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*Subsurface Exploration, Geologic Hazards, and
Hydrogeologic and Geotechnical Engineering Evaluation*

FERRUCCI JUNIOR HIGH ADDITIONS

Puyallup, Washington

Prepared For:

PUYALLUP SCHOOL DISTRICT

Project No. 20200128E001/H001

July 2, 2020



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July 2, 2020

Project No. 20200128E001/H001

Puyallup School District
323 12th Street NW
Puyallup, Washington 98371

Attention: Mr. Larry Vandeberg
Assistant Director of Construction Management

Subject: Subsurface Exploration, Geologic Hazards, and
Hydrogeologic and Geotechnical Engineering Evaluation
Ferrucci Junior High Additions
3213 Wildwood Park Drive
Puyallup, Washington

Dear Mr. Vandeberg:

Associated Earth Sciences, Inc. (AESI) is pleased to present this report providing the results of our hydrogeologic and geotechnical engineering evaluation for the proposed additions at the Ferrucci Junior High campus in Puyallup, Washington. This report summarizes the results of our subsurface exploration, limited infiltration rate testing, and geologic hazards analysis, and offers hydrogeologic and geotechnical recommendations for design of the proposed project.

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. Please contact us if you have any questions or if we can be of additional help to you.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

DRAFT

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

KDM/lid
20200128E001-3

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I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of our subsurface exploration, limited infiltration testing, geologic hazards analysis, geotechnical engineering evaluation, and stormwater infiltration feasibility for the proposed improvements at Ferrucci Junior High in Puyallup, Washington. Our understanding of the project is based on our discussions with the design team and the following documents provided to us by the Puyallup School District:

- A conceptual site plan prepared by Sitts & Hill Engineers, Inc., dated March 17, 2020, containing the locations of requested explorations, groundwater monitoring wells, and infiltration tests;
- A document prepared by PCS Structural Solutions containing the geotechnical reporting requirements for this project, dated June 2018; and
- A civil site plan prepared by Sitts & Hill Engineers, Inc., dated May 22, 2020.

We also reviewed historical exploration data obtained by Associated Earth Sciences, Inc. (AESI) on the project site which included the following documents:

- A limited geotechnical engineering report prepared by AESI, titled “Ferrucci Junior High School Pavement Distress Evaluation,” dated November 21, 2005; and
- A limited geotechnical engineering feasibility analysis report prepared by AESI, titled “Ferrucci Junior High School Proposed Renovation of Existing Gravel Parking Area,” dated March 6, 2006.

The site location is shown on the “Vicinity Map,” Figure 1. The approximate locations of explorations completed for this study relative to existing site features are shown on the “Existing Site and Exploration Plan,” Figure 2. Interpretive exploration logs of subsurface explorations completed for this study, historical exploration logs by AESI, laboratory test data, and infiltration test data sheets are included in Appendix A through E.

1.1 Purpose and Scope

The purpose of this study was to obtain subsurface soil and groundwater data to aid in the design of the proposed improvements at the Ferrucci Junior High campus. Our study included reviewing available geologic literature, advancing thirteen exploration borings and four test pits, installing four groundwater monitoring wells, performing two field infiltration tests, performing laboratory testing consisting of grain-size analyses on selected soils samples, and performing a geologic

study to assess the type, thickness, distribution, and physical properties of the subsurface sediments and groundwater conditions onsite. Geotechnical and hydrogeologic evaluations were completed to provide recommendations regarding general site preparation, grading and embankment construction, temporary and permanent slopes, suitable foundation types, allowable foundation soil bearing pressures, anticipated foundation settlements, erosion and drainage considerations, and infiltration feasibility at the project site.

1.2 Authorization

Authorization to proceed with this study was granted to AESI by Mr. Larry Vandenberg with the Puyallup School District. Our study was accomplished in general accordance with our proposal dated April 9, 2020 and a Change Order for additional subsurface exploration dated May 19, 2020. This report has been prepared for the exclusive use of the Puyallup School District and their 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 and engineering geology 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 project site is located at the existing Ferrucci Junior High School in Puyallup, Washington. The existing school building is situated on the south-central portion of the site, with paved parking areas to the west and north, portable structures to the north and east, natural turf play areas to the north and east, paved field access to the north and east, and a bus drop-off lane to the south. The overall topography at the site slopes down to the north and east, with an overall vertical relief across the site of approximately 30 feet. Vertical relief is concentrated in three areas: (i) in cut slopes descending to the east from the east edge of the existing school building and adjacent pavement areas, (ii) in slopes adjacent to intact wooded areas located to the north and south of the existing school building, and (iii) in the slopes descending to the existing detention ponds located at the southern portion of the site.

Based on the referenced civil site plan, we understand that the proposed site improvements include two building additions located at the east and south ends of the existing school building, new driveways, bus loops, and parking lots, and a stormwater infiltration pond located south of the school building entrance. The locations of the proposed improvements relative to the existing school building and our exploration locations are shown on the "Proposed Site and Exploration Plan" (Figure 3).

3.0 SITE EXPLORATION

Our field studies were conducted for this project in April and June 2020 and included advancing thirteen exploration borings and four test pits, installing four groundwater observation wells, and performing two field infiltration tests. The various types of sediments, as well as the depths where the characteristics of the sediments changed, are indicated on the exploration logs presented in Appendix A and Appendix B. Historical explorations are included in Appendix C. Laboratory testing data are included in Appendix D. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types. If changes occurred between sample intervals in our exploration borings, they were interpreted. Our explorations were approximately located in the field by measuring from existing site features.

The conclusions and recommendations presented in this report are based, in part, on the explorations completed for this study. The number, locations, and depths of the explorations were completed within site and budgetary constraints. Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions may be present due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of 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

For this study, twelve of the exploration borings (EB-1 through EB-12) were completed by advancing an 8-inch, outside-diameter, hollow-stem auger using a track-mounted drill, and one exploration boring (EB-13W) was completed by advancing an 8-inch, outside-diameter track-mounted rotosonic drill rig. During the drilling process, samples were generally obtained at 2½- to 5-foot-depth intervals. Grab samples were obtained from the rotosonic drill core at approximate 2.5- to 5-foot intervals. The borings were continuously observed and logged by either an engineer or geologist from our firm. The exploration logs presented in Appendix A are based on the field logs, drilling action, and observation of the samples collected.

Disturbed, but representative samples of explorations EB-1 through EB-12 were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *ASTM International* (ASTM) D-1586. In addition, the uppermost 25 feet of EB-13W was sampled using the SPT procedure in addition to the rotosonic method. The SPT 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 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 exploration boring logs.

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

3.2 Exploration Borings Completed as Groundwater Monitoring Wells

Four exploration borings were completed as a 2-inch-diameter observation wells, designated as EB-3W, EB-7W, EB-10W, and EB-13W. The wells were installed to allow for monitoring of seasonal groundwater levels. The wells were constructed with 5 to 10 feet of 2-inch-diameter machine-slotted Schedule 40 polyvinyl chloride (PVC) well screen, solid Schedule 40 PVC casing above the well screen, and a flush-mount steel well cover. Wells EB-3W, EB-7W, and EB-10W were completed with the well screen within the water-bearing zone. EB-13W was completed as a dry well, with no evidence of the regional groundwater table encountered at time of drilling (June 2020). The sand filter pack material surrounding the well screen consisted of 12/20 Colorado Silica Sand. The well was sealed with a combination of bentonite chips and concrete. The well casing was capped with a locking plastic compression cap. Well construction details are presented on the geologic and well construction logs in Appendix A. Wells EB-3W, EB-7W, and EB-10W were developed and sounded by AESI on April 27, 2020. Pressure transducers connected to data loggers recording hourly data were installed and groundwater level monitoring is ongoing.

3.3 Exploration and Infiltration Test Pits

Exploration test pits (EP-1 and EP-2) and two infiltration test pits (IT-1 and IT-2) were excavated at the site using a Bobcat E55 rubber track-mounted excavator with an approximately 3-foot-wide toothed bucket. The test pits permitted direct, visual observation of subsurface conditions. Materials encountered in the infiltration test pits were studied and classified in the field by a geologist from our firm. The approximate locations of the test pits are shown on Figures 2 and 3. The test pit logs are presented in Appendix B and infiltration test data are presented in Appendix E. Infiltration testing is discussed in more detail in Section 5.0.

Samples collected from the test pits were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification and laboratory testing, as necessary.

4.0 SUBSURFACE CONDITIONS

4.1 Regional Geologic and Soils Mapping and Historical Information

Published Geologic Map

Review of the *Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington* by Schuster, Cabibbo, Schilter, and Hubert (Washington Division of Geology and Earth Resources Map Series 2015-03, November 2015) indicates that the subject site is mapped as Vashon lodgement till and Vashon recessional outwash. Our interpretation of the sediments encountered in our explorations is in general agreement with the regional geologic map.

Historical Geotechnical Information

We reviewed two partial geotechnical reports prepared by AESI in 2005 and 2006, respectively. The reports were prepared in support of the design of the hardscapes surrounding the existing school building. The 2005 and 2006 geotechnical reports included the log of one exploration boring in each report that encountered soils consistent with those observed in our current study. Copies of the historical exploration logs from AESI are included in Appendix C for reference.

Published Soils Map

Review of the U.S. Department of Agriculture (USDA), Soils Conservation Service (SCS) now referred to as Natural Resources Conservation Service (NRCS) web soil survey indicates that the subject site is underlain by Kapowsin gravelly ashy loam. Kapowsin gravelly ashy loams formed from volcanic ash mixed with weathered glacial drift sediments, over dense glaciomarine deposits. The southeast corner of the subject site is mapped as Everett very gravelly sandy loam, formed from sandy and gravelly glacial outwash. Our interpretation of the soils encountered in our exploration is in general agreement with the regional soils mapping, although we encountered more recessional-age deposits than indicated by the regional mapping.

4.2 Site Stratigraphy

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, review of historical exploration borings performed by AESI, visual reconnaissance of the site, and review of selected applicable geologic literature. The shallow soil and groundwater conditions were variable across the site. In general, the depth of existing fill varied from about 2 to 7 feet within the existing soccer field, 2 to 3 feet within the footprint of the east school addition, and 1 to 3 feet within the footprint of the south school addition. Below the fill, we encountered multiple native geologic units of varying depth and thickness. In general, the native soils consisted of soft to medium stiff/loose to medium dense recessional lacustrine and outwash deposits underlain by dense to very dense glacially consolidated soils consisting of either

Vashon lodgement till, and/or pre-Fraser deposits. Some areas did not contain fill or recessional deposits and were directly underlain by glacially consolidated soils. The following section presents more detailed subsurface information on the sediment types encountered at the site. Hydrogeologic conditions are illustrated on the “Schematic Hydrogeologic Cross-Section A-A” (Figure 4).

