recommendations of this report, and revision of such if necessary. If there is a substantial lapse of time between submission of this report and the start of construction, or if conditions change due to construction operations, it is recommended that this report be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

Within the limitations of approved scope, schedule and budget, HWA attempted to execute these services in accordance with generally accepted professional principles and practices in the fields of geotechnical engineering and engineering geology at the time the report was prepared. No warranty, express or implied, is made.

HWA does not practice or consult in the field of safety engineering. We do not direct the contractor's operations and cannot be responsible for the safety of personnel other than our own on the site. As such, the safety of others is the responsibility of the contractor. However, the contractor should notify the owner if any of the recommended actions presented herein are considered unsafe.

We appreciate the opportunity to provide geotechnical services for this project. Should you have any questions, or if we may be of further service, please call.

Sincerely,

HWA GEOSCIENCES INC.

Bryan Hawkins, P.E.
Senior Geotechnical Engineer

6. REFERENCES

AASHTO, 2017, *LRFD Bridge Design Specification, 8th Edition*, November 2017.

American Association of State Highway and Transportation Officials, 1993, *AASHTO Guide for Design of Pavement Structures*, American Association of State Highway and Transportation Officials.

Minard J.P., 1983, *Geologic Map of the Edmonds East and Part of the Edmonds West Quadrangles, Washington*, U.S. Geological Survey, Miscellaneous Field Studies Map MF-1541, scale 1:24,000.

SEAOC and OSHPD, *Seismic Design Maps*, https://seismicmaps.org/

USGS, 2019, *Design Ground Motions*, Earthquake Hazards Program, https://earthquake.usgs.gov/hazards/designmaps/index.phpWSDOT, 2003, *WSDOT Pavement Guide*, Washington State Department of Transportation.

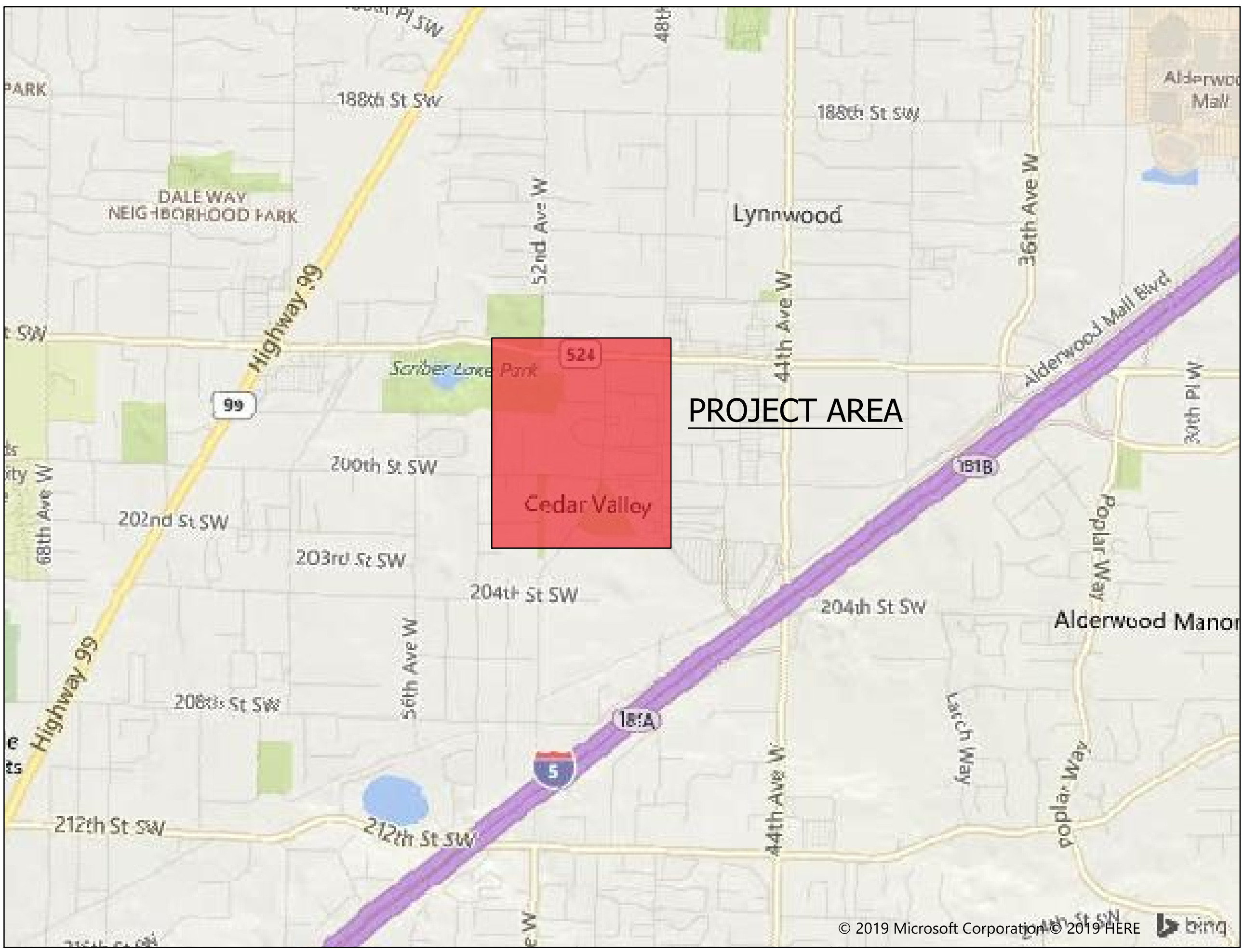
WSDOT, 2020, *Standard Specifications for Road, Bridge, and Municipal Construction*, M 41-10.

WSDOT, Memo to Designers, 2017, "*AASHTO Guide Specifications for LRFD Seismic Bridge Design Amendments*" dated January 8, 2017

SITE MAP

0 500' 1000' 1500' 2000'

SCALE: 1" = 1000'



VICINITY MAP

0 1000' 2000' 3000' 4000'

SCALE: 1" = 2000'

HWA GEOSCIENCES INC.
DBE/MWBE

SITE AND VICINITY MAP

SCRIBER CREEK TRAIL
LYNNWOOD, WASHINGTON

FIGURE NO.:	1
DRAWN BY: CF	CHECK BY: BH
PROJECT #	2018-102-21

S:\2018 PROJECTS\2018-102-21 SCRIBER CREEK TRAIL\CAD\2018-102-21 SCRIBER CREEK TRAIL_12.30.2019.DWG <1> Plotted: 1/3/2020 8:09 AM

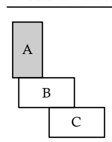
SCRIBER CREEK TRAIL

Scale: 1" = 80'-0"

EXPLORATION LEGEND

BH-1 ⊕ BOREHOLE DESIGNATION AND APPROXIMATE LOCATION

KEY MAP



0 40 80 120 160

SCALE: 1" = 80'

BASE MAP PROVIDED BY: BING AND SURVEYOR

HWA GEOSCIENCES INC. DBE/MWBE

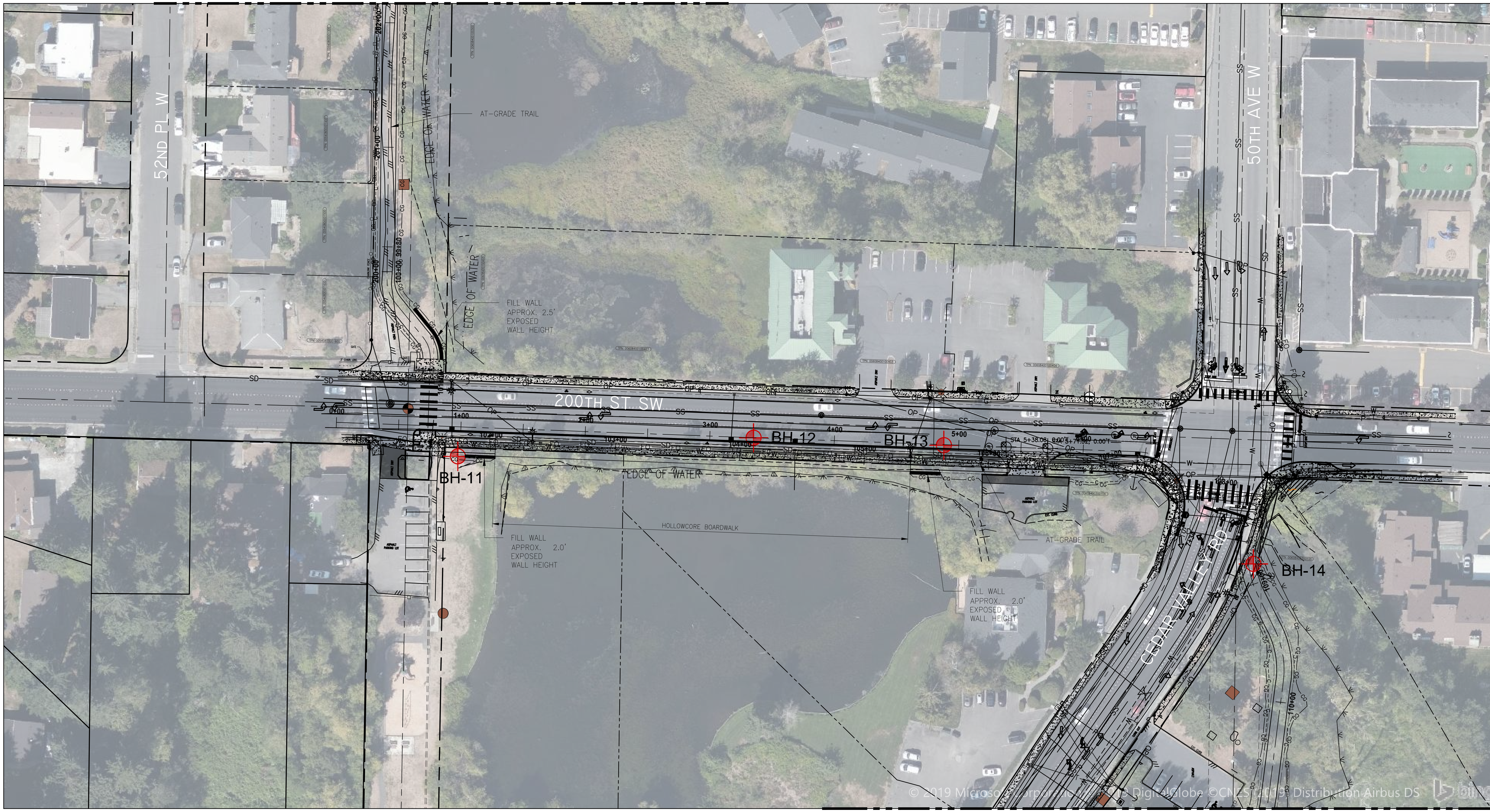
SCRIBER CREEK TRAIL
LYNNWOOD, WASHINGTON

SITE & EXPLORATION PLAN

DRAWN BY:	FIGURE NO.:
CF	2A
CHECK BY:	PROJECT NO.:
BH	2018-102-21

S:\2018 PROJECTS\2018-102-21 SCRIBER CREEK TRAIL\TASK 300 - FINAL DESIGN\CAD\2018-102-21 SCRIBER CREEK TRAIL_12.30.2019.DWG <2A> Plotted: 2/11/2020 12:14 PM

MATCHLINE SEE 2A



MATCHLINE SEE 2C

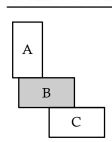
SCRIBER CREEK TRAIL

Scale: 1" = 80'-0"

EXPLORATION LEGEND

BH-1 ⊕ BOREHOLE DESIGNATION AND APPROXIMATE LOCATION

KEY MAP



N

0 40 80 120 160

SCALE: 1" = 80'

BASE MAP PROVIDED BY: BING AND SURVEYOR

HWA GEOSCIENCES INC. DBE/MWBE

SCRIBER CREEK TRAIL LYNNWOOD, WASHINGTON	SITE & EXPLORATION PLAN	DRAWN BY: CF	FIGURE NO.: 2B
		CHECK BY: BH	PROJECT NO.: 2018-102-21

S:\2018 PROJECTS\2018-102-21 SCRIBER CREEK TRAIL\TASK 300 - FINAL DESIGN\CAD\2018-102-21 SCRIBER CREEK TRAIL_12.30.2019.DWG <2B> Plotted: 2/11/2020 12:23 PM

SCRIBER CREEK TRAIL

Scale: 1" = 80'-0"

EXPLORATION LEGEND

BH-1 BOREHOLE DESIGNATION AND APPROXIMATE LOCATION

KEY MAP

A B C

0 40 80 120 160

SCALE: 1" = 80'

BASE MAP PROVIDED BY: BING AND SURVEYOR

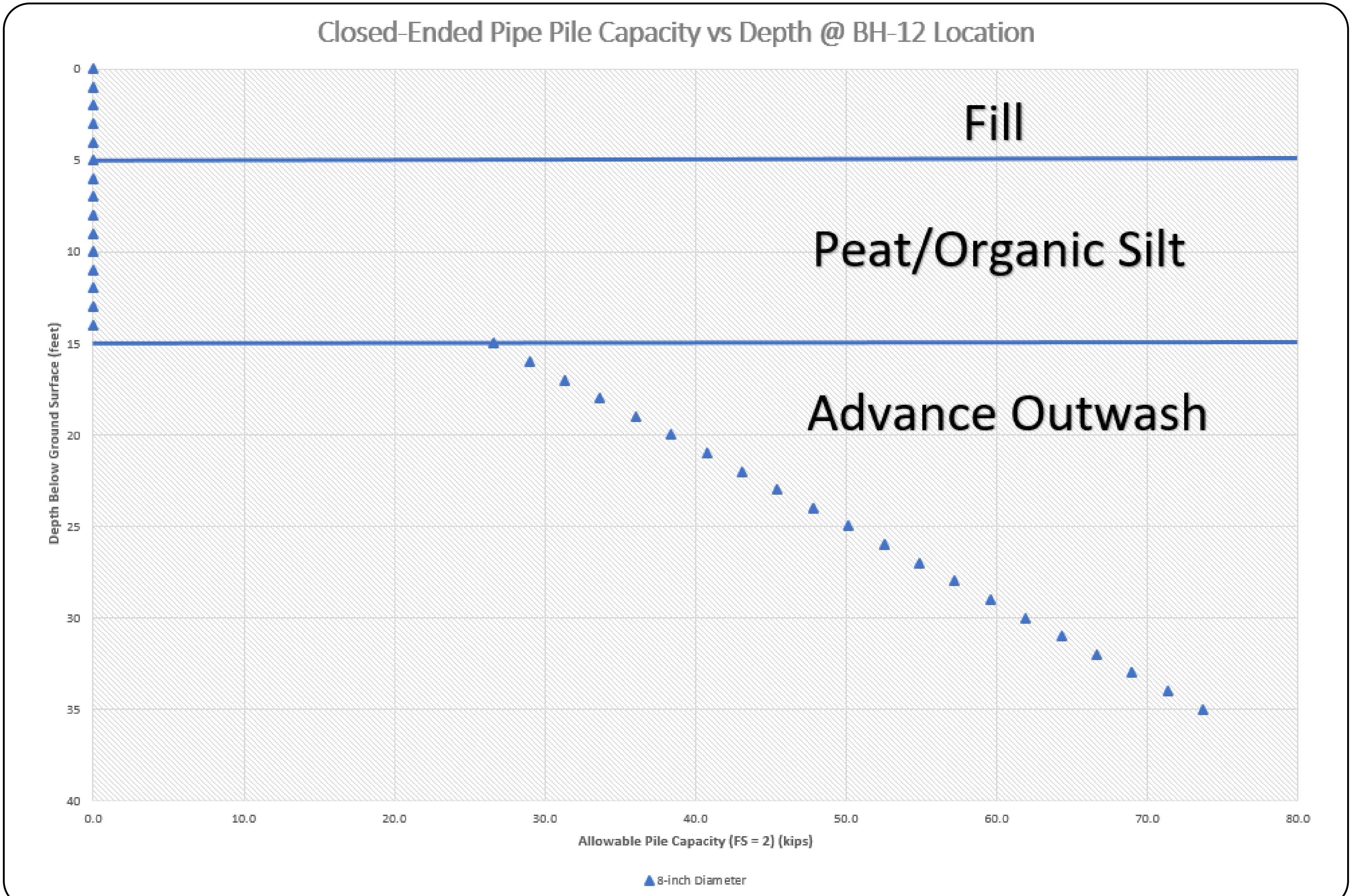
HWA GEOSCIENCES INC. DBE/MWBE

SCRIBER CREEK TRAIL
LYNNWOOD, WASHINGTON

SITE & EXPLORATION PLAN

DRAWN BY:	FIGURE NO.:
CF	2C
CHECK BY:	PROJECT NO.:
BH	2018-102-21

S:\2018 PROJECTS\2018-102-21 SCRIBER CREEK TRAIL\TASK 300 - FINAL DESIGN\CAD\2018-102-21 SCRIBER CREEK TRAIL_12.30.2019.DWG <2C> Plotted: 2/11/2020 12:10 PM



