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Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report

SEQUIM BRANCH LIBRARY EXPANSION AND RENOVATION

Sequim, Washington

Prepared For

NORTH OLYMPIC LIBRARY SYSTEM

August 25, 2022
Project No. 20220259E001



Associated Earth Sciences, Inc.

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August 25, 2022
Project No. 20220259E001

North Olympic Library System
2210 South Peabody Street
Port Angeles, Washington 98362

Attention: Brian Phillips

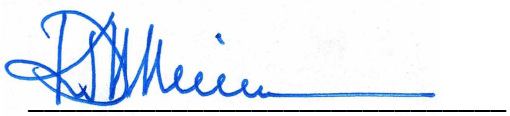
Subject: Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report
Sequim Branch Library Expansion and Renovation
630 North Sequim Avenue
Sequim, Washington

Dear Mr. Phillips:

We are pleased to present this copy of our geotechnical engineering report for the referenced project. This report summarizes the results of our subsurface exploration, geologic hazard, and geotechnical engineering evaluation, and offers recommendations for the design and development of the proposed project. Project plans were in the conceptual phase at the time this report was prepared. We recommend that we be allowed to review the recommendations contained in this report and modify them, if necessary, once project plans have been finalized.

We have enjoyed working with you on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. If you should have any questions, or if we can be of additional help to you, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington



Kurt D. Merriman
Senior Principal Geotechnical Engineer

KDM/ld - 20220259E001-002

SUBSURFACE EXPLORATION, GEOLOGIC HAZARD, AND GEOTECHNICAL ENGINEERING REPORT

SEQUIM BRANCH LIBRARY EXPANSION AND RENOVATION

Sequim, Washington

Prepared for:
North Olympic Library System
2210 South Peabody Street
Port Angeles, Washington 98362

Prepared by:
Associated Earth Sciences, Inc.
911 Fifth Avenue
Kirkland, Washington 98033
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August 25, 2022
Project No. 20220259E001

I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of our subsurface exploration, geologic hazard, and geotechnical engineering evaluation for the proposed project. The project site location is shown on the "Vicinity Map," Figure 1. The approximate location of our explorations completed for this study are shown on Figure 2, "Existing Site and Exploration Plan." The logs of the subsurface explorations are included in Appendix A, and laboratory test results are included in Appendix B.

1.1 Purpose and Scope

The purpose of this study was to provide geotechnical engineering design recommendations to be utilized in the design of the project. This study included a review of selected available geologic literature, completing five exploration borings, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow groundwater at the site. Geotechnical engineering studies were completed to formulate recommendations for site preparation, temporary cut slopes, erosion control, structural fill, foundations, seismic site class, floor slabs, site drainage, and pavements. This report summarizes our fieldwork and offers geotechnical engineering recommendations based on our present understanding of the project. We recommend that we be allowed to review the recommendations presented in this report and revise them, if needed, once project plans are finalized.

1.2 Authorization

Authorization to proceed with this study was granted by means of a signed copy of our scope of work and cost proposal dated July 14, 2022. This report has been prepared for the exclusive use of the North Olympic Library System and its agents for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

2.0 PROJECT AND SITE DESCRIPTION

The subject site is the existing Sequim Branch Library (Clallam County Parcel Number 033020-220047-0000) located at 630 North Sequim Avenue in Sequim, Washington. We understand the library was constructed in 1983, and the existing building is approximately 6,000 square feet in

area and situated on a 620-foot by 135-foot rectangular parcel. The property is bordered to the south and east by agricultural land, to the north by an existing church and asphalt parking lot, and to the west by North Sequim Avenue. The site is occupied by the existing library building, located near the center of the parcel. An asphalt parking lot occupies the western half of the parcel and a paved drive lane exists along the southern border of the property. The eastern portion of the property is occupied by a gravel parking lot and two small accessory buildings.

The topography at the site and surrounding area generally slopes down gently to the east. Overall vertical relief within the vicinity of the library building is estimated at about 1 to 2 feet except for a few landscape areas that slope up against the exterior walls of the building.

Based on our review of the conceptual site plan, we understand that the proposed development will involve an expansion of the library building to the south and east with expansion of the parking area to the northeast. We understand the building expansion will consist of at-grade single-story structures.

3.0 SUBSURFACE EXPLORATION

Our field study included advancing five exploration borings (EB-1 through EB-5) at the site. Our exploration borings are generally located in the vicinity of the proposed building expansion and new parking lot area. The locations of our exploration borings were coordinated with the project architect, SHKS Architects, and are shown on Figure 2. The conclusions and recommendations presented in this report are based on the conditions encountered in these explorations. The number, locations, and depths of our explorations were completed within site and budgetary constraints. Copies of the exploration logs completed for this study are included in Appendix A.

Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that subsurface conditions between the explorations may differ from those inferred by the boring data due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of any variations between the field explorations may not become fully evident until construction. If variations are observed at that time, it may be necessary to re-evaluate specific recommendations in this report and make appropriate changes.

3.1 Exploration Borings

The exploration borings were performed by Holt Services, Inc., an independent firm working under subcontract to Associated Earth Sciences, Inc. (AESI). The borings were completed by advancing a 6-inch outside-diameter core barrel with a rotosonic track-mounted drill rig. The

borings were continuously observed and logged by a representative of AESI. During the drilling process, samples were obtained at 5-foot-depth intervals. The boring logs presented in Appendix A are based on the field logs, drilling action, and inspection of the samples secured.

During the rotosonic drilling process, disturbed but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *ASTM International* (ASTM) D-1586. This test and sampling method consists of driving a standard, 2-inch outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer, free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance ("N") or blow count. If a total of 50 blows is recorded within one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils; these values are plotted on the attached boring logs. In addition to the SPT samples, grab samples were taken from each 5-foot-long rotosonic core run.

Samples obtained from the split-barrel sampler and the rotosonic cores were classified in the field and representative portions placed in watertight containers. The samples were then transported to AESI's laboratory for further visual classification and laboratory testing, as necessary.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, visual reconnaissance of the site, and review of selected applicable geologic literature. The following section presents detailed subsurface information organized from the shallowest (youngest) to the deepest (oldest) sediment types.

4.1 Stratigraphy

Asphalt

A surficial layer of asphalt was encountered within explorations EB-4 and EB-5, located at the southeast loading area and southern drive lane, respectively. The existing asphalt had a measured thickness of approximately 4 inches at both locations.

Crushed Rock Aggregate and Gravel

Directly beneath the asphalt in EB-4 and EB-5, our explorations encountered a thin layer of crushed rock aggregate approximately 2 inches in thickness. Directly below the ground surface at explorations EB-1 through EB-3, we encountered a surficial layer of gravel approximately 6 inches in thickness. The crushed rock aggregate and gravel were placed to support pavements and vehicle traffic.

Fill

Fill soils (those not naturally placed) were encountered directly below the asphalt pavement and surficial gravel layer at all exploration locations. The fill generally consisted of loose to medium dense, dry to moist, grayish brown to dark brown with minor oxidation staining, silty sand with variable gravel content ranging to sandy gravel with variable silt content. Some of the fill also contained scattered organics (rootlets), cemented angular gravel (possibly crushed recycled concrete), and occasional cobbles. The fill extended to depths ranging from about 3 to 5 feet below the existing ground surface. Due to the typically loose composition and inherent variability of the fill and unknown placement and compaction methods, the fill soils are not considered suitable for direct foundation support and may require remedial measures for support of new pavements, hardscapes, and slabs-on-grade.

Older Alluvium

Directly underlying the fill at all exploration locations, we encountered older alluvial (river-deposited) sediments to the termination depth of each boring (ranging from about 11.5 to 26.5 feet). The older alluvium generally consisted of slightly moist to moist, tan to brown, gravelly sand to sandy gravel with variable silt content. We interpret these sediments to be representative of alluvial floodplain terrace deposits associated with the ancestral Dungeness River. The SPT N-values suggest some of the soils encountered are in a dense or very dense state; however, these N-values are overstated due to the presence of gravel within the sampler. Since these soils were deposited in an alluvial setting, it is our opinion that the majority of the alluvial soils encountered are in a medium dense state. The alluvial sediments are suitable for shallow foundation support with proper preparation.

4.2 Regional Geologic and Soils Mapping

We reviewed the regional geologic map of the project area (*Geologic Map of the Sequim 7.5-minute Quadrangle, Clallam County*, *Washington,* by H.W. Schasse, and R.L. Logan, Washington Division of Geology and Earth Resources, Open File Report 98-7, scale 1:24,000 [1998]), which indicates the site is underlain by “Older Alluvium” and generally comprised of flood plain

terrace deposits of the ancestral Dungeness River. Our interpretation of the sediments encountered in our explorations is in general agreement with the regional geologic map.

Review of the U.S. Department of Agriculture (USDA) Soil Conservation Service (SCS), now referred to as Natural Resources Conservation Service (NRCS), *Web Soil Survey* indicates that the subject site is underlain by Sequim very gravelly sandy loam. Sequim very gravelly sandy loam is derived from alluvium according to the NRCS description. Our interpretation of the sediments encountered in our explorations is in general agreement with the regional soils map.