Sod/Topsoil

Sod and organic-rich brown topsoil was encountered at the ground surface at exploration borings EB-1, EB-2, EB-5, EB-6, EB-7W, EB-8, EB-10W, EB-11, EB-12, EB-13W, exploration pits EP-1 and EP-2, and infiltration test pits IT-1 and IT-2 to depths of less than 1 foot.

Fill

Fill soils (those not naturally placed), were encountered in exploration borings EB-1, EB-3W, EB-4, EB-5, EB-6, EB-7W, EB-8, EB-9, EB-12, EB-13W, exploration pit EP-2, and infiltration test pit IT-2 to depths ranging from 1 to 7 feet below the existing ground surface. The fill generally consisted of loose to medium dense, moist, fine to medium sand with variable silt content to sandy silt with variable gravel content and minor organics. Existing fill is not considered suitable for foundation support and may require remediation below new pavement areas. Additionally, existing fill is not suitable for infiltration of stormwater runoff. Excavated existing fill material may be suitable for reuse in structural fill applications if such reuse is specifically allowed by project plans and specifications, if excessively organic and any other deleterious materials are removed, and if moisture content is adjusted to allow compaction to the specified level and to a firm and unyielding condition. We anticipate that the sandier fill soils onsite will be feasible for reuse, whereas the siltier fill soils onsite will be difficult to moisture-condition and achieve proper compaction. Fill soils are also likely present in unexplored areas of the site near the existing buildings, such as in existing utility trench areas, landscaped or yard areas, and at previously graded/backfilled areas.

We noted that a hydrocarbon odor was encountered in the shallow fill soils in exploration EB-4. Environmental soil sampling and analytical testing were performed by the Puyallup School District’s environmental consultant, Environmental Specialties. The results of the analytical testing are provided in Appendix F.

Vashon Recessional Deposits

Medium stiff silt and loose to medium dense silty fine sand deposits were encountered underlying the fill in explorations EP-2 and IT-2, EB-1, EB-3W, EB-6, EB-7W, EB-12, and EB-13W and interpreted as Vashon recessional lacustrine deposits. The thickness ranged from about 3 to 7 feet. Recessional lacustrine deposits are typically very fine-grained sand, silt, and clay deposited in small ice-enclosed, ice-marginal, and ice-dammed lakes, and can contain stratified sands with scattered dropstones and occasional lenses of till.

The Vashon recessional lacustrine deposits encountered onsite are typically silty and moisture-sensitive when excavated and placed as structural fill, and are expected to require drying during favorable weather conditions if reused for fill in structural areas.

Vashon Recessional Outwash

Stratigraphically underlying the fill and/or recessional lacustrine deposits, loose to medium dense, stratified sand with varying amounts of silt and gravel were encountered in EP-2, IT-2, EB-3W, EB-4, EB-5, and EB-12 interpreted as Vashon recessional outwash. The thickness ranged from about 3.5 to 7 feet where fully penetrated. EP-2 and IT-2 terminated in recessional outwash at depths of 10.1 and 11.9 feet, respectively. Recessional outwash was deposited by meltwater streams from the retreating glacial ice sheet, not glacially consolidated and is generally less compact than other glacial soils.

Recessional outwash may be suitable for support of structural loads when prepared as recommended in this report. The recessional outwash soils encountered on this site may contain a significant fine-grained fraction, and may be sensitive to excess moisture during placement in structural fill applications. Reuse of the sandier recessional outwash in structural fill applications is feasible if allowed by project specifications, and will require drying to achieve moisture contents within 3 percent of optimum for compaction purposes.

Vashon Lodgement Till

Dense, non-stratified, silty, fine-grained sand with some gravel interpreted as Vashon lodgement till was encountered at shallow depths beneath topsoil or fill in EP-1, IT-2, EB-8, EB-9, EB-10, and EB-11, and in historical boring EB-1 (2006). Till was encountered below recessional deposits in EB-1, EB-2, EB-3, EB-4, EB-5, EB-6, and EB-12. The Vashon till was deposited by basal, debris-laden, glacial ice during the Vashon Stade of the Fraser Glaciation, approximately 12,500 to 15,000 years ago. The high relative density characteristic of the Vashon lodgement till is due to its consolidation by the massive weight of the glacial ice from which it was deposited. Depths to till ranged from presentation at or near the surface (0.8 feet) to 13 feet. Thickness of the till varied from about 2 feet to 14 feet. At EB-12, near the existing detention pond, the till encountered was noted as weathered due to a lower blow count.

Lodgement till was observed in most areas, and is expected to be handled in substantial amounts during site work for the project. Lodgement till is typically silty and moisture-sensitive when excavated and placed as structural fill, and is expected to require drying during favorable weather conditions if it is to be reused for fill in structural areas.

Pre-Fraser Fine-Grained Deposits

Five of our explorations (EB-2, EB-8, EB-9, EB-11, and EB-13W) encountered pre-Fraser fine-grained deposits, generally stratigraphically underlying the till, except for EB-13W which encountered Vashon recessional outwash mantling pre-Fraser fine-grained deposits. The pre-Fraser fine-grained deposits consist of typically very stiff to hard silt, clayey silt and sandy silt and dense to very dense silty sand with generally trace amounts of gravel. Pre-Fraser fine-grained sediments were deposited before the Vashon Stade of the Fraser Glaciation and have been glacially overridden and compacted. Observed thickness of the deposits ranged from 5.5 to 16 feet where fully penetrated.

Pre-Fraser Coarse-Grained Deposits

Most explorations encountered dense to very dense, stratified sands and gravels with varying amounts of silt interpreted as undifferentiated Vashon advance outwash and pre-Fraser coarse-grained deposits and referred to as pre-Fraser coarse-grained deposits in this report. The material was difficult to drill through, a few borings encountered refusal conditions, and recovery was somewhat limited by gravel content. The undifferentiated sediments were encountered beneath glacial till in EP-1, IT-1, EB-1, EB-3, EB-4, EB-5, EB-6, EB-7W, EB-10W, and EB-12. At EB-2, EB-8, EB-9, EB-11, and EB-13W, the pre-Fraser coarse-grained deposits were observed underlying pre-Fraser fine-grained deposits. The observed depth to pre-Fraser coarse-grained sediments ranged from 2 to 27 feet below the existing ground surface and the thickness ranged from 37 feet (in EB-7W) to the maximum observed of about 60 feet (in EB-13W which terminated within the deposit). Pre-Fraser coarse-grained sediments were deposited before the Vashon Stade of the Fraser Glaciation and have been glacially overridden and compacted. These deposits are suitable for support of structural loads when prepared as recommended in this report. Pre-Fraser coarse-grained deposits contain a variable fine-grained fraction, and may be suitable for infiltration applications. Reuse of coarse grained deposits in structural fill applications is feasible if allowed by project specifications, and will require drying to achieve moisture contents within 1 to 2 percent of optimum for compaction purposes.

Pre-Fraser Older Till

Stratigraphically underlying the pre-Fraser coarse-grained deposits, EB-7W encountered typically dense to very dense, olive, silty sand to sandy silt with varying amounts of gravel interpreted as pre-Fraser older till. The older till was deposited before the Vashon Stade of the Fraser Glaciation and has been glacially overridden and compacted. The observed depth to older till was 57 feet

below the existing ground surface. EB-7W terminated in the older till. Pre-Fraser older till deposits were observed at significant depth, and the material is not expected to be handled in substantial amounts during site work for the project.

4.3 Hydrology

Groundwater is interpreted to be present in several intervals at the site: shallow perched water above till; shallow perched water within recessional-age deposits; and deeper groundwater within the pre-Fraser-age sediments. Depth to groundwater observations at the time of drilling are summarized in Table 1 with geologic unit noted. Hydrogeologic conditions are illustrated on the “Schematic Hydrogeologic Cross-Section A-A” (Figure 4).

Table 1
Groundwater Observations At the Time of Drilling

Exploration Number	Approximate Ground Surface Elevation (feet)	Depth to Groundwater (feet) ¹	Geologic Unit With Water ²	Comments
EB-1	512	None observed	Shallow Qvrl silt present over till	District noted past drainage issues
EB-2	515	7.5	Qpff	Perched
EB-3W	497	10.5 (8 in well)	Qvrl/Qvr	Well set, monitoring ongoing
EB-4	501	7.5	Qvrl/Qvr	Perched
EB-5	502	5	Qvr	Perched
EB-6	497	11	Qvrl	Perched
EB-7W	498	50 (48 in well)	Qpfc	Well set, monitoring ongoing
EB-8	514	None observed		
EB-9	514	None observed		
EB-10W	510	1.5 and 35 (28 in well)	Perched on Qvt	Located in a detention pond
		35 (28 in well)	Qpfc	Well set, monitoring ongoing
EB-11	514	None observed		
EB-12	494	7.5 and 20	Qvrl/Qvr	Located adjacent to a detention pond
EB-13W	497	6	Qvrl	Perched;
		Drilled to 80, dry hole	Qpfc	Well set, monitoring is ongoing
EP-1	512	0.8	Perched on Qvt	Located in a detention pond
EP-2	515	9.7	Qvrl/Qvr	Perched

1. EB-1 to EB-12 drilled April 21 to April 23, 2020; EP-1 and EP-2 dug April 30, 2020; EB-13W drilled June 1, 2020.

2. Qvrl: Vashon recessional lacustrine deposits; Qvr: Vashon recessional outwash deposits; Qvt: Vashon lodgement till deposits; Qpff: pre-Fraser fine-grained deposits; Qpfc: pre-Fraser coarse-grained deposits.

Perched water occurs when surface water infiltrates down through relatively permeable soils, such as existing fill or coarser-grained natural strata, and becomes trapped or “perched” atop a comparatively low-permeability barrier, such as the surface of the hard, unweathered till. When

water becomes perched, it may travel laterally and may follow flow paths related to ground surface topography. The duration and quantity of perched groundwater seepage within the weathered till or fill deposits will largely depend on the soil grain-size distribution, topography, seasonal precipitation, on- and off-site land usage, and other factors.