HWA GEOSCIENCES INC.
DBE/MWBE

ALLOWABLE PILE CAPACITIES	FIGURE NO. 3
SCRIBER CREEK TRAIL LYNNWOOD, WASHINGTON	PROJECT NO. 2018-102-21

APPENDIX A

FIELD EXPLORATIONS

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALUE

COHESIONLESS SOILS			COHESIVE SOILS		
Density	N (blows/ft)	Approximate Relative Density(%)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	0 - 15	Very Soft	0 to 2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	35 - 65	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	over 30	>4000

USCS SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP DESCRIPTIONS	
Coarse Grained Soils	Gravel and Gravelly Soils	Clean Gravel (little or no fines)	GW	Well-graded GRAVEL
			GP	Poorly-graded GRAVEL
	More than 50% of Coarse Fraction Retained on No. 4 Sieve	Gravel with Fines (appreciable amount of fines)	GM	Silty GRAVEL
			GC	Clayey GRAVEL
More than 50% Retained on No. 200 Sieve Size	Sand and Sandy Soils	Clean Sand (little or no fines)	SW	Well-graded SAND
			SP	Poorly-graded SAND
	50% or More of Coarse Fraction Passing No. 4 Sieve	Sand with Fines (appreciable amount of fines)	SM	Silty SAND
			SC	Clayey SAND
Fine Grained Soils	Silt and Clay	Liquid Limit Less than 50%	ML	SILT
			CL	Lean CLAY
			OL	Organic SILT/Organic CLAY
50% or More Passing No. 200 Sieve Size	Silt and Clay	Liquid Limit 50% or More	MH	Elastic SILT
			CH	Fat CLAY
			OH	Organic SILT/Organic CLAY
Highly Organic Soils			PT	PEAT

TEST SYMBOLS

%F	Percent Fines
AL	Atterberg Limits: PL = Plastic Limit, LL = Liquid Limit
CBR	California Bearing Ratio
CN	Consolidation
DD	Dry Density (pcf)
DS	Direct Shear
GS	Grain Size Distribution
K	Permeability
MD	Moisture/Density Relationship (Proctor)
MR	Resilient Modulus
OC	Organic Content
pH	pH of Soils
PID	Photoionization Device Reading
PP	Pocket Penetrometer (Approx. Comp. Strength, tsf)
Res.	Resistivity
SG	Specific Gravity
CD	Consolidated Drained Triaxial
CU	Consolidated Undrained Triaxial
UU	Unconsolidated Undrained Triaxial
TV	Torvane (Approx. Shear Strength, tsf)
UC	Unconfined Compression

SAMPLE TYPE SYMBOLS

- 2.0" OD Split Spoon (SPT) (140 lb. hammer with 30 in. drop)
- Shelby Tube
- Non-standard Penetration Test (3.0" OD Split Spoon with Brass Rings)
- Small Bag Sample
- Large Bag (Bulk) Sample
- Core Run
- 3-1/4" OD Split Spoon

GROUNDWATER SYMBOLS

- Groundwater Level (measured at time of drilling)
- Groundwater Level (measured in well or open hole after water level stabilized)

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5 mm) to No. 200 (0.074 mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074mm)

COMPONENT PROPORTIONS

PROPORTION RANGE	DESCRIPTIVE TERMS
< 5%	Clean
5 - 12%	Slightly (Clayey, Silty, Sandy)
12 - 30%	Clayey, Silty, Sandy, Gravelly
30 - 50%	Very (Clayey, Silty, Sandy, Gravelly)

Components are arranged in order of increasing quantities.

NOTES: Soil classifications presented on exploration logs are based on visual and laboratory observation. Soil descriptions are presented in the following general order:

Density/consistency, color, modifier (if any) GROUP NAME, additions to group name (if any), moisture content. Proportion, gradation, and angularity of constituents, additional comments. (GEOLOGIC INTERPRETATION)

Please refer to the discussion in the report text as well as the exploration logs for a more complete description of subsurface conditions.

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
MOIST	Damp but no visible water.
WET	Visible free water, usually soil is below water table.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

LEGEND OF TERMS AND SYMBOLS USED ON EXPLORATION LOGS

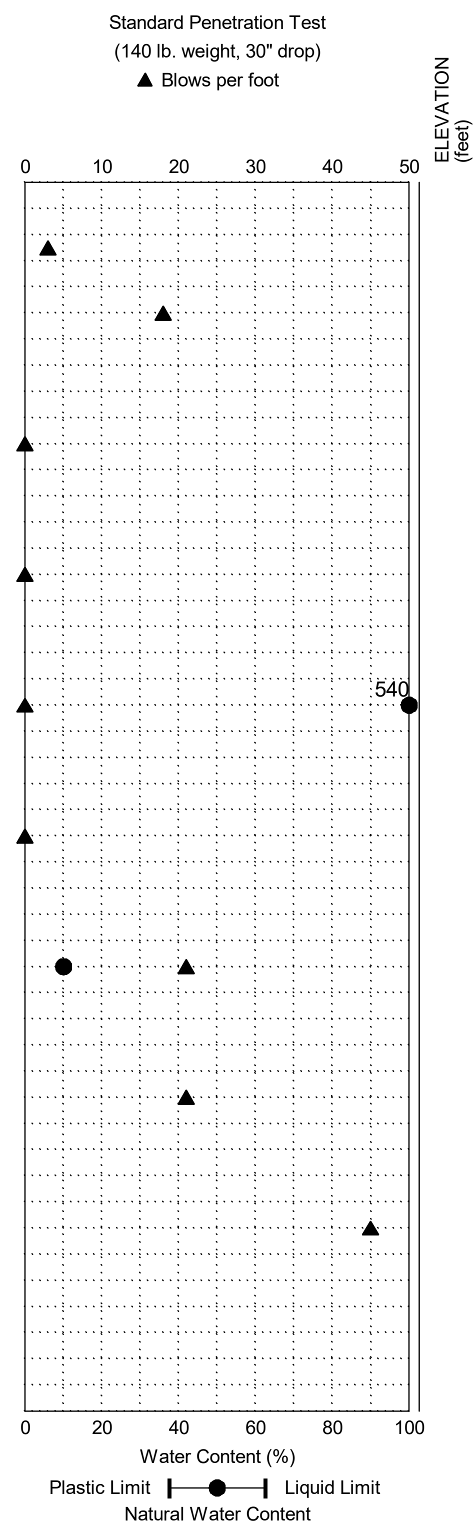
PROJECT NO.: 2018-102-21 FIGURE: A-1

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2A

DATE STARTED: 7/10/2019
DATE COMPLETED: 7/10/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0	SM	Very loose, brown, silty SAND, moist to wet.			
		Very loose, olive brown to brown, slightly gravelly, very silty, fine to medium SAND, moist to wet. **(TOPSOIL/FILL)**	S-1	3-1-2	
5	PT	Water added to borehole to counter heave. Driven through piece of wood. Blow counts may be overstated. Very soft, dark brown, PEAT, moist to wet. **(PEAT)**	S-2	7-15-3	
10		Same. Abundant organics such as root and bark debris. Sample is moist.	S-3	0-0-0	
15		Same. Sample is more decomposed than above.	S-4	0-0-0	
20		Same. Very dark brown PEAT.	S-5	0-0-0	OC
25		Same. Grades to lighter brown and more decomposed. Grades to an organic SILT at tip.	S-6	0-0-0	
30	SP SM	Medium dense, gray, slightly silty, gravelly, fine to medium SAND, moist. **(ADVANCE OUTWASH)**	S-7	0-6-15	GS
35	SP	Medium dense, gray, rounded gravelly, fine to medium SAND, wet.	S-8	6-12-9	
40	SM	Dense, gray, gravelly, silty, fine to medium SAND, wet.	S-9	15-25-20	

Borehole terminated at 41.5 feet below ground surface (bgs).
Ground water seepage not observable, since water was added to borehole. Borehole abandoned with bentonite chips.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH- 1

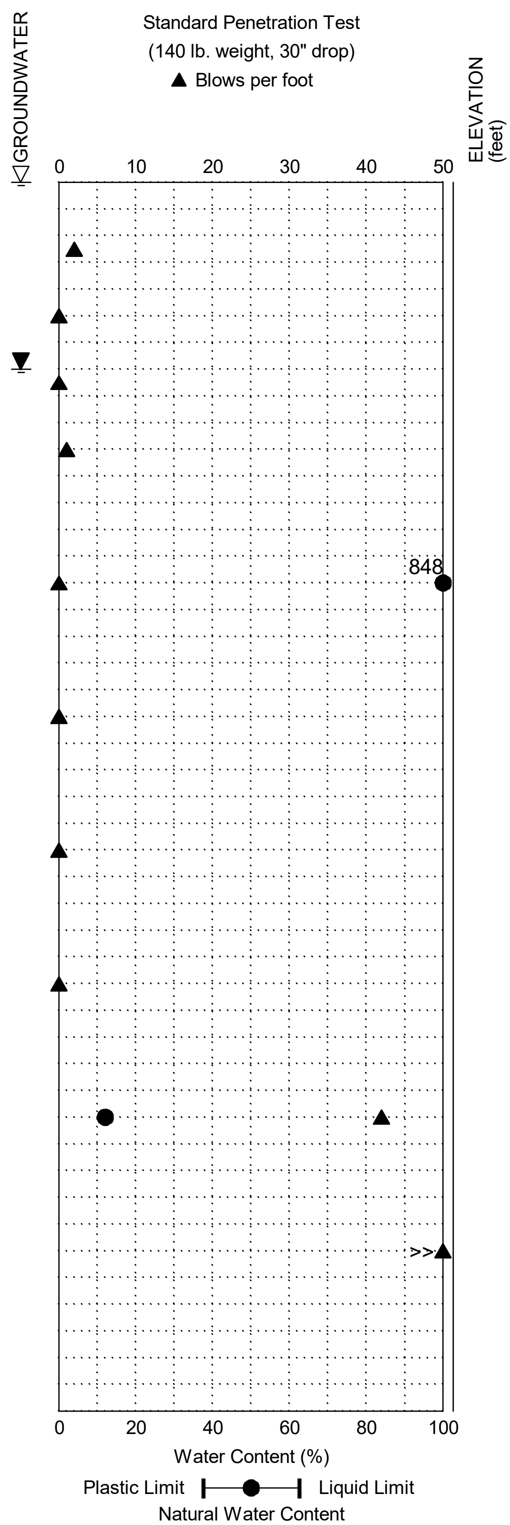
PAGE: 1 of 1

PROJECT NO.: 2018-102-21 FIGURE: A-2

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2A

DATE STARTED: 7/10/2019
DATE COMPLETED: 7/10/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0	SM	Very loose, brown, silty SAND, wet.			
3	PT	Very loose, brown to olive brown, slightly gravelly, fine to medium SAND, moist with organics. **(TOPSOIL/FILL)**	S-1	2-1-1	
5		Very soft, dark brown, PEAT, moist. **(PEAT)**	S-2	0-0-0	
		Same. Abundant organics such as intact roots and bark.	S-3	0-0-0	
10		Same. Sample is wet. Water added to borehole to counter heave.	S-4	0-0-1	
15		Same. Minor black organics observed.	S-5	0-0-0	OC
20		Same. Less dark brown in color. Grading towards an organic silt.	S-6	0-0-0	
25		Same. Organics appear more decomposed.	S-7	0-0-0	
30		Very soft, dark brown, PEAT, grading to gray fine sandy, SILT with depth, wet.	S-8	0-0-0	
32	SP SM	Driller notes change in density.			
35		Dense, gray, slightly rounded gravelly, slightly silty, fine to medium SAND, wet. **(ADVANCE OUTWASH)**	S-9	5-15-27	GS
40	SP	Dense, gray, poorly graded, clean, medium SAND, moist.	S-10	37-50/6"	
45		Borehole terminated at 41 feet below ground surface (bgs). Ground water seepage observed from 0 to 2 feet bgs (perched) and from 7 feet bgs. Borehole abandoned with bentonite chips.			



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH- 2
PAGE: 1 of 1

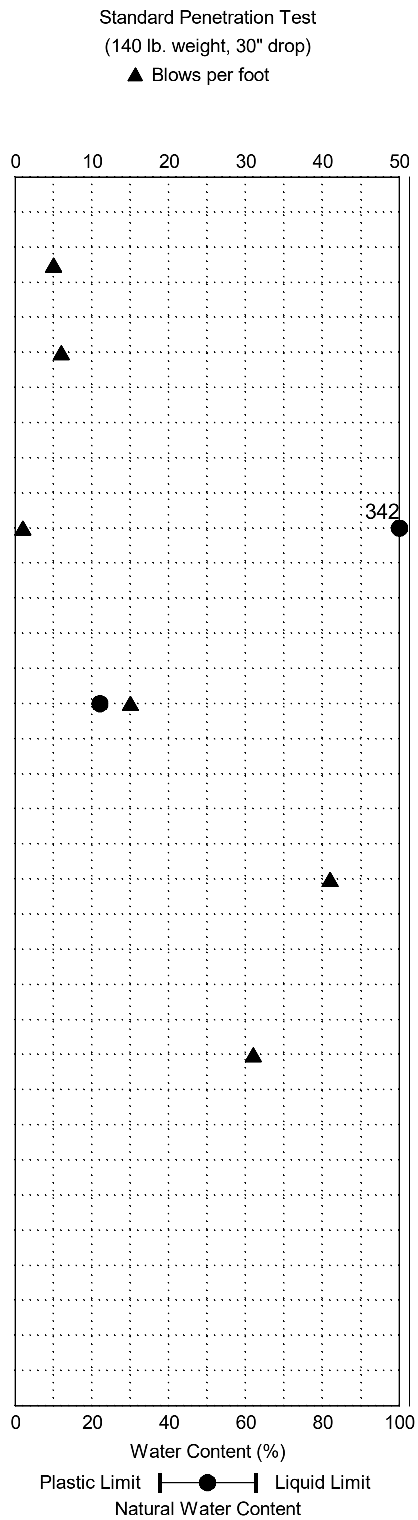
PROJECT NO.: 2018-102-21 FIGURE: A-3

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2A

DATE STARTED: 7/3/2019
DATE COMPLETED: 7/3/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	SM	Very loose, brown, silty SAND, moist.				
		Loose, olive brown to dark brown, silty SAND, moist. 2" of bark/ wood and abundant organics. **(TOPSOIL/FILL)**	S-1	1-2-3		
5	PT	Sample driven through piece of wood. Blow counts overstated. **(PEAT)**	S-2	4-3-3		
10		Very soft, dark brown, PEAT, wet. Abundant roots and bark. Water added to borehole to counter heave.	S-3	0-0-1	OC	▽
15	SP	Medium dense, gray, slightly gravelly, poorly graded SAND, wet. Grades coarser with depth. **(ADVANCE OUTWASH)**	S-4	4-8-7	GS	
20		Dense, gray, clean, fine to medium SAND, moist. Scattered gravels, 2" layer of blue-gray silty sand.	S-5	11-19-22		
25		Dense, gray, poorly graded, clean, fine SAND, wet.	S-6	5-12-19		

Borehole terminated at 26.5 feet below ground surface (bgs).
Ground water seepage observed at 10 feet bgs.
Borehole abandoned with bentonite chips.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH- 3