4.3 Hydrology

No groundwater was encountered in any of the borings at the time of drilling in late July; however, groundwater is expected deeper below the site as the area is known to be within an extensive aquifer system associated with the Dungeness River as described by the United States Geological Survey (USGS) (Thomas et al., 1999). In addition, a comprehensive summary of regional and local groundwater studies is included in a report by Pacific Groundwater Group (PGG) titled "2008 Dungeness Groundwater Flow Model, Design, Construction, Calibration and Results" prepared for Clallam County, dated February 19, 2009.

The USGS and PGG studies describe the regional hydrogeology as a layered system of laterally extensive aquifers and aquitards consisting of a "shallow aquifer" underlain by a fine-grained "upper confining bed," a confined "middle aquifer," a "lower confining bed," a "lower aquifer" and deeper undifferentiated sediments. Over most of the Dungeness peninsula, all or some of these hydrostratigraphic units overlie Tertiary bedrock of sedimentary and volcanic origin. The total thickness of the unconsolidated sediments beneath the peninsula ranges from zero feet in the south to as much as 2,500 feet in the northeast.

The referenced "shallow aquifer" includes the ancestral Dungeness River alluvium that underlies the site. The thickness of the shallow aquifer generally ranges from 50 to 200 feet, although greater and smaller thicknesses have been observed. The aquifer is generally unconfined but can exhibit some local confinement with the occurrence of fine-grained, low-permeability deposits. Regional potentiometric maps show a north to northwesterly flow direction in the shallow aquifer (Thomas et al., 1999 and PGG, 2009) downvalley toward the Strait of Juan de Fuca and slightly westerly toward the Dungeness River.

Although groundwater was not encountered during our exploration, it should be noted that the occurrence and level of groundwater seepage below the site may vary in response to such factors as changes in season, amounts of precipitation, changes in site use, and other on- and off-site factors.

4.4 Laboratory Testing

We performed three grain-size analyses on representative soil samples obtained from the existing fill and older alluvium layers within exploration EB-3 to support soil classification in the field. The grain-size analyses test results are summarized in Table 1 below (and attached in Appendix B) with soil descriptions based on the ASTM D-2487 Unified Soil Classification System (USCS).

Table 1
Summary of Grain-Size Analyses

Exploration Boring No.	Sample Depth (feet)	Geologic Unit	USCS Soil Description	Fines Content (%)
EB-3	2	Fill	Very sandy GRAVEL, some silt (GW-GM)	5.2
	7	Older Alluvium	Very gravelly SAND, some silt (SW-SM)	5.9
	22	Older Alluvium	Very sandy GRAVEL, trace silt (GP)	3.7

USCS = Unified Soil Classification System
% = percent of total weight passing the U.S. No. 200 Sieve

II. GEOLOGIC HAZARDS AND MITIGATIONS

The following discussion of potential geologic hazards is based on the geologic, slope, and ground and surface water conditions, as observed and discussed herein. The discussion will be limited to landslide, seismic, and erosion hazards. Individual geologic hazard topics are discussed in further detail below.

5.0 LANDSLIDE HAZARDS AND MITIGATIONS

The topography at the site and surrounding area generally slopes down gently to the east. Overall vertical relief within the vicinity of the library building is estimated at about 1 to 2 feet except for a few landscape areas that slope up against the exterior walls of the building. It is our opinion that the risk of damage to the proposed library expansion by landsliding is low and that no mitigation measures are warranted for the project due to the lack of steep slopes at the project site and vicinity and the presence of medium dense alluvial sediments at shallow depths. No detailed assessment of slope stability was prepared as part of this report and none is warranted, in our opinion.

6.0 SEISMIC HAZARDS AND MITIGATIONS

The following discussion is a general assessment of seismic hazards that is intended to be useful to the project design team in terms of understanding seismic issues, and to the structural engineer for design.

All of Western Washington is at risk of strong seismic events resulting from movement of the tectonic plates associated with the Cascadia Subduction Zone (CSZ), where the offshore Juan de Fuca plate subducts beneath the continental North American plate. The site lies within a zone of strong potential shaking from subduction zone earthquakes associated with the CSZ. The CSZ can produce earthquakes up to magnitude 9.0, and the recurrence interval is estimated to be on the order of 500 years. Geologists infer the most recent subduction zone earthquake occurred in 1700 (Goldfinger et al., 2012 [1]). Three main types of earthquakes are typically associated with subduction zone environments: crustal, intraplate, and interplate earthquakes. Seismic records in the Puget Sound region document a distinct zone of shallow crustal seismicity (e.g., the Seattle Fault Zone [SFZ]). These shallow fault zones may include surficial

[1] Goldfinger, C., Nelson, C.H., Morey, A.E., Johnson, J.E., Patton, J.R., Karabanov, E., Gutierrez-Pastor, J., Eriksson, A.T., Gracia, E., Dunhill, G., Enkin, R.J, Dallimore, A., and Vallier, T., 2012, *Turbidite Event History—Methods and Implications for Holocene Paleoseismicity of the Cascadia Subduction Zone*: U.S. Geological Survey Professional Paper 1661–F, 170.

expressions of previous seismic events, such as fault scarps, displaced shorelines, and shallow bedrock exposures. The shallow fault zones typically extend from the surface to depths ranging from 16 to 19 miles. A deeper zone of seismicity is associated with the subducting Juan de Fuca plate. Subduction zone seismic events produce intraplate earthquakes at depths ranging from 25 to 45 miles beneath the Puget Lowland including the 1949, 7.2-magnitude event; the 1965, 6.5-magnitude event; and the 2001, 6.8-magnitude event) and interplate earthquakes at shallow depths near the Washington coast including the 1700 earthquake, which had a magnitude of approximately 9.0. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides or lateral spreading, 3) liquefaction, and 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

6.1 Surficial Ground Rupture

The nearest suspected fault trace to the project site is the Sequim Fault located approximately 2 miles south of the site. Recent geologic mapping suggests this fault may be the westward extension of the Little River, Lake Creek-Boundary Creek Fault system located south of Port Angeles, Washington. Studies of the Little River, Lake Creek-Boundary Creek Fault system by the USGS are ongoing and include *Map and Data for Quaternary Faults and Folds in Washington State* (Open-File Report 03-428) by Lidke et al., 2003, *Geologic Map of the Port Angeles and Ediz Hook Quadrangles, Clallum County, Washington* (Open File Report 2004-13) by Schasse et al., 2004, and *Field and Laboratory Data from an Earthquake History Study of the Scarps of the Lake Creek-Boundary Creek Fault Between the Elwha River and Siebert Creek, Clallum County, Washington* (Scientific Investigations Map 2691) by Alan R. Nelson et al., 2007.

There is evidence suggesting portions of the Littler River Fault have had up to 1.3 meters of displacement in the late Holocene epoch. The evidence generally includes geographic and geomorphic surface features (scarps), and stratigraphic offsets and observed deformational features (folds) in outcrop and in trenches excavated by the USGS across the fault traces. Radiocarbon ages on fragments of wood charcoal from two scarp-derived wedges of sediment suggest two surface faulting features between 2,000 and 600 years ago. Other radiocarbon dating performed on similar sediments in association with these faults suggests a possible earlier surface faulting earthquake less than 5,000 years ago.

Though no specific recurrence interval for earthquakes associated with these faults has been indicated, the referenced documents seem to suggest the earthquakes have occurred in excess

of every 1,000 years. No ground surface displacements associated with the faults described above had been documented to date on the subject site. Given the inferred long recurrence interval and the distance from the faults described above, the risk of surficial ground rupture at the subject site associated with the Little River Fault, Lake Creek-Boundary Creek Fault, and Sequim Fault is considered to be low during the expected life of the proposed structures.

6.2 Seismically Induced Landslides

Similar to the discussion in Section 5.0, "Landslide Hazards and Mitigations," it is our opinion that the potential risk of damage to the proposed improvements by seismically induced slope failures is low and that no mitigation measures are warranted for the project due to the lack of steep slopes in the immediate project area.

6.3 Liquefaction

Liquefaction is a process through which unconsolidated soil loses strength as a result of vibrations, such as those which occur during a seismic event. During normal conditions, the weight of the soil is supported by both grain-to-grain contacts and by the fluid pressure within the pore spaces of the soil below the water table. Extreme vibratory shaking can disrupt the grain-to-grain contact, increase the pore pressure, and result in a temporary decrease in soil shear strength. The soil is said to be liquefied when nearly all of the weight of the soil is supported by pore pressure alone. Liquefaction can result in deformation of the sediment and settlement of overlying structures. Areas most susceptible to liquefaction include those areas underlain by very soft to stiff, non-cohesive silt and very loose to medium dense, non-silty to silty sands with low relative densities, accompanied by a shallow water table.

In our opinion, the potential risk of damage to the proposed structures by liquefaction is low due to the high gravel content within the older alluvium and the absence of adverse shallow groundwater conditions below the site.