Perched water within the Vashon recessional age deposits is interpreted to be more laterally continuous than perched water within the weathered till deposits. Dewatering considerations for excavations that encounter groundwater in recessional-age deposits are discussed in the “Design Recommendations” section of this report.

Water within the pre-Fraser coarse-grained deposits was encountered at various depths and is also interpreted to be perched; corresponding elevations ranged from less than 417 feet (EB-13W) to about 482 feet (EB-10W). Maintaining vertical separation from the groundwater within the pre-Fraser coarse-grained deposits is important for infiltration facility design. The regional groundwater table is interpreted to be lower than groundwater observed at the time of drilling.

Wells EB-3W, EB-7W, EB-10W, and EB-13W were installed in support of our infiltration feasibility study for the project. Groundwater monitoring is ongoing. EB-3W was screened approximately 10 to 15 feet below the existing ground surface in Vashon recessional outwash to monitor perched groundwater beneath the site. EB-7W and EB-10W were screened in pre-Fraser coarse-grained deposits from approximately 45 to 55 feet and 25 to 35 feet, respectively, below the existing ground surface. EB-13W was screened approximately 68 to 78 feet below the existing ground surface in pre-Fraser coarse-grained deposits, and has been dry since installation.

4.4 Laboratory Testing

Grain-Size Analysis

Seven grain-size analyses (sieves) were performed on representative samples obtained from IT-1, IT-2, EB-4, and EB-13W. The grain-size analyses test results are presented below in Table 2 (and attached in Appendix D) with soil descriptions based on the ASTM D-2487 Unified Soil Classification System (USCS). The respective fine-grained content for each sample was measured on the No. 200 sieve and is presented in Table 2.

Table 2
Summary of Grain-Size Analyses

Exploration Number	Depth (feet)	Geologic Unit	USCS Soil Description	Fines Content (%)
IT-1	3.3	Qpfc	Silty gravel with sand (GM)	13.8
IT-2	5.7	Qvrl	Very silty sand (SM)	49.0
EB-4	20	Qpfc	Well-graded sand with silt and gravel (SW-SM)	7.2
EB-13W	21-24*	Qpfc	Very sandy gravel, some silt (GP-GM)	11.6
EB-13W	48	Qpfc	Very sandy gravel, some silt (GP-GM)	4.4
EB-13W	63-65*	Qpfc	Very sandy gravel, some silt (GP-GM)	6.4
EB-13W	76	Qpfc	Sand, some silt, some gravel (SP-SM)	11.8

*Composite sample; USCS = Unified Soil Classification System; % = percent of total weight passing the U.S. No. 200 Sieve; Qvrl: Vashon recessional lacustrine deposits; Qpfc: pre-Fraser coarse-grained deposits

5.0 FIELD INFILTRATION TESTS

Two infiltration tests were completed at the locations shown on Figures 2 and 3 as IT-1 and IT-2. Infiltration test IT-1 was completed to obtain representative infiltration rates for the existing detention pond located near the southern entrance of the school building. Infiltration test IT-2 was completed to obtain representative infiltration rates for a potential infiltration facility located at the northwest corner of the existing soccer field.

The infiltration test pits were excavated by Northwest Excavating and Trucking, an independent firm working under subcontract to AESI. The pits (IT-1 and IT-2) permitted direct, visual observation of subsurface conditions. Materials encountered in the pits were studied and classified in the field by a geologist from AESI. After logging the exposed soils, the pits were backfilled with the excavated soil and lightly tamped with the excavator bucket. Disturbed soil samples were selected from the pits, placed in moisture-tight containers, and transported to AESI's laboratory for further visual classification and testing, as necessary. The exploration logs in Appendix A are based on the field observations and inspection of the samples.

Each test was conducted using the small-scale Pilot Infiltration Test (PIT) procedure outlined in the 2014 Washington State Department of Ecology (Ecology) *Stormwater Management Manual for Western Washington* (Ecology Manual). All tests were conducted in open pits at depths between about 3.3 to 5.7 feet below existing ground surface. Infiltration test IT-1 was dug through the silty lodgement till deposits into the underlying pre-Fraser coarse-grained deposits. Infiltration test IT-2 was conducted within the fine-grained Vashon recessional lacustrine deposits. A staff gauge with 0.01-foot divisions was placed in the base of each infiltration test pit to allow for water level stage monitoring during testing. Water was introduced into the test area using fire hoses attached to a digital propeller flow meter assembly, and was sourced from an on-site fire hydrant. The discharge hose was equipped with a diffuser to minimize turbulence and

scouring of the pit bottom. The flow meter has both an instant read flow rate and a total flow volume readout. Readings of the depth to water, instantaneous flow rate, and total flow volume were recorded at approximately 5- to 15-minute intervals. No water was present prior to testing.

Each test included a constant-head phase and a falling-head phase. During the first (constant-head) phase of each test, the test pit was filled with water to a height of about 6 to 8 inches, then maintained for approximately 7 hours. For IT-1, the total time of soil saturation and inflow was 7 hours. At the end of the constant-head phase, the water flow was shut off and falling-head data were recorded for a duration of 1 hour. IT-2 was observed to have a low infiltration rate, and the water flow was shut off approximately 2 hours into the soaking phase. The falling-head phase lasted approximately 6 hours. During the falling-head phase, the water level drop in the test pit was measured at approximately 5- to 15-minute intervals on a staff gauge. After completing each test, we observed the test pit subgrade being overexcavated to the limits of the excavating equipment. This allowed for direct observation of the types of sediments that received the infiltration testing water, and to identify any restrictive layers.

The field infiltration rate in IT-1 in the pre-Fraser coarse-grained deposits was 4.1 inches per hour during the constant-head phase and 2.5 inches per hour during the falling-head phase. The field infiltration rate in IT-2 in the Vashon recessional lacustrine deposits was approximately 0.3 inches per hour for the falling-head phase. The constant-head rate was too low to maintain a constant rate of inflow. The infiltration test data were recorded by hand in the field and subsequently transferred to an electronic spreadsheet. Infiltration test data sheets are included in Appendix E. The test depth, depth to water, test base area, total water volume discharged, and the uncorrected field infiltration rates of the infiltration tests are summarized in Table 3.

Table 3
Infiltration Test Summary

Test Number	Test Depth (feet)	Geologic Unit	Test Base Area (square feet)	Total Water Discharged (feet)	Uncorrected Constant-Head Field Infiltration Rate (inches/hour)	Uncorrected Falling-Head Field Infiltration Rate (inches/hour)
IT-1	3.3	Pre-Fraser Coarse-Grained	13.8	346	4.1	2.5
IT-2	5.7	Recessional Lacustrine	12.1	52	Not obtained	0.36

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.

6.0 LANDSLIDE HAZARDS AND MITIGATIONS

It is our opinion that the risk of damage to the proposed school additions by landsliding is low due to the lack of steep slopes at the project site and vicinity and the presence of dense to very dense glacially consolidated soils. Based on our review of the Washington Geologic Information Portal¹, there is a potential landslide hazard area mapped at the north end of the school building (located within 25 feet of exploration boring EB-2). However, exploration boring EB-2 encountered dense to very dense native soils consisting of Vashon lodgement till underlain by very stiff to hard pre-Fraser fine-grained deposits which are not susceptible to landsliding. No detailed slope stability analysis was performed for this project, and none is warranted, in our opinion.

7.0 SEISMIC HAZARDS AND MITIGATIONS

Earthquakes regularly occur in the Puget Sound Lowland. The majority of these events are small and are usually not felt by people. However, large earthquakes do occur as evidenced by the most recent 6.8-magnitude event on February 28, 2001, near Olympia Washington; the 1965 6.5-magnitude event; and the 1949 7.2-magnitude event. The 1949 earthquake appears to have been the largest in this area during recorded history. Evaluation of 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) liquefaction, 3) seismically induced landslides, and 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

7.1 Surficial Ground Rupture

The project area is located approximately 30 miles south of the Seattle Fault Zone and approximately 10 miles southeast of the Tacoma Fault Zone. Our current understanding of the Seattle Fault suggests that several fault traces are spread across a relatively wide zone. Recent studies by the U.S. Geological Survey (USGS) (e.g., Johnson et al., 1994, *Origin and Evolution of*

¹ https://geologyportal.dnr.wa.gov/#natural_hazards

the Seattle Fault and Seattle Basin, Washington, *Geology*, v. 22, p. 71-74 and Johnson et al., 1999, *Active Tectonics of the Seattle Fault and Central Puget Sound Washington - Implications for Earthquake Hazards*, Geological Society of America Bulletin, July 1999, v. 111, n. 7, p. 1042-1053) have provided evidence of surficial ground rupture along a northern splay of the Seattle Fault. The recognition of this fault is relatively new, and data pertaining to it are limited, with the studies still ongoing. According to the USGS studies, the latest movement of this fault was about 1,100 years ago when about 20 feet of surficial displacement took place. This displacement can presently be seen in the form of raised, wave-cut beach terraces along Alki Point in West Seattle and Restoration Point at the south end of Bainbridge Island. The recurrence interval of movement along this fault system is still unknown, although it is hypothesized to be in excess of several thousand years.

Geophysical surveys of the Puget Lowland in 1998 suggested the presence of a fault zone along the north side of the Tacoma basin generally between Tacoma and the south end of Hood Canal (*Upper Crustal Structure in the Puget Lowland, Washington: Results from 1998 Seismic Hazards Investigation in Puget Sound*, Journal of Geophysical Research, v. 106, p. 13,541-13,564, by T.M. Brocher, T. Parsons, R.A. Blakely, N.I. Christiansen, M.A. Fisher, R.E. Wells, and SHIPS Working Group, 2001). More recent studies by the USGS have provided evidence of surficial ground rupture along the Tacoma Fault near Burly, Washington (*The Catfish Lake Scarp, Allyn, Washington: Preliminary Field Data and Implications for Earthquake Hazards Posed by The Tacoma Fault*, USGS Open-File Report 03-455, by B.L. Sherrod, A.R. Nelson, H.M. Kelsey, T.M. Brocher, R.J. Blakely, C.S. Weaver, N.K. Rountree, S.B. Rhea, and B.S. Jackson, 2003). The recognition of this fault is relatively new, and data pertaining to it are limited, with studies still ongoing. According to the USGS studies, the latest movement of this fault was about 1,100 years ago when several meters of surficial displacement took place. This displacement can presently be seen in the form of raised tidal flats in the Burly Lagoon, Lynch Bay, and North Cove, resulting in the present-day freshwater marshes and forested lowlands. Further evidence of the faulting activity in this system has been seen at Wollochet Bay, where forested areas were inundated by water. Additionally, linear fault scarp features in the ground surface were exposed in recent Light Detection and Ranging (LIDAR) maps. The scarp features are located near Allyn, Washington, and have been described as trending parallel to the Tacoma Fault system. Studies also point to the fault system continuing across the Puget Sound, and it is inferred as continuing through Commencement Bay and the Puyallup River Delta. The slip rate along the Tacoma Fault is thought to be approximately 2 millimeters per year. However, very little is known about the recurrence interval of earthquakes along the Tacoma Fault.