PAGE: 1 of 1

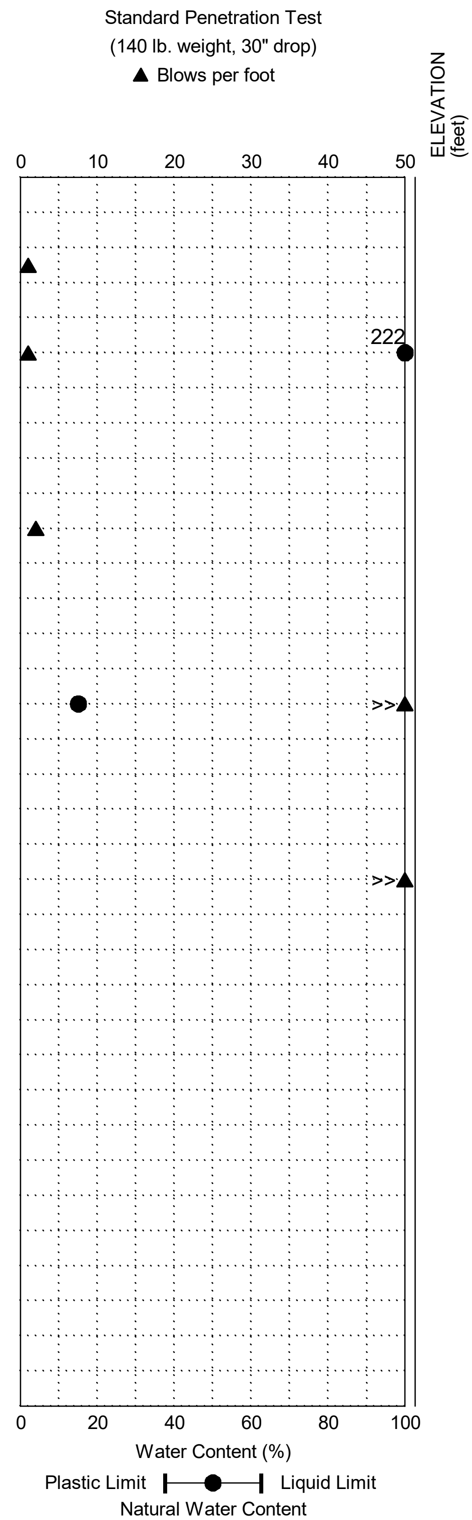
PROJECT NO.: 2018-102-21 FIGURE: A-4

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2A

DATE STARTED: 7/3/2019
DATE COMPLETED: 7/3/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	SM	Very loose, brown, silty SAND, moist. **(TOPSOIL)**				
	PT					
		Very soft, dark brown, PEAT, moist. 1/8" sand lens. Abundant root and wood debris. **(PEAT)**	S-1	1-0-1		
5		Same. Sample is more moist. 3" lenses of poorly graded medium sand, scattered gravel.	S-2	1-0-1	OC	
						∇
10		Very soft, dark brown, PEAT, grading to gray, clean, medium SAND, moist. Scattered gravel.	S-3	1-1-1		
	SP SM					
15		Very dense, gray, slightly silty, poorly graded, medium SAND, moist. Scattered gravel and coarse sand. **(ADVANCE OUTWASH)**	S-4	9-30-36	GS	
20		Same.	S-5	20-25-30		
25						
30						
35						

Borehole terminated at 21.5 feet below ground surface (bgs).
Ground water seepage observed at 9 feet bgs.
Borehole abandoned with bentonite chips.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

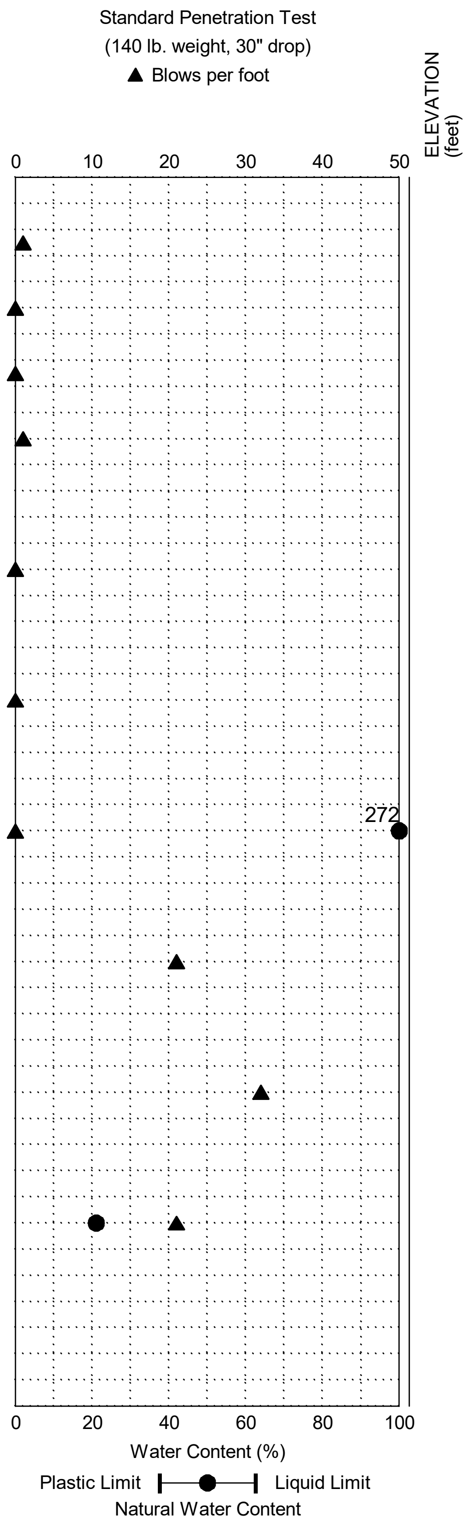
BORING:
BH- 4

PROJECT NO.: 2018-102-21 FIGURE: A-5

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2A

DATE STARTED: 7/3/2019
DATE COMPLETED: 7/3/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0		SM	Very loose, brown, silty SAND, moist. **(TOPSOIL)**					
		PT	Very soft, dark brown to reddish brown, PEAT, moist. Abundant root and wood debris. **(PEAT)**	☒	S-1	0-0-1		
5			Same. Sample grades from dark brown to reddish brown with depth. Root and bark pieces.	☒	S-2	0-0-0		
			Same. Dark brown in color, with strong organic ordor. Intact roots and bark pieces.	☒	S-3	0-0-0		
10			Same. 2" piece of wood, sample is more moist. Driller added water to borehole to counter heave.	☒	S-4	1-0-1		▽
15			Same. 1" piece of wood. Color grades from reddish brown to dark brown with depth.	☒	S-5	1-0-0		
20			Same. Organics less intact.	☒	S-6	0-0-0		
25			Same. Organics appear more decomposed.	☒	S-7	0-0-0	OC	
30		SP	Medium dense, gray, slightly gravelly, slightly silty to clean, fine to medium SAND, moist. Scattered coarse sand and gravel. **(ADVANCE OUTWASH)**	☒	S-8	4-10-11		
35			Dense, gray, clean, medium, poorly graded SAND, moist. Scattered gravel and coarse sand.	☒	S-9	14-19-13		
40		SM	Medium dense, gray, silty, grades from fine to medium, SAND, moist. Scattered gravel.	☒	S-10	5-9-12	GS	
45			Borehole terminated at 41.5 feet below ground surface (bgs). Ground water seepage observed at 10 feet bgs. Borehole abandoned with bentonite chips.					



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH- 5

PAGE: 1 of 1

PROJECT NO.: 2018-102-21 FIGURE: A-6

BORING-DSM 2018-102-21.GPJ 6/28/24

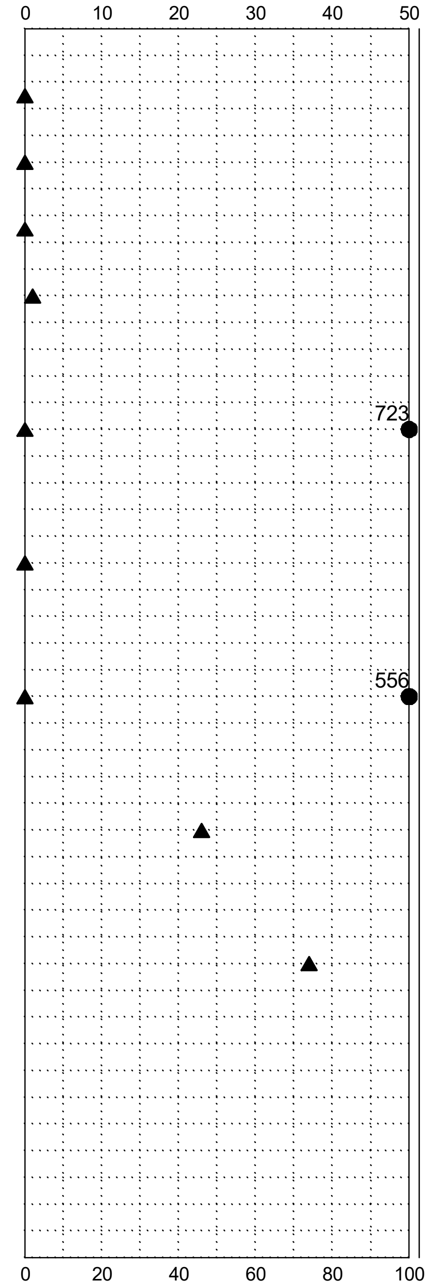
DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2A

DATE STARTED: 7/3/2019
DATE COMPLETED: 7/3/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	SM	Very loose, brown, silty SAND, moist. **(TOPSOIL)**				
2.5	PT	Very soft, dark brown, PEAT, moist to wet. 4" at top of silty fine to medium SAND, wet, with abundant organics. Sample grades less moist with depth. **(PEAT)**	S-1	0-0-0		
5		Same. Abundant roots and bark. Bottom 3" color change to orange brown.	S-2	0-0-0		
7.5		Same. Sample is moist to wet. Strong organic odor.	S-3	1-0-0		▼
10		Same. Sample is wet. Color change to darker brown. Intact bark in shoe of sampler.	S-4	0-0-1		
15		Same. Sample is more decomposed.	S-5	0-0-0	OC	
20		Same. Sample is wet.	S-6	0-0-0		
25		Same. Color change to brown, organics are less intact and more decomposed.	S-7	0-0-0	GS	
30	SM	Medium dense, gray, silty, fine SAND, moist to wet. 1" medium sand lens. **(ADVANCE OUTWASH)**	S-8	5-10-13		
35	SP	Dense, gray, to olive gray, fine, clean SAND, moist, with scattered gravel. Last 3" of silty, gravelly, fine SAND, moist. Driller notes possible heave in borehole.	S-9	13-22-15		

Borehole terminated at 36.5 feet below ground surface (bgs).
Ground water seepage observed from 0 to 2 feet bgs (perched) and from 7.5 feet bgs. Borehole abandoned with bentonite chips.

Standard Penetration Test
(140 lb. weight, 30" drop)
▲ Blows per foot



ELEVATION (feet)

Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

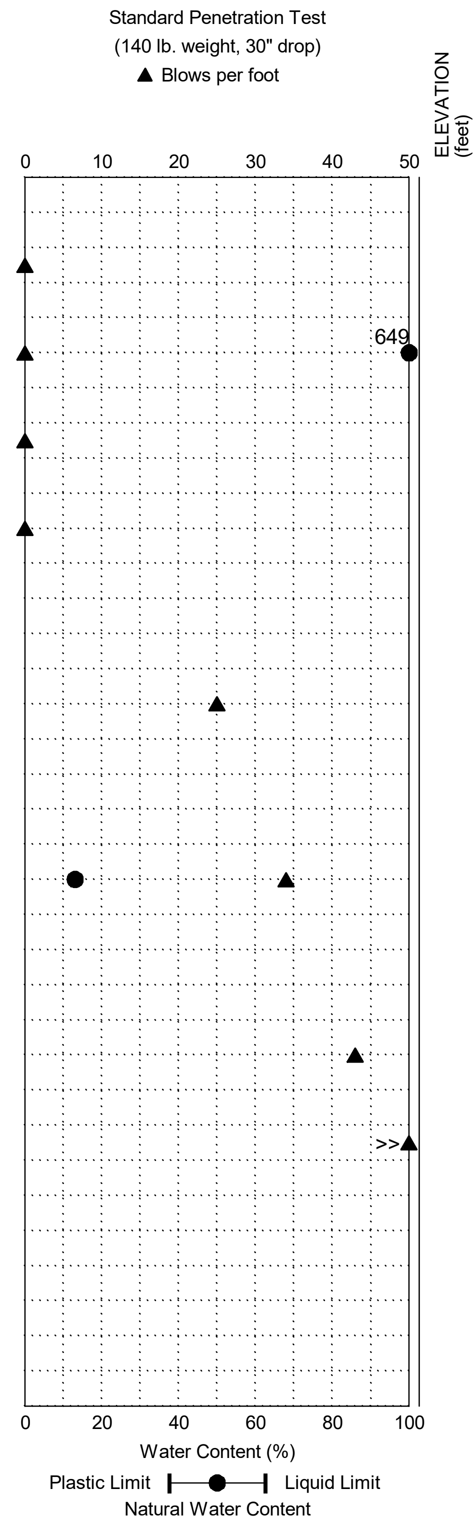
BORING:
BH- 6

PROJECT NO.: 2018-102-21 FIGURE: A-7

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2A

DATE STARTED: 7/2/2019
DATE COMPLETED: 7/2/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0	SM	Very loose, brown, silty SAND, moist. **(TOPSOIL)**			
	PT	Very soft, dark brown, PEAT, moist to wet. Abundant organics. **(PEAT)**	S-1	0-0-0	
5		Same. 2" lens of black organics.	S-2	0-0-0	OC
		Same. Sample is more moist and red brown in color.	S-3	0-0-0	
10		Same. Strong organic odor.	S-4	0-0-0	
15	SP	Medium dense, gray, clean, fine to medium SAND, moist. Scattered gravel, grades finer with depth to a silt. **(ADVANCE OUTWASH)**	S-5	4-12-13	
20	SP SM	Dense, gray, slightly silty, slightly rounded gravelly, fine to medium, SAND, moist. Scattered coarse sand.	S-6	10-16-18	GS
25		Same. 1" coarse sand lens.	S-7	14-18-25	
	SM	Very dense, gray, gravelly, silty, gravelly, fine to medium SAND, moist. Low recovery. Driller notes heave in borehole.	S-8	50/2"	
30		Borehole terminated at 27.67 feet below ground surface (bgs). Ground water seepage not observable since water was added to borehole during drilling. Borehole abandoned with bentonite chips.			
35					



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH- 7

PAGE: 1 of 1

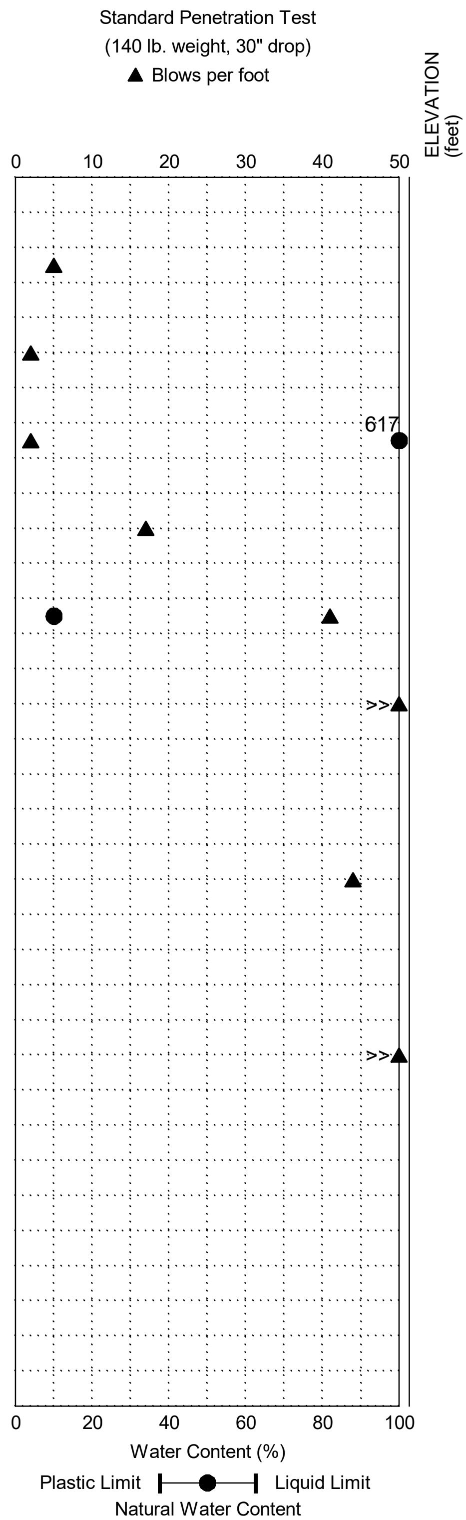
PROJECT NO.: 2018-102-21 FIGURE: A-8

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2A

DATE STARTED: 7/2/2019
DATE COMPLETED: 7/2/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	SM	Very loose, brown to olive brown, silty, gravelly, fine to medium SAND, moist. **(TOPSOIL/ FILL)**	S-1	2-3-2		
	PT	Soft, dark brown, PEAT, moist. Abundant organics. **(PEAT)**				
5		Same. Bark observed, strong organic odor.	S-2	1-1-1		
		Same. Scattered black organics. Reddish brown in color.	S-3	1-1-1	OC	
10		Same. 2" of black organics.	S-4a	0-2-15		
	SP	Medium dense, gray, clean, fine to medium SAND, moist. **(ADVANCE OUTWASH)**	S-4b			
	SM	Dense, gray, silty, fine to coarse SAND, moist, with scattered gravel.	S-5	14-19-22	GS	
15	SP	Very dense, gray, gravelly, clean, fine to medium SAND, moist. Gravel is rounded.	S-6	22-30-26		
20		Dense, gray, fine to medium, clean SAND, moist, with scattered gravel.	S-7	13-18-26		
25	SM	Very dense, gray, silty, gravelly, fine to coarse SAND, moist. Low recovery.	S-8	50/2"		

