# Geotechnical Engineering Report

Pe Ell K-12 Track
519 N 2nd Street
Pe Ell, Washington

Prepared for:

Pe Ell School District
519 N 2nd Steet
Pe Ell, Washington 98572

October 28, 2024
PBS Project 78253.000

PBS
AN APEX COMPANY
4412 S CORBETT AVENUE
PORTLAND, OR 97239
503.248.1939 MAIN
866.727.0140 FAX
PBSUSA.COM

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Prepared by:

Frank Jarman, EIT
Geotechnical Engineering Staff

Reviewed by:

RYAN K. WHITE
39104
10/28/2024

Ryan White, PE, GE (OR)
Principal Geotechnical Engineer

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# 1 INTRODUCTION

## 1.1 General

This report presents results of PBS Engineering and Environmental LLC (PBS) geotechnical engineering services for the proposed track and field improvements located at 519 N 2nd Street in Pe Ell, Washington (site). The general site location is shown on the Vicinity Map, Figure 1. The locations of PBS' explorations in relation to existing site features are shown on the Site Plan, Figure 2.

## 1.2 Purpose and Scope

The purpose of PBS' services was to develop geotechnical design and construction recommendations in support of the planned new track. This was accomplished by performing the following scope of services.

### 1.2.1 Literature and Records Review

PBS reviewed various published geologic maps of the area for information regarding geologic conditions and hazards at or near the site. PBS also reviewed previously completed reports for the project site and vicinity.

### 1.2.2 Subsurface Explorations

Five borings were advanced to depths ranging from approximately 4.7 to 7.0 feet below the existing ground surface (bgs) within the development footprint. The borings were logged and representative soil samples collected by a member of the PBS geotechnical engineering staff. The approximate boring locations are shown on the Site Plan, Figure 2. The interpreted boring logs are presented as Figures A1 through A5 in Appendix A, Field Explorations.

### 1.2.3 Field Infiltration Testing

One cased-hole, falling-head field infiltration test was completed in boring B-5 within the proposed development at a depth of 5 feet bgs. Infiltration testing was monitored by PBS geotechnical engineering staff.

### 1.2.4 Soils Testing

Soil samples were returned to our laboratory and classified in general accordance with the Unified Soil Classification System (ASTM D2487) and/or the Visual-Manual Procedure (ASTM D2488). Laboratory tests included natural moisture contents, grain-size analyses, and Atterberg limits. Laboratory test results are included in the exploration logs in Appendix A, Field Explorations; and in Appendix B, Laboratory Testing.

### 1.2.5 Geotechnical Engineering Analysis

Data collected during the subsurface exploration, literature research, and testing were used to develop site-specific geotechnical design parameters and construction recommendations.

### 1.2.6 Report Preparation

This Geotechnical Engineering Report summarizes the results of our explorations, testing, and analyses, including information relating to the following:

- Field exploration logs and site plan showing approximate exploration locations
- Laboratory test results
- Infiltration test results
- Groundwater considerations
- Earthwork and grading, cut, and fill recommendations:
    - Structural fill materials and preparation, and reuse of on-site soils
    - Wet weather considerations

  - Utility trench excavation and backfill requirements
  - Temporary and permanent slope inclinations
- Track asphalt concrete (AC) and portland cement concrete (PCC) pavement and subgrade preparation recommendations
- Construction considerations

### 1.3 Project Understanding

PBS understands that in conjunction with the ongoing school modernization project, the client intends to reconstruct the existing track and add drainage and irrigation to the football field at the Pe Ell K-12 school in Pe Ell, Washington. Current plans do not include any grading of the football field.

## 2 SITE CONDITIONS

### 2.1 Surface Description

The site consists of an elliptical shaped track and football field at the Pe Ell K-12 school in Pe Ell, Washington. It is bordered to the west by residential property and the north-south oriented Chehalis River, to the north by agricultural property, to the east by baseball fields associated with the Pe Ell school, and to the south by the Pe Ell K-12 school building and associated parking areas. The area surrounding the track and field consists of bleacher seating and fence line. Based on available topographic data, the site is generally flat, with ground surface elevations ranging from a maximum of about 399 feet at the southern end of the track to 397 feet at the northern end of the track (NAVD88). Outside of the site, the ground surface is generally flat, with the exception of ground surfaces sloping down slightly to the north, with a ground surface elevation of 392 feet at the agricultural property to the north.

### 2.2 Geologic Setting

The site is located within the Portland-Vancouver Basin, a tectonic depression within the physiographic province of the Puget-Willamette Lowland that separates the Cascade Range from the Coast Range, and extends from the Puget Sound, Washington, to Eugene, Oregon (Yeats et al., 1996). The Puget-Willamette Lowland is situated along the Cascadia Subduction Zone (CSZ) where oceanic rocks of the Juan de Fuca Plate are subducting beneath the North American Plate, resulting in deformation and uplift of the Coast Range and volcanism in the Cascade Range. Northwest-trending faults accommodating clockwise rotation of the North American Plate are found throughout the Puget-Willamette Lowland (Brocher et al., 2017; USGS, 2024).

The greater Portland Basin is underlain by Columbia River Basalt Group (CRBG) flows consisting of numerous fine-grained volcanic eruptions between approximately 17 million years ago (Ma) and 6 Ma from fissures located in eastern Oregon, eastern Washington, and western Idaho (Beeson et al., 1991). These fissures released thousands of square kilometers, inundating areas east of the Cascade Range and entering western Oregon through a Miocene gap in the Cascade Range (present day Columbia Gorge) before reaching the ocean. Magmatic compositions of the CRBG allow the flows to be subdivided into distinct formations that can be further divided into members-based geochemical, paleomagnetic, and lithological properties.

Numerous northwest-trending faults govern the topography within the basin. Uplift and down dropping of crustal blocks have created topographic high points by offsetting regional scale flood basalts and down dropping basement rocks, creating infilled depressions and sediment basins and have historically generated accommodation space for the accumulation of volcanic flows entering the basin and overlying fluvial deposits. Of these deposits, the Pliocene Troutdale Formation is the most widespread unit within the basin overlying CRBG volcanic flows. These friable to moderately strong conglomerates, with minor interbeds of sandstone and claystone, consist of well-rounded CRBG clasts and other exotic metamorphic and plutonic clasts. Above these conglomerates, younger quaternary deposits have accumulated.

Cyclical Pleistocene cataclysmic floods deposited sediments and recarved the landscape within the Portland Basin more than 40 times over a 3,000-year timespan (Burns and Coe, 2012). As floodwaters entered the basin from the Columbia River Gorge, they slowed, depositing suspended sediments and bed loads. Topographic highpoints within the basin deflected floodwaters and generated areas that were scoured and eroded into older sediments and bedrock. These geomorphic features dominate the modern-day landscape and are indistinguishable within the Portland Basin lidar data (WADNR 2024; DOGAMI, 2024).

## 2.3 Local Geology

The site is mapped as underlain by Holocene age stratified clay, silt, sand, and gravel deposited along rivers and streams, and locally includes organic-rich mud in valley bottoms and poorly sorted alluvial fan deposits along valley margins (Wells et al., 2020).

## 2.4 Subsurface Conditions

The site was explored by drilling five borings, designated B-1 through B-5, to depths of approximately 4.7 to 7 feet bgs. All five borings were terminated due to practical refusal in gravel. The drilling was performed by Dan J. Fischer Excavating, Inc., of Forest Grove, Oregon, using a trailer-mounted Big Beaver drill rig and solid-stem auger drilling techniques.

PBS has summarized the subsurface units as follows:

| | |
|---|---|
| TOPSOIL: | Topsoil with roots was encountered in the upper approximate 12 inches of each boring. This material consisted of brown, low plasticity silt with sand. |
| FILL: | Brown, moist, sandy silt with gravel fill was encountered from 1 to 4 feet bgs in boring B-4. The silt content exhibited low plasticity, and the gravel and sand content were fine to coarse, with the gravel clasts being subangular to angular in shape. This material had an SPT N-value of 10, classifying it as stiff. |
| SANDY SILT: | Brown, moist, elastic sandy silt was encountered beneath the topsoil in borings B-1 through B-3 as well as B-5. This silt extended to depths ranging from 3.5 to 5 feet bgs. The sand content was generally fine-grained, and SPT N-values ranged from 7 to 23, classifying it as medium stiff to very stiff. |
| SILTY GRAVEL: | Brown to gray, moist, silty gravel with sand was encountered beneath the sandy silt and fill material and extended to the termination depth in all borings. Silt content exhibited low plasticity, and sand and gravel content were generally fine to coarse-grained, with gravel clasts being subangular to angular in shape. SPT N-values ranged from 50 to 92, classifying this material as very dense. |

## 2.5 Groundwater

Static groundwater was not encountered during our explorations to the depths explored. Based on a review of regional groundwater logs available from the Washington State Department of Ecology and site proximity to the adjacent Chehalis River, we anticipate the static groundwater level is present at a depth greater than 7 feet bgs. Please note that groundwater levels can fluctuate during the year depending on climate, irrigation season, extended periods of precipitation, drought, and other factors. Due to the presence of high plasticity soils near the ground surface, groundwater could perch on or in this layer during wet conditions.