Related fault systems in the Puget Sound region have been hypothesized to have reoccurrence intervals in excess of several thousand years. Due to the suspected long recurrence interval, the potential for surficial ground rupture is considered to be low during the expected life of the proposed development. No mitigation efforts beyond complying with the requirements of the local jurisdictions and the 2018 *International Building Code* (IBC) are recommended for this site.

7.2 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 non-cohesive silt and sand with low relative densities, accompanied by a shallow water table.

Review of a liquefaction susceptibility map (*Liquefaction Susceptibility Map of Pierce County, Washington, 1:150,000-scale*, Stephen P. Palmer et al., dated September 2004) identifies the site as having a very low susceptibility to liquefaction. The soils encountered in our explorations that are located below the groundwater table consisted of dense to very dense glacially consolidated soils that are not considered susceptible to liquefaction during a design-level seismic event. No detailed liquefaction hazard analysis was performed for this study, and none is warranted, in our opinion.

7.3 Seismically Induced Landslides

Similar to the discussion in Section 5.0, it is our opinion that the potential risk of damage to the proposed school improvements by seismically induced slope failure is low during a design-level seismic event due to the lack of steep slopes at the project site and vicinity and the presence of dense to very dense glacially consolidated soils.

7.4 Ground Motion/Seismic Site Class (2018 International Building Code)

Structural design of the school building additions should follow 2018 IBC standards. We recommend that the project be designed in accordance with Site Class "C" in accordance with the 2018 IBC, and the publication *American Society of Civil Engineers (ASCE)-7* referenced therein, the most recent version of which is ASCE 7-16.

8.0 EROSION HAZARDS AND MITIGATIONS

The sediments underlying the site generally contain silt and sand that can be sensitive to erosion. In order to reduce the amount of sediment transport off the site during construction, the following recommendations should be followed:

1. Construction activity should be scheduled or phased as much as possible to avoid earthwork activity during the wet season.
2. The winter performance of a site is dependent on a well-conceived plan for control of site erosion and stormwater runoff. The site plan should include ground-cover measures and staging areas. The contractor should be prepared to implement and maintain the required measures to reduce the amount of exposed ground.
3. Temporary erosion and sedimentation control (TESC) elements and perimeter flow control should be established prior to the start of grading. This should include, but is not limited to, silt fencing, swales with check dams, rock construction entrance, etc.
4. During the wetter months of the year, or when significant storm events are predicted during the summer months, the work area should be stabilized so that if showers occur, it can receive the rainfall without excessive erosion or sediment transport. The required measures for an area to be "buttoned-up" will depend on the time of year and the duration that the area will be left unworked. During the winter months, areas that are to be left unworked for more than 2 days should be mulched or covered with plastic. During the summer months, stabilization will usually consist of seal-rolling the subgrade. Such measures will aid in the contractor's ability to get back into a work area after a storm event. The stabilization process also includes establishing temporary stormwater conveyance channels through work areas to route runoff to the approved treatment/discharge facilities.
5. All disturbed areas should be revegetated as soon as possible. If it is outside of the growing season, the disturbed areas should be covered with mulch. Straw mulch provides a cost-effective cover measure and can be made wind-resistant with the application of a tackifier after it is placed.
6. Surface runoff and discharge should be controlled during and following development. Uncontrolled discharge may promote erosion and sediment transport.
7. Avoid tracked-out sediments on the local roads by installing and maintaining crushed rock or paved construction access points. Install wheel wash facilities, if needed.
8. Soils that are to be reused around the site should be stored in such a manner as to reduce erosion from the stockpile. Protective measures may include, but are not limited to, covering stockpiles with plastic sheeting, or the use of silt fences around stockpile perimeters.

It is our opinion that with the proper implementation of the TESC plans and by field-adjusting appropriate erosion mitigation (Best Management Practices [BMPs]) throughout construction, the potential for adverse impacts from erosion hazards on the project may be mitigated.

9.0 CRITICAL AQUIFER RECHARGE AREAS

Critical aquifer recharge areas (CARAs) have prevailing geologic conditions associated with infiltration rates that create a high potential for contamination of groundwater resources or contribute significantly to the replenishment of groundwater. The CARAs are classified in part by time of travel (TOT) around individual wells. The TOT refers to the amount of time it takes water to discharge to a well from its point of infiltration.

Per *Puyallup Municipal Code* [PMC] 21.06.1110(3) and 21.06.1110(4):

- (3) For purposes of this chapter, critical aquifer recharge areas include the following:
 - (a) Aquifer recharge areas identified using the DRASTIC (Pierce County health department) model that are susceptible or vulnerable to degradation or depletion because of hydrogeologic characteristics; and
 - (b) Wellhead protection areas as defined by the boundaries of the one-, five- and 10-year time of ground water travel, or boundaries established using alternate criteria approved by the Pierce County health department in those settings where ground water time of travel is not a reasonable delineation criterion, in accordance with WAC [246-290-135](#).
- (4) Critical aquifer recharge areas shall be rated as high or low susceptibility areas as follows:
 - (a) High susceptibility aquifer recharge areas are all areas on the Puyallup valley floor, plus all wellhead protection areas within the five-year travel time boundary; and
 - (b) Low susceptibility aquifer recharge areas are all areas within the city that do not meet the criteria for a high susceptibility rating. (Ord. 2859 § 1, 2006).

The site is considered to be in a Low Susceptibility aquifer recharge area because the site development areas are located on a glaciated upland and outside of the 5-year TOT zones. The site is located within the 10-year wellhead protection area of a Group A water supply well for the Fruitland Mutual Water Company, and the TOT zones of two City of Puyallup Group A water supply wells are within 1,300 feet of the site as shown on the map of “Wellhead Protection Zones” (Figure 5). Site surface geologic conditions include low-permeability glacial till and low-permeability fine-grained recessional lacustrine deposits overlying pre-Fraser coarse-grained deposits (see Figure 4).

The proposed project will be designed to be protective of groundwater and surface water resources by treating and retaining/detaining stormwater in compliance with the requirements of the City of Puyallup stormwater requirements, and incorporating infiltration BMPs where feasible. Currently an infiltration pond is proposed as described in this report.

In our opinion, there should be no deleterious impact from the proposed development on nearby water supply wells because the wells are screened in a deep aquifer. The depth to the first open interval on the producing wells ranges from 501 feet for Fruitland Mutual Water Company Well 5A AFR833, and ranges from 465 feet (City of Puyallup Well #33 - 23rd Avenue SE ACA528) to 550 feet (City of Puyallup Cherokee Park Well #43) with substantial thicknesses of low-permeability sediments separating the source from near-surface impacts.

No detailed CARA analysis was performed for this project, and none is warranted, in our opinion.

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III. DESIGN RECOMMENDATIONS

10.0 INTRODUCTION

Our explorations indicate that, from a geotechnical engineering standpoint, the proposed project is feasible provided the recommendations contained herein are properly followed. The bearing stratum is generally shallow and conventional shallow foundations should perform well with proper subgrade preparation. Existing fill was encountered beneath the footprint of the proposed school additions in exploration borings EB-4, EB-5, EB-8, and EB-9 to depths ranging from about 1 foot to 3.5 feet below the existing ground surface. The existing fill will require removal where present under areas of new foundations and may require partial remediation under new slabs-on-grade and pavement areas. Our recommendations regarding general site preparation, structural fill, foundations, floor support, foundation walls, drainage considerations, driveway and parking lot grading, pavement design, and stormwater infiltration feasibility are provided in the following sections of this report.

11.0 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. The existing fill soils encountered in our explorations appeared to be above the optimum moisture content and can be difficult to reuse as structural fill during the wet season. Existing underground utilities should either be removed or relocated if they are located below the planned building area. Erosion and surface water control should be established around the perimeter of the excavation to satisfy City of Puyallup requirements.

11.1 Temporary Cut Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction based on the conditions encountered at that time. For estimating purposes, however, we anticipate that temporary, unsupported cut slopes in existing fill and native recessional lacustrine/outwash soils can be planned at 1.5H:1V (Horizontal: Vertical) or flatter. This slope angle is for areas where groundwater seepage is not present at the faces of the slopes. Excavations below the perched groundwater zones onsite may require flatter slope angles or temporary shoring and dewatering measures as discussed in the “Dewatering Considerations” section of this report. Temporary cut slopes may need to be adjusted in the field at the time of construction to accommodate unforeseen soil conditions and prevailing weather conditions. This should be determined in the field by the geotechnical engineer. As is typical with

earthwork operations, some sloughing and raveling may occur, and cut slopes may have to be adjusted in the field. In addition, WISHA/OSHA regulations should be followed at all times.

11.2 Dewatering Considerations

Perched groundwater was encountered across most of the site at depths ranging from about 5 to 11 feet below the existing ground surface. Temporary dewatering measures may be required during excavation for storm drains and the proposed stormwater pump station structure located at the east end of the school building. We anticipate that the accumulation of perched groundwater seepage within the excavations can be handled by sump pumps. We recommend that groundwater be kept a minimum of 3 feet below the bottom of the excavations at all times to facilitate the construction of the pump station and various utilities.

11.3 Site Disturbance

The existing fill and native soils onsite contain a significant amount of fine-grained material and can be expected to be moisture-sensitive and subject to disturbance when wet. Some of the soils encountered in our explorations appeared to be above their optimum moisture content for compaction at the time of our study. The contractor must use care during site preparation and excavation operations so that the underlying soils are not softened, particularly during wet weather conditions. If disturbance occurs in areas of conventional footings, the softened soils should be removed and the area brought to grade with clean crushed rock fill. Because of the moisture-sensitive nature of the soils, we anticipate that wet weather construction would increase the earthwork costs over dry weather construction.