Borehole terminated at 26.5 feet below ground surface (bgs).
Ground water seepage not observable since water was added to borehole during drilling.
Borehole abandoned with bentonite chips.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH- 8

PAGE: 1 of 1

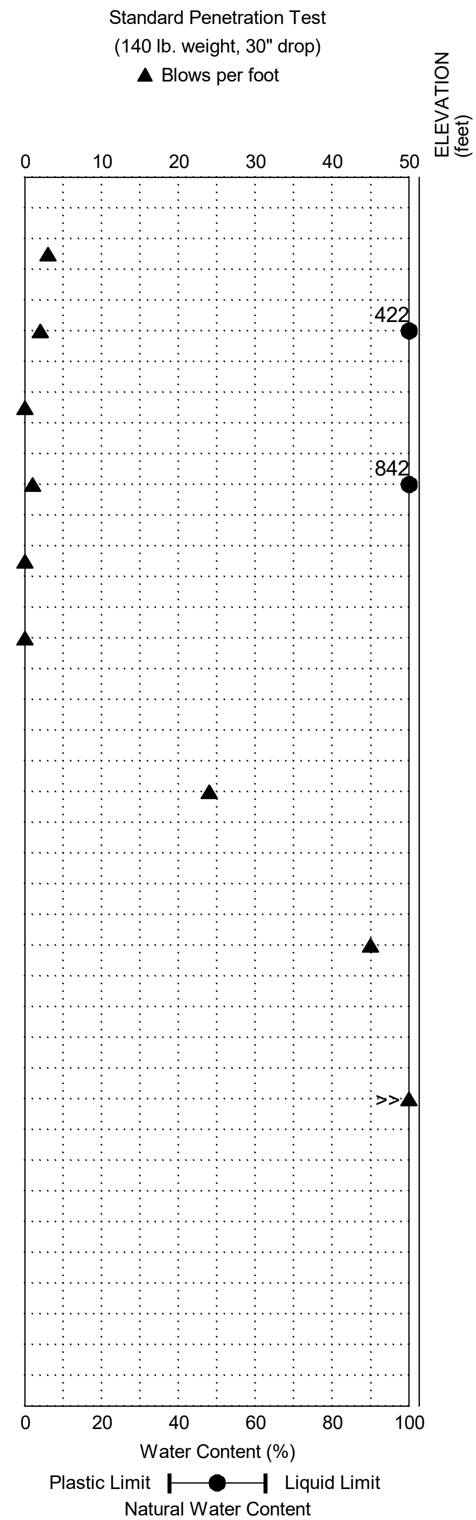
PROJECT NO.: 2018-102-21 FIGURE: A-9

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2A

DATE STARTED: 7/2/2019
DATE COMPLETED: 7/2/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	SM	Very loose, brown, silty, fine to medium SAND, moist. **(TOPSOIL)**				
2.5	PT	Soft, dark brown, PEAT, moist. Abundant organics. Water added to borehole to counter heave. **(PEAT)**	S-1	1-1-2		
5		Same. Sample grades to darker brown and more intact organics such as roots and bark.	S-2	1-1-1	OC	
		Same. Sample is more moist. Strong organic odor.	S-3	0-0-0		
10		Same. Intact 2" piece of bark at 11.75 ft.	S-4	0-0-1	GS	
		Same. Sample is more moist.	S-5	0-0-0		
15		Same. Sample is more decomposed.	S-6	0-0-0		
20	SM	Medium dense, gray, silty fine SAND, moist. **(ADVANCE OUTWASH)**	S-7	9-11-13		
25	SP	Dense, gray, fine to medium, clean SAND, moist. Scattered gravel and coarse sand.	S-8	18-22-23		
30		Very dense, gray, gravelly, fine to medium, clean SAND, moist. Gravel is angular.	S-9	31-50/4"		

Borehole terminated at 31.5 feet below ground surface (bgs).
Ground water seepage not observable since water was added to borehole during drilling. Borehole abandoned with bentonite chips.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH- 9

PROJECT NO.: 2018-102-21 FIGURE: A-10

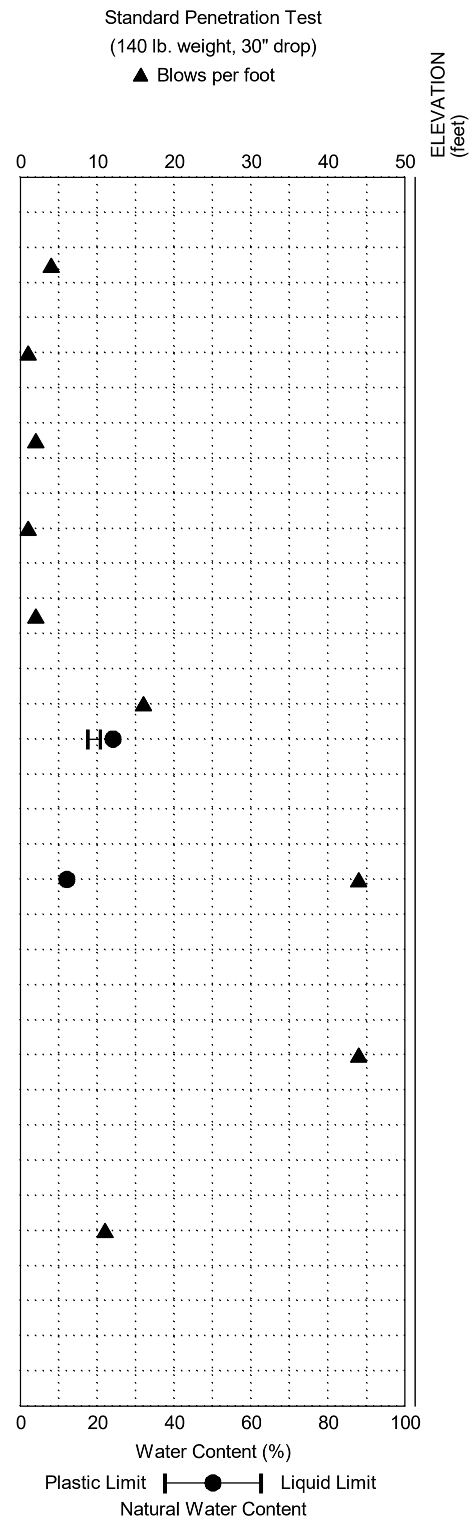
BORING-DSM 2018-102-21.GPJ 6/28/24

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2A

DATE STARTED: 7/2/2019
DATE COMPLETED: 7/2/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	SM	Very loose, dark brown to gray, silty, fine to medium SAND, moist with gravel. Heavily rust mottled, abundant organics. 2" of peat at tip of sample. **(TOPSOIL/ FILL)**	S-1	3-3-1		
4	PT	Very soft, dark brown, PEAT, moist. **(PEAT)**	S-2	1-0-1		
		Same. Abundant roots and other organics. Slightly reddish in color.	S-3	1-1-1		
10		Same. Sample is more moist. 1" layer of black organics at bottom of sample.	S-4	1-0-1		
		Same. Dark brown in color.	S-5	1-1-1		
15		Same.	S-6a	1-2-14		
16	ML	Very stiff, gray, fine sandy, plastic SILT, moist. Medium gray sand at contact. **(ADVANCE OUTWASH)**	S-6b		AL	
20	SM	Dense, gray, slightly gravelly, silty, fine to medium SAND, moist.	S-7	17-23-21	GS	∇ (24 ft)
25	SP	Dense, gray, slightly gravelly, fine to medium SAND, moist.	S-8	14-21-23		
30		Same. Driller notes 8 feet of heave, blow counts may not be representative.	S-9	4-5-6		

Borehole terminated at 31.5 feet below ground surface (bgs).
Ground water seepage observed at 24 feet bgs. Borehole abandoned with bentonite chips.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH-10

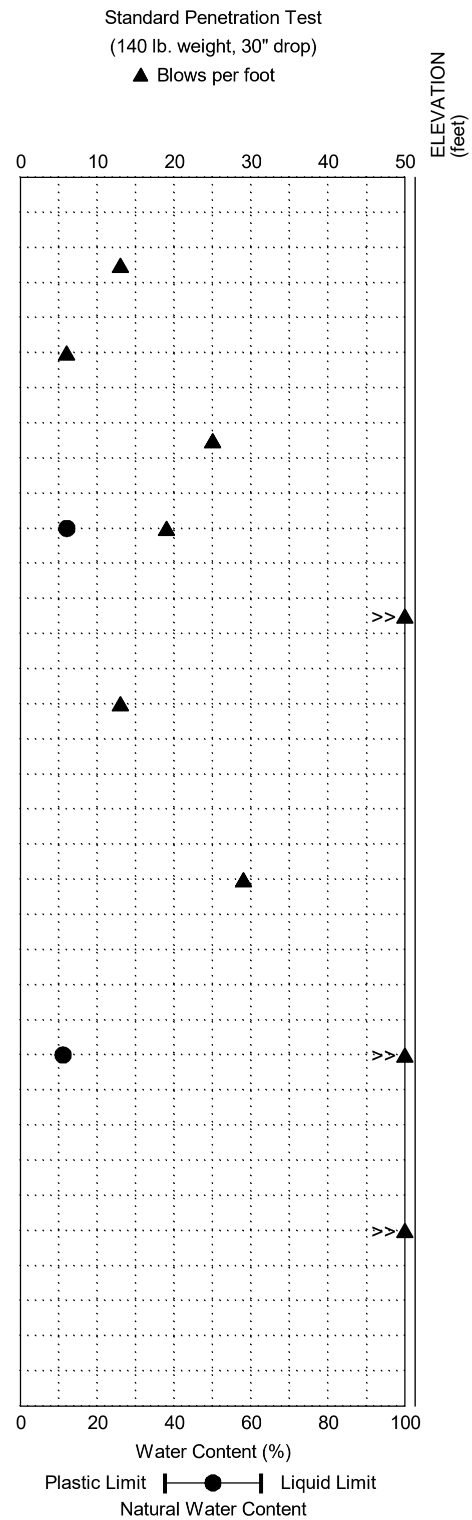
PAGE: 1 of 1

PROJECT NO.: 2018-102-21 FIGURE: A-11

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2B

DATE STARTED: 7/1/2019
DATE COMPLETED: 7/1/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	SM	Medium dense, olive brown, slightly rounded gravelly, silty, fime to medium SAND, moist. **(FILL)**	S-1	6-6-7		
5		Loose, brown, slightly gravelly, silty, fine to medum SAND, moist.	S-2a	3-2-4		
	ML	Medium stiff, gray, sandy, SILT, moist. Moderately rust mottled, scattered organics and gravel. **(ALLUVIUM)**	S-2b			
	GM	Dense, gray, silty, sandy, angular GRAVEL, wet.	S-3	11-11-14		∇ (9 ft)
10	SM	Medium dense, gray, silty, gravelly, fine to medium SAND, wet. 2" of brown decomposed wood at tip of sample.	S-4	11-13-6	GS	
	PT	Stiff, dark brown, PEAT, wet. 12" of wood in sampler. Sampler driven through wood, blow counts overstated. **(PEAT)**	S-5	9-21-50/5"		
15		Low recovery. Very stiff, dark brown, PEAT to silty SAND, wet.	S-6	8-6-7		
20	SP	Medium dense, gray, clean, fine to medium SAND, moist to wet. Scattered gravel. **(ADVANCE OUTWASH)**	S-7	8-11-18		
25	SP SM	Very dense, gray, grades from clean to slightly silty, gravelly, SAND, wet.	S-8	19-32-46	GS	
30	SP	Very dense, olive brown, clean, fine SAND, wet.	S-9	30-45-42		
35		Borehole terminated at 31.5 feet below ground surface (bgs). Ground water seepage observed at 9 feet bgs. Borehole abandoned with bentonite chips.				



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH-11

PAGE: 1 of 1

PROJECT NO.: 2018-102-21 FIGURE: A-12

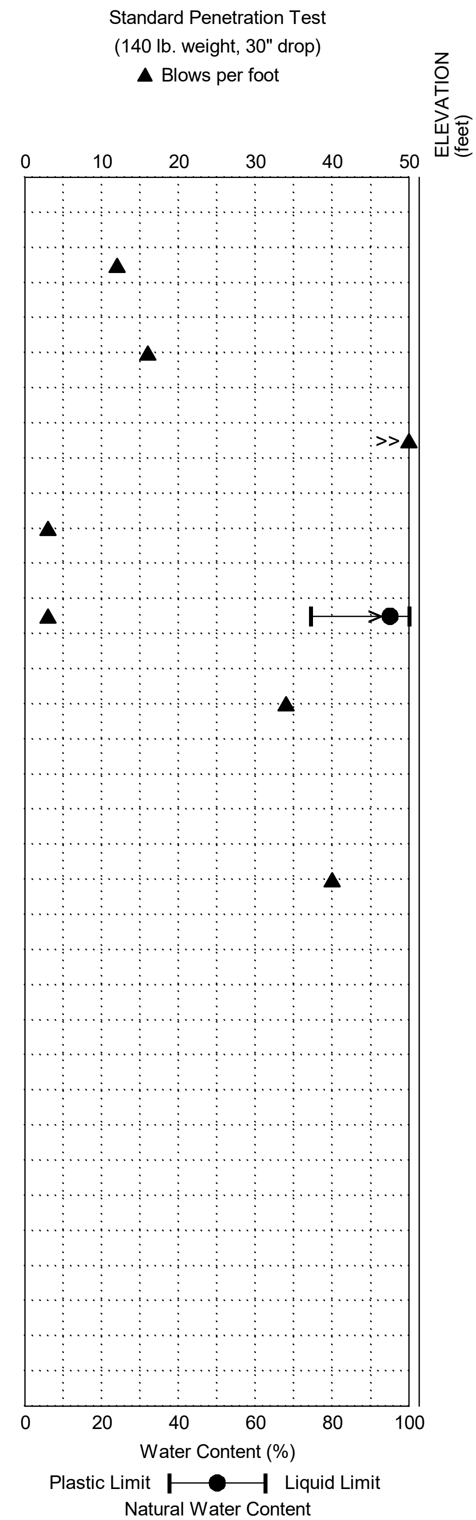
BORING-DSM 2018-102-21.GPJ 6/28/24

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig and Deep Rock XL
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2B