### 2.6 Infiltration Testing

PBS completed a cased-hole, falling-head infiltration test in boring B-5 at a depth of 5 feet bgs. The infiltration test was conducted in general accordance with the Stormwater Management Manual for Western Washington (SWMMWW) procedures. The infiltration test was conducted within a 6-inch inside diameter piece of PVC casing that was inserted into the borehole after drilling to the designated depth. The casing was filled with water to achieve a minimum 1-foot-high column of water. After a period of saturation, the height of the water column in the casing was then measured initially and at regular, timed intervals. Results of our field infiltration testing are presented in Table 1.

**Table 1. Infiltration Test Results**

| Test Location | Depth (feet bgs) | Field Measured Infiltration Rate (in/hr) | Soil Classification |
|---|---|---|---|
| B-5 | 5 | 9 | GW-GM |

The infiltration rate listed in Table 1 is not a permeability/hydraulic conductivity, but a field-measured rate, and does not include correction factors related to long-term infiltration rates. The design engineer should determine the appropriate correction factors to account for the planned level of pre-treatment, maintenance, vegetation, siltation, etc. Field-measured infiltration rates are typically reduced by a minimum factor of 2 to 4 for use in design.

Soil types can vary significantly over relatively short distances. The infiltration rate noted above is representative of one discrete location and depth. Installation of infiltration systems within the layer the field rate was measured is considered critical to proper performance of the systems.

## 3 CONCLUSIONS AND RECOMMENDATIONS

### 3.1 Geotechnical Design Considerations

The subsurface conditions at the site consist of medium stiff to stiff sandy silt over very dense silty gravel with sand.

- Based on our observations and analyses, conventional support of the new track is feasible.
- Twelve inches of topsoil was encountered in our explorations and should be removed from beneath any proposed hard surfaces.
- The near-surface soils are sensitive to disturbance when at a moisture content that is above optimum.
- Excavation with conventional equipment is feasible at the site. Deeper excavations, if necessary, may require a larger excavator and a toothed bucket.

### 3.2 Track Improvements

Satisfactory subgrade support for the new track can be obtained from the native sandy silt or the silty gravel with sand subgrade prepared in accordance with our recommendations presented in the Site Preparation, Wet/Freezing Weather and Wet Soil Conditions, and Select Granular Fill sections of this report. A minimum 6-inch-thick layer of imported granular material should be placed and compacted over the prepared subgrade. Thicker aggregate sections or cement amendment of track subgrades may be necessary where undocumented fill is present, soft/loose soils are present at subgrade elevation, and/or during wet conditions. Imported granular material should be composed of crushed rock or crushed gravel that is relatively well graded between coarse and fine, contains no deleterious materials, has a maximum particle size of 1 inch, and has less than 5% by dry weight passing the US Standard No. 200 Sieve.

Track pavements supported on a subgrade and base course prepared in accordance with the preceding recommendations may be designed using a modulus of subgrade reaction (k) of 110 pounds per cubic inch (pci).

### 3.3 Temporary and Permanent Slopes

All temporary cut slopes should be excavated with a smooth-bucket excavator, with the slope surface repaired if disturbed. In addition, upslope surface runoff should be rerouted to not run down the face of the slopes. Equipment should not be allowed to induce vibration or infiltrate water above the slopes, and no surcharges are allowed within 25 feet of the slope crest.

PBS understands no permanent cut or fill slopes are currently planned for the project.

### 3.4 Ground Moisture

The perimeter ground surface and hard-scape should be sloped to drain away from the track.

### 3.5 Pavement Design

PBS understands the track reconstruction will consist of new asphalt concrete (AC) or portland cement concrete (PCC) overlain by the track wearing surface. The minimum recommended pavement section thicknesses are provided in Table 2. These sections are recommended based on the assumption of infrequent low-volume passenger vehicle traffic, and are generally consistent with the recommendations for paved paths and pedestrian trails presented in the Washington Department of Transportation Pavement Policy (WSDOT, 2018).

Depending on weather conditions at the time of construction, a thicker aggregate base course section could be required to support construction traffic during preparation and placement of the pavement section.

**Table 2. Minimum AC and PCC Pavement Sections for New Track**

| Pavement Type | Pavement Thickness (inches) | Base Course Thickness (inches) | Subgrade |
|---|---|---|---|
| AC | 3 | 6 | Stiff subgrade as verified by PBS personnel* |
| PCC | 4 | 6 | |

* Subgrade must be approved by evaluation with a steel foundation probe

For new AC sections, the asphalt cement binder should be selected following WSDOT SS 9-02.1(4) – Performance Graded Asphalt Binder. The AC should consist of ½-inch hot mix asphalt (HMA). The AC should conform to WSDOT SS 5-04.3(7)A – Mix Design, WSDOT SS 9-03.8(2) – HMA Test Requirements, and WSDOT SS 9-03.8(6) – HMA Proportions of Materials. The AC should be compacted to 91% of the maximum theoretical density (Rice value) of the mix, as determined in accordance with ASTM D2041, following the guidelines set in WSDOT SS 5-04.3(10) – Compaction.

We recommend construction traffic not be allowed on new pavements, or that the contractor take appropriate precautions to protect the subgrade and pavement during construction.

# 4 CONSTRUCTION RECOMMENDATIONS

## 4.1 Site Preparation

Construction of the proposed improvements will involve clearing and grubbing of the existing vegetation or demolition of possible existing structures. In vegetated areas, site stripping should include removing topsoil, roots, and other deleterious materials to a minimum depth of 12 inches bgs. Demolition should include removing existing pavement, utilities, etc., throughout the proposed new development. Underground utility lines or other abandoned structural elements should also be removed. The voids resulting from removal of foundations or loose soil in utility lines should be backfilled with compacted structural fill. The base of these excavations should be excavated to stiff native subgrade before filling, with sides sloped at a minimum of 1H:1V (horizontal to vertical) to allow for uniform compaction. Materials generated during demolition should be transported off site or stockpiled in areas designated by the owner's representative.

### 4.1.1 Proofrolling/Subgrade Verification

Following site preparation and prior to placing aggregate base over shallow foundation, floor slab, and pavement subgrades, the exposed subgrade should be evaluated either by proofrolling or another method of subgrade verification. The subgrade should be proofrolled with a fully loaded dump truck or similar heavy, rubber-tire construction equipment to identify unsuitable areas. If evaluation of the subgrades occurs during wet conditions, or if proofrolling the subgrades will result in disturbance, they should be evaluated by PBS using a steel foundation probe. We recommend that PBS be retained to observe the proofrolling and perform the subgrade verifications. Unsuitable areas identified during the field evaluation should be compacted to a stiff condition or be excavated and replaced with structural fill.

### 4.1.2 Wet/Freezing Weather and Wet Soil Conditions

Due to the presence of fine-grained silt and sands in the near-surface materials at the site, construction equipment may have difficulty operating on the near-surface soils when the moisture content of the surface soil is more than a few percentage points above the optimum moisture required for compaction. Soils disturbed during site preparation activities, or unsuitable areas identified during proofrolling or probing, should be removed and replaced with compacted structural fill.

Site earthwork and subgrade preparation should not be completed during freezing conditions, except for mass excavation to the subgrade design elevations. We recommend the earthwork construction at the site be performed during the dry season.

Protection of the subgrade is the responsibility of the contractor. Construction of granular haul roads to the project site entrance may help reduce further damage to the pavement and disturbance of site soils. The actual thickness of haul roads and staging areas should be based on the contractors' approach to site development, and the amount and type of construction traffic. The imported granular material should be placed in one lift over the prepared undisturbed subgrade and compacted using a smooth-drum, non-vibratory roller. A geotextile fabric should be used to separate the subgrade from the imported granular material in areas of repeated construction traffic. Depending on site conditions, the geotextile should meet Washington State Department of Transportation (WSDOT) SS 9-33.2 – Geosynthetic Properties for soil separation or stabilization. The geotextile should be installed in conformance with WSDOT SS 2-12.3 – Construction Geosynthetic (Construction Requirements) and, as applicable, WSDOT SS 2-12.3(2) – Separation or WSDOT SS 2-12.3(3) – Stabilization.

### 4.1.3 Dry Weather Conditions

Medium to high plasticity silt soils should be covered within 4 hours of exposure by a minimum of 4 inches of crushed rock or plastic sheeting during the dry season. Exposure of these materials should be coordinated with the geotechnical engineer so that the subgrade suitability can be evaluated prior to being covered.