6.4 Ground Motion

It is our opinion that earthquake damage to the proposed structures, when founded on suitable bearing stratum in accordance with the recommendations contained herein, will likely be caused by the intensity and acceleration associated with the event. We understand that structural design of the building additions will follow the 2018 *International Building Code* (IBC) standards. Based on the subsurface conditions encountered within our exploration borings, we recommend using Site Class "D" as defined in Table 20.3-1 of American Society of Civil Engineers (ASCE) 7-16 *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*.

7.0 EROSION HAZARDS AND MITIGATIONS

The *Sequim Municipal Code* (SMC) Section 18.80.030 defines Erosion Hazard Areas as the following:

"Erosion hazard areas" means those areas containing soils which, according to the USDA NRCS Soil Classification System, may experience severe to very severe erosion. Erosion hazard areas also include coastal erosion-prone areas and channel migration zones.

Review of the USDA NRCS *Web Soil Survey* indicates that the soil present at the subject site is Sequim very gravelly sandy loam. The USDA NRCS identifies the Sequim very gravelly sandy loam erosion hazard risk as "slight." Our explorations encountered shallow soils that resemble Sequim Series soils. The topography of the site is relatively flat to very gently sloping. Based on these conditions, it is our opinion that the site would not classify as an Erosion Hazard Area under the SMC.

Although the site does not classify as an Erosion Hazard Area, the near-surface fill soils underlying the site generally consist of silty fine sand. These sediments will be susceptible to erosion and off-site sediment transport when exposed during construction. Therefore, the project should follow best management practices (BMPs) to mitigate erosion hazards and potential for off-site sediment transport. To mitigate the potential for off-site sediment transport, we recommend the following:

1. Silt fencing should be placed around the lower perimeter of ground disturbance area(s). The fencing should be periodically inspected and maintained as necessary to ensure proper function.

2. To the extent possible, earthwork-related construction should proceed during the drier periods of the year and disturbed areas should be revegetated as soon as possible. Temporary erosion control measures should be maintained until permanent erosion control measures are established.

3. Areas stripped of vegetation during construction should be mulched and hydroseeded, replanted as soon as possible, or otherwise protected. During winter construction, hydroseeded areas should be covered with clear plastic to facilitate grass growth.

4. If excavated soils are to be stockpiled on the site for reuse, measures should be taken to reduce the potential for erosion from the stockpile. These could include, but are not limited to, covering the pile with plastic sheeting, the use of low stockpiles in flat areas, and the use of straw bales/silt fences around pile perimeters.

5. Interceptor swales with rock check dams should be constructed to divert stormwater from construction areas and to route collected stormwater to an appropriate discharge location.

6. A rock construction entrance should be provided to reduce the amount of sediment transported offsite on truck tires.

7. All stormwater from impermeable surfaces, including driveways and roofs, should be tightlined into approved facilities and not be directed onto or above steeply sloping areas.

It is our opinion that with the proper implementation of the temporary erosion and sedimentation control (TESC) plans and by field-adjusting appropriate erosion mitigation measures (BMPs) throughout construction, the potential adverse impacts from erosion hazards on the project may be mitigated.

III. DESIGN RECOMMENDATIONS

8.0 INTRODUCTION

Our exploration indicates that, from a geotechnical standpoint, the subject site is feasible for the proposed development provided the recommendations contained herein are properly followed. At the locations explored, we encountered a surficial horizon of existing fill ranging in thickness from about 3 to 5 feet, underlain by native alluvial soils consisting of gravelly sand and sandy gravel. The native alluvial soils will provide suitable support for conventional spread and strip footings. The existing fill soils are not considered suitable for direct foundation support and may require remedial measures for support of new pavements and floor slabs.

The following sections provide our recommendations for site preparation, temporary and permanent slopes, structural fill, foundation support, drainage considerations, slab-on-grade support, and pavement design.

9.0 SITE PREPARATION

Site preparation should include removal of all existing pavements, topsoil, and any other deleterious materials located within the footprint of the proposed improvements. Where any existing loose fill or natural sediments are relatively free of organics and near their optimum moisture content for compaction, they can be segregated and considered for reuse as structural fill. Existing underground utilities should either be removed or relocated if they are located below the planned building additions. Erosion and surface water control should be established around the perimeter of the site to satisfy City of Sequim requirements.

After stripping, planned excavation, and any required overexcavation have been performed, the resulting surface should be proof-rolled with a fully loaded dump truck or other suitable equipment. Any soft, loose, or yielding areas should be excavated to expose suitable bearing soils. The subgrade should then be compacted to a firm and unyielding condition as determined by the geotechnical engineer. Structural fill can then be placed to achieve desired grades, if needed.

9.1 Subgrade Protection

The on-site soils generally contain relatively minor quantities of fine-grained material (silt and clay) and are not considered highly moisture-sensitive. However, isolated areas of the subject site may contain higher quantities of fine-grained material and will be subject to disturbance when wet. The contractor must use care during site preparation and excavation operations so

that the underlying soils are not softened. If disturbance occurs the softened soils should be removed, and the area brought to grade with structural fill.

9.2 Temporary and Permanent Cut Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction. For estimating purposes, however, we anticipate that temporary, unsupported cut slopes in unsaturated existing fill and native alluvial soils can be made at a maximum slope of 1.5H:1V (Horizontal:Vertical) or flatter. As is typical with earthwork operations, some sloughing and raveling may occur, and cut slopes may have to be adjusted in the field. If groundwater seepage is encountered in cut slopes, or if surface water is not routed away from temporary cut slope faces, flatter slopes will be required. In addition, WISHA/OSHA regulations should be followed at all times.

Permanent cut and structural fill slopes that are not intended to be exposed to surface water should be designed at inclinations of 2H:1V or flatter. All permanent cut or fill slopes should be compacted to at least 95 percent of the modified Proctor maximum dry density, as determined by ASTM D-1557, and the slopes should be protected from erosion by sheet plastic until vegetation cover can be established during favorable weather.

10.0 STRUCTURAL FILL

Placement of structural fill may be necessary to establish desired grades in some areas or to backfill utility trenches or around foundations. All references to structural fill in this report refer to subgrade preparation, fill type, and placement and compaction of materials as discussed in this section. If a percentage of compaction is specified under another section of this report, the value given in that section should be used.

The on-site soils contained minor quantities of fine-grained material and moisture contents near or below optimum for proper compaction and are generally considered suitable for use as structural fill with proper preparation. Depending on the time of year, weather conditions, and depth of excavation, these sediments may require the addition of water or aeration (drying) before use as structural fill.

Construction equipment traversing the site can cause considerable disturbance. If fill is placed during wet weather or if proper compaction cannot be attained, a select import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction.

10.1 Subgrade Compaction

After overexcavation/stripping has been performed to the satisfaction of the geotechnical engineer/engineering geologist, the upper 12 inches of exposed ground should be recompacted to a firm and unyielding condition. If the subgrade contains too much moisture, adequate recompaction may be difficult or impossible to obtain and should probably not be attempted. In lieu of recompaction, the area to receive fill should be blanketed with washed rock or quarry spalls to act as a capillary break between the new fill and the wet subgrade. Where the exposed ground remains soft and further overexcavation is impractical, placement of an engineering stabilization fabric may be necessary to prevent contamination of the free-draining layer by silt migration from below.

10.2 Structural Fill Compaction

After stripping and subgrade preparation of the exposed ground is approved, or a free-draining rock course is laid, structural fill may be placed to attain desired grades. Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts, with each lift being compacted to at least 95 percent of the modified Proctor maximum dry density using ASTM D-1557 as the standard. Utility trench backfill should be placed and compacted in accordance with applicable municipal codes and standards. The top of the compacted fill should extend horizontally a minimum distance of 3 feet beyond footings or pavement edges before sloping down at an angle no steeper than 2H:1V. Fill slopes should either be overbuilt and trimmed back to final grade or surface-compacted to the specified density.

10.3 Moisture-Sensitive Fill

Soils in which the amount of fine-grained material (smaller than No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. Use of moisture-sensitive soil in structural fills should be limited to favorable dry weather conditions. Most of the on-site sediments appear to contain a minor percentage (about 5 percent) of fine-grained material and are not considered highly moisture-sensitive.

11.0 FOUNDATIONS

No structural or architectural plans were available at the time of this report; however, we anticipate that the proposed building additions will be supported on conventional strip footings with slab-on-grade floors. Our exploration borings encountered existing fill soils that are not considered suitable for direct foundation support. We recommend either extending the bottom

of the footings to the native alluvial soils (ranging from about 3 to 5 feet below existing grade, but may vary) or removing the existing fill beneath the footing areas and replacing with structural fill, compacted crushed rock, or a lean grout (referred to as a foundation trench in this report). Foundation trenches should extend laterally beyond all foundation elements by at least 1 foot, and should have a minimum width of 4 feet. All foundation trenches should be excavated down to expose the underlying native sediments. Because of the potential for caving, the actual trench width may be greater than specified. We recommend backfilling the foundation trenches as the excavation proceeds to reduce caving. In order to reduce disturbance of the bearing soils exposed in the foundation trench, we recommend using a smooth-edge bucket.