DATE STARTED: 7/9/2019
DATE COMPLETED: 7/1/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0		6-8" of HMA **(HMA)**				
	SM	Medium dense, gray to olive gray, slightly gravelly, silty, fine to medium SAND, moist. **(FILL)**	S-1	28-6-6		
5	GM	Medium dense, gray to olive brown, silty, sandy, angular GRAVEL, wet.	S-2	6-7-9		▽ (approx. 7 ft)
		Gravelly drilling action at 7 feet. Driller notes possible cobbles. Very dense, gray, silty, sandy, GRAVEL, wet.	S-3	50/2"		
	PT	Driller notes change in density from 7.5- 7.75 feet. Very soft, dark brown, PEAT, moist. Bark and root debris. **(PEAT)**	S-4	1-1-2		
	OH	Soft, brown grading to gray, sandy, organic SILT, moist. Interlayered with medium sand.	S-5	1-1-2	AL	▼ (approx. 13 ft)
15	SP	Dense, gray, fine to medium, clean SAND, moist to wet. 2" of silt at 15.5 ft. Brown organics near silt lens. **(ADVANCE OUTWASH)**	S-6	6-14-20		
20		Sampler lost in borehole. No recovery.	S-7	17-18-22		

Borehole terminated at 9 feet below ground surface (bgs) due to refusal with mini bobcat drill rig on 7-1-19. Borehole drilled again, 3 feet to the west from original location with Deep Rock XL drill rig on 7-9-19 and terminated at 21.5 feet bgs. Ground water seepage observed at 9 feet bgs on 7-1-19 and at 13 feet bgs on 7-9-19. Borehole abandoned with bentonite chips.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

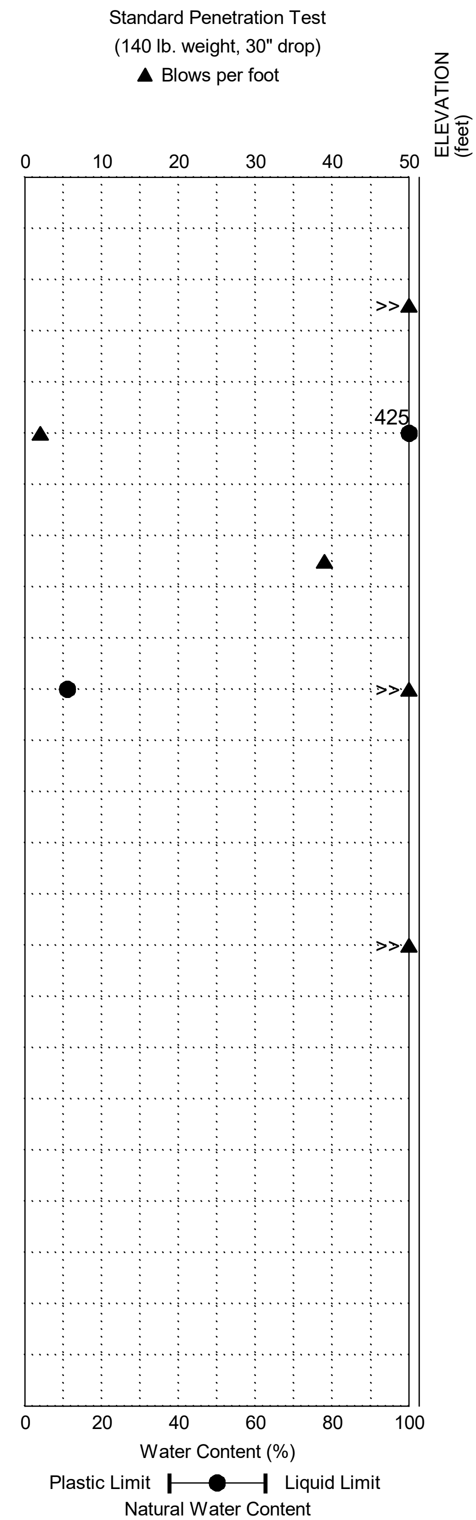
BORING: BH-12
PAGE: 1 of 1

PROJECT NO.: 2018-102-21 FIGURE: A-13

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Deep Rock XL
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2B

DATE STARTED: 7/9/2019
DATE COMPLETED: 7/9/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0			6" of HMA **(HMA)**					
		SP SM	Medium dense, brown, slightly silty, SAND, moist. Gravels coming up with auger cuttings. Gravelly drilling action.					
			Very dense, olive brown, slightly silty, gravelly, fine to medium SAND, moist. Minor rust mottling and root debris. **(FILL)**		S-1	8-40-11		
5		PT	Very soft, dark brown, PEAT, moist. Abundant organics and 2" of bark. **(PEAT)**		S-2	3-1-1	OC	
		SM	Dense, brown to gray, organic silt grading to gravelly, silty, fine SAND, wet. **(WEATHERED ADVANCE OUTWASH)**		S-3	10-17-22		∇
10			Very dense, gray, slightly gravelly, silty, fine to medium SAND, moist.		S-4	12-31-36	GS	
15			Same. Scattered coarse sand and gravel.		S-5	50/5"		
			Borehole terminated at 15.5 feet below ground surface (bgs). Ground water seepage observed at 7.5 feet bgs. Borehole abandoned with bentonite chips.					
20								



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH-13

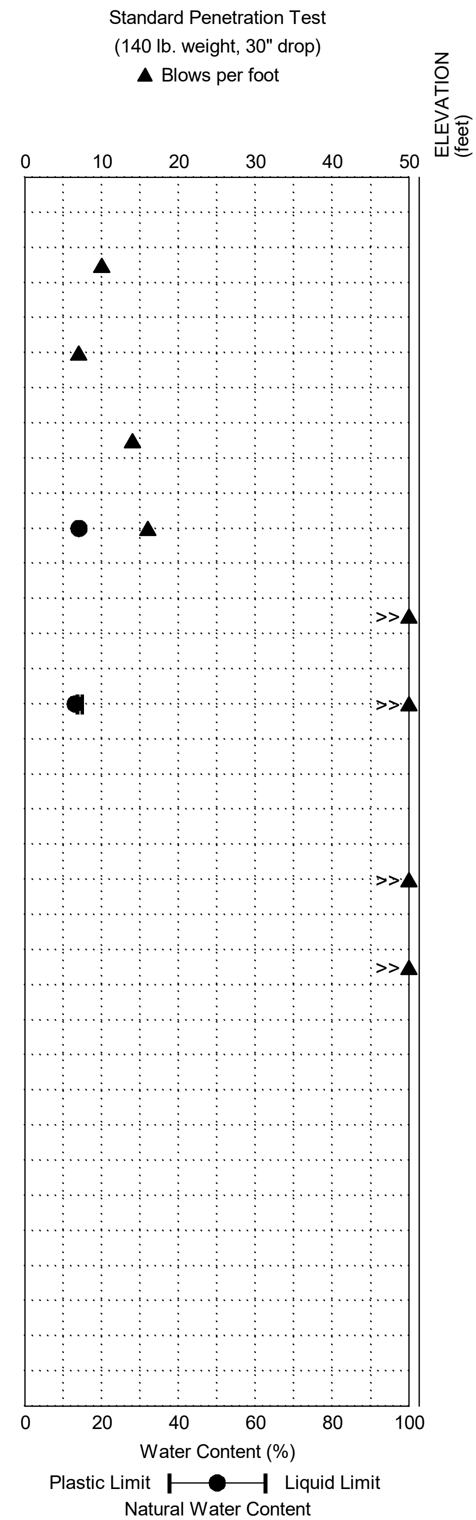
PROJECT NO.: 2018-102-21 FIGURE: A-14

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2B

DATE STARTED: 7/1/2019
DATE COMPLETED: 7/1/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	SM	Medium dense, brown, silty SAND, moist. Gravels coming up with auger cuttings.				
		Low recovery. Medium dense, brown, silty SAND, moist. Abundant rootlets. **(FILL/TOPSOIL)**	S-1	6-6-4		
5	ML	Medium stiff, light yellow brown to gray, sandy SILT, moist. 2" lens of coarse sand. **(ALLUVIUM)**	S-2	2-3-4		
	ML	Very stiff, brown grading to gray, sandy SILT, moist with scattered gravel. Last 1" is wet. Abundant organics in top 4". **(WEATHERED ADVANCE OUTWASH)**	S-3	4-8-6		∇ (9 ft)
10	SM	Medium dense, gray, slightly rounded gravelly, silty, fine to medium SAND, wet.	S-4	18-7-9	GS	
	SM	Very dense, gray, silty, fine SAND, wet. Scattered gravel and coarse sand. **(ADVANCE OUTWASH)**	S-5	16-24-30		
15	ML	Hard, gray, slightly rounded fine gravelly, fine sandy, SILT, moist.	S-6	19-50/4"	AL	
20		Same. Silt is plastic.	S-7	100/6"		
		Hard, gray, slightly gravelly, fine sandy SILT, moist.	S-8	50/3"		

Borehole terminated at 22.75 feet below ground surface (bgs). Ground water seepage observed at 9 feet bgs. Borehole abandoned with bentonite chips.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH-14

PAGE: 1 of 1

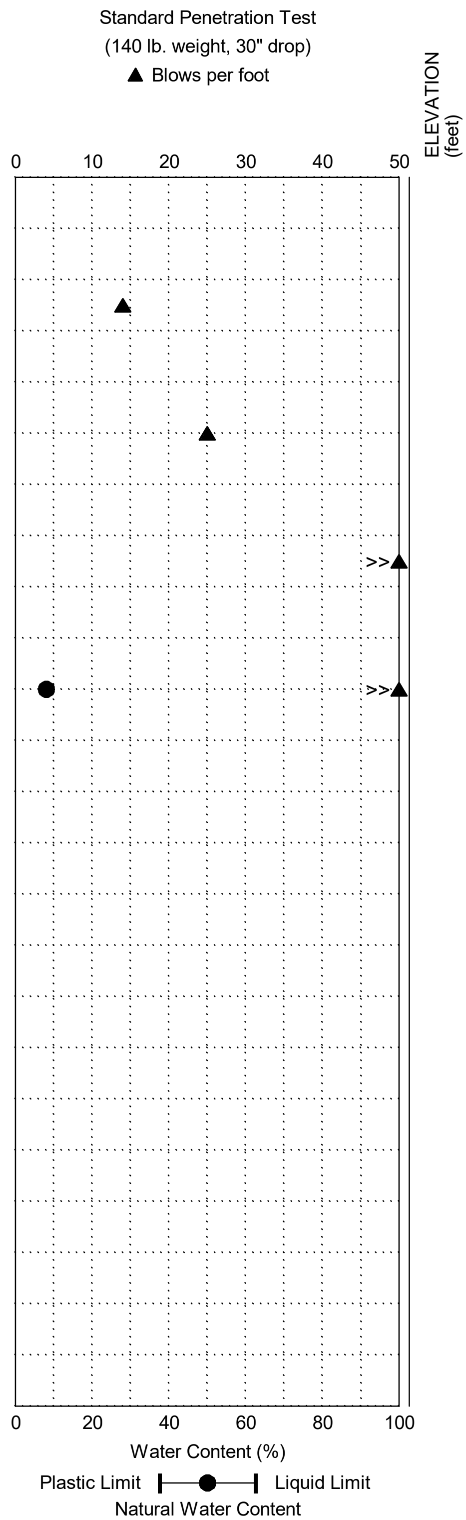
PROJECT NO.: 2018-102-21 FIGURE: A-15

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2C

DATE STARTED: 7/8/2019
DATE COMPLETED: 7/8/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	SM	Medium dense, olive gray, rounded gravelly, silty, fine to medium SAND, moist. Heavily rust mottled orange. **(WEATHERED ADVANCE OUTWASH)**	S-1	5-6-8		
5	SM	Same. Slightly rounded gravelly. Heavily rust mottled and sample is more moist. **(ADVANCE OUTWASH)**	S-2	9-11-14		
		Very dense, olive gray grading to gray, gravelly, very silty, fine to medium SAND, moist. Moderately rust mottled.	S-3	17-35-50/2"		
10		Very dense, gray, silty, gravelly, medium to coarse SAND, moist.	S-4	17-50/3"	GS	

Borehole terminated at 10.75 feet below ground surface (bgs). Ground water seepage not observed. Borehole abandoned with bentonite chips.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH-15

PAGE: 1 of 1

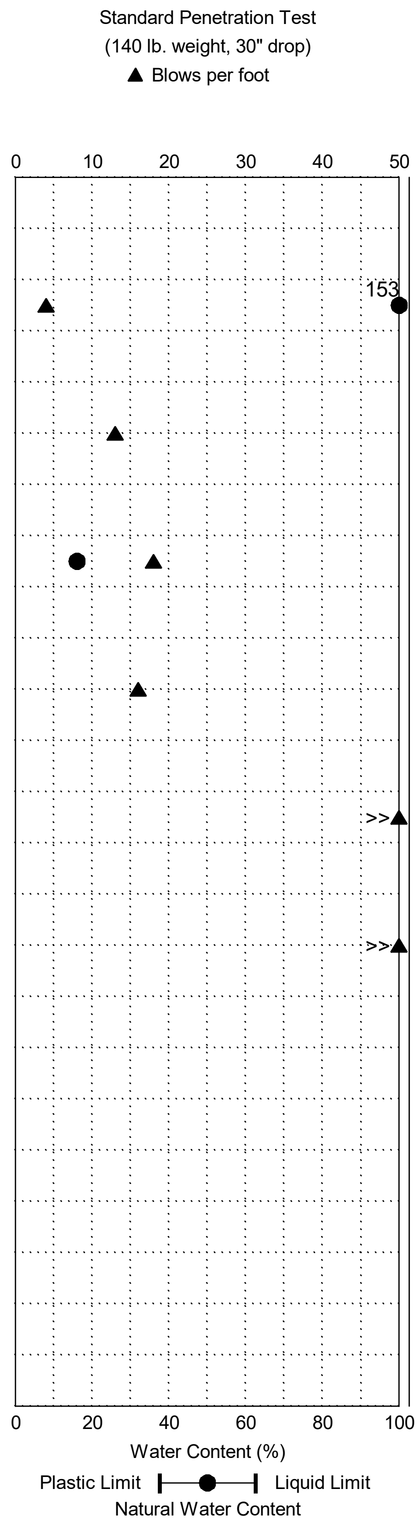
PROJECT NO.: 2018-102-21 FIGURE: A-16

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2C

DATE STARTED: 7/8/2019
DATE COMPLETED: 7/8/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0	OH	Soft, brown to dark brown, organic SILT, moist. **(PEAT)**	S-1	1-2-2	OC	
5	SP	Medium dense, gray, slightly gravelly, clean to slightly silty, medium to coarse SAND, wet. Water added to borehole to counter heave. **(ADVANCE OUTWASH)**	S-2	2-6-7		∇ (5 ft)
	SM	Medium dense, gray, slightly gravelly, silty, SAND, moist.	S-3	7-8-10	GS	
10		Same. Scattered gravel and coarse sand.	S-4	5-7-9		
		Very dense, gray, very silty, fine to medium SAND, wet. No gravel in sample.	S-5	50/6"		
15		Same. Scattered fine gravel.	S-6	50/2"		

Borehole terminated at 15.2 feet below ground surface (bgs). Ground water seepage observed from 5 feet bgs. Borehole abandoned with bentonite chips.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH-16