11.4 Winter Construction

Soils excavated onsite will likely require drying during favorable dry weather conditions to allow their reuse in structural fill applications. Care should be taken to seal all earthwork areas during mass grading at the end of each workday by grading all surfaces to drain and sealing them with a smooth-drum roller. Stockpiled soils that will be reused in structural fill applications should be covered whenever rain is possible.

If winter construction is expected, crushed rock fill should be used to provide construction staging areas where exposed soil is present. The stripped subgrade should be observed by the geotechnical engineer, and should then be covered with a geotextile fabric, such as Mirafi 500X or equivalent. Once the fabric is placed, we recommend using a crushed rock fill layer at least 10 inches thick in areas where construction equipment will be used.

11.5 Frozen Subgrades

If earthwork takes place during freezing conditions, all exposed subgrades should be allowed to thaw, and then be recompacted prior to placing subsequent lifts of structural fill. Alternatively, the frozen material could be stripped from the subgrade to reveal unfrozen soil prior to placing subsequent lifts of fill. The frozen soil should not be reused as structural fill until allowed to thaw and adjusted to the proper moisture content, which may not be possible during winter months.

12.0 STRUCTURAL FILL

Should structural fill be necessary, it should be placed and compacted according to the recommendations presented in this section. All references to structural fill in this report refer to subgrade preparation, fill type, 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.

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.

We anticipate that the pre-Fraser-age sediments to be excavated from the proposed infiltration pond near the south entrance of the school building will be difficult to reuse as structural fill due to the high fines content, gap-graded soil matrix, and presence of large cobbles and boulders. We recommend that project plans specify the use of an imported structural fill for all proposed embankment construction onsite.

The contractor should note that AESI should evaluate any proposed fill soils prior to their use in fills. This would require that we have a sample of the material at least 3 business days in advance of filling activities to perform a Proctor test and determine its field compaction standard. Soils in which the amount of fine-grained material (smaller than the No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. Some of the on-site soils are moisture-sensitive and have natural moisture contents over optimum for compaction and will likely require moisture-conditioning before use as structural fill. In addition, construction equipment traversing the site when the soils are wet can cause considerable disturbance.

If fill is placed during wet weather or if proper compaction cannot be obtained, 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, and at least 25 percent retained on the No. 4 sieve.

A representative from our firm should observe the subgrades and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses and any problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not assure uniformity or acceptable performance of a fill. As such, we are available to aid the owner in developing a suitable monitoring and testing frequency.

13.0 FOUNDATIONS

Spread footings may be used for building support when they are founded on undisturbed native recessional outwash or lodgement till soils or on approved structural fill placed as described above. Based on our boring data, suitable foundation bearing soils consisting of medium dense recessional outwash and dense to very dense lodgement till are generally present at 1 to 3.5 feet below the existing ground surface; however, existing fill was deeper than 3.5 feet below the existing ground surface in other areas of the site, and could be present due to alteration of topography by past grading and/or filling. Our recommendations for each school building addition are provided below.

13.1 South School Addition

Explorations EB-8 and EB-9 were performed for the south school addition. The borings generally encountered 1 to 3 feet of existing fill underlain by medium dense to very dense glacially consolidated soils. No groundwater was encountered within the maximum boring depth of 25 feet. Foundation support for the south school addition may consist of conventional spread footings bearing on the native glacially consolidated soils. We recommend that an allowable bearing pressure of 3,000 pounds per square foot (psf) be used for design purposes, including both dead and live loads. An increase of one-third may be used for transient wind and seismic loading.

13.2 East School Addition

Explorations EB-4 and EB-5 were performed for the east school addition. The borings generally encountered 2 to 3 feet of existing fill underlain by medium dense recessional outwash soils and very dense glacially consolidated soils. Shallow groundwater was perched on top of the glacially consolidated soils at depths ranging from about 5 feet to 7.5 feet below existing grade. Foundation support for the east school addition may consist of conventional spread footings bearing on the native soils. We recommend that an allowable bearing pressure of 3,000 psf be used for design purposes, including both dead and live loads. An increase of one-third may be used for transient wind and seismic loading. Depending on the time of construction and bearing

elevation, perched groundwater seepage may be encountered within the foundation excavation; however, we anticipate that any accumulated water can be removed with sump pumps.

13.3 General Foundation Recommendations

Perimeter footings should be buried at least 18 inches into the surrounding soil for frost protection. However, all foundations must penetrate to the prescribed bearing strata, and no foundations should be constructed in or above loose, organic, or existing fill 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 foundation subgrades are undisturbed and construction conforms to the recommendations contained in this report. Foundation bearing verification will likely also be required by the local municipality. Perimeter footing drains should be provided as discussed under the "Drainage Considerations" section of this report.

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 and away from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus, footings should not be placed near the edges of steps or cuts in the bearing soils.

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 foundations extended down to competent natural soil. If foundation excavation will occur during the wet season, consideration should be given to "armoring" the exposed subgrade with a thin layer of rock to provide a working surface during foundation construction. We recommend a 6-inch layer of crushed rock for this purpose.

14.0 PASSIVE RESISTANCE AND FRICTION FACTORS

Lateral loads can be resisted by friction between the foundation and the medium dense native 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

15.0 FLOOR SUPPORT

Floor slabs can be supported on the medium dense native 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. Floor slabs 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. Floor slabs should also be protected from dampness by an impervious moisture barrier at least 10 mils thick. The moisture barrier should be placed between the capillary break material and the concrete slab.

16.0 FOUNDATION WALLS

All backfill behind foundation walls or around foundation units should be placed as per our recommendations for structural fill and as described in this section of the report. Horizontally backfilled walls, which are free to yield laterally at least 0.1 percent of their height, may be designed to resist lateral earth pressure represented by an equivalent fluid equal to 35 pcf. Fully restrained, horizontally backfilled, rigid walls that cannot yield should be designed for an equivalent fluid of 55 pcf. If parking areas are adjacent to walls, a surcharge equivalent to 2 feet of soil should be added to the wall height in determining lateral design forces.

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 5H and 10H 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.

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. Surcharges from adjacent footings or heavy construction equipment must be added to the above values. Perimeter footing drains should be provided for all foundation walls, as discussed under the “Drainage Considerations” section of this report.

17.0 DRAINAGE CONSIDERATIONS

Traffic across the on-site soils when they are damp or wet will result in disturbance of the otherwise firm stratum. Therefore, during site work and construction, the contractor should provide surface drainage and subgrade protection, as necessary.

Any retaining walls onsite and all perimeter footings and/or foundation walls should be provided with a drain at the footing elevation. Drains should consist of rigid, perforated, PVC pipe surrounded by washed gravel. The level of the perforations in the pipe should be set at the bottom of the footing, and the drains should be constructed with sufficient gradient to allow gravity discharge away from the building additions. The perforations should be located on the lower portion of the pipe. In addition, any retaining or subgrade walls should be lined with a minimum, 12-inch-thick, washed gravel blanket over the full height of the wall (excluding the first 1 foot below the surface). It is imperative that proper drainage be provided so that hydrostatic pressures do not develop against the walls. Roof and surface runoff should not discharge into the footing drain system, but should be handled by a separate, rigid, tightline drain.

To minimize erosion, stormwater discharge or concentrated runoff should not be allowed to flow down any steep excavation cuts. In planning, exterior grades adjacent to walls should be sloped downward away from the additions to achieve surface drainage. Runoff water from impervious surfaces should be collected by a storm drain system that discharges into the site stormwater system.

18.0 DRIVEWAYS AND PARKING LOTS

18.1 South Entrance Driveway

Exploration EB-11 was performed for the new south entrance driveway that connects to Wildwood Park Drive. This boring encountered medium dense to very dense glacially consolidated soils beginning at the ground surface. No groundwater was encountered within the total boring depth of 25 feet. These soils are suitable for roadway embankment support and 2H:1V permanent side slopes. The soils also contain a high percentage of silt and thus are very moisture-sensitive and will require careful planning during preparation of roadway subgrade.

18.2 East Bus Lot and Parking Area

Explorations EB-3W, EB-6, and EB-7W were performed for the east bus lot and parking area. The borings generally encountered about 4 to 7 feet of existing fill underlain by soft to medium stiff/loose to medium dense recessional lacustrine and outwash overlying dense to very dense glacially consolidated soils. Perched groundwater was encountered at about 7 to 11 feet in EB-3W

and EB-6 within the recessional deposits, and a deeper water-bearing zone was encountered at about 47 feet in EB-7W.

Based on the conceptual grading plan, it appears that the eastern portion of the embankment ranges in height from about 2 feet at the north end to 6 feet at the south end. The soils encountered in this area are suitable for embankment support and 2H:1V permanent structural fill slopes. We anticipate that a few inches of settlement of the existing subgrade fill soils will occur due to the embankment construction in this area, particularly at the south end where fill heights are greatest. Due to the variable nature of the existing fill onsite, an accurate magnitude of settlement is difficult to predict. The majority of settlement will likely occur as embankment construction takes place and may not reach completion until a few weeks after final grading. Therefore, we recommend installing at least three settlement monitoring monuments near the base of the new embankment before embankment construction begins. The monuments should be surveyed weekly during construction and after construction to confirm that subgrade settlement has stabilized before beginning new pavement construction. Pavement construction should only take place after confirming that subgrade settlement is completed to minimize any pavement cracking and/or unlevel surfaces caused by differential settlement of subgrade soils.

We further recommend that the embankment be constructed during the dry season when the water table is at its lowest. This will allow the greatest amount of potential settlement to take place. If the embankment is constructed with the water table at its highest elevation, the buoyant pressures will temporarily support some of the new load until the water table lowers, resulting in potential further settlement.

18.3 North Driveway Loop

Exploration EB-2 was performed in this area and encountered dense to very dense glacially consolidated soils. Perched groundwater was encountered at about 7.5 feet in EB-2 within the pre-Fraser-age deposits. Permanent side slopes of 2H:1V are suitable for the embankment. Similar to the south entrance driveway, the silty soils will require careful planning during preparation of roadway subgrade.