Where the removal of existing fill for new foundations will occur adjacent to and below existing foundations, the excavation of existing fill should occur in a series of alternating 4-foot-long slot cuts to avoid undermining the existing foundation. Once the first series of slot cuts are excavated to bearing soils, they should be backfilled with controlled density fill (CDF) the same day they were excavated. Once the CDF has cured, excavation of the remaining areas can begin. Excavations below existing foundations should not remain open overnight.

For footings bearing directly on the native alluvial sediments or on structural fill placed over these sediments, a maximum allowable soil bearing pressure of 2,500 pounds per square foot (psf) may be used for design purposes, including both dead and live loads. An increase of one-third may be used for short-term wind or seismic loading. All footings should have a minimum width of 16 inches. Perimeter footings for the proposed buildings should be buried a minimum of 18 inches into the surrounding soil for frost protection. No minimum burial depth is required for interior footings; however, all footings must penetrate to the prescribed stratum, and no footings should be founded in or above loose, organic, existing fill soils or loose native sediments.

It should be noted that the area bounded by lines extending downward at 1H:1V from any footing must not intersect another footing or intersect a filled area that has not been compacted to at least 95 percent of ASTM D-1557. In addition, a 1.5H:1V line extending down from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus, footings should not be placed near the edge of steps or cuts in the bearing soils.

Anticipated settlement of footings founded as recommended should be less than 1 inch with differential settlements at about one-half of the anticipated total settlement. Most of this movement should occur during initial dead load applications. However, disturbed material not removed from footing trenches prior to footing placement could result in increased settlements. All footing areas should be inspected by AESI prior to placing concrete to verify that the design bearing capacity of the soils has been attained and that construction conforms

with the recommendations contained in this report. Such inspections may be required by the governing municipality. Perimeter footing drains should be provided, as discussed under the "Drainage Considerations" section of this report.

11.1 Passive Resistance and Friction Factor

Lateral loads can be resisted by friction between the foundation and the native alluvial soils or supporting structural fill soils, and by passive earth pressure acting on the buried portions of the foundations. The foundations must be backfilled with structural fill and compacted to at least 95 percent of the maximum dry density to achieve the passive resistance provided below. We recommend the following allowable design parameters which include a factor of safety of 1.5:

- Passive equivalent fluid = 300 pounds per cubic foot (pcf)
- Coefficient of friction = 0.30

12.0 FLOOR SUPPORT

Floor slabs can be supported directly on the native alluvial soils, on new structural fill placed above native sediments, or on a minimum of 2 feet of new structural fill where thicker existing fill soils are encountered.

Interior slabs where control of moisture migration through the slab is needed should be cast atop a minimum of 4 inches of clean washed crushed rock or pea gravel to act as a capillary break. Areas of subgrade that are disturbed (loosened) during construction should be compacted to a non-yielding condition prior to placement of capillary break material. It should also be protected from dampness by an impervious moisture barrier at least 10 mils thick. The impervious barrier should be placed between the capillary break material and the concrete slab.

13.0 LATERAL EARTH PRESSURES FOR BELOW-GRADE WALLS

Horizontally backfilled walls, which are free to yield laterally at least 0.1 percent of their height, may be designed to resist lateral earth pressures represented by an "active" equivalent fluid equal to 35 pcf. Fully restrained, horizontally backfilled, rigid walls that cannot yield should be designed for an "at-rest" equivalent fluid of 55 pcf. Walls with sloping backfill up to a maximum gradient of 2H:1V should be designed using an equivalent fluid of 55 pcf for yielding conditions or 80 pcf for fully-restrained conditions. If parking areas are adjacent to walls, a surcharge of 250 psf should be added to the wall height in determining lateral design forces.

The lateral pressures presented above are based on the conditions of a uniform backfill consisting of excavated on-site soils or imported structural fill compacted to 95 percent of ASTM D-1557. Surcharge loading from adjacent footings or heavy construction equipment must be added to the above values. Perimeter footing drains should be provided for all retaining walls, as discussed under the "Drainage Considerations" section of this report.

13.1 Seismic Surcharge

As required by the 2018 IBC, retaining wall design should include a seismic surcharge pressure in addition to the equivalent fluid pressures presented above. Considering the site soils and the recommended wall backfill materials, we recommend a seismic surcharge pressure of 10H and 13H psf, where H is the wall height in feet for the "active" and "at-rest" loading conditions, respectively. The seismic surcharge should be modeled as a rectangular distribution with the resultant applied at the midpoint of the walls.

14.0 DRAINAGE CONSIDERATIONS

All retaining and perimeter footing walls should be provided with a drain at the footing elevation. The drains should consist of rigid, perforated, polyvinyl chloride (PVC) pipe surrounded by washed gravel. The level of the perforations in the pipe should be set approximately 2 inches below the bottom of the footing, and the drains should be constructed with sufficient gradient to allow gravity discharge away from the structures. All retaining walls should be lined with a minimum, 12-inch-thick, washed gravel blanket provided to within 1 foot of finish grade, and which ties into the footing drain. Roof and surface runoff should not discharge into the footing drain system, but should be handled by a separate, rigid, tightline drain.

Exterior grades adjacent to walls should be sloped downward away from the additions to achieve surface drainage. Final exterior grades should promote free and positive drainage away from the buildings at all times. Water must not be allowed to pond or to collect adjacent to the foundation or within the immediate building areas. It is recommended that a gradient of at least 3 percent for a minimum distance of 10 feet from the building perimeter be provided, except in paved locations. In paved locations, a minimum gradient of 1 percent should be provided unless provisions are included for collection and disposal of surface water adjacent to the structures. Additionally, pavement subgrades should be crowned to provide drainage toward catch basins and pavement edges.

15.0 PAVEMENT RECOMMENDATIONS

The pavement sections included in this report section are for driveway and parking areas onsite and are not applicable to right-of-way improvements. At this time, we are not aware of any planned right-of-way improvements; however, if any new paving of public streets is required, we should be allowed to offer situation-specific recommendations.

New pavement areas should be prepared in accordance with the "Site Preparation" section of this report. Soft or yielding areas should be overexcavated to provide a suitable subgrade and backfilled with structural fill.

New pavements onsite may include areas subject only to light traffic loads from passenger vehicles, and may also include areas subject to heavier loading from vehicles that may include fire trucks, delivery trucks, and garbage trucks. In light traffic areas, we recommend a pavement section consisting of 3 inches of hot-mix asphalt (HMA) underlain by 4 inches of crushed surfacing base course (CSBC). In heavy traffic areas, we recommend a minimum pavement section consisting of 4 inches of HMA underlain by 6 inches of CSBC. The crushed rock base course must be compacted to at least 95 percent of the modified Proctor maximum dry density (ASTM D-1557). All paving materials should meet the gradation criteria contained in the current Washington State Department of Transportation (WSDOT) Standard Specifications.

16.0 STORMWATER INFILTRATION FEASIBILITY

The feasibility of stormwater infiltration depends upon the presence of a suitable native receptor soil of sufficient thickness, extent, permeability, and vertical separation from groundwater. We anticipate that the native alluvial sediments consisting of gravelly sand to sandy gravel with relatively minor quantities of silt would be suitable receptor soils for shallow infiltration facilities provided there is adequate vertical separation from seasonal high groundwater.

Infiltration design for this project would require additional exploration and testing, well installation, and groundwater monitoring during the wet winter months to estimate the seasonal high groundwater level at the site and to estimate the design infiltration rate within the native alluvial soils. We are available to discuss stormwater management strategies and to develop a scope of work to provide additional subsurface information necessary for design upon request.

17.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

We recommend that AESI perform a geotechnical review of the plans prior to final design completion. In this way, we can confirm that our earthwork and foundation recommendations have been properly interpreted and implemented in the design.

We are also available to provide geotechnical engineering services during construction. Construction monitoring services are not part of this current scope of work. If these services are desired, please let us know, and we will prepare a cost proposal.