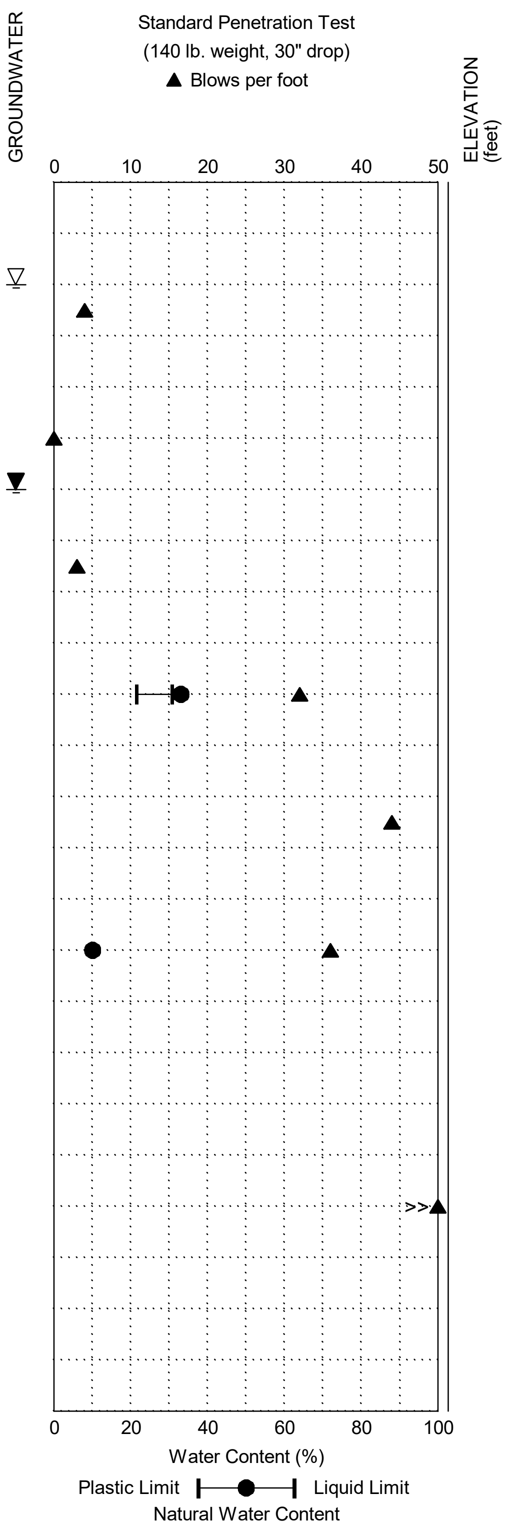
PROJECT NO.: 2018-102-21 FIGURE: A-17

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2C

DATE STARTED: 7/8/2019
DATE COMPLETED: 7/8/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0	OH	Medium stiff, brown to light yellow brown, organic SILT, wet. Abundant organics. **(PEAT)**	S-1	2-2-2	
5	PT	Very soft, dark brown, PEAT, moist to wet. 2" pieces of bark and abundant roots.	S-2	0-0-0	
		Same. Grades less dark in color with depth. Roots and bark pieces intact.	S-3	0-1-2	
10	CL	Hard, brown grading to gray, lean CLAY, wet. Scattered organics, finely bedded. Less organics observed with depth. **(ADVANCE OUTWASH)** Water added to borehole to counter heave.	S-4	12-16-16	AL
	SM	Dense, gray, silty, fine to medium SAND, wet. Scattered gravel and coarse sand.	S-5	12-19-25	
15		Dense, gray, gravelly, silty, fine to medium SAND, moist.	S-6	17-18-18	GS
20		Very dense, gray, rounded gravelly, silty, fine to medium SAND, wet.	S-7	20-50/6"	

Borehole terminated at 21 feet below ground surface (bgs). Ground water seepage observed from 2 to 2.5 feet bgs (perched) and from 6 feet bgs. Borehole abandoned with bentonite chips.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH-17

PAGE: 1 of 1

PROJECT NO.: 2018-102-21 FIGURE: A-18

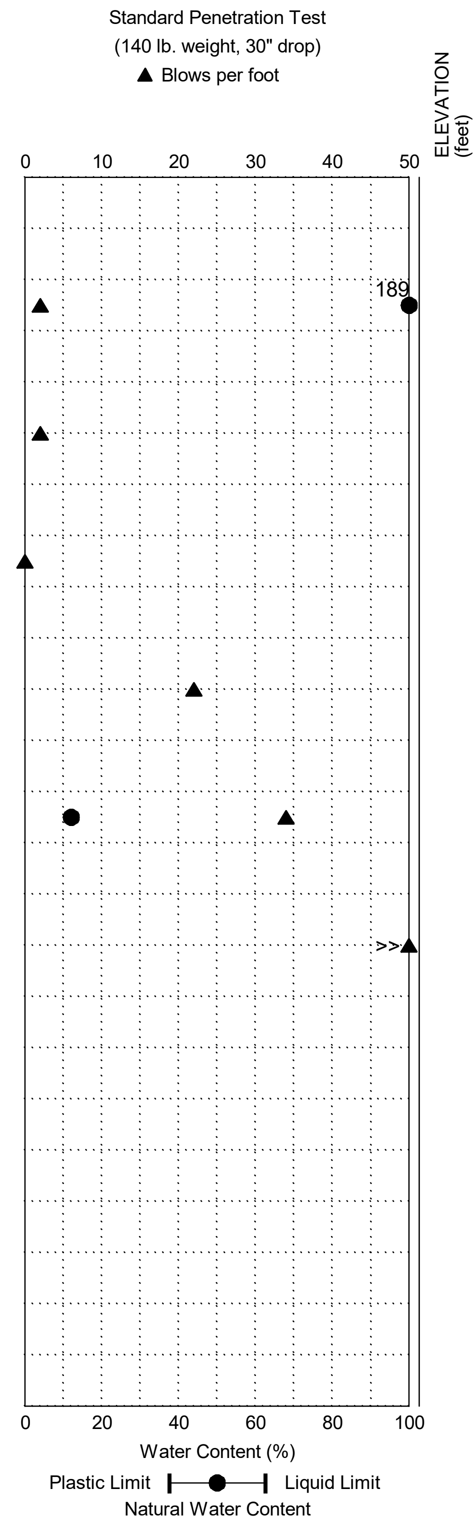
BORING-DSM 2018-102-21.GPJ 6/28/24

DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2C

DATE STARTED: 7/8/2019
DATE COMPLETED: 7/8/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0	OH	Very soft, light yellow brown to brown, organic SILT, moist. Scattered black organics. Abundant organic debris such as bark and roots. **(PEAT)**	S-1	1-1-1	OC
5	PT	Very soft, brown grades to dark brown, grades from organic SILT to PEAT, wet. Abundant organics.	S-2	1-1-1	
		Same. Abundant roots.	S-3	0-0-0	
10	ML	Hard, gray, slightly fine sandy, SILT, wet. **(ADVANCE OUTWASH)**	S-4a	2-5-17	
	SP	Medium dense, gray, clean, poorly graded, medium SAND, wet with scattered gravel.	S-4b		
	SM	Dense, gray, silty to silty, medium SAND, moist with scattered gravel.	S-5	12-17-17	GS
15		Very dense, gray, slightly gravelly, very silty, fine to medium SAND, wet. Scattered gravel and coarse sand. Gravelly drilling action.	S-6	9-50/5"	

Borehole terminated at 16 feet below ground surface (bgs). Ground water seepage observed from 1 to 2 feet bgs (perched) and from 5 feet bgs. Borehole abandoned with bentonite chips.



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH-18

PROJECT NO.: 2018-102-21 FIGURE: A-19

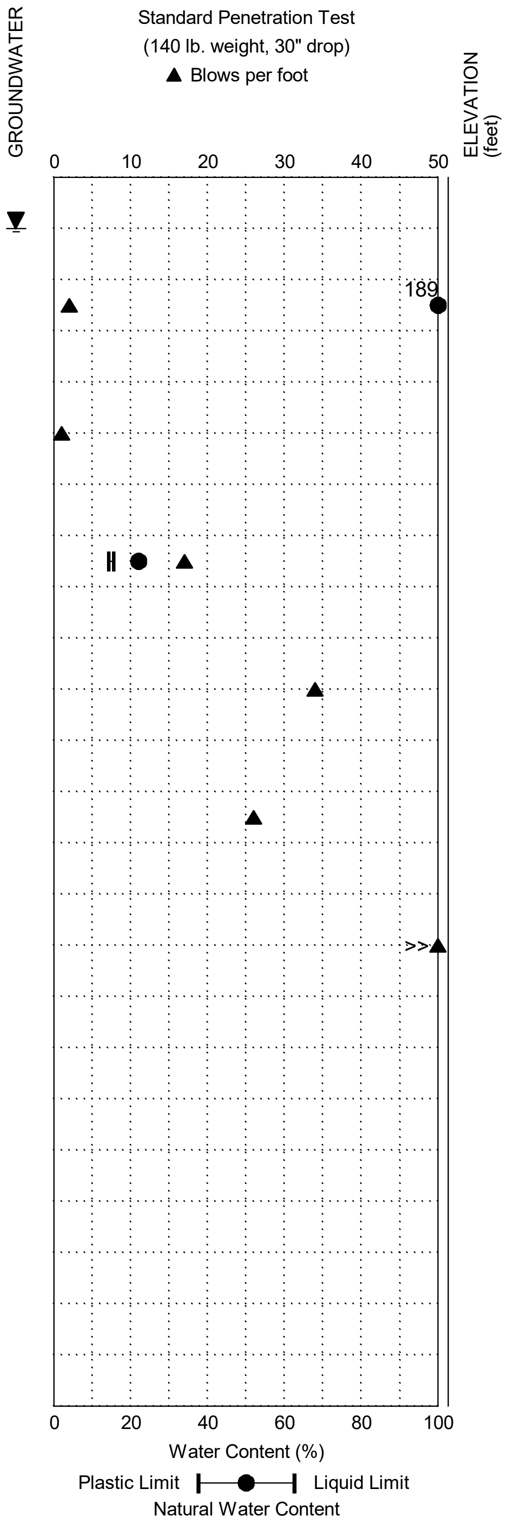
DRILLING COMPANY: Geologic Drill Partners Inc.
DRILLING METHOD: HSA with Bobcat Mini Drill Rig
SAMPLING METHOD: SPT w/ Cathead
LOCATION: See Figure 2C

DATE STARTED: 7/8/2019
DATE COMPLETED: 7/8/2019
LOGGED BY: S. Khandaker

DEPTH (feet)	USCS SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0	OH	Very soft, brown to dark brown, organic SILT, wet. Abundant organic debris. **(PEAT)**	S-1	1-1-1	OC
5	PT	Very soft, dark brown, PEAT moist. Abundant root and bark debris. Strong organic odor. 2" of gray silt near toe of sample.	S-2	1-0-1	
	ML	Hard , gray, fine sandy SILT, moist to wet. Scattered medium sand and organics. **(ADVANCE OUTWASH)**	S-3	2-6-11	AL
10	SP	Dense, gray, rounded gravelly, slightly silty to clean, medium SAND, wet.	S-4	11-12-22	
		Dense, gray, slightly silty to clean, poorly graded, medium SAND, wet with scattered gravel. 2" silty sand lens.	S-5	12-13-13	
15	SM	Very dense, gray, gravelly, very silty, fine to medium SAND, moist. Gravel is rounded. Gravelly drilling action. Heave encountered at 17 feet.	S-6	9-17-43	

Borehole terminated at 17 feet below ground surface (bgs). Ground water seepage observed from 1-2 feet bgs (perched). Borehole abandoned with bentonite chips.

20



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

BORING:
BH-19

PROJECT NO.: 2018-102-21 FIGURE: A-20

BORING-DSM 2018-102-21.GPJ 6/28/24

APPENDIX B

LABORATORY TEST RESULTS

APPENDIX B

LABORATORY TEST RESULTS

Representative soil samples obtained from our explorations were placed in plastic bags to prevent loss of moisture and transported to our Bothell, Washington, laboratory for further examination and testing. Laboratory tests were conducted on selected soil samples to characterize relevant engineering and index properties of the site soils. Laboratory testing was conducted as described below:

MOISTURE CONTENT, ASH AND ORGANIC MATTER: Selected samples were tested in general accordance with method ASTM D 2974, using moisture content method 'A' (oven dried at 1050 C) and ash content method 'C' (burned at 4400 C). The test results are summarized on the logs in Appendix A and the Summary of Material Properties, Figures B-1 and B-2. The results are percent by weight of dry soil.

PARTICLE SIZE ANALYSIS OF SOILS: Selected samples were tested to determine the particle (grain) size distribution of material in general accordance with ASTM D 6913. The results are summarized on the Summary of Material Properties, Figures B-1 and B-2, and the Particle Size Analysis of Soils reports, Figures B-3 through B-8, which also provide information regarding the classification of the sample, and the moisture content at the time of testing.

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS (ATTERBERG LIMITS): Selected samples were tested using method ASTM D 4318, multi-point method. The results are summarized on the Summary of Material Properties, Figures B-1 and B-2, and on the Liquid Limit, Plastic Limit, and Plasticity Index of Soils report, Figure B-9.

EXPLORATION DESIGNATION	TOP DEPTH (feet)	BOTTOM DEPTH (feet)	MOISTURE CONTENT (%)	ORGANIC CONTENT (%)	SPECIFIC GRAVITY	ATTERBERG LIMITS (%)			% GRAVEL	% SAND	% FINES	ASTM SOIL CLASSIFICATION	SAMPLE DESCRIPTION
						LL	PL	PI					
BH- 1,S-5	20.0	21.5	539.5	42.8								PT	Very dark brown, PEAT
BH- 1,S-7	30.0	31.5	9.6						22.9	71.9	5.2	SP-SM	Dark gray, poorly graded SAND with silt and gravel
BH- 2,S-5	15.0	16.5	847.7	71.6								PT	Very dark brown, PEAT
BH- 2,S-9	35.0	36.5	12.4						5.1	84.6	10.2	SP-SM	Gray, poorly graded SAND with silt
BH- 3,S-3	10.0	11.5	341.5	27.7								PT	Very dark brown, PEAT
BH- 3,S-4	15.0	16.5	22.4						7.6	90.5	1.9	SP	Dark gray, poorly graded SAND
BH- 4,S-2	5.0	6.5	222.2	22.8								PT	Very dark brown, PEAT with sand
BH- 4,S-4	15.0	16.5	15.2						6.7	87.7	5.6	SP-SM	Gray, poorly graded SAND with silt
BH- 5,S-7	25.0	26.5	272.5	29.6								PT	Very dark brown, PEAT
BH- 5,S-10	40.0	41.5	20.9						2.1	73.9	24.0	SM	Grayish-brown, silty SAND
BH- 6,S-5	15.0	16.5	722.9	61.8								PT	Very dark brown, PEAT
BH- 6,S-7	25.0	26.5	556.1							63.8	36.2	PT	Dark brown, PEAT
BH- 7,S-2	5.0	6.5	648.8	64.7								PT	Very dark brown, PEAT
BH- 7,S-6	20.0	21.5	12.8						19.7	69.3	11.0	SP-SM	Dark gray, poorly graded SAND with silt and gravel
BH- 8,S-3	7.5	9.0	616.8	85.7								PT	Very dark brown, PEAT
BH- 8,S-5	12.5	14.0	10.3						22.0	55.5	22.5	SM	Grayish-brown, silty SAND with gravel
BH- 9,S-2	5.0	6.5	421.6	52.0								PT	Very dark brown, PEAT
BH- 9,S-4	10.0	11.5	842.3						45.8	54.3	0.0	PT	Very dark brown, PEAT
BH-10,S-6b	16.0	16.5	23.6			21	17	4				ML	Gray, SILT
BH-10,S-7	20.0	21.5	12.0						12.7	68.9	18.4	SM	Grayish-brown, silty SAND

Notes: 1. This table summarizes information presented elsewhere in the report and should be used in conjunction with the report test, other graphs and tables, and the exploration logs.
2. The soil classifications in this table are based on ASTM D2487 and D2488 as applicable.

GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

SUMMARY OF MATERIAL PROPERTIES

PROJECT NO.: 2018-102-21 FIGURE: B-1

EXPLORATION DESIGNATION	TOP DEPTH (feet)	BOTTOM DEPTH (feet)	MOISTURE CONTENT (%)	ORGANIC CONTENT (%)	SPECIFIC GRAVITY	ATTERBERG LIMITS (%)			% GRAVEL	% SAND	% FINES	ASTM SOIL CLASSIFICATION	SAMPLE DESCRIPTION
						LL	PL	PI					
BH-11,S-4	10.0	11.5	12.2						31.6	55.1	13.4	SM	Grayish-brown, silty SAND with gravel
BH-11,S-8	25.0	26.5	11.2						18.8	70.0	11.1	SP-SM	Olive-brown, poorly graded SAND with silt and gravel
BH-12,S-5	12.5	14.0	95.2			110	74	36				OH	Grayish-brown, organic SILT
BH-13,S-2	5.0	6.5	425.2	67.2								PT	Very dark brown, PEAT
BH-13,S-4	10.0	11.5	11.1						8.4	51.9	39.6	SM	Gray, silty SAND
BH-14,S-4	10.0	11.5	14.2						22.6	56.7	20.8	SM	Dark gray, silty SAND with gravel
BH-14,S-6	15.0	15.8	13.2			15	13	2				ML	Gray, SILT
BH-15,S-4	10.0	10.8	8.2						23.6	53.6	22.7	SM	Grayish-brown, silty SAND with gravel
BH-16,S-1	2.5	4.0	152.9	11.6								OH	Olive-brown, organic SILT
BH-16,S-3	7.5	9.0	15.9						7.4	65.3	27.3	SM	Gray, silty SAND
BH-17,S-4	10.0	11.5	32.6			31	21	10				CL	Gray, lean CLAY
BH-17,S-6	15.0	16.5	10.2						18.5	59.1	22.4	SM	Dark gray, silty SAND with gravel
BH-18,S-1	2.5	4.0	188.9	12.3								OH	Olive-brown, organic SILT
BH-18,S-5	12.5	14.0	12.2						14.1	56.7	29.3	SM	Grayish-brown, silty SAND
BH-19,S-1	2.5	4.0	188.8	10.8								OH	Olive-brown, organic SILT
BH-19,S-3	7.5	9.0	22.2			15	14	1				ML	Gray, SILT

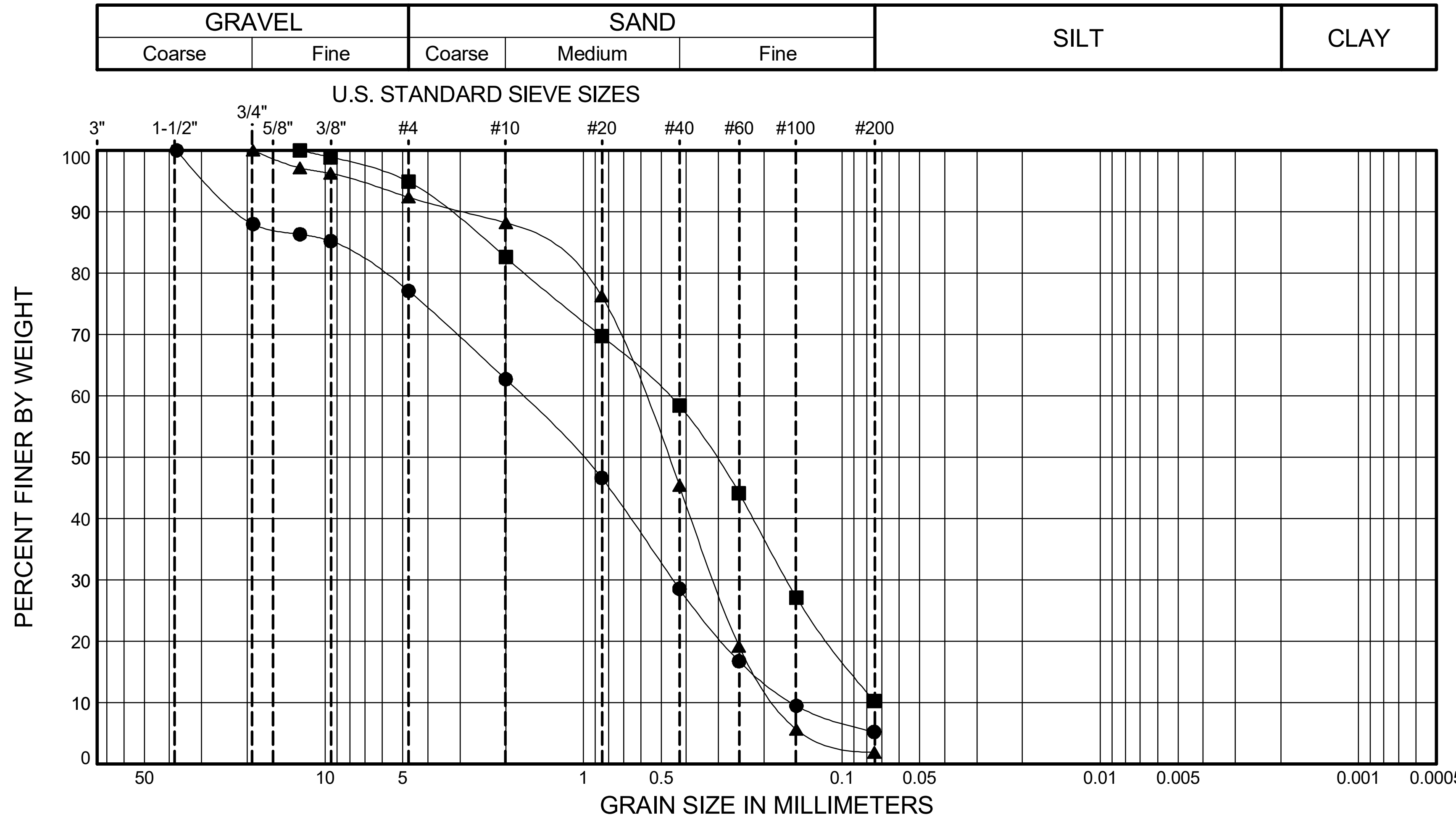
Notes: 1. This table summarizes information presented elsewhere in the report and should be used in conjunction with the report test, other graphs and tables, and the exploration logs.
2. The soil classifications in this table are based on ASTM D2487 and D2488 as applicable.

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

SUMMARY OF MATERIAL PROPERTIES

PROJECT NO.: 2018-102-21 FIGURE: B-2



SYMBOL	SAMPLE		DEPTH (ft.)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	BH- 1	S-7	30.0 - 31.5	(SP-SM) Dark gray, poorly graded SAND with silt and gravel	10				22.9	71.9	5.2
■	BH- 2	S-9	35.0 - 36.5	(SP-SM) Gray, poorly graded SAND with silt	12				5.1	84.6	10.2
▲	BH- 3	S-4	15.0 - 16.5	(SP) Dark gray, poorly graded SAND	22				7.6	90.5	1.9

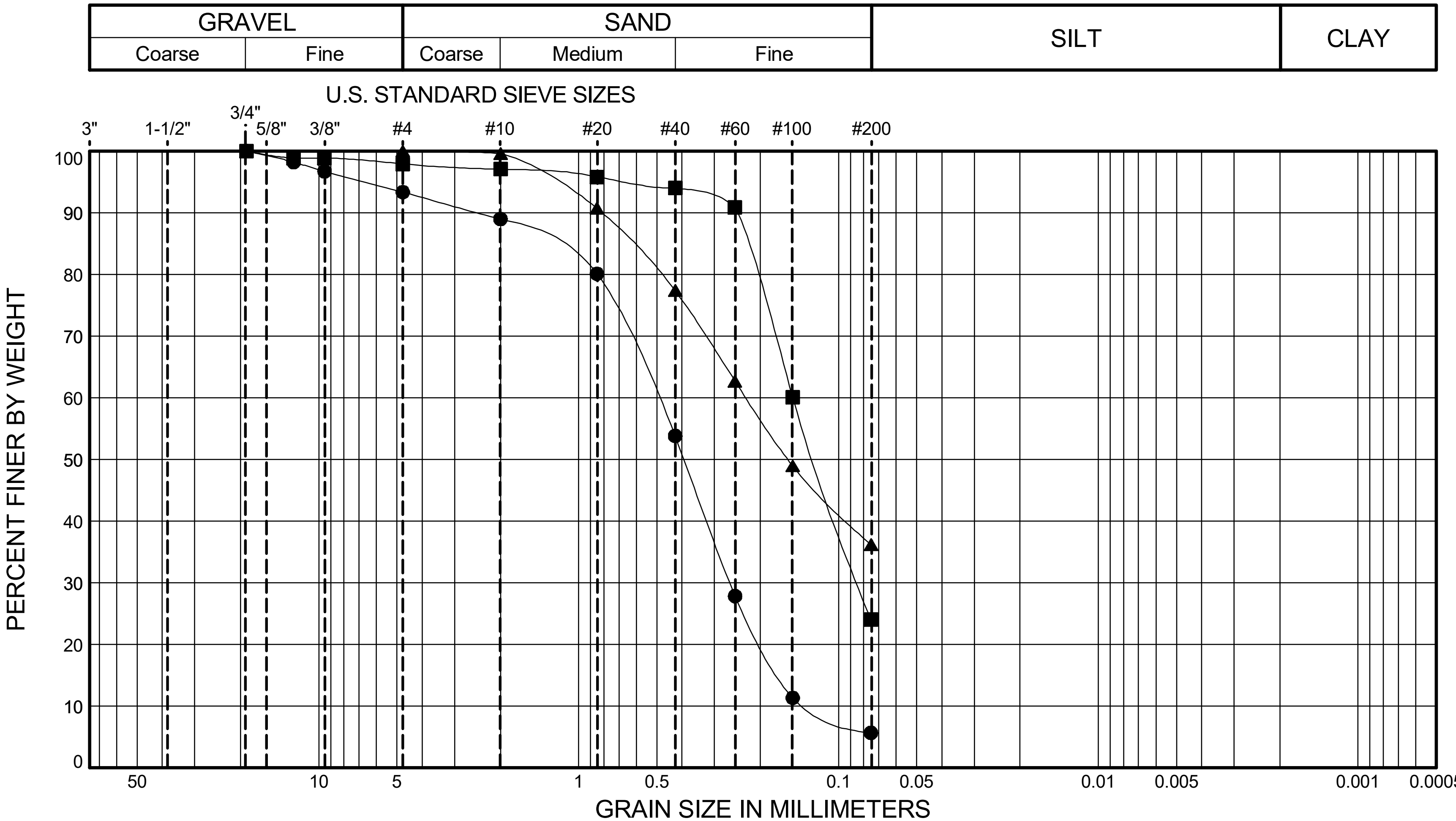
HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D6913

PROJECT NO.: 2018-102-21 FIGURE: B-3

HWAGRSZ 2018-102-21.GPJ 6/28/24



SYMBOL	SAMPLE		DEPTH (ft.)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	BH- 4	S-4	15.0 - 16.5	(SP-SM) Gray, poorly graded SAND with silt	15				6.7	87.7	5.6
■	BH- 5	S-10	40.0 - 41.5	(SM) Grayish-brown, silty SAND	21				2.1	73.9	24.0
▲	BH- 6	S-7	25.0 - 26.5	(PT) Dark brown, PEAT	556					63.8	36.2

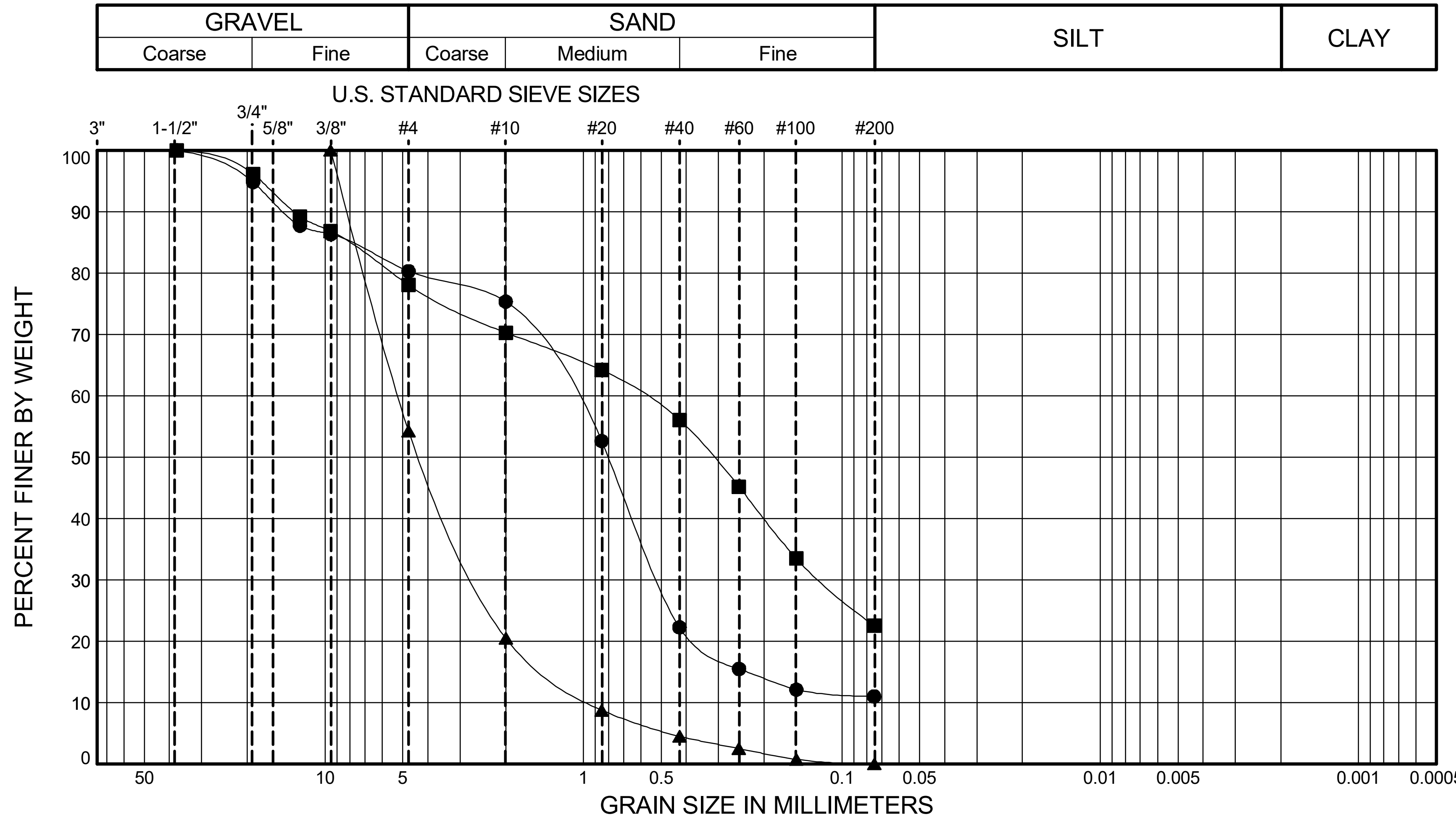
HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHOD ASTM D6913

PROJECT NO.: 2018-102-21 FIGURE: B-4

HWAGRSZ 2018-102-21.GPJ 6/28/24



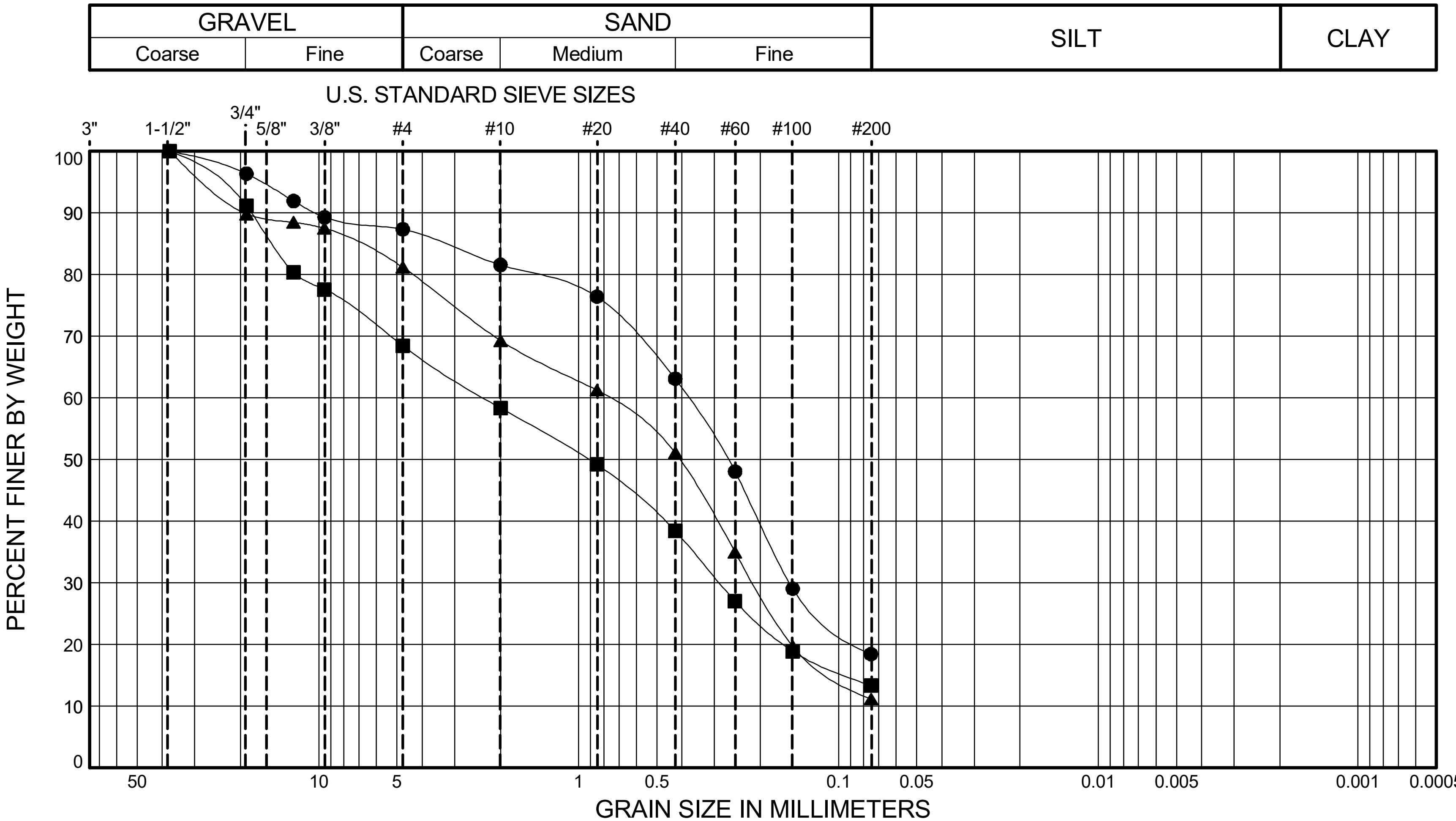
SYMBOL	SAMPLE		DEPTH (ft.)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	BH- 7	S-6	20.0 - 21.5	(SP-SM) Dark gray, poorly graded SAND with silt and gravel	13				19.7	69.3	11.0
■	BH- 8	S-5	12.5 - 14.0	(SM) Grayish-brown, silty SAND with gravel	10				22.0	55.5	22.5
▲	BH- 9	S-4	10.0 - 11.5	(PT) Very dark brown, PEAT	842				45.8	54.3	0.0