19.0 PAVEMENT RECOMMENDATIONS

We anticipate that the proposed driveways and parking lots will include both light-duty and heavy-duty pavement areas. We recommend that all new pavements be supported on a subgrade that has been compacted to a firm and non-yielding condition. All subgrades should be proof-rolled to identify any soft areas prior to placement of base course. Soft areas should be overexcavated and replaced with structural fill.

The design of a pavement is dependent on the traffic volume, type and weight of vehicles, and the soil subgrade strength. Until traffic volume data becomes available for the project, we recommend the following preliminary light-duty and heavy-duty pavement sections:

- For light-duty pavement areas, we recommend a preliminary section that consists of 3 inches of ½-inch hot-mix asphalt (HMA) over 4 inches of 1¼-inch crushed rock base (Washington State Department of Transportation [WSDOT] 9-03.9(3) Crushed Surfacing Base Course or equivalent).
- For heavy-duty asphalt pavement, we recommend a preliminary section that consists of 4 inches of HMA over 2 inches of 5/8-inch crushed rock top course (WSDOT 9-03.9(3) Crushed Surfacing Top Course or equivalent) over 4 inches of 1¼-inch crushed rock base course (WSDOT 9-03.9(3) Crushed Surfacing Base Course or equivalent).

The crushed rock top course and base course placed beneath all pavements should be compacted to a minimum of 95 percent of the maximum dry density per the ASTM D-1557 modified Proctor. Depending on construction staging and desired performance, the crushed base course material may be substituted with asphalt treated base (ATB) beneath the final asphalt surfacing if desired. The substitution of ATB should be as follows: 4 inches of crushed rock can be substituted with 3 inches of ATB, and 6 inches of crushed rock may be substituted with 4 inches of ATB. ATB should be placed over a native or structural fill subgrade compacted to a minimum of 95 percent relative density, and a 1½- to 2-inch thickness of crushed rock to act as a working surface. If ATB is used for construction access and staging areas, some rutting and disturbance of the ATB surface should be expected to result from construction traffic. The general contractor should remove affected areas and replace them with properly compacted ATB prior to final surfacing.

20.0 INFILTRATION FEASIBILITY

The results of our explorations indicate that shallow stormwater infiltration may only be feasible at certain areas of the site. The shallow soils are generally silty, and there is both shallow and deeper groundwater bearing zones limiting the unsaturated thickness. Overall, the areas of the site located to the north and northeast of the school building do not appear feasible for stormwater infiltration; however, there appears to be infiltration opportunity in the existing detention pond located south of the school entrance. Additionally, there appears to be potential for deeper infiltration at the east end of the existing soccer field.

Below is a summary of our findings for the various areas onsite that have been considered for potential infiltration during the course of our study:

- In the existing pond located south of the school building entrance (EB-10W location), the glacial till at the ground surface was thin (less than 3 feet thick) and underlain by a silty gravel deposit. Deeper groundwater was present within coarse-grained sediments at a depth of about 28 feet. Seasonal high groundwater will likely be shallower. An infiltration test (IT-1) was conducted in the existing pond at a depth of about 3.5 feet within the silty gravel deposits. Field rates were moderate – on the order of 2.5 inches per hour. EB-10W was completed as a monitoring well to document groundwater levels through the next wet season.
- An infiltration test (IT-2) was conducted in the fine-grained recessional lacustrine deposits in the northern area of the proposed east parking lot (near EB-3W). Field infiltration rates were low – on the order of 0.3 to 0.4 inches per hour. Shallow perched groundwater was present within recessional deposits at a depth of about 8.5 feet. Seasonal high groundwater will likely be shallower. Deeper infiltration beneath the east parking lot does not appear feasible because of the limited unsaturated zone beneath the glacial till and above the lower water-bearing zone. EB-3W was completed as a monitoring well to document shallow groundwater levels through the next wet season.
- The existing southeastern pond (by EB-12) appears to have been constructed in low-permeability glacial till; hence, the lack of infiltration observed within the pond. Pre-Fraser coarse-grained deposits consisting of very dense gravelly sand were encountered in EB-12 at a depth of about 15 feet, corresponding to about 8 feet below the pond bed. Groundwater was encountered at about 20 feet and is interpreted to be a result of leakage from the detention pond accumulating on stratified sediments. Infiltration in this area does not appear feasible due to the presence of glacial till at shallow depth and limited unsaturated zone beneath the glacial till and above the lower perched water-bearing zone.
- Exploration EB-2 was performed within the proposed north driveway loop area. Glacial till and hard silt were encountered, and groundwater was encountered at the base of the silt at 21 feet. There is no potential for shallow or deep infiltration in this area.
- Exploration EB-13W was performed at the northeast corner of the existing soccer fields. Shallow perched groundwater was encountered at approximately 6 feet and soils were wet to 20 feet below existing ground surface. Pre-Fraser coarse grained deposits were encountered from 21 feet below existing ground surface to the bottom of the exploration at 80 feet, with a noted decrease in silt content from approximately 45 feet to the bottom of the exploration. The regional groundwater table was not encountered within the maximum depth of our boring (80 feet). EB-13W was completed as a dry well to document groundwater levels through the next wet season. A deeper infiltration system, such as an underground injection control (UIC) well system, appears feasible in this area. We understand that deeper infiltration is not being pursued at this time.

- Exploration EB-1 was performed at the northwest corner of the school campus in an area that has been observed to have poor drainage. The purpose of this boring was to assess the subsurface drainage conditions in this area. EB-1 encountered loose silty fill to 5 feet, underlain by soft native silt to 8 feet, underlain by dense glacial till. The silt was very moist in places, but no perched groundwater was encountered. Any ground surface depressions in this area are likely to accumulate ponded water during storm events due to the high silt content of the fill and native soils.

20.1 Design Infiltration Rate Determination

The City of Puyallup has adopted the 2014 Ecology Manual as their stormwater management manual. The 2014 Ecology Manual allows the use of the small-scale PIT method as a basis for infiltration rate determination. The field infiltration rates obtained from IT-1 and IT-2 are considered to be uncorrected and, therefore, non-conservative for design purposes. As such, the Ecology Manual requires that a series of partial correction factors be applied to these short-term values. The design infiltration rate was derived using the correction factors for site variability (CF_v), testing (CF_t), and maintenance (CF_m), per the following formulas:

$$\text{Total Correction Factor} = CF_T = CF_v \times CF_t \times CF_m$$

and

$$K_{sat} \text{ design} = K_{sat} \text{ initial} \times CF$$

where $K_{sat} \text{ design}$ and $K_{sat} \text{ initial}$ are the design and measured infiltration rates, respectively.

The specific factors derived for individual test results are summarized in Table 4. The corrected infiltration rates shown in the last column of Table 4 represent the maximum allowable long-term design rate after the total correction factor (CF_T) has been applied.

Table 4
Summary of Infiltration Rates and Correction Factors

Data Source	Uncorrected Infiltration Rate	Correction Factors				Corrected Infiltration Rate
	(in/hr)	CF _v	CF _t	CF _m	CF _T	(in/hr)
IT-1	4.1	0.7 ¹	0.5 ³	0.9 ⁴	0.315	1.3
IT-2	0.3	0.8 ²	0.5 ³	0.9 ⁴	0.36	0.1

in/hr = inches per hour

CF_v = correction factors for site variability

CF_t = correction factors for testing

CF_m = correction factors for maintenance

CF_T = total correction factor

1. This value reflects the variable conditions within the pre-Fraser coarse-grained deposits.

2. This value reflects the variable conditions within the Vashon Recessional Lacustrine Deposits.

3. This value reflects the prescribed correction factor of 0.5 for a small-scale Pilot Infiltration Test.

4. This value is suggested by the Ecology 2014 *Stormwater Management Manual for Western Washington*.

20.2 Infiltration Conclusions and Recommendations

Our explorations and testing indicate that, from a geotechnical and hydrogeologic standpoint, the subject site is suitable for stormwater infiltration in the existing pond located south of the school building entrance. Specifically, the infiltration pond is feasible if the base of the pond is situated in the pre-Fraser coarse-grained deposits consisting of silty gravel (approximately 3 feet below the existing pond bottom elevation). The infiltration pond bottom must extend through the near-surface fine-grained Vashon lodgement till so that the base of the infiltration pond is in full contact with the pre-Fraser coarse-grained deposits. We recommend that the infiltration pond design be consistent with the Ecology Manual and be based on a design rate of 1.3 inches per hour. Additional infiltration testing could be conducted to reduce the site variability correction factor and potentially increase the design infiltration rate.

It is our opinion that stormwater infiltration is not recommended at the proposed northeast bus loop area (northwest corner of the existing soccer fields) due to the low infiltration rate obtained at IT-2 in the recessional lacustrine deposits and the likelihood of higher seasonal groundwater.

There is potential for deeper infiltration in the vicinity of EB-13W located at the northeast corner of the existing soccer fields. Deep infiltration in this area could be accomplished by installing a UIC system within the sandy unsaturated zone of the pre-Fraser coarse-grained deposits (approximately 45 to 80 feet below the existing ground surface). We understand that this option is not currently being evaluated by the design team. If a UIC system is chosen for this area, additional well testing will be required to assess the design infiltration for the system. Seasonal groundwater data would need to be collected and evaluated to determine the deeper groundwater flow direction and maximum depth of the UIC system. Additional hydrogeologic studies would be required to evaluate potential groundwater quality impacts.

The design infiltration rate requires that a representative of AESI observe the subgrade, is present during the excavation and backfilling of the pit drain trenches, and completes performance verification testing at the time of construction. In addition, the infiltration system must remain off-line during construction to avoid siltation. Stormwater runoff must not be routed to the infiltration facility until the site is stabilized and runoff is clear.

The recommended design infiltration rate assumes that permeable deposits similar to sediments tested in IT-1 will be encountered in the facility base and within pit drain trenches.

We understand that the proposed facility layouts may be updated as design plans progress. We recommend that AESI review any updated plans as they become available.

20.3 Seasonal High Groundwater Level

Water level monitoring is ongoing within the monitoring wells and will continue through the next wet season. The monitoring program is intended to document that there is adequate vertical separation from the base of the proposed stormwater infiltration system and perched groundwater. Groundwater beneath the proposed infiltration pond was encountered in monitoring well EB-10W at a depth of approximately 28 feet, or elevation 482 feet above mean sea level in the pre-Fraser coarse-grained deposits. The groundwater in EB-10W will limit infiltration and is interpreted to represent perched water within the pre-Fraser deposits. The regional groundwater table is interpreted to be lower in elevation, and was not encountered onsite as documented by EB-13W (dry to 80 feet).