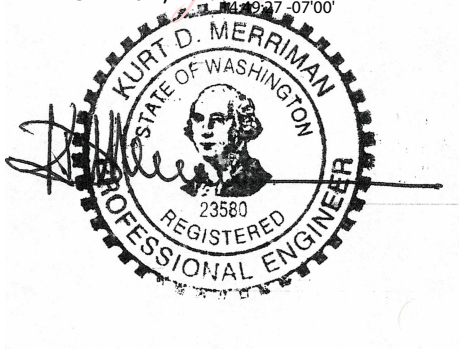
We have enjoyed working with you on this study and are confident that these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Brendan C. Young, L.G.
Senior Staff Geologist

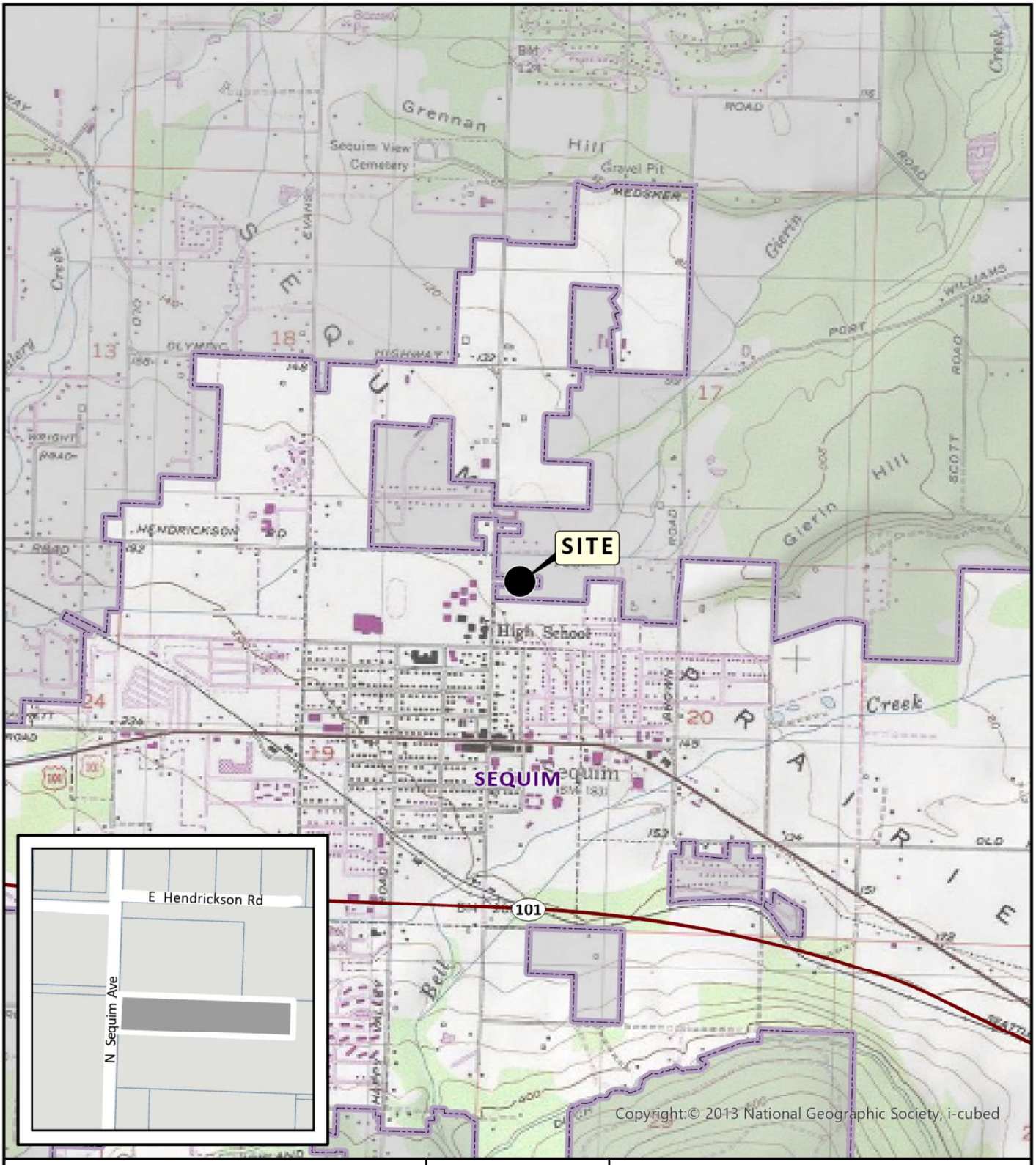
G. Bradford Drew, P.E.
Senior Engineer

Kurt D. Merriman, P.E.
Digitally signed by Kurt D. Merriman, P.E.
Date: 2022.08.25 14:19:27 -07'00'



Kurt D. Merriman, P.E.
Senior Principal Engineer

Attachments:
Figure 1: Vicinity Map
Figure 2: Existing Site and Exploration Plan
Appendix A: Exploration Logs
Appendix B: Laboratory Test Results





DATA SOURCES / REFERENCES:
USGS: 7.5' SERIES TOPOGRAPHIC MAPS, ESRI/I-CUBED/NATIONAL GEOGRAPHIC SOCIETY 2013
CLALLAM CO: STREETS, PARCELS 12/20, CITY LIMITS 7/22
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

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FEET

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

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VICINITY MAP

SEQUIM BRANCH LIBRARY EXPANSION & RENOVATION
SEQUIM, WASHINGTON

PROJ NO.	DATE:	FIGURE:
20220259E001	7/22	1

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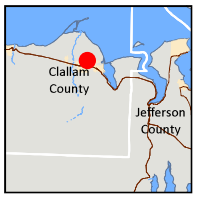


LEGEND

- SITE
- EXPLORATION BORING
- PARCEL
- CITY BOUNDARY
- CONTOUR 10 FT
- CONTOUR 2 FT

DATA SOURCES / REFERENCES:
USGS: OLYMPIC PENINSULA, WASHINGTON 3DEP LIDAR - AREA 1, FLOWN 9/17 - 4/19, CONTOURS FROM LIDAR
CLALLAM CO: PARCELS, STREETS, ZONING 7/22
AERIAL: BING IMAGERY 7/20

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



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BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

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EXISTING SITE AND EXPLORATION PLAN

SEQUIM BRANCH LIBRARY EXPANSION & RENOVATION
SEQUIM, WASHINGTON

PROJ NO.	DATE:	FIGURE:
20220259E001	7/22	2

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APPENDIX A

Exploration Logs

Coarse-Grained Soils - More than 50% [1] Retained on No. 200 Sieve	Gravels - More than 50% [1] of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines [5]	GW	Well-graded gravel and gravel with sand, little to no fines
			GP	Poorly-graded gravel and gravel with sand, little to no fines
		≥12% Fines [5]	GM	Silty gravel and silty gravel with sand
			GC	Clayey gravel and clayey gravel with sand
	Sands - 50% [1] or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines [5]	SW	Well-graded sand and sand with gravel, little to no fines
			SP	Poorly-graded sand and sand with gravel, little to no fines
		≥12% Fines [5]	SM	Silty sand and silty sand with gravel
			SC	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50% [1] or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		ML	Silt, sandy silt, gravelly silt, silt with sand or gravel
			CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		MH	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt
			CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

	Density	SPT [2] blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50
	Consistency	**SPT [2] blows/foot**
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

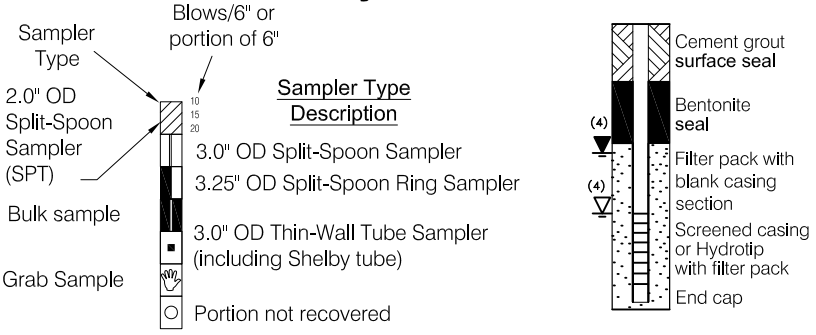
[3] Estimated Percentage

Component	Percentage by Weight
Trace	<5
Some	5 to <12
Modifier (silty, sandy, gravelly)	12 to <30
Very *modifier* (silty, sandy, gravelly)	30 to <50

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols



(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of ground water
▼ ATD = At time of drilling
▽ Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 12%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

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Exploration Boring — EB-1

Sequim Branch Library Expansion and Renovation — Sheet: 1 of 1

Sequim, WA	Start Date: 7/25/22	Logged By: BCY
20220259E001	Ending Date: 7/25/22	Approved By: CMM

Driller/Equipment: Holt/Sonic Drill
Hammer Weight/Drop: 140#/30
Hole Diameter (in): 6
Groundwater Depth ATD (ft): N/A

Total Depth (ft): 11.5
Ground Surface Elevation (ft): 158
Datum: NAVD88
Groundwater Depth Post Drilling (ft) (Date): N/A ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
0		1			**Gravel - 6 inches**		2 2 3	5	
					Fill Slightly moist, dark brown, silty, fine SAND, some gravel; scattered organics (rootlets) (SM).				
2.5		2			Slightly moist to dry, brown to gray brown, gravelly, silty, SAND, some cobbles (≈4" nominal diameter) (SM).				
5		4			**Alluvium** Dry to slightly moist, brown mixed with gray and occasional inclusion of dark brown, silty, fine to medium SAND, some gravel; broken gravel in spoon; blow counts may be overstated (SM).		7 28 27	55	
7.5		5			Moist, brown, fine to medium SAND, some gravel, some silt; occasional beds (6 inches thick) of gray, silty, sand, some gravel; gravel (typically 3 inches or less); occasional cobbles (SP-SM).				
		6			Moist, brown, gravelly, medium SAND, some silt; some gravel have red coloration (SP-SM).				
10		7			Moist to slightly moist, grayish brown, gravelly, fine to medium SAND, trace to some silt; broken gravel in spoon; blow counts may be overstated (SP-SM/SP).		11 18 42	60	
					No groundwater encountered.				
12.5									
15									
17.5									