## 4.2 Excavation

The near-surface soils at the site can be excavated with conventional earthwork equipment. Sloughing and caving should be anticipated. All excavations should be made in accordance with applicable Occupational Safety and Health Administration (OSHA) and state regulations. The contractor is solely responsible for adherence to the OSHA requirements. Trench cuts should stand relatively vertical to a depth of approximately 4 feet bgs, provided no groundwater seepage is present in the trench walls. Open excavation techniques may be used provided the excavation is configured in accordance with the OSHA requirements, groundwater seepage is not present, and with the understanding that some sloughing may occur. Trenches/excavations should be flattened if sloughing occurs or seepage is present. Use of a trench shield or other approved temporary shoring is recommended if vertical walls are desired for cuts deeper than 4 feet bgs. If dewatering is used, we recommend that the type and design of the dewatering system be the responsibility of the contractor, who is in the best position to choose systems that fit the overall plan of operation.

## 4.3 Structural Fill

The extent of site grading is currently unknown; however, PBS estimates that cuts and fills will be on the order of up to a few feet to raise or lower the grades within the proposed site. Structural fill should be placed over subgrade that has been prepared in conformance with the Site Preparation and Wet/Freezing Weather and Wet Soil Conditions sections of this report. Structural fill material should consist of relatively well-graded soil, or an approved rock product that is free of organic material and debris, and contains particles not greater than 4 inches nominal dimension.

The suitability of soil for use as compacted structural fill will depend on the gradation and moisture content of the soil when it is placed. As the amount of fines (material finer than the US Standard No. 200 Sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and compaction becomes more difficult to achieve. Soils containing more than about 5% fines cannot consistently be compacted to a dense, non-yielding condition when the water content is significantly greater (or significantly less) than optimum.

If fill and excavated material will be placed on slopes steeper than 5H:1V, these must be keyed/benched into the existing slopes and installed in horizontal lifts. Vertical steps between benches should be approximately 2 feet.

### 4.3.1 On-Site Soil

Shallow soils encountered in our explorations consist primarily of high plasticity elastic silt soils, which may be difficult to use as structural fill, except during extended periods of dry weather. Even with construction during the dry summer grading season, it could take several days of frequent aeration to dry soils to near the optimum moisture content for compaction. Subsequently, we do not recommend reusing on-site soils as structural fill. If reusing on-site soil is necessary, it should be moisture conditioned to within a few percent of optimum moisture, placed in lifts with a maximum uncompacted thickness of approximately 8 inches, and compacted to at least 92% of the maximum dry density, as determined by ASTM D1557 (modified proctor).

### 4.3.2 Imported Granular Materials

Imported granular material used during periods of wet weather or for haul roads, building pad subgrades, staging areas, etc., should be pit or quarry run rock, crushed rock, or crushed gravel and sand, and should meet the specifications provided in WSDOT SS 9-03.14(2) – Select Borrow. In addition, the imported granular material should be fairly well graded between coarse and fine, and of the fraction passing the US Standard No. 4 Sieve, less than 5% by dry weight should pass the US Standard No. 200 Sieve.

Imported granular material should be placed in lifts with a maximum uncompacted thickness of 9 inches and be compacted to not less than 95% of the maximum dry density, as determined by ASTM D1557.

### 4.3.3 Base Aggregate

Base aggregate beneath pavements should be clean crushed rock or crushed gravel. The base aggregate should contain no deleterious materials, meet specifications provided in WSDOT SS 9-03.9(3) – Crushed Surfacing Base Course, and have less than 5% (by dry weight) passing the US Standard No. 200 Sieve. The imported granular material should be placed in one lift and compacted to at least 95% of the maximum dry density, as determined by ASTM D1557.

### 4.3.4 Stabilization Material

Stabilization rock should consist of pit or quarry run rock that is well-graded, angular, crushed rock consisting of 4- or 6-inch-minus material with less than 5% passing the US Standard No. 4 Sieve. The material should be free of organic matter and other deleterious material. WSDOT SS 9-13.1(5) – Quarry Spalls can be used as a general specification for this material with the stipulation of limiting the maximum size to 6 inches.

## 5 ADDITIONAL SERVICES AND CONSTRUCTION OBSERVATIONS

In most cases, other services beyond completion of a final geotechnical engineering report are necessary or desirable to complete the project. Occasionally, conditions or circumstances arise that require additional work that was not anticipated when the geotechnical report was written. PBS offers a range of environmental, geological, geotechnical, and construction services to suit the varying needs of our clients.

PBS should be retained to review the plans and specifications for this project before they are finalized. Such a review allows us to verify that our recommendations and concerns have been adequately addressed in the design.

Satisfactory earthwork performance depends on the quality of construction. Sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. We recommend that PBS be retained to observe general excavation, stripping, fill placement, footing subgrades, and/or pile installation. Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated.

## 6 LIMITATIONS

This report has been prepared for the exclusive use of the addressee, and their architects and engineers, for aiding in the design and construction of the proposed development and is not to be relied upon by other parties. It is not to be photographed, photocopied, or similarly reproduced, in total or in part, without express written consent of the client and PBS. It is the addressee's responsibility to provide this report to the appropriate design professionals, building officials, and contractors to ensure correct implementation of the recommendations.

The opinions, comments, and conclusions presented in this report are based upon information derived from our literature review, field explorations, laboratory testing, and engineering analyses. It is possible that soil, rock, or groundwater conditions could vary between or beyond the points explored. If soil, rock, or groundwater conditions are encountered during construction that differ from those described herein, the client is responsible for ensuring that PBS is notified immediately so that we may reevaluate the recommendations of this report.

Unanticipated fill, soil and rock conditions, and seasonal soil moisture and groundwater variations are commonly encountered and cannot be fully determined by merely taking soil samples or completing explorations such as soil borings. Such variations may result in changes to our recommendations and may require additional funds for expenses to attain a properly constructed project; therefore, we recommend a contingency fund to accommodate such potential extra costs.

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

If there is a substantial lapse of time between the submission of this report and the start of work at the site, if conditions have changed due to natural causes or construction operations at or adjacent to the site, or if the basic project scheme is significantly modified from that assumed, this report should be reviewed to determine the applicability of the conclusions and recommendations presented herein. Land use, site conditions (both on and off site), or other factors may change over time and could materially affect our findings; therefore, this report should not be relied upon after three years from its issue, or in the event that the site conditions change.

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# Important Information about This

# Geotechnical-Engineering Report

**Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.**

**While you cannot eliminate all such risks, you can manage them. The following information is provided to help.**

**The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.**

## Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

## Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

*Do not rely on this report* if your geotechnical engineer prepared it:
- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

## Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

## You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:
- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

## Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

## This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

## This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

## Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

## Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

## Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

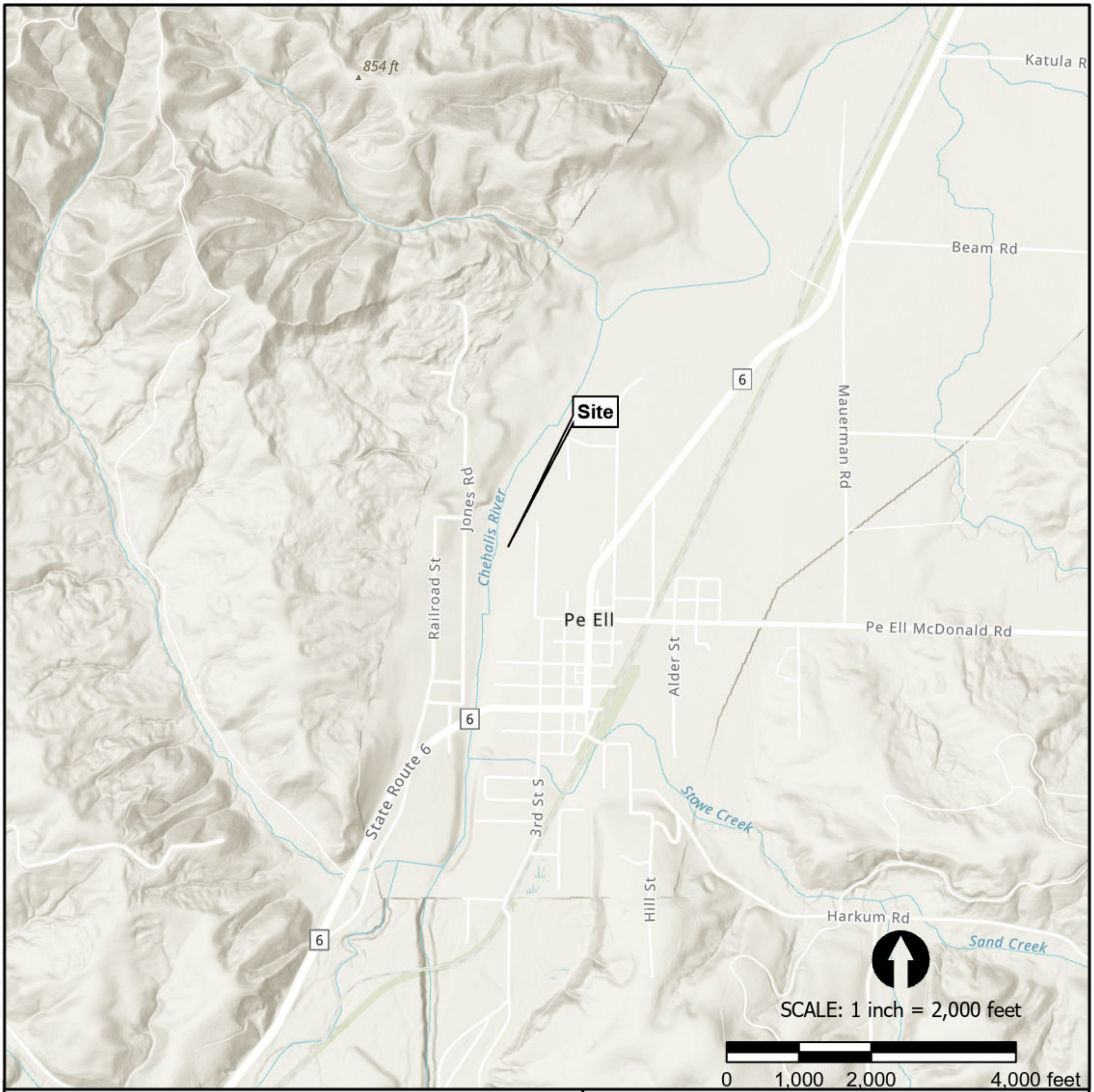
## Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL
BUSINESS
ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