20.4 Stripping and Subgrade Overexcavation

We have the following comments and recommendations:

1. The base of the infiltration facility should be situated a minimum of 1 foot into the native outwash sediments. AESI should confirm the required minimum embedment into outwash sediments at the time of construction. We recommend that the infiltration pond base be stripped of topsoil and excavated through the fine-grained Vashon lodgement till so that the base of the pond is in full contact with the underlying pre-Fraser coarse-grained deposits. If thicker deposits of fine-grained sediments are encountered at the base of the infiltration pond, they should be overexcavated to expose the underlying silty gravel deposits. Subgrade preparations should be observed by AESI. Any overexcavation can be backfilled with washed free-draining aggregate up to the design pond base elevation.

Stripping and overexcavation should be performed in a manner that does not disturb the underlying receptor horizon. Use of heavy equipment in the areas proposed for infiltration has the potential to compact the subgrade and reduce infiltration potential.

As such, we recommend using an excavator with a toothed bucket to strip and scarify the subgrade without tracking over it. An excavator should also be used to initially place the aggregate material over the stripped subgrade to reduce the potential for disturbance. Construction activity on the surface that results in compaction of the native soil or tracking a layer of fine-grained sediments at the subgrade surface will have a detrimental effect on the infiltration rate.

2. Pit drains (short infiltration trenches) should be completed in the base of the infiltration facility, if there is sufficient vertical separation from groundwater. The depth of the pit drains should be reviewed once facility designs are available. Pit drain dimensions would likely be on the order of 3-feet wide times the length of the facility. As plans are developed, alternative pit drain configurations can be considered.
3. Past experience excavating in glacially-consolidated pre-Fraser deposits suggests that it is possible to excavate a pit drain with only minor caving, however careful consideration should be paid to sequencing, excavation techniques, staging of backfill materials, and backfill installation methods.
4. Specialized subgrade aggregate backfill is used to maintain effective drainage into the pit drains, and is described in Section 20.5 “Pit Drain Backfill and Infiltration Testing.”

Due to natural variability of the subsurface conditions, the potential for field adjustments should be anticipated based on actual conditions encountered during construction. Depending on the season the infiltration facility is constructed, perched water should be anticipated. The contractor should be prepared to handle the perched water. The pit drains should be backfilled with washed gravel meeting the specifications of Table 5. The washed gravel backfill will need to be protected from siltation and sand by proper TESC practices and management of the imported materials stockpile.

Embedding the pit drains into the infiltration receptor horizons acts to improve infiltration performance by penetrating low-permeability interbeds and preventing “micro-mounding” beneath an infiltration facility, and can result in a high degree of connectivity with more-permeable receptor horizons. This allows for high-rate horizontal flow to occur as early in the storm event as possible and results in improved facility performance. In addition, the deeper pit drains can provide an effective transfer of hydraulic head into the subsurface. This allows the head to drive water away from the facility as efficiently as possible into the subsurface. Deeper pit drains allow for exposure to a large cross-sectional area of the most-permeable intervals present in the receptor interval, and provide hydraulic head to optimize flow rates into the formation. AESI has worked on similar projects with deepened pit drain sections to improve the flow characteristics of the receptor soils beneath bioretention systems, infiltration ponds, and infiltration vaults. It is AESI’s experience that properly constructed deepened pit drains can provide a significant improvement in infiltration system performance.

20.5 Pit Drain Backfill and Infiltration Testing

Pit Drain Backfill

The recommended pit drain configuration consists of a trench filled with pea gravel in the pre-Fraser coarse-grained deposits and a graded media filter to protect the gravel backfill. In general, we provide the following general pit drain configuration recommendations:

- **Pit Drain:** Pit drains should be completed from the bottom of the infiltration facility using a track-mounted excavator. Past experience excavating in glacially-consolidated deposits suggests that it is possible to excavate a trench of these dimensions with only minor caving, however careful consideration should be paid to sequencing, excavation techniques, staging of backfill materials, and backfill installation methods.
- **Piezometers:** Within selected individual pit drains, we recommend installing piezometers. The piezometers shall consist of 2-inch Schedule 80 PVC, the bottom 10 feet of which shall be factory-slotted well screen, with end caps. Two piezometers shall be accessible from the ground surface upon completion of construction for long-term system performance monitoring.
- **Gravel Backfill:** The pit drain trench will be backfilled with washed gravel, per the following specifications (Table 5). The gravel backfill must be installed into the trench in such a way as to prevent scouring of the excavation sidewalls. Should caving occur during backfilling, the caved sidewall materials and all contaminated gravel shall be removed prior to continuing backfilling. The gravel backfill shall extend to the top of the trench, and form a minimum 1-foot blanket across the facility bottom.

Table 5
Gravel Backfill for Pit Drain

U.S. Sieve Number	Percent Passing
1/2"	100
3/8"	80-100
#4	5-15
#8	0-10
#100	0-0.5
#200 (wet sieve)	0-0.5

- **Sand Filter Layers:** Two successive layers of sand filter media shall be placed over the top of the gravel backfill. The sand filter layers should consist of a minimum 12-inch layer of 4x8 coarse sand overlying the gravel backfill, and a minimum 12-inch layer of filter sand overlying the 4x8 sand. Inclusion of the sand filter layers will provide additional filtration

of suspended particles that may remain in the stormwater. Specifications for the 4x8 sand and filter sand are presented in Table 6 and Table 7.

Table 6
4 x 8 Sand Specification

U.S. Sieve Number	Percent Passing
3/8"	100
#4	90-100
#8	0-10
#10	0-5
#100	0-0.5
#200 (wet sieve)	0-0.5

Table 7
Filter Sand Specification

U.S. Sieve Number	Percent Passing
4	95-100
8	70-100
16	40-90
30	25-75
50	2-25
100	<2
200	<1

Care must be taken to ensure the gravel backfill and sand products are clean and free of fines. Stockpiled backfill materials must be protected from site soils and run-on from silt-contaminated surfaces. Contaminated backfill materials cannot be used in the pit drain and will be rejected by AESI.

Pit Drain Infiltration Testing

Following the completion of pit drain construction, we recommend that the drains be flow-tested by a representative of AESI to establish a baseline level of performance. During the inflow phase of testing, water will be introduced onto the surface of the backfill media. An electronic pressure transducer placed inside a piezometer will be used to measure water levels.

Water supply is the responsibility of the contractor. Typically, fire hydrant(s) will be used to provide a continuous supply of water during the inflow portion of the test. The flow rate, total volume, and stage height/water level will be recorded at regular intervals (usually 15 minutes). The duration of the constant-rate testing should be sufficient to confirm pseudo-stabilization of water level in the drain, and will likely be on the order of 7 hours. Following completion of the

inflow phase, the falling-head water levels will be measured. We anticipate the testing will require high flow rates, which may entail the use of more than one fire hydrant.

20.6 Protection of Infiltration Facility During Construction

Once the facility is excavated and constructed, the contractor must provide temporary protection of the facility subgrade to keep the subgrade free of water and fine-grained sediments. Uncontrolled runoff into the infiltration facility constitutes failure of the subgrade, requiring removal of all backfill materials and contaminated subgrade, and replacement with clean backfill materials.

The infiltration facility must be kept isolated from influent flows until after the site has been stabilized, so that only clean water is introduced into the infiltration facility.

Prior to bringing the infiltration facility on-line, the following elements must be achieved:

1. All planned earthwork must be complete.
2. Site stabilization must be complete:
 - a. All permanent groundcover in place.
 - b. No exposed topsoil.
 - c. Hydroseeded areas must have established growth sufficient to fix topsoil in place.
 - d. No visible sediment transport by stormwater during rain events.
 - e. Catch-basin filter socks should no longer be needed and shall be removed.
3. Hard surfaces such as paving and sidewalks must be cleaned with no visible sediment or substances that could be transported by stormwater.
4. All stormwater collection system components must be cleaned and inspected:
 - a. All catch basins, manholes, and similar structures shall be cleaned by rinsing and vacuuming to remove visible sediment. No water used in the cleaning of the upstream system shall be discharged into the infiltration facility.
 - b. All stormwater pipes shall be jetted to remove visible sediment.

- c. After cleaning, a video survey shall be completed of all pipes and structures in the stormwater collection system. The owner shall be notified prior to the video survey work so they may observe the work in progress if desired. A recording of the video survey shall be provided to the owner, civil engineer, and AESI. The survey shall include sufficient detail to correlate video images with on-site locations.
5. AESI shall be notified that construction is complete, and shall be allowed to install long-term monitoring components such as water level loggers before water is routed to the infiltration facility.
6. The owner, civil engineer, and AESI must be notified that the above items have been completed, and must concur that the above items have been satisfactorily completed.
7. Written authorization must be provided from the owner, civil engineer, and AESI to the contractor that water may be routed to the infiltration facility for disposal.
8. Following the first substantial rain event after the infiltration facility is brought on-line, the system shall be visually inspected. The contractor shall contact the owner, civil engineer, and AESI to attend the inspection, and shall open facility enclosures, catch basins, manholes, and other structures as needed to allow visual inspection.

20.7 Recommendations for Future Infiltration-Related Study

We recommend a review of infiltration design details prior to final plans and if any adjustments are needed we will recommend them at that time. Once infiltration designs are available, we recommend that we review the locations and quantity of proposed stormwater infiltration relative to the project proposal and surrounding properties. Final design of an infiltration system may warrant additional on-site testing depending on the location(s) and design of infiltration facilities, groundwater mounding, or additional studies.

21.0 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 recommendations have been correctly interpreted and implemented in the design. The City may require a plan review by the geotechnical engineer as a condition of permitting.

The City may also require geotechnical special inspections during construction and preparation of a final summary letter when construction is complete. We are available to provide geotechnical engineering services during construction. The integrity of the earthwork, foundations, and stormwater infiltration pond depends on proper site preparation and

construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent.