8/24/2022

20220259E001

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Exploration Boring — EB-2

Sequim Branch Library Expansion and Renovation — Sheet: 1 of 2

Sequim, WA	Start Date: 7/26/22	Logged By: BCY
20220259E001	Ending Date: 7/26/22	Approved By: CMM

Driller/Equipment: Holt/Sonic Drill
Hammer Weight/Drop: 140#/30
Hole Diameter (in): 6
Groundwater Depth ATD (ft): N/A

Total Depth (ft): 26.5
Ground Surface Elevation (ft): 159
Datum: NAVD88
Groundwater Depth Post Drilling (ft) (Date): N/A ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
0		1			**Gravel - 6 inches**		3 8 14	22	
					Fill Slightly moist to moist, dark brown, silty, fine SAND, some gravel; poor recovery (SM).				
		2			Moist, brown to dark brown, gravelly, fine to medium SAND, some silt (SP-SM).				
2.5									
		3			Dry to slightly moist, tan to gray, gravelly, silty, fine SAND; gravel and rocks are angular and partially cemented (SM).				
5		4			**Alluvium** Dry to slightly moist, gray transitioning to brown, gravelly, fine to medium SAND, some silt; broken gravel in spoon; blow counts overstated (SP-SM).		23 38 32	70	
		5			Moist, brown, gravelly, fine to medium SAND, some silt (SP-SM).				
7.5									
		6			Moist, gray to brown, silty, gravelly, fine to medium SAND; layer (2 inches thick) of dry, sandy, silt (SM)				
10		7			Slightly moist, tan to gray, gravelly, fine to medium SAND, trace to some silt; minor broken gravel in spoon; blow counts may be overstated (SP/SP-SM).		3 18 27	45	
		8			Moist, brown, gravelly, medium SAND, trace silt; interbedded (6 to 12 inches thick) beds Slightly moist to moist, grayish brown, gravelly, fine SAND, some silt (SP).				
12.5									
		9							
15		10			Slightly moist, brown and gray, gravelly, fine to medium SAND, trace to some silt; layers of gray, siltier, fine sand; broken gravel in spoon; blow counts overstated (SP/SP-SM).		5 10 43	53	
		11			Moist, brown, gravelly, silty, fine to medium SAND (SM).				
17.5									

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Exploration Boring — EB-2

Sequim Branch Library Expansion and Renovation — Sheet: 2 of 2

Sequim, WA	Start Date: 7/26/22	Logged By: BCY
20220259E001	Ending Date: 7/26/22	Approved By: CMM

Driller/Equipment: Holt/Sonic Drill
Hammer Weight/Drop: 140#/30
Hole Diameter (in): 6
Groundwater Depth ATD (ft): N/A

Total Depth (ft): 26.5
Ground Surface Elevation (ft): 159
Datum: NAVD88
Groundwater Depth Post Drilling (ft) (Date): N/A ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
					Contractor casing hole in order to proceed.				
20		12			Slightly moist, grayish brown, fine SAND, some gravel, trace silt (SP).		18 50/5"	50/5"	
22.5		13			Slightly moist to moist, grayish brown, gravelly, fine to medium SAND, trace to some silt; occasional boulder to large cobble (greater than 6 inches) (SP/ SP-SM).				
25		14			Slightly moist, brownish gray to gray, gravelly, fine to medium SAND, trace to some silt (SP-SM).		22 24 22	46	
					No groundwater encountered.				
27.5									
30									
32.5									
35									
37.5									

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Exploration Boring — EB-3

Sequim Branch Library Expansion and Renovation — Sheet: 1 of 2

Sequim, WA	Start Date: 7/26/22	Logged By: BCY
20220259E001	Ending Date: 7/26/22	Approved By: CMM

Driller/Equipment: Holt/Sonic Drill
Hammer Weight/Drop: 140#/30
Hole Diameter (in): 6
Groundwater Depth ATD (ft): N/A

Total Depth (ft): 26.5
Ground Surface Elevation (ft): 159
Datum: NAVD88
Groundwater Depth Post Drilling (ft) (Date): N/A ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
0					**Gravel - 6 inches**				
		1			**Fill** Slightly moist, dark brown with some gray, silty, gravelly, fine SAND (SM).		9 9 11	20	
		2			Slightly moist, brown, very sandy, GRAVEL, some silt, some inclusions of dark brown, silty, fine to medium SAND, some gravel (up to 5 inches) as lenses (GW-GM).				
2.5									
		3			Dry, gray, gravelly, silty, fine SAND; angular gravel and some cementing (recycled concrete ?) (SM) .			50/6"	
5		4			**Alluvium** Slightly moist, grayish brown to brown, gravelly, fine to medium SAND, some silt (SP-SM).		29 50/6"		
		5			Moist, brown, very gravelly (commonly 2 inches in diameter), fine to coarse SAND, some silt (SW-SM).				
7.5									
		6			Moist, gray brown, fine to coarse but predominantly medium SAND, some gravel, trace to some silt; zones from 7 to 10 feet range to very gravelly (SP/SP-SM).			50/6"	
10		7			Slightly moist to moist, grayish brown, fine to medium SAND, some gravel, trace to some silt (SP SM).		9 41 50/6"		
		8			Slightly moist, brown, gravelly, silty, fine SAND; gravel (up to 3 inches thick) (SM).				
12.5									
		9			Slightly moist to moist, brown, gravelly, fine to medium SAND, trace silt; occasional interbed of grayish brown, gravelly, silty, fine SAND (SP). Hole collapsed from 12 to 15 feet. Contractor adds casing.				
15		10			Very moist, brownish gray, gravelly, silty, fine to medium SAND; sand size increases with depth; excess moisture from driller adding water (SM).		26 35 49	84	
		11			Very moist, brownish gray, very sandy, GRAVEL, some cobbles (up to 5 inches), some silt (GW-GM).				
17.5									
		12			Moist, brown, gravelly, fine to predominantly medium SAND, trace silt (SP).				

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Exploration Boring EB-3

Sequim Branch Library Expansion and Renovation — Sheet: 2 of 2

Sequim, WA	Start Date: 7/26/22	Logged By: BCY
20220259E001	Ending Date: 7/26/22	Approved By: CMM

Driller/Equipment: Holt/Sonic Drill
Hammer Weight/Drop: 140#/30
Hole Diameter (in): 6
Groundwater Depth ATD (ft): N/A

Total Depth (ft): 26.5
Ground Surface Elevation (ft): 159
Datum: NAVD88
Groundwater Depth Post Drilling (ft) (Date): N/A ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
20		13			Moist, brown, gravelly, predominantly fine SAND, some silt; blow counts overstated; broken gravel in tip of spoon (SP-SM).		17 50/5"	50/5"	
		14			Moist, brown, sandy, gravel (up to 4 inches in diameter), some silt (GW-GM).				
22.5		15			Moist, brown, very sandy, GRAVEL, trace silt (GP).				
25		16			Moist to slightly moist, grayish brown, gravelly, fine to medium SAND, trace silt (SP).		5 15 36	51	
					No groundwater encountered.				
27.5									
30									
32.5									
35									
37.5									

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Exploration Boring — EB-4

Sequim Branch Library Expansion and Renovation — Sheet: 1 of 2

Sequim, WA	Start Date: 7/26/22	Logged By: BCY
20220259E001	Ending Date: 7/26/22	Approved By: CMM

Driller/Equipment: Holt/Sonic Drill
Hammer Weight/Drop: 140#/30
Hole Diameter (in): 6
Groundwater Depth ATD (ft): N/A

Total Depth (ft): 26.5
Ground Surface Elevation (ft): 159
Datum: NAVD88
Groundwater Depth Post Drilling (ft) (Date): N/A ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
0		1			**Asphalt - 4 inches**		8	20	
					Crushed Aggregate - 2 inches		8		
					Fill		12		
		2			Moist, brown to dark brown with minor orange oxidation staining, gravelly, silty, fine to medium SAND (SM). Run 1: 0 to 5 feet				
2.5					Moist to very moist, dark brown, gravelly, silty, fine to medium SAND (SM).				
		3			**Alluvium** Moist, brown, gravelly, fine to medium SAND, some silt (SP-SM).				
5		4			Moist, brown, gravelly, fine to medium SAND, some silt; broken gravel in spoon; blow counts may be overstated (SP-SM).		25	74	
							32		
							42		
7.5		5			Moist, brown, fine to medium sandy, GRAVEL (commonly 1 to 2 inches; occasionally up to 4 inches), some silt (GP-GM).				
10		6			As above; broken gravel in spoon; blow counts overstated; poor recovery (GP-GM).		10	50/5"	
							50/5"		
		7			Slightly moist, brown, gravelly, fine to medium SAND, trace silt (SP).				
12.5									
15		8			Slightly moist, grayish brown to brown, medium SAND, some gravel, trace silt (SP).		38	83	
							37		
							46		
		9			Run 4: 15 to 20 feet				
17.5					Moist, brown, fine to medium SAND, some gravel, trace silt (SP).				
		10			Moist, brown, fine to medium SAND, some gravel, some silt (SP-SM).				