# Figures



# VICINITY MAP

## PE ELL K-12 TRACK
## PE ELL, WASHINGTON

DATE: OCT 2024· PROJECT: 78253.000

PBS

FIGURE

1

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**EXPLANATION**

● B-1 Boring name and approximate location

🔵 B-1 Boring name and approximate location with infiltration

Notes: Google Earth 2024

Coordinate System: NAD 1983 2011 StatePlane Washington North FIPS 4601 Ft US

SCALE: 1 inch = 90 feet

0 45 90 180 feet

## SITE PLAN

PE ELL K-12 TRACK
PE ELL, WASHINGTON

DATE: OCT 2024 · PROJECT: 78253.000

FIGURE
2

Path: \\pbsenv.lan\L\Gis\GEOTECH-GIS\project\78253.000\78253.000\78253.000.aprx User: alexis.sansing Date Saved: 9/11/2024 9:53 AM

# Appendix A

## Field Explorations

# Appendix A: Field Explorations

## A1 GENERAL

PBS explored subsurface conditions at the project site by advancing five borings to depths of up to approximately 7 feet bgs on August 5, 2024. The approximate locations of the explorations are shown on Figure 2, Site Plan. The procedures used to advance the borings, collect samples, and other field techniques are described in detail in the following paragraphs. Unless otherwise noted, all soil sampling and classification procedures followed engineering practices in general accordance with relevant ASTM procedures. "General accordance" means that certain local drilling/excavation and descriptive practices and methodologies have been followed.

## A2 BORINGS

### A2.1 Drilling

Borings were advanced using a trailer-mounted Big Beaver drill rig provided and operated by Dan J. Fischer Excavating, Inc., of Forest Grove, Oregon, using solid-stem drilling techniques. The borings were observed by a member of the PBS geotechnical staff, who maintained a detailed log of the subsurface conditions and materials encountered during the course of the work.

### A2.2 Sampling

Disturbed soil samples were taken in the borings at selected depth intervals. The samples were obtained using a standard 2-inch outside diameter, split-spoon sampler following procedures prescribed for the standard penetration test (SPT). Using the SPT, the sampler is driven 18 inches into the soil using a 140-pound hammer dropped 30 inches. The number of blows required to drive the sampler the last 12 inches is defined as the standard penetration resistance (N-value). The N-value provides a measure of the relative density of granular soils such as sands and gravels, and the consistency of cohesive soils such as clays and plastic silts. The disturbed soil samples were examined by a member of the PBS geotechnical staff and then sealed in plastic bags for further examination and physical testing in our laboratory.

### A2.3 Boring Logs

The boring logs show the various types of materials that were encountered in the borings and the depths where the materials and/or characteristics of these materials changed, although the changes may be gradual. Where material types and descriptions changed between samples, the contacts were interpreted. The types of samples taken during drilling, along with their sample identification number, are shown to the right of the classification of materials. The N-values and natural water (moisture) contents are shown farther to the right.

## A3 MATERIAL DESCRIPTION

Initially, samples were classified visually in the field. Consistency, color, relative moisture, degree of plasticity, and other distinguishing characteristics of the soil samples were noted. Afterward, the samples were reexamined in the PBS laboratory, various standard classification tests were conducted, and the field classifications were modified where necessary. The terminology used in the soil classifications and other modifiers are defined in Table A-1, Terminology Used to Describe Soil.

# Table A-1
# Terminology Used to Describe Soil

## Soil Descriptions

Soils exist in mixtures with varying proportions of components. The predominant soil, i.e., greater than 50% based on total dry weight, is the primary soil type and is capitalized in our log descriptions (SAND, GRAVEL, SILT, or CLAY). Smaller percentages of other constituents in the soil mixture are indicated by modifier words in general accordance with the ASTM D2488 Visual-Manual Procedure. "General Accordance" means that certain local and common descriptive practices may have been followed. In accordance with ASTM D2488, group symbols (such as GP or CH) are applied on the portion of soil passing the 3-inch (75mm) sieve based on visual examination. The following explains the soil names and modifying terms used to describe fine- and coarse-grained soils.

**Fine-Grained Soils (50% or greater fines passing 0.075mm, No. 200 sieve)**

The primary soil type, i.e., SILT or CLAY, is designated through visual-manual procedures to evaluate soil toughness, dilatancy, dry strength, and plasticity. The following outlines the terminology used to describe fine-grained soils and may vary from ASTM D2488 terminology in the use of some common terms.

| **Primary Soil NAME, Symbols, and Adjectives** | | | **Plasticity Description** | **Plasticity Index (PI)** |
|---|---|---|---|---|
| **SILT (ML & MH)** | **CLAY (CL & CH)** | **ORGANIC SOIL (OL & OH)** | | |
| SILT | | Organic SILT | Non-plastic | 0 – 3 |
| SILT | | Organic SILT | Low plasticity | 4 – 10 |
| SILT/Elastic SILT | Lean CLAY | Organic SILT/ Organic CLAY | Medium Plasticity | 10 – 20 |
| Elastic SILT | Lean/Fat CLAY | Organic CLAY | High Plasticity | 20 – 40 |
| Elastic SILT | Fat CLAY | Organic CLAY | Very Plastic | >40 |

Modifying terms describing secondary constituents, estimated to 5% increments, are applied as follows:

| **Description** | **% Composition** | |
|---|---|---|
| **With Sand** | % Sand ≥ % Gravel | 15% to 25% plus No. 200 |
| **With Gravel** | % Sand < % Gravel | |
| **Sandy** | % Sand ≥ % Gravel | ≤30% to 50% plus No. 200 |
| **Gravelly** | % Sand < % Gravel | |

**Borderline Symbols**, for example, CH/MH, are used when soils are not distinctly in one category or when variable soil units contain more than one soil type. **Dual Symbols,** for example, CL-ML, are used when two symbols are required in accordance with ASTM D2488.

**Soil Consistency** terms are applied to fine-grained, plastic soils (i.e., PI ≥ 7). Descriptive terms are based on direct measure or correlation to the Standard Penetration Test N-value as determined by ASTM D1586, as follows. SILT soils with low to non-plastic behavior (i.e., PI < 7) may be classified using relative density.

| **Consistency Term** | **SPT N-value** | **Unconfined Compressive Strength** | |
|---|---|---|---|
| | | **tsf** | **kPa** |
| **Very soft** | Less than 2 | Less than 0.25 | Less than 24 |
| **Soft** | 2 – 4 | 0.25 – 0.5 | 24 – 48 |
| **Medium stiff** | 5 – 8 | 0.5 – 1.0 | 48 – 96 |
| **Stiff** | 9 – 15 | 1.0 – 2.0 | 96 – 192 |
| **Very stiff** | 16 – 30 | 2.0 – 4.0 | 192 – 383 |
| **Hard** | Over 30 | Over 4.0 | Over 383 |

## Table A-1
## Terminology Used to Describe Soil
2 of 2

## Soil Descriptions

### Coarse-Grained Soils (less than 50% fines)

Coarse-grained soil descriptions, i.e., SAND or GRAVEL, are based on the portion of materials passing a 3-inch (75mm) sieve. Coarse-grained soil group symbols are applied in accordance with ASTM D2488 based on the degree of grading, or distribution of grain sizes of the soil. For example, well-graded sand containing a wide range of grain sizes is designated SW; poorly graded gravel, GP, contains high percentages of only certain grain sizes. Terms applied to grain sizes follow.

| Material NAME | Particle Diameter | |
|---|---|---|
| | Inches | Millimeters |
| **SAND (SW or SP)** | 0.003 – 0.19 | 0.075 – 4.8 |
| **GRAVEL (GW or GP)** | 0.19 – 3 | 4.8 – 75 |
| **Additional Constituents:** | | |
| **Cobble** | 3 – 12 | 75 – 300 |
| **Boulder** | 12 – 120 | 300 – 3050 |

The primary soil type is capitalized and the fines content in the soil are described as indicated by the following examples. Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5%. Other soil mixtures will have similar descriptive names.