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D6913

PROJECT NO.: 2018-102-21 FIGURE: B-5



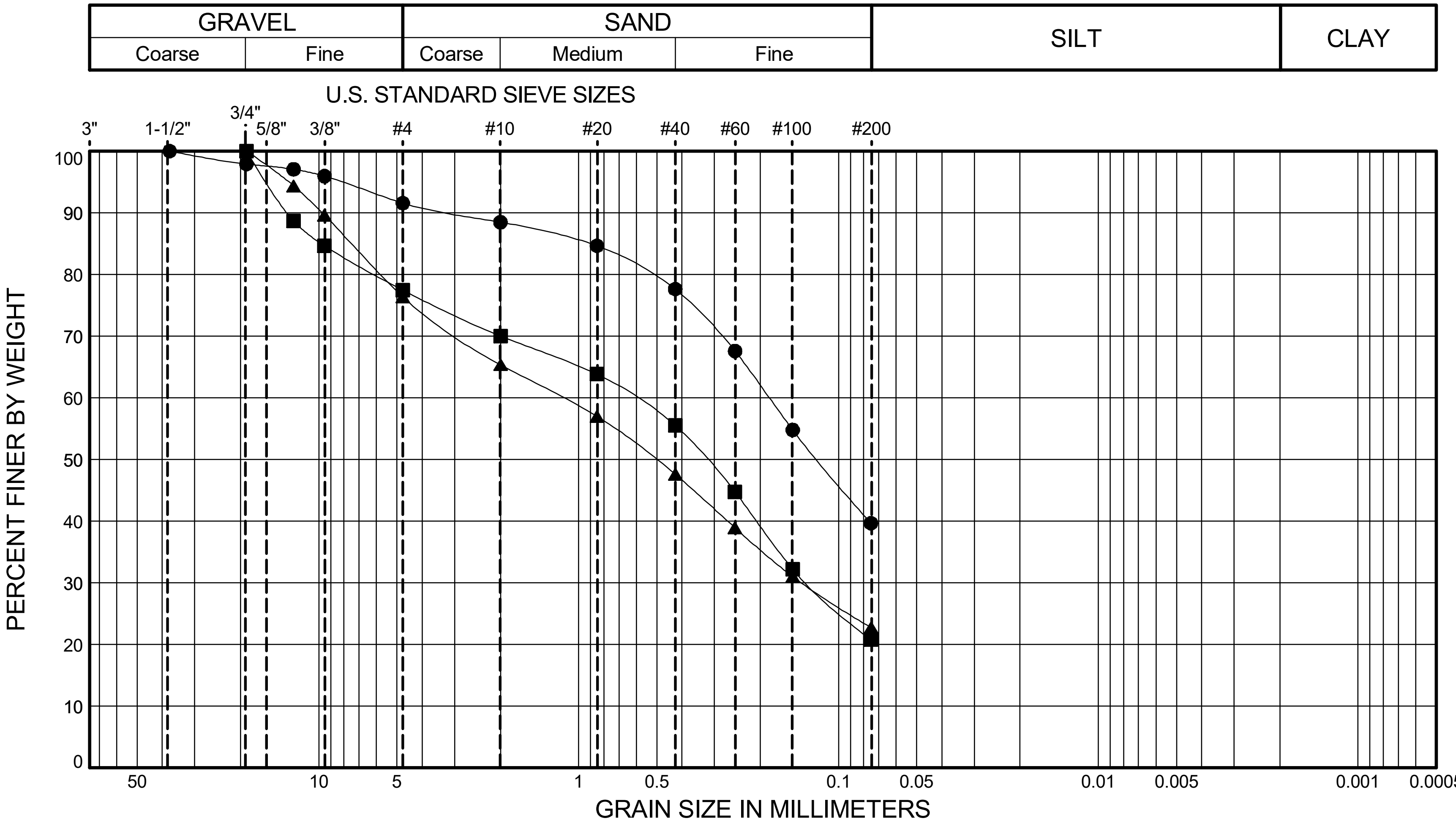
SYMBOL	SAMPLE		DEPTH (ft.)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	BH-10	S-7	20.0 - 21.5	(SM) Grayish-brown, silty SAND	12				12.7	68.9	18.4
■	BH-11	S-4	10.0 - 11.5	(SM) Grayish-brown, silty SAND with gravel	12				31.6	55.1	13.4
▲	BH-11	S-8	25.0 - 26.5	(SP-SM) Olive-brown, poorly graded SAND with silt and gravel	11				18.8	70.0	11.1

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D6913

PROJECT NO.: 2018-102-21 FIGURE: B-6



SYMBOL	SAMPLE		DEPTH (ft.)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	BH-13	S-4	10.0 - 11.5	(SM) Gray, silty SAND	11				8.4	51.9	39.6
■	BH-14	S-4	10.0 - 11.5	(SM) Dark gray, silty SAND with gravel	14				22.6	56.7	20.8
▲	BH-15	S-4	10.0 - 10.8	(SM) Grayish-brown, silty SAND with gravel	8				23.6	53.6	22.7

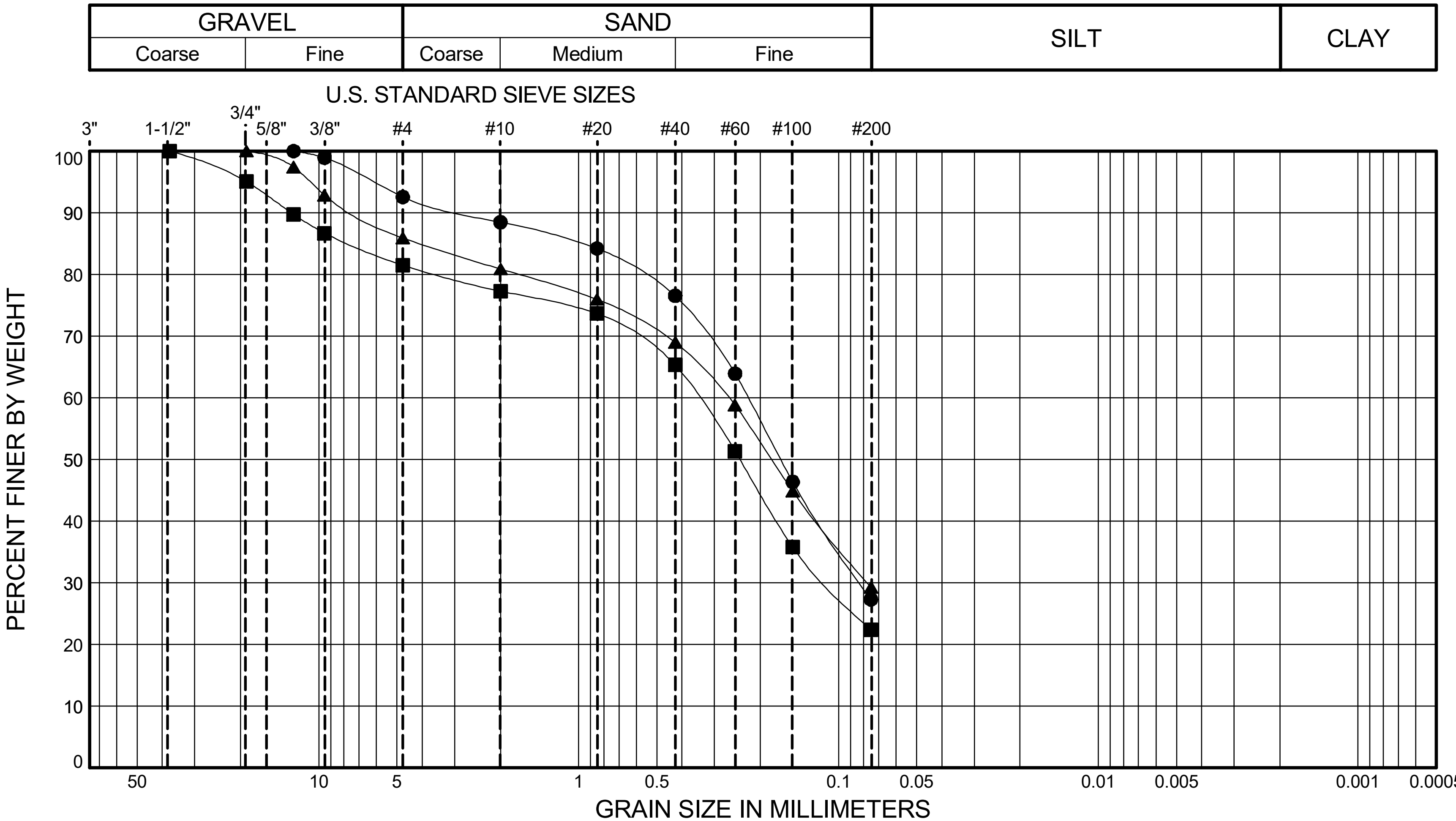
HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

PARTICLE-SIZE ANALYSIS
OF SOILS
METHOD ASTM D6913

PROJECT NO.: 2018-102-21 FIGURE: B-7

HWAGRSZ 2018-102-21.GPJ 6/28/24



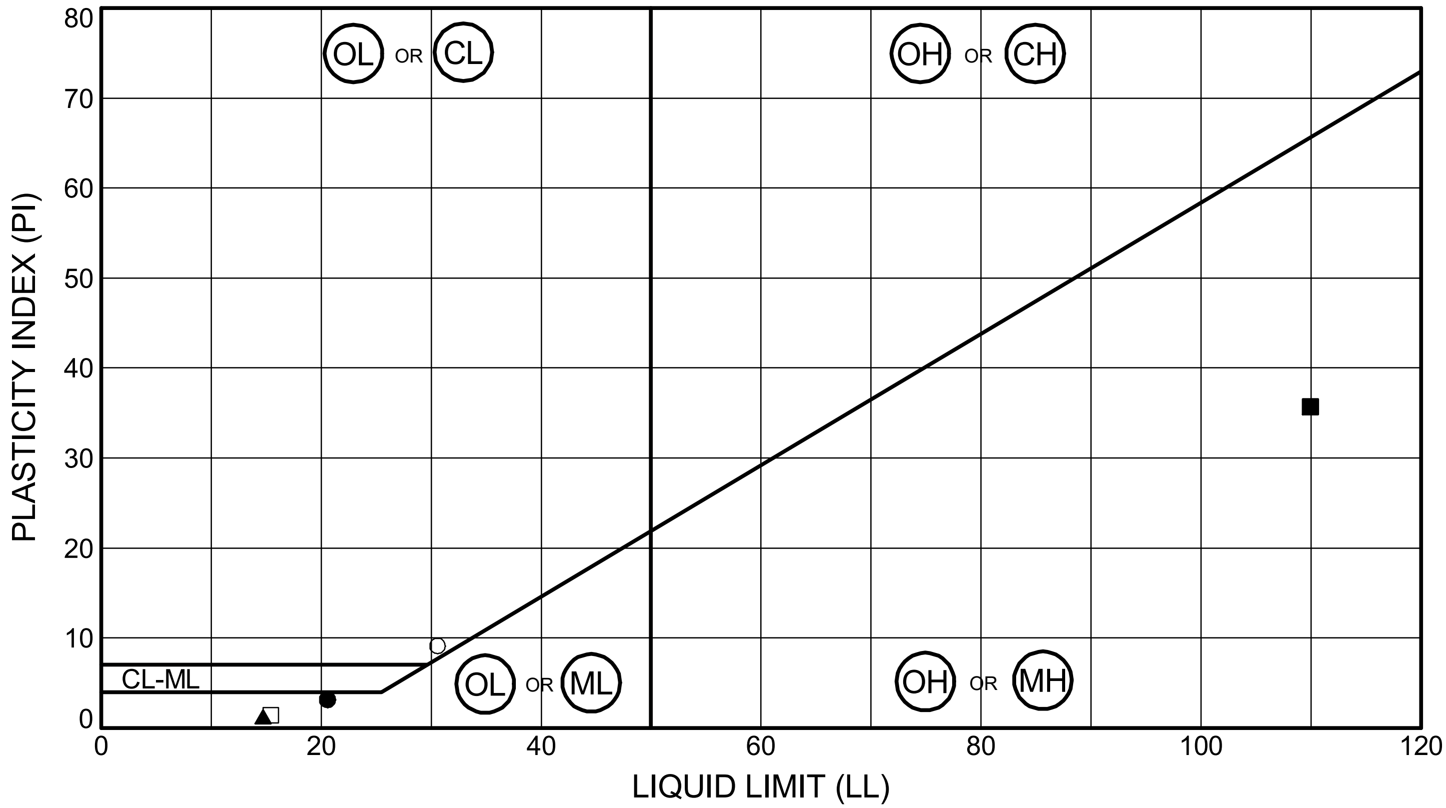
SYMBOL	SAMPLE		DEPTH (ft.)	CLASSIFICATION OF SOIL- ASTM D2487 Group Symbol and Name	% MC	LL	PL	PI	Gravel %	Sand %	Fines %
●	BH-16	S-3	7.5 - 9.0	(SM) Gray, silty SAND	16				7.4	65.3	27.3
■	BH-17	S-6	15.0 - 16.5	(SM) Dark gray, silty SAND with gravel	10				18.5	59.1	22.4
▲	BH-18	S-5	12.5 - 14.0	(SM) Grayish-brown, silty SAND	12				14.1	56.7	29.3

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

PARTICLE-SIZE ANALYSIS OF SOILS METHOD ASTM D6913

PROJECT NO.: 2018-102-21 FIGURE: B-8



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Fines
●	BH-10	S-6b	16.0 - 16.5	(ML) Gray, SILT	24	21	17	4	
■	BH-12	S-5	12.5 - 14.0	(OH) Grayish-brown, organic SILT	95	110	74	36	
▲	BH-14	S-6	15.0 - 15.8	(ML) Gray, SILT	13	15	13	2	
○	BH-17	S-4	10.0 - 11.5	(CL) Gray, lean CLAY	33	31	21	10	
□	BH-19	S-3	7.5 - 9.0	(ML) Gray, SILT	22	15	14	1	

HWA GEOSCIENCES INC.

Scriber Creek Trail
Lynnwood, Washington

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS METHOD ASTM D4318

PROJECT NO.: 2018-102-21 FIGURE: B-9