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Exploration Boring — EB-4

Sequim Branch Library Expansion and Renovation — Sheet: 2 of 2

Sequim, WA	Start Date: 7/26/22	Logged By: BCY
20220259E001	Ending Date: 7/26/22	Approved By: CMM

Driller/Equipment: Holt/Sonic Drill
Hammer Weight/Drop: 140#/30
Hole Diameter (in): 6
Groundwater Depth ATD (ft): N/A

Total Depth (ft): 26.5
Ground Surface Elevation (ft): 159
Datum: NAVD88
Groundwater Depth Post Drilling (ft) (Date): N/A ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
20		11			Moist, brown, gravelly, fine to medium SAND, trace silt; broken gravel in spoon; blow counts may be overstated (SP).		14 19 26	45	
22.5		12			Moist, brown, gravelly, fine to coarse SAND, trace to some silt (SP/SP-SM).				
		13			Moist, brown, fine to medium SAND, some gravel, trace silt (SP).				
25		14			Slightly moist, brown to gray, gravelly, fine to medium SAND, trace silt; broken gravel in spoon; blow counts may be overstated (SP).		8 22 24	46	
					No groundwater encountered.				
27.5									
30									
32.5									
35									
37.5									

8/24/2022

20220259E001

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Exploration Boring — EB-5

Sequim Branch Library Expansion and Renovation — Sheet: 1 of 2

Sequim, WA	Start Date: 7/27/22	Logged By: BCY
20220259E001	Ending Date: 7/27/22	Approved By: CMM

Driller/Equipment: Holt/Sonic Drill
Hammer Weight/Drop: 140#/30
Hole Diameter (in): 6
Groundwater Depth ATD (ft): N/A

Total Depth (ft): 26.5
Ground Surface Elevation (ft): 160
Datum: NAVD88
Groundwater Depth Post Drilling (ft) (Date): N/A ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
0		1			**Asphalt - 4 inches** **Crushed Aggregate - 2 inches** **Fill** Moist, brown to dark brown with minor oxidation staining to orange, fine sandy, GRAVEL (≈1 inch in diameter) , trace to some silt (GP/GP-GM).		9 13 34	47	
2.5		2			Moist, brown, fine sandy, GRAVEL (<4 inches in diameter), some silt (GP-GM).				
		3			Dry, tan to gray, silty, gravelly, fine SAND; angular gravel: partially cemented? (SM).			38	
5		4			**Alluvium** Slightly moist, gray mixed with brown, fine to medium sandy, GRAVEL, trace to some silt; broken gravel in spoon; blow counts may be overstated (GP).		1 12 26		
7.5		5			Moist, brown, gravelly (<2 inches in diameter), fine SAND, trace silt (SP).				
		6			Slightly moist, tan to brown, gravelly (>1.5 inches in diameter), fine SAND, some silt (SP-SM).				
10		7			Slightly moist, brownish gray, very sandy, GRAVEL, trace to some silt; broken gravel in spoon; blow counts over stated (GP-GM).		8 43 50/6"	50/6"	
12.5		8			Slightly moist to moist, brown, gravelly, fine to medium SAND, trace to some silt; interbed (≈6 inches thick) of fine sand, some gravel, trace silt (SP/SP-SM).				
15		9/ 10			Moist, brown, fine to medium SAND, some gravel, trace silt; no SPT recovery; on rock; sample from sonic core(SP).		50/4"	50/4"	
17.5		11			Moist, brown, fine to medium SAND, some gravel, trace to some silt; layers (4 inches thick) of slightly moist, gray to tan, silty, fine sand, some gravel (SP/SP-SM).				

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20220259E001

associated earth sciences incorporated

Exploration Boring EB-5

Sequim Branch Library Expansion and Renovation — Sheet: 2 of 2

Sequim, WA	Start Date: 7/27/22	Logged By: BCY
20220259E001	Ending Date: 7/27/22	Approved By: CMM

Driller/Equipment: Holt/Sonic Drill
Hammer Weight/Drop: 140#/30
Hole Diameter (in): 6
Groundwater Depth ATD (ft): N/A

Total Depth (ft): 26.5
Ground Surface Elevation (ft): 160
Datum: NAVD88
Groundwater Depth Post Drilling (ft) (Date): N/A ()

Depth (ft)	Sample Type	Sample	% Recovery	Graphic Symbol	Description	Water Level	Blows/6"	Blows/Foot (10 20 30 40 50+)	Other Tests
20		12			Moist, brown, fine sandy, GRAVEL, trace silt; poor recovery; broken gravel in spoon; blow counts overstated (GP).		32 50/3"	50/3"	
		13			Moist, brown, fine to medium sandy, GRAVEL (4 inches in diameter), trace silt (GP).				
22.5		14			Moist to slightly moist, gravelly, fine to medium SAND, some silt; layers (up to 6 inches thick) of dry, tan, silty, fine sand, some gravel (SP-SM).				
25		15			Slightly moist with dry layers, brown, gravelly, fine to medium SAND, trace to some silt; broken gravel in spoon; blow counts overstated (SP/SP-SM) .		11 50/6"	50/6"	
					No groundwater encountered.				
27.5									
30									
32.5									
35									
37.5									

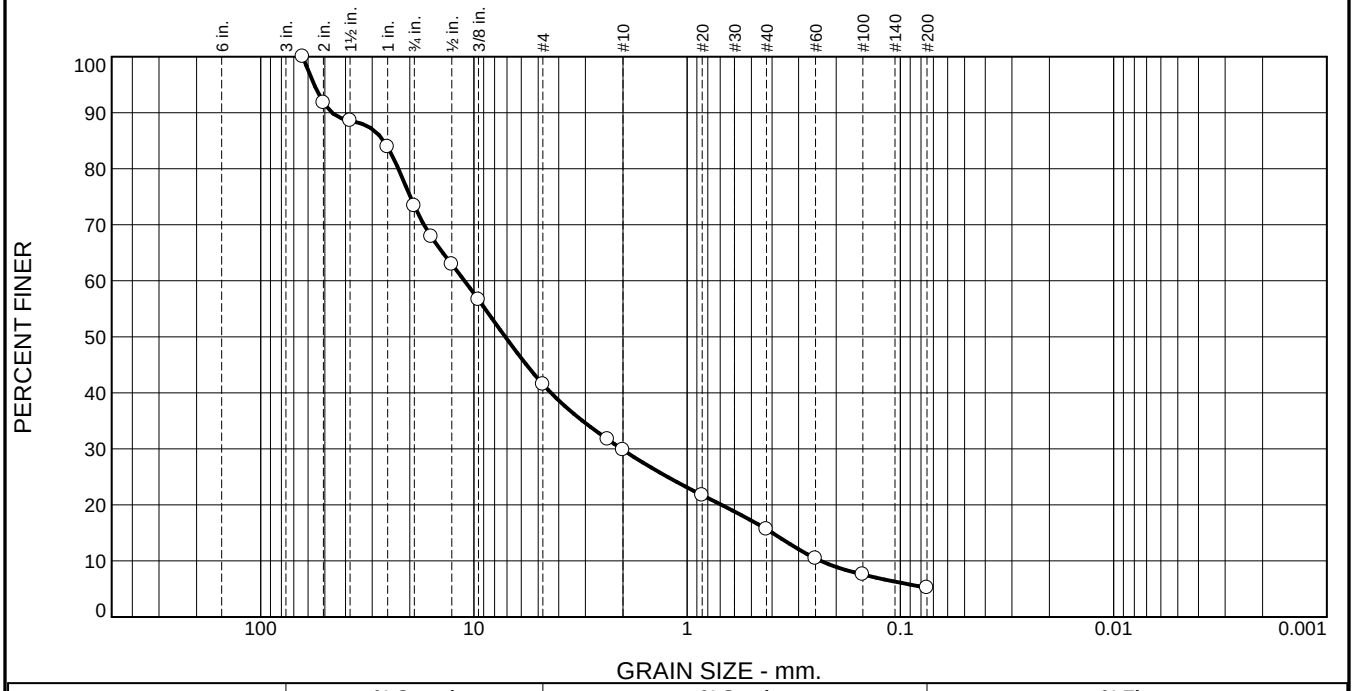
8/24/2022

20220259E001

APPENDIX B

Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	26.6	31.9	11.7	14.1	10.5	5.2	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
2.5"	100.0		
2"	91.8		
1.5"	88.6		
1"	83.9		
3/4"	73.4		
5/8"	67.9		
1/2"	62.9		
3/8"	56.6		
#4	41.5		
#8	31.7		
#10	29.8		
#20	21.7		
#40	15.7		
#60	10.4		
#100	7.6		
#200	5.2		