**Example: Coarse-Grained Soil Descriptions with Fines**

| >5% to < 15% fines (Dual Symbols) | ≥15% to < 50% fines |
|---|---|
| Well-graded GRAVEL with silt: GW-GM | Silty GRAVEL: GM |
| Poorly graded SAND with clay: SP-SC | Silty SAND: SM |

Additional descriptive terminology applied to coarse-grained soils follow.

**Example: Coarse-Grained Soil Descriptions with Other Coarse-Grained Constituents**

| Coarse-Grained Soil Containing Secondary Constituents | |
|---|---|
| **With sand or with gravel** | ≥ 15% sand or gravel |
| **With cobbles; with boulders** | Any amount of cobbles or boulders. |

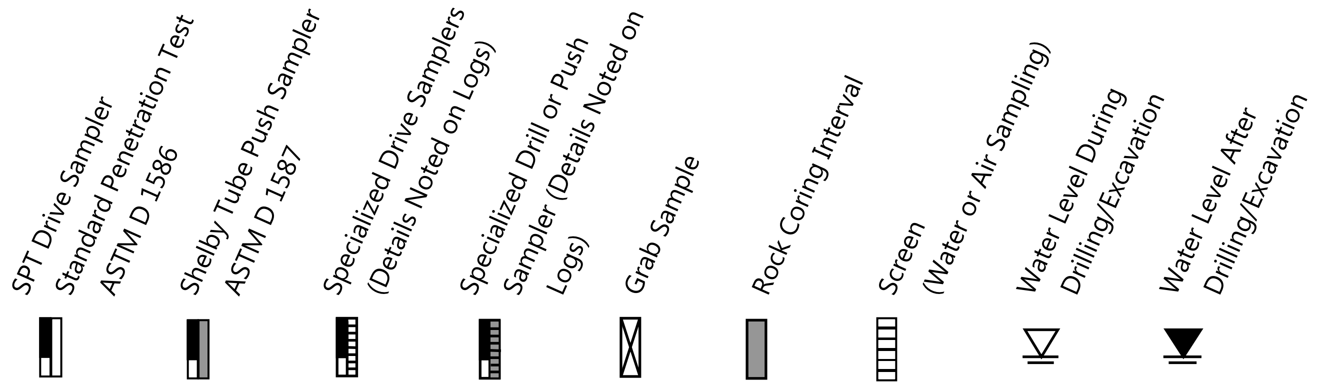
Cobble and boulder deposits may include a description of the matrix soils, as defined above.

**Relative Density** terms are applied to granular, non-plastic soils based on direct measure or correlation to the Standard Penetration Test N-value as determined by ASTM D1586.

| Relative Density Term | SPT N-value |
|---|---|
| **Very loose** | 0 – 4 |
| **Loose** | 5 – 10 |
| **Medium dense** | 11 – 30 |
| **Dense** | 31 – 50 |
| **Very dense** | > 50 |

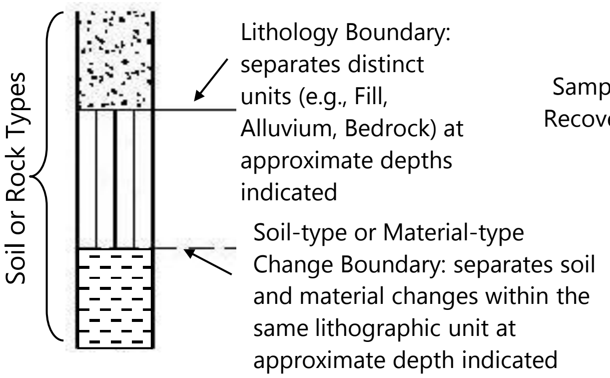
# Table A-2
# Key To Test Pit and Boring Log Symbols

## SAMPLING DESCRIPTIONS

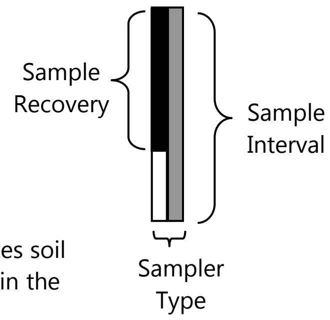


## LOG GRAPHICS

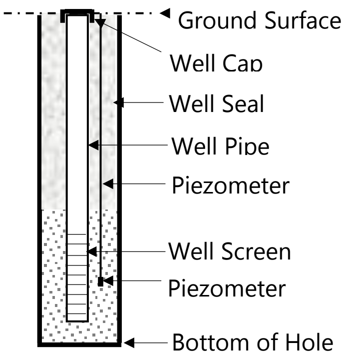
### Soil and Rock



### Sampling Symbols



### Instrumentation Detail



## Geotechnical Testing Acronym Explanations

| | | | |
|---|---|---|---|
| PP | Pocket Penetrometer | HYD | Hydrometer Gradation |
| TOR | Torvane | SIEV | Sieve Gradation |
| DCP | Dynamic Cone Penetrometer | DS | Direct Shear |
| ATT | Atterberg Limits | DD | Dry Density |
| PL | Plasticity Limit | CBR | California Bearing Ratio |
| LL | Liquid Limit | RES | Resilient Modulus |
| PI | Plasticity Index | VS | Vane Shear |
| P200 | Percent Passing US Standard No. 200 Sieve | bgs | Below ground surface |
| OC | Organic Content | amsl | Above Mean Sea Level |
| CON | Consolidation | HCL | Hydrochloric Acid |
| UC | Unconfined Compressive Strength | | |

Details of soil and rock classification systems are available upon request.

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PE ELL K-12 SCHOOL MODERNIZATION
PE ELL, WASHINGTON

# BORING B-1

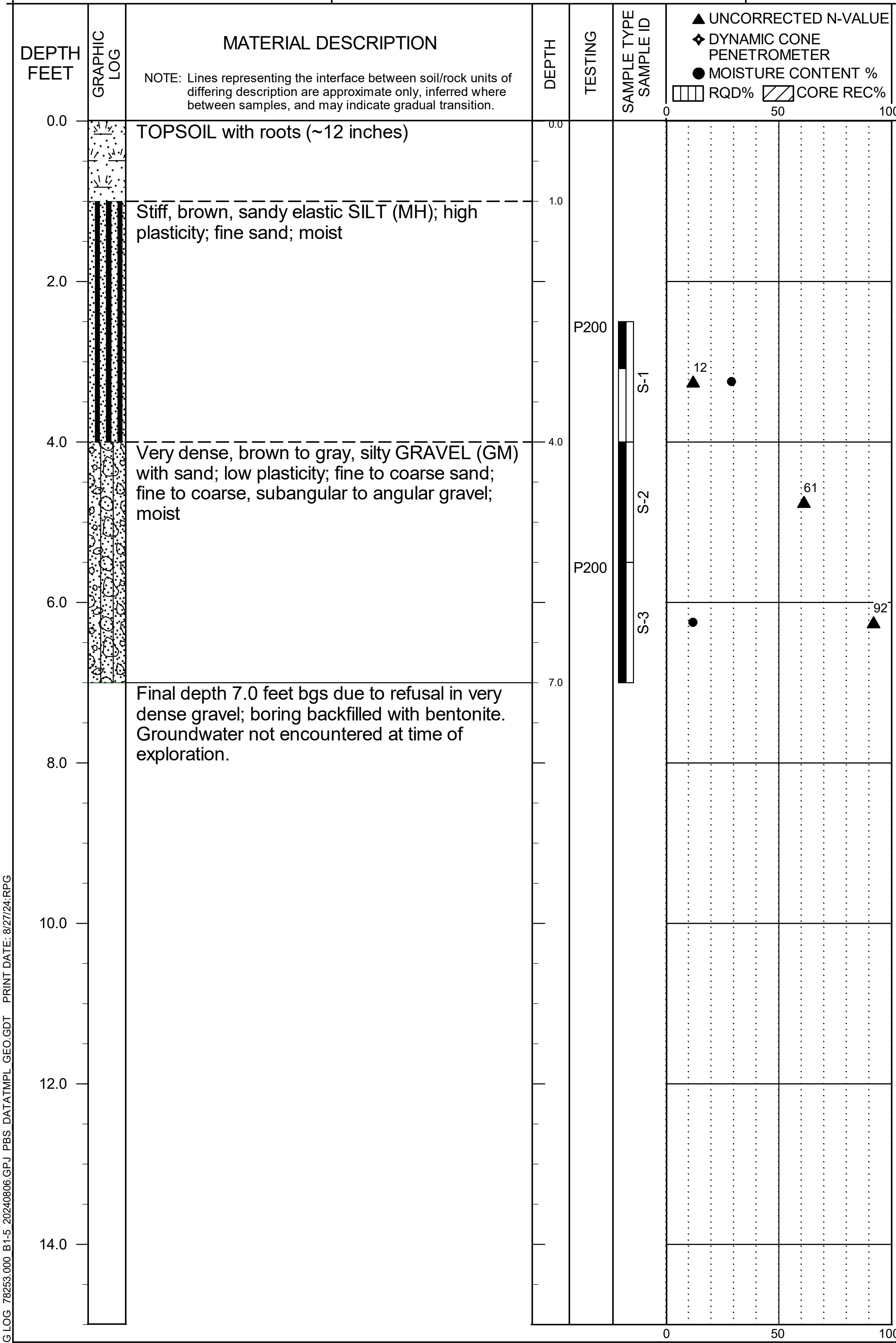
PBS PROJECT NUMBER:
78253.000

APPROX. BORING B-1 LOCATION:
(See Site Plan)
Lat: 46.57549 Long: -123.30035

NOTE: Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.

Surface Conditions: Grass

| DEPTH FEET | MATERIAL DESCRIPTION | TESTING | SAMPLE ID | INSTALLATION AND COMMENTS |
|---|---|---|---|---|
| 0.0 | TOPSOIL with roots (~12 inches) | | | |
| 1.0 | Stiff, brown, sandy elastic SILT (MH); high plasticity; fine sand; moist | P200 | S-1 | P200 = 62% |
| 4.0 | Very dense, brown to gray, silty GRAVEL (GM) with sand; low plasticity; fine to coarse sand; fine to coarse, subangular to angular gravel; moist | | S-2 | |
| | | P200 | S-3 | P200 = 31% |
| 7.0 | Final depth 7.0 feet bgs due to refusal in very dense gravel; boring backfilled with bentonite. Groundwater not encountered at time of exploration. | | | |



DRILLING METHOD: Solid-Stem Auger
DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: F. Jarman

BIT DIAMETER: 4 7/8 inches
HAMMER EFFICIENCY PERCENT: 60
LOGGING COMPLETED: 8/05/2024

FIGURE A1

PE ELL K-12 SCHOOL MODERNIZATION
PE ELL, WASHINGTON

# BORING B-2

PBS PROJECT NUMBER:
78253.000

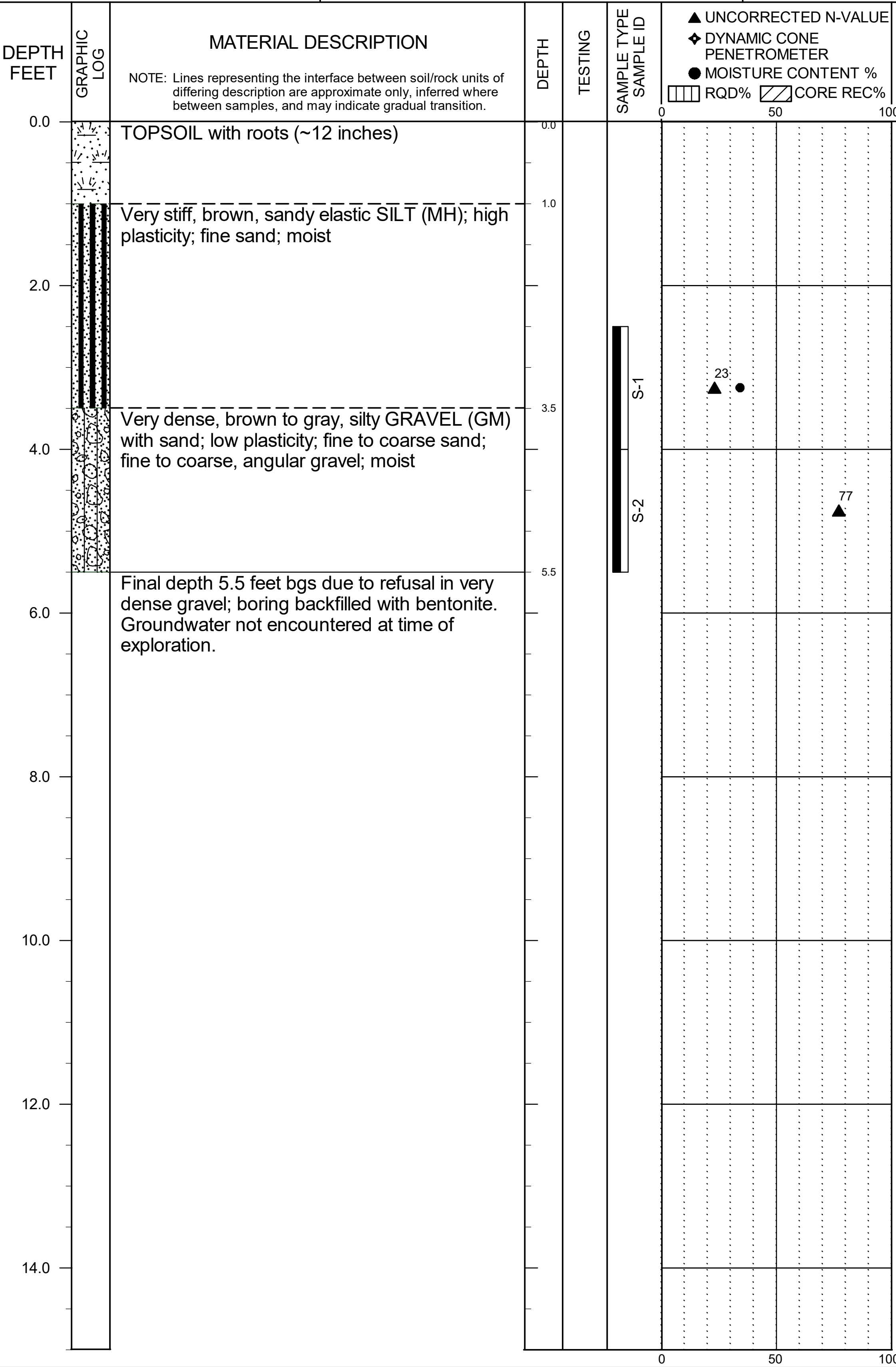
APPROX. BORING B-2 LOCATION:
(See Site Plan)
Lat: 46.57568 Long: -123.29982

NOTE: Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.

INSTALLATION AND COMMENTS

Surface Conditions: Grass

| DEPTH FEET | MATERIAL DESCRIPTION | DEPTH | SAMPLE TYPE SAMPLE ID | UNCORRECTED N-VALUE |
|---|---|---|---|---|
| 0.0 | TOPSOIL with roots (~12 inches) | 0.0 | | |
| | Very stiff, brown, sandy elastic SILT (MH); high plasticity; fine sand; moist | 1.0 | S-1 | 23 |
| | Very dense, brown to gray, silty GRAVEL (GM) with sand; low plasticity; fine to coarse sand; fine to coarse, angular gravel; moist | 3.5 | S-2 | 77 |
| | Final depth 5.5 feet bgs due to refusal in very dense gravel; boring backfilled with bentonite. Groundwater not encountered at time of exploration. | 5.5 | | |



DRILLING METHOD: Solid-Stem Auger
DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: F. Jarman

BIT DIAMETER: 4 7/8 inches
HAMMER EFFICIENCY PERCENT: 60
LOGGING COMPLETED: 8/05/2024

FIGURE A2

PBS
AN APEX COMPANY

PE ELL K-12 SCHOOL MODERNIZATION
PE ELL, WASHINGTON

# BORING B-3

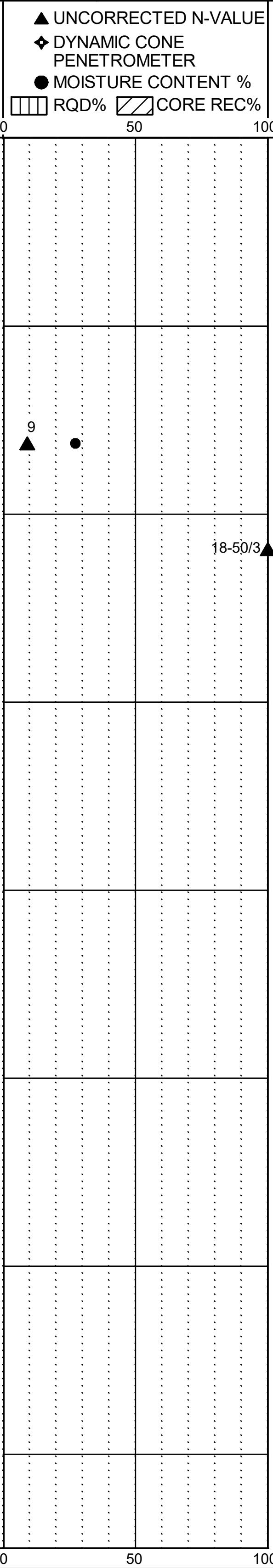
PBS PROJECT NUMBER:
78253.000

APPROX. BORING B-3 LOCATION:
(See Site Plan)
Lat: 46.57675 Long: -123.30051

NOTE: Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.