* (no specification provided)

Material Description

very sandy GRAVEL, some silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= GW-GM **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 46.3634 D_{85}= 26.5187 D_{60}= 11.0754
D_{50}= 7.1300 D_{30}= 2.0331 D_{15}= 0.3985
D_{10}= 0.2364 C_u= 46.84 C_c= 1.58

Remarks

Date Received: 8/3/2022 **Date Tested:** 8/5/2022

Tested By: CI

Checked By: BCY/BD

Title:

Location: Onsite
Sample Number: EB-3 **Depth:** 2'

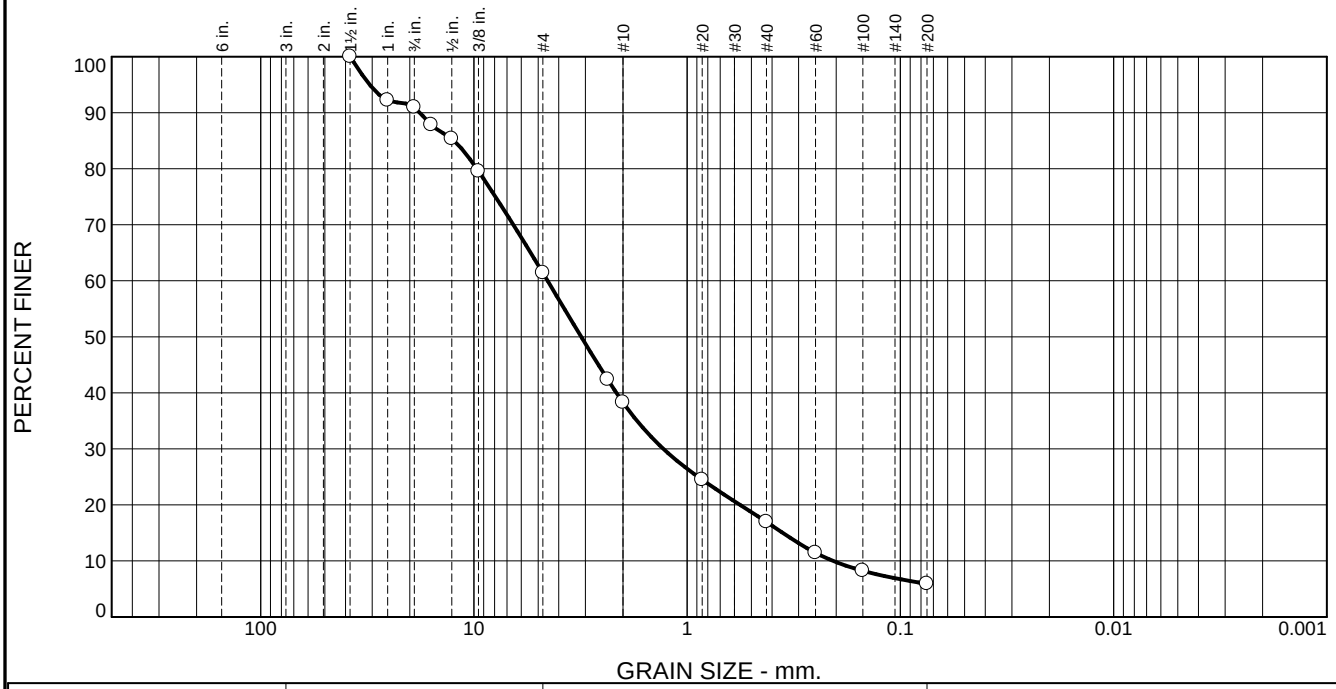
Date Sampled: 7/26/2022

associated earth sciences incorporated

Client: North Olympic Library System
Project: Sequim Branch Library Expansion and Renovation

Project No: 20220259 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.1	29.5	23.1	21.3	11.1	5.9	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	92.2		
3/4"	90.9		
5/8"	87.8		
1/2"	85.3		
3/8"	79.5		
#4	61.4		
#8	42.4		
#10	38.3		
#20	24.5		
#40	17.0		
#60	11.4		
#100	8.2		
#200	5.9		

* (no specification provided)

Material Description

very gravelly SAND, some silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= SW-SM **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 17.9069 D_{85}= 12.3969 D_{60}= 4.5143
D_{50}= 3.1400 D_{30}= 1.2934 D_{15}= 0.3560
D_{10}= 0.2069 C_u= 21.81 C_c= 1.79

Remarks

Date Received: 8/3/2022 **Date Tested:** 8/5/2022

Tested By: CI

Checked By: BCY/BD

Title:

Location: Onsite
Sample Number: EB-3 **Depth:** 7'

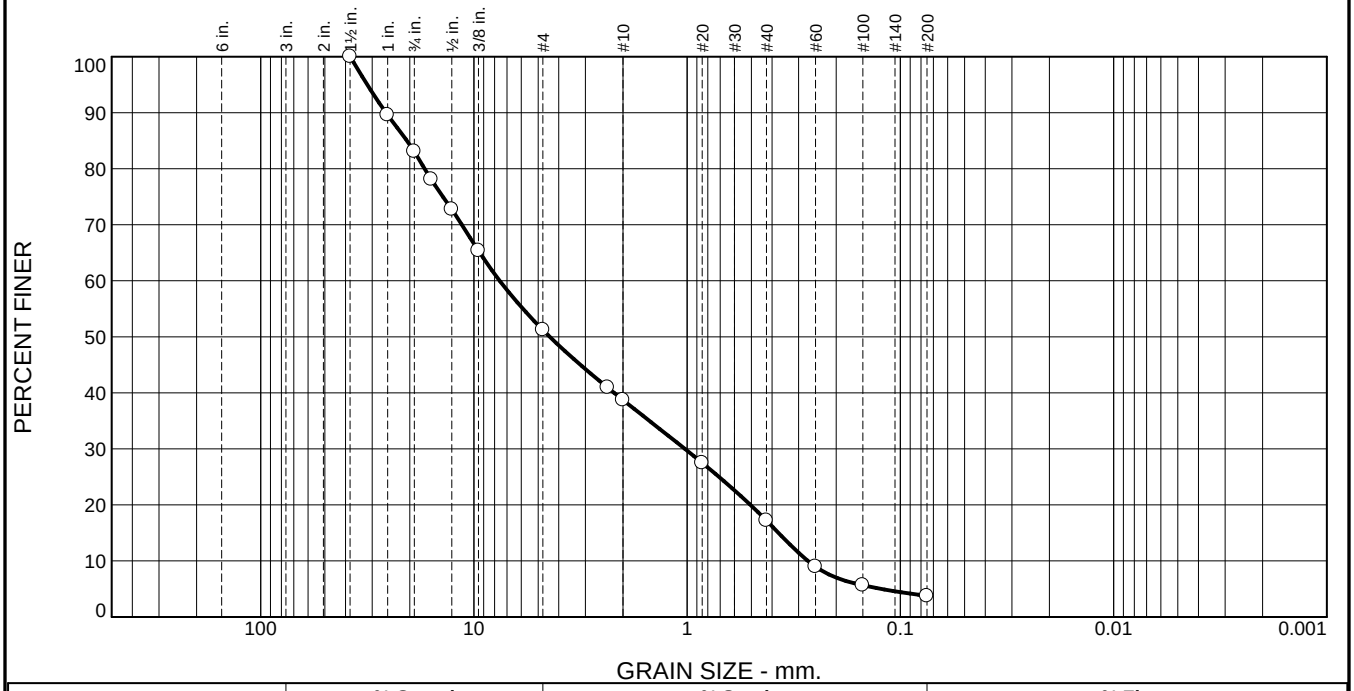
Date Sampled: 7/26/2022

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Client: North Olympic Library System
Project: Sequim Branch Library Expansion and Renovation

Project No: 20220259 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	16.9	31.9	12.5	21.5	13.5	3.7	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	89.6		
3/4"	83.1		
5/8"	78.1		
1/2"	72.7		
3/8"	65.4		
#4	51.2		
#8	40.9		
#10	38.7		
#20	27.5		
#40	17.2		
#60	9.0		
#100	5.7		
#200	3.7		

* (no specification provided)

Material Description

very sandy GRAVEL, trace silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= GP **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 25.8587 D_{85}= 20.6272 D_{60}= 7.5705
D_{50}= 4.4092 D_{30}= 1.0253 D_{15}= 0.3730
D_{10}= 0.2715 C_u= 27.88 C_c= 0.51

Remarks

Date Received: 8/3/2022 **Date Tested:** 8/5/2022

Tested By: CI

Checked By: BCY/BD

Title:

Location: Onsite
Sample Number: EB-3 **Depth:** 22'

Date Sampled: 7/26/2022

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Client: North Olympic Library System
Project: Sequim Branch Library Expansion and Renovation

Project No: 20220259 E001 **Figure**