Surface Conditions: Grass

| DEPTH FEET | MATERIAL DESCRIPTION | DEPTH | TESTING | SAMPLE TYPE SAMPLE ID | UNCORRECTED N-VALUE | INSTALLATION AND COMMENTS |
|---|---|---|---|---|---|---|
| 0.0 | TOPSOIL with roots (~12 inches) | 0.0 | | | | |
| 1.0 | Stiff, brown SILT (ML) with sand; low plasticity; fine sand; moist | 1.0 | | S-1 | 9 | |
| 4.0 | Very dense, brown to gray, silty GRAVEL (GM) with sand; low plasticity; fine to coarse sand; fine to coarse, angular gravel; moist | 4.0 | | S-2 | 18-50/3 | |
| 4.7 | Final depth 4.67 feet bgs due to refusal in very dense gravel; boring backfilled with bentonite. Groundwater not encountered at time of exploration. | 4.7 | | | | |



DRILLING METHOD: Solid-Stem Auger
DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: F. Jarman

BIT DIAMETER: 4 7/8 inches
HAMMER EFFICIENCY PERCENT: 60
LOGGING COMPLETED: 8/05/2024

FIGURE A3

BORING LOG 78253.000 B1-5 20240806.GPJ PBS DATATMPL GEO.GDT PRINT DATE: 8/27/24:RPG

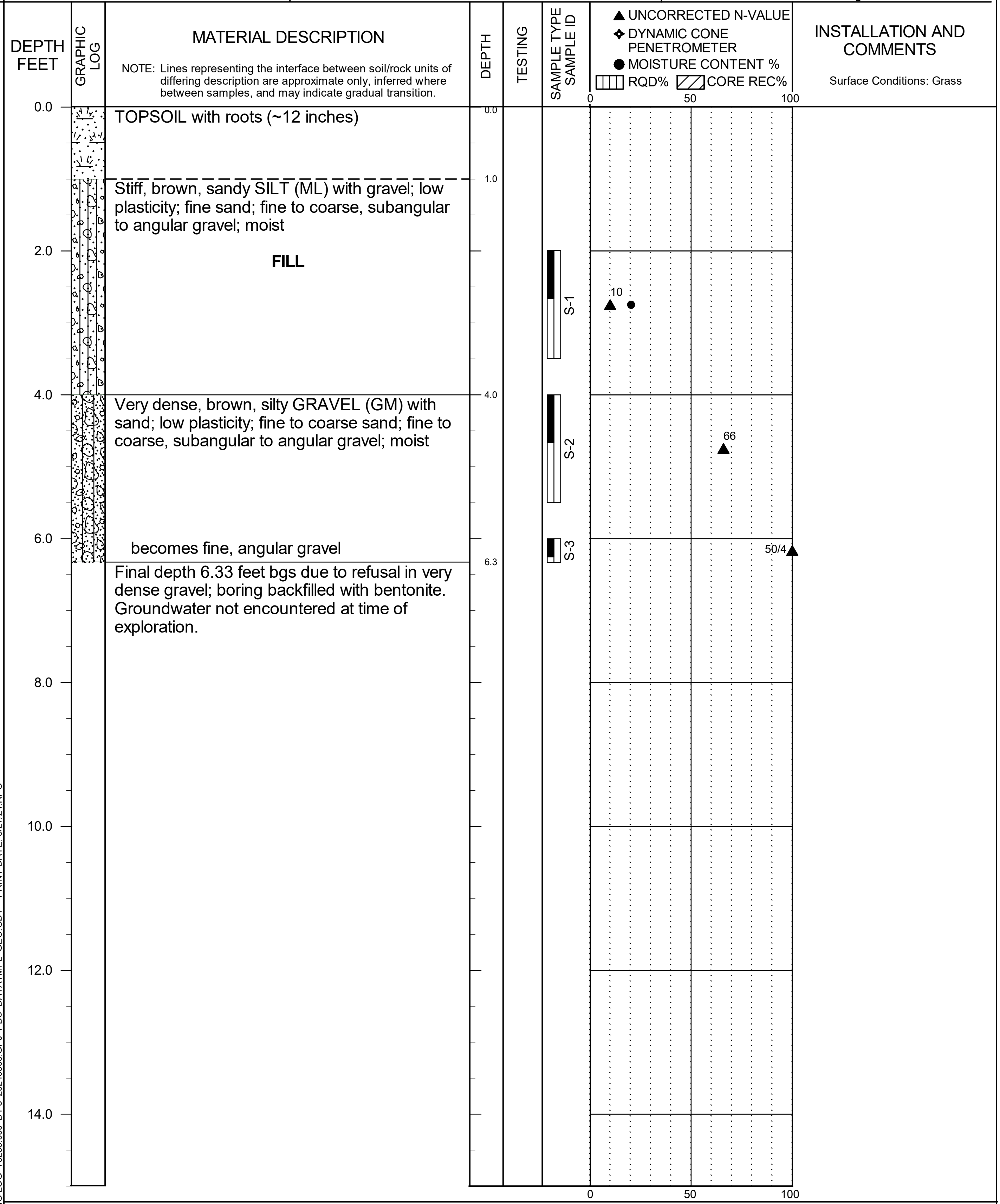
PBS AN APEX COMPANY

PE ELL K-12 SCHOOL MODERNIZATION
PE ELL, WASHINGTON

# BORING B-4

PBS PROJECT NUMBER:
78253.000

APPROX. BORING B-4 LOCATION:
(See Site Plan)
Lat: 46.57664 Long: -123.29973



MATERIAL DESCRIPTION

NOTE: Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.

INSTALLATION AND COMMENTS

Surface Conditions: Grass

| Depth (ft) | Material Description | Sample ID | Uncorrected N-Value |
|---|---|---|---|
| 0.0 | TOPSOIL with roots (~12 inches) | | |
| 1.0 | Stiff, brown, sandy SILT (ML) with gravel; low plasticity; fine sand; fine to coarse, subangular to angular gravel; moist<br>**FILL** | S-1 | 10 |
| 4.0 | Very dense, brown, silty GRAVEL (GM) with sand; low plasticity; fine to coarse sand; fine to coarse, subangular to angular gravel; moist | S-2 | 66 |
| | becomes fine, angular gravel | S-3 | 50/4 |
| 6.3 | Final depth 6.33 feet bgs due to refusal in very dense gravel; boring backfilled with bentonite. Groundwater not encountered at time of exploration. | | |

DRILLING METHOD: Solid-Stem Auger
DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: F. Jarman

BIT DIAMETER: 4 7/8 inches
HAMMER EFFICIENCY PERCENT: 60
LOGGING COMPLETED: 8/05/2024

FIGURE A4

PE ELL K-12 SCHOOL MODERNIZATION
PE ELL, WASHINGTON

# BORING B-5

PBS PROJECT NUMBER:
78253.000

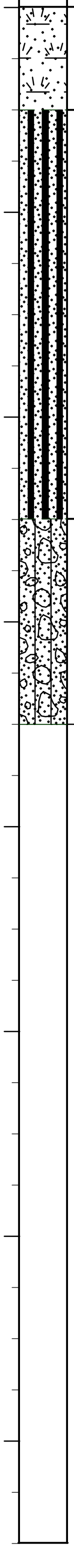
APPROX. BORING B-5 LOCATION:
(See Site Plan)
Lat: 46.57610 Long: -123.30009

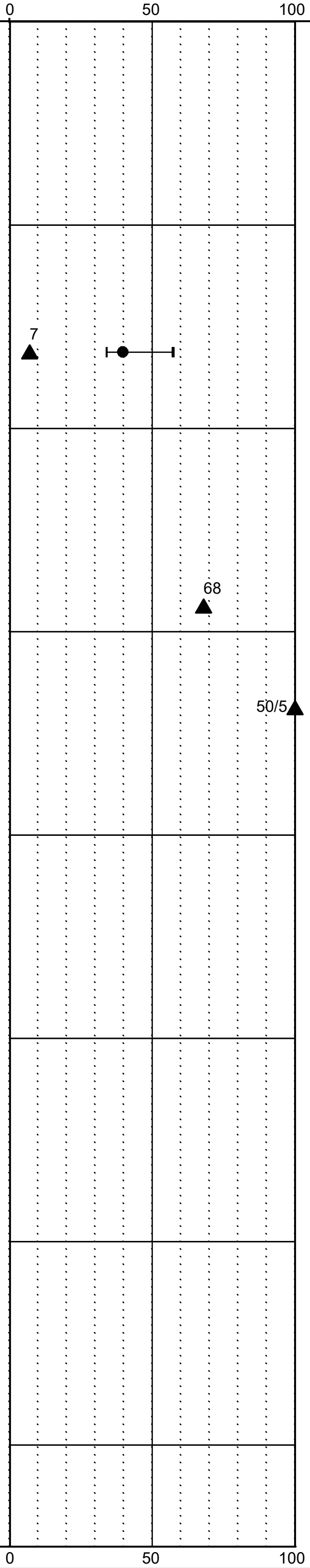
NOTE: Lines representing the interface between soil/rock units of differing description are approximate only, inferred where between samples, and may indicate gradual transition.

Legend: ▲ UNCORRECTED N-VALUE; ✦ DYNAMIC CONE PENETROMETER; ● MOISTURE CONTENT %; ▥ RQD%; ▨ CORE REC%

Surface Conditions: Grass

| DEPTH FEET | MATERIAL DESCRIPTION | DEPTH | TESTING | SAMPLE TYPE SAMPLE ID | UNCORRECTED N-VALUE | INSTALLATION AND COMMENTS |
|---|---|---|---|---|---|---|
| 0.0 | TOPSOIL with roots (~12 inches) | 0.0 | | | | |
| 1.0 | Medium stiff, brown, sandy elastic SILT (MH); high plasticity; fine sand; moist | 1.0 | ATT | S-1 | 7 | LL = 57<br>PL = 34<br>PI = 23 |
| 5.0 | Very dense, brown to gray, silty GRAVEL (GM) with sand; low plasticity; fine to coarse sand; fine to coarse, subangular to angular gravel; moist | 5.0 | | S-2 | 68 | |
| | | | | S-3 | 50/5 | No recovery |
| 7.0 | Final depth 7.0 feet bgs due to refusal in very dense gravel; boring backfilled with bentonite. Groundwater not encountered at time of exploration. | 7.0 | | | | |





DRILLING METHOD: Solid-Stem Auger
DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: F. Jarman

BIT DIAMETER: 4 7/8 inches
HAMMER EFFICIENCY PERCENT: 60
LOGGING COMPLETED: 8/05/2024

FIGURE A5

# Appendix B

## Laboratory Testing

# Appendix B: Laboratory Testing

## B1 GENERAL

Samples obtained during the field explorations were examined in the PBS laboratory. The physical characteristics of the samples were noted and field classifications were modified where necessary. During the course of examination, representative samples were selected for further testing. The testing program for the soil samples included standard classification tests, which yield certain index properties of the soils important to an evaluation of soil behavior. The testing procedures are described in the following paragraphs. Unless noted otherwise, all test procedures are in general accordance with applicable ASTM standards. "General accordance" means that certain local and common descriptive practices and methodologies have been followed.

## B2 CLASSIFICATION TESTS

### B2.1 Visual Classification

The soils were classified in accordance with the Unified Soil Classification System with certain other terminology, such as the relative density or consistency of the soil deposits, in general accordance with engineering practice. In determining the soil type (that is, gravel, sand, silt, or clay) the term that best described the major portion of the sample is used. Modifying terminology to further describe the samples is defined in Table A-1, Terminology Used to Describe Soil, in Appendix A.

### B2.2 Moisture (Water) Contents

Natural moisture content determinations were made on samples of the fine-grained soils (that is, silts, clays, and silty sands). The natural moisture content is defined as the ratio of the weight of water to dry weight of soil, expressed as a percentage. The results of the moisture content determinations are presented on the exploration logs in Appendix A and on Figure B2, Summary of Laboratory Data, in Appendix B.

### B2.3 Atterberg Limits

Atterberg limits were determined on select samples for the purpose of classifying soils into various groups for correlation. The results of the Atterberg limits test, which included liquid and plastic limits, are plotted on Figure B1, Atterberg Limits Test Results, and on the explorations logs in Appendix A where applicable.

### B2.4 Grain-Size Analyses (P200 Wash)

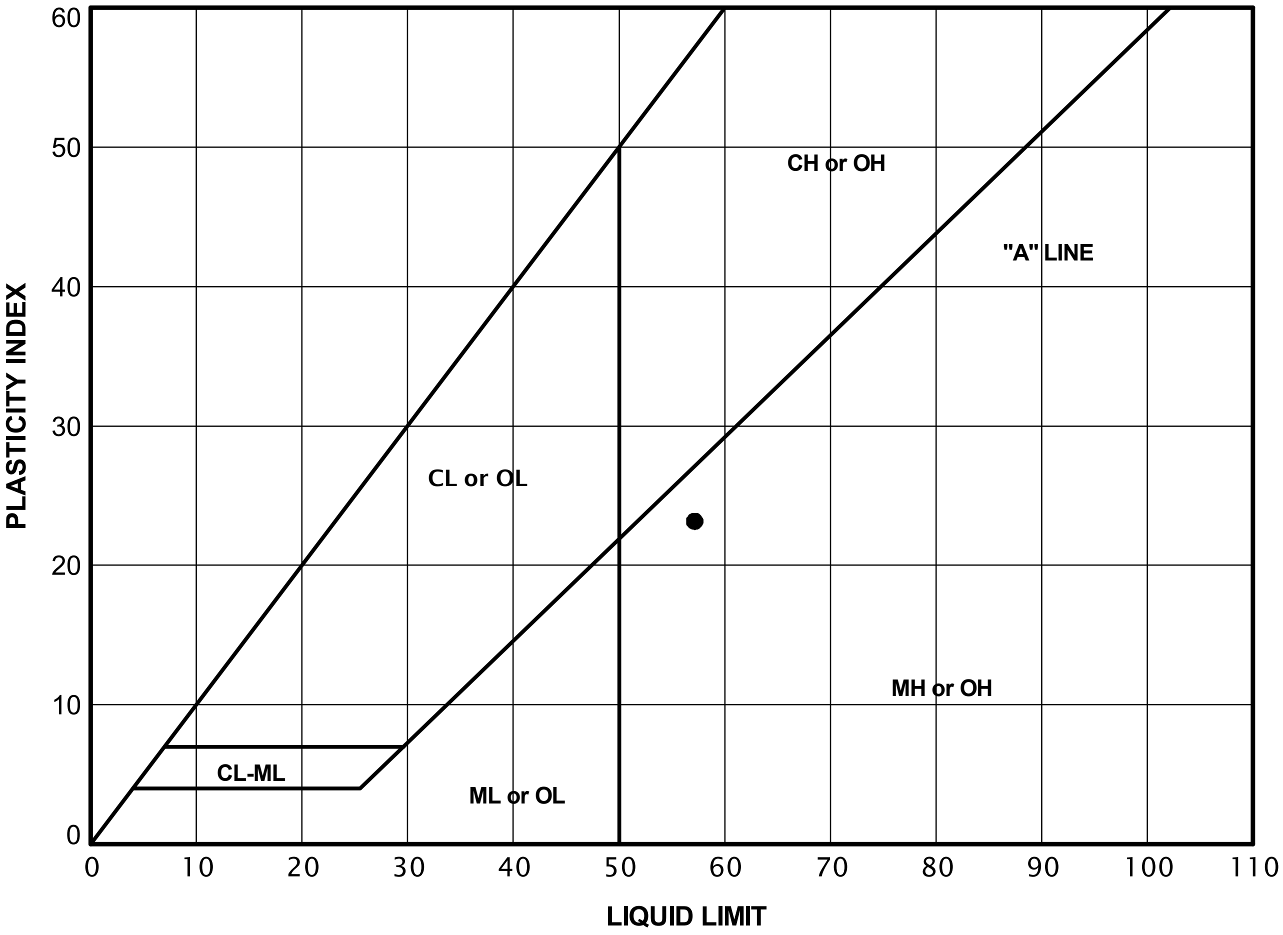
Washed sieve analyses (P200) were completed on samples to determine the portion of soil samples passing the No. 200 Sieve (i.e., silt and clay). The P200 test results are presented on the exploration logs in Appendix A and on Figure B2, Summary of Laboratory Data, in Appendix B.

# ATTERBERG LIMITS TEST RESULTS

PE ELL K-12 SCHOOL MODERNIZATION
PE ELL, WASHINGTON

PBS PROJECT NUMBER:
78253.000

## TEST METHOD: ASTM D4318



| KEY | EXPLORATION NUMBER | SAMPLE NUMBER | SAMPLE DEPTH (FEET) | NATURAL MOISTURE CONTENT (PERCENT) | PERCENT PASSING NO. 40 SIEVE (PERCENT) | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX |
|---|---|---|---|---|---|---|---|---|
| ● | B-5 | S-1 | 2.5 | 39.6 | NA | 57 | 34 | 23 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

# SUMMARY OF LABORATORY DATA

PE ELL K-12 SCHOOL MODERNIZATION
PE ELL, WASHINGTON

PBS PROJECT NUMBER:
78253.000

| SAMPLE INFORMATION | | | | MOISTURE CONTENT (PERCENT) | DRY DENSITY (PCF) | SIEVE | | | ATTERBERG LIMITS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EXPLORATION NUMBER | SAMPLE NUMBER | SAMPLE DEPTH (FEET) | ELEVATION (FEET) | | | GRAVEL (PERCENT) | SAND (PERCENT) | P200 (PERCENT) | LIQUID LIMIT (PERCENT) | PLASTIC LIMIT (PERCENT) | PLASTICITY INDEX (PERCENT) |
| B-1 | S-1 | 2.5 | | 28.9 | | | | 62 | | | |
| B-1 | S-3 | 5.5 | | 11.8 | | | | 31 | | | |
| B-2 | S-1 | 2.5 | | 34.1 | | | | | | | |
| B-3 | S-1 | 2.5 | | 27.2 | | | | | | | |
| B-4 | S-1 | 2 | | 20.3 | | | | | | | |
| B-5 | S-1 | 2.5 | | 39.6 | | | | | 57 | 34 | 23 |

**FIGURE B2**