We have enjoyed working with you on this study and are confident 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

DRAFT

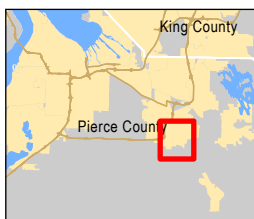
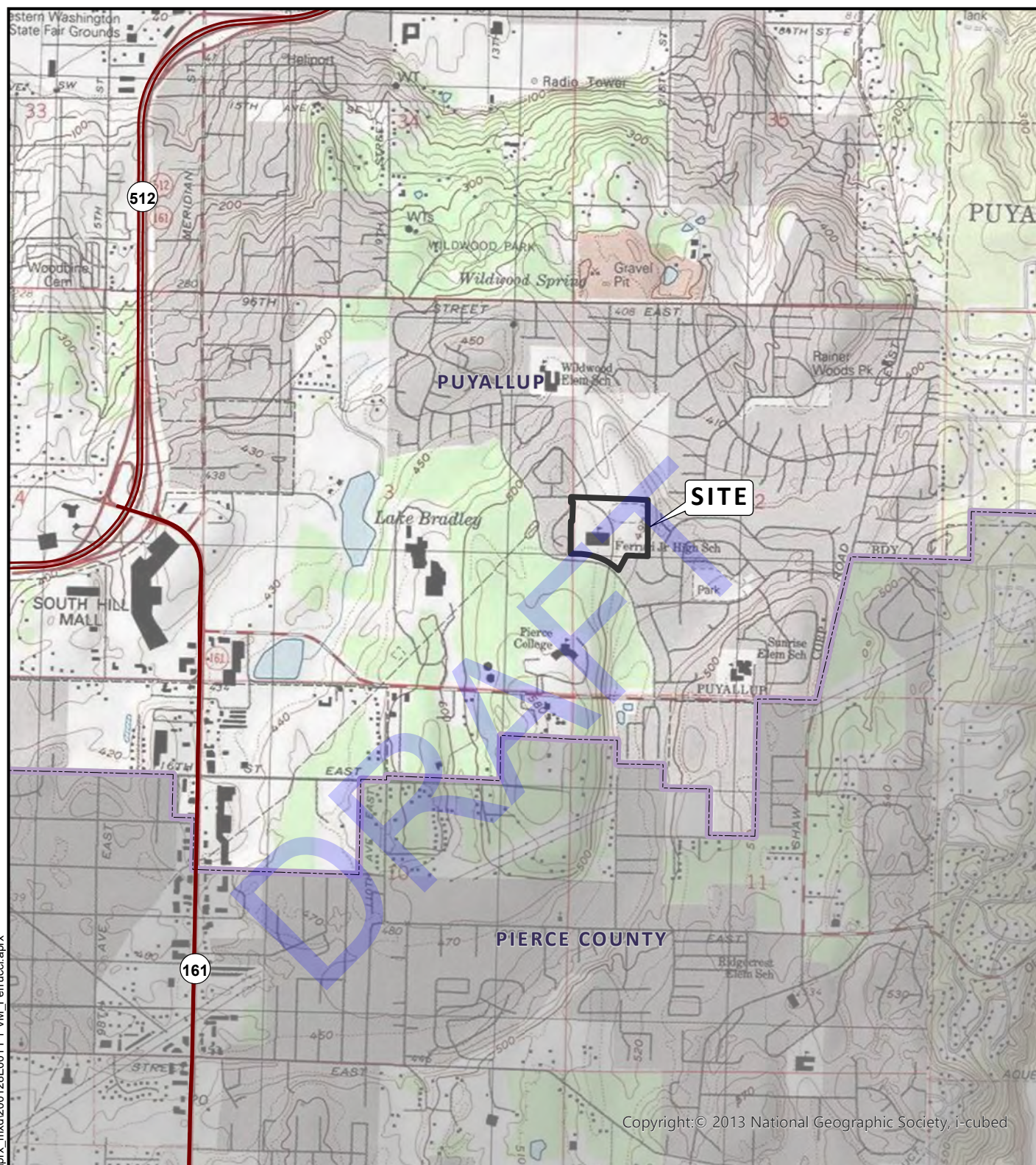
Angela L. Gelfer, G.I.T.
Staff Geologist

DRAFT

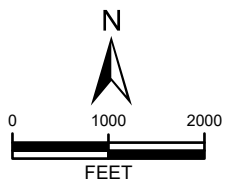
G. Bradford Drew, P.E.
Senior Engineer

DRAFT

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



DATA SOURCES / REFERENCES:
USGS: 7.5' SERIES TOPOGRAPHIC MAPS, ESRI/I-CUBED/NGS 2013
PIERCE CO: STREETS, CITY LIMITS, PARCELS 3/19
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



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



VICINITY MAP

FERRUCCI JUNIOR HIGH ADDITION
PUYALLUP, WASHINGTON

PROJ NO.
20200128E001

DATE: 6/20

FIGURE: 1

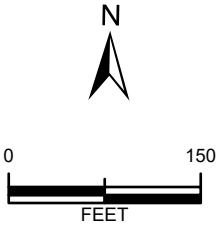
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- SITE
- EXPLORATION BORING - 2005
- EXPLORATION BORING - 2006
- EXPLORATION BORING - 2020
- EXPLORATION PIT- 2020
- INFILTRATION TEST - 2020
- MONITORING WELL - 2020
- PROPOSED INFILTRATION POND
- PARCEL
- CONTOUR 10 FT
- CONTOUR 2 FT

DATA SOURCES / REFERENCES:
PIERCE COUNTY 2010/2011, GRID CELL SIZE IS 3'.
WA STATE PLANE SOUTH COORDINATE SYSTEM.
NAD83(1991 HARN). VERTICAL NAVD88 GEOID09.
US SURVEY FEET. CONTOURS FROM LIDAR
PIERCE CO: STREETS, PARCELS 3/19
AERIAL: BING IMAGERY 2018

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



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



associated
earth sciences
incorporated

EXISTING SITE AND EXPLORATION PLAN

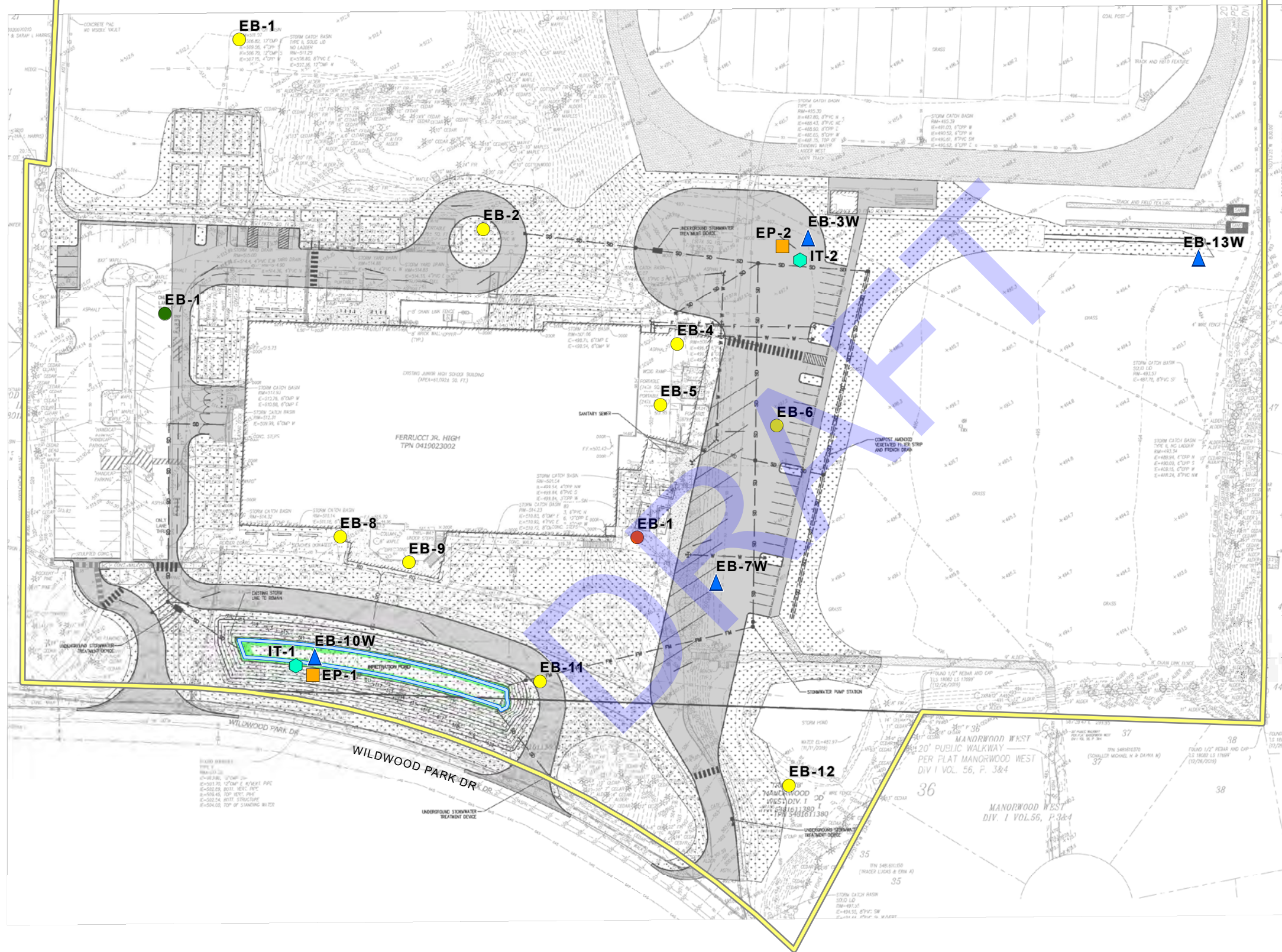
FERRUCCI JUNIOR HIGH ADDITION
PUYALLUP, WASHINGTON

PROJ NO.
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DATE:
6/20

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2

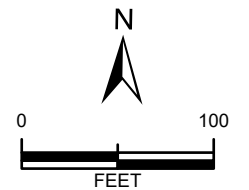
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- SITE
- EXPLORATION BORING - 2005
- EXPLORATION BORING - 2006
- EXPLORATION BORING - 2020
- EXPLORATION PIT- 2020
- INFILTRATION TEST - 2020
- MONITORING WELL - 2020
- PROPOSED INFILTRATION POND

DATA SOURCES / REFERENCES:
SITTS & HILL ENGINEERS INC., FERRUCCI JUNIOR HIGH ADDITION,
CIVIL SITE PLAN, 5/22/20
PIERCE CO: STREETS, PARCELS 3/19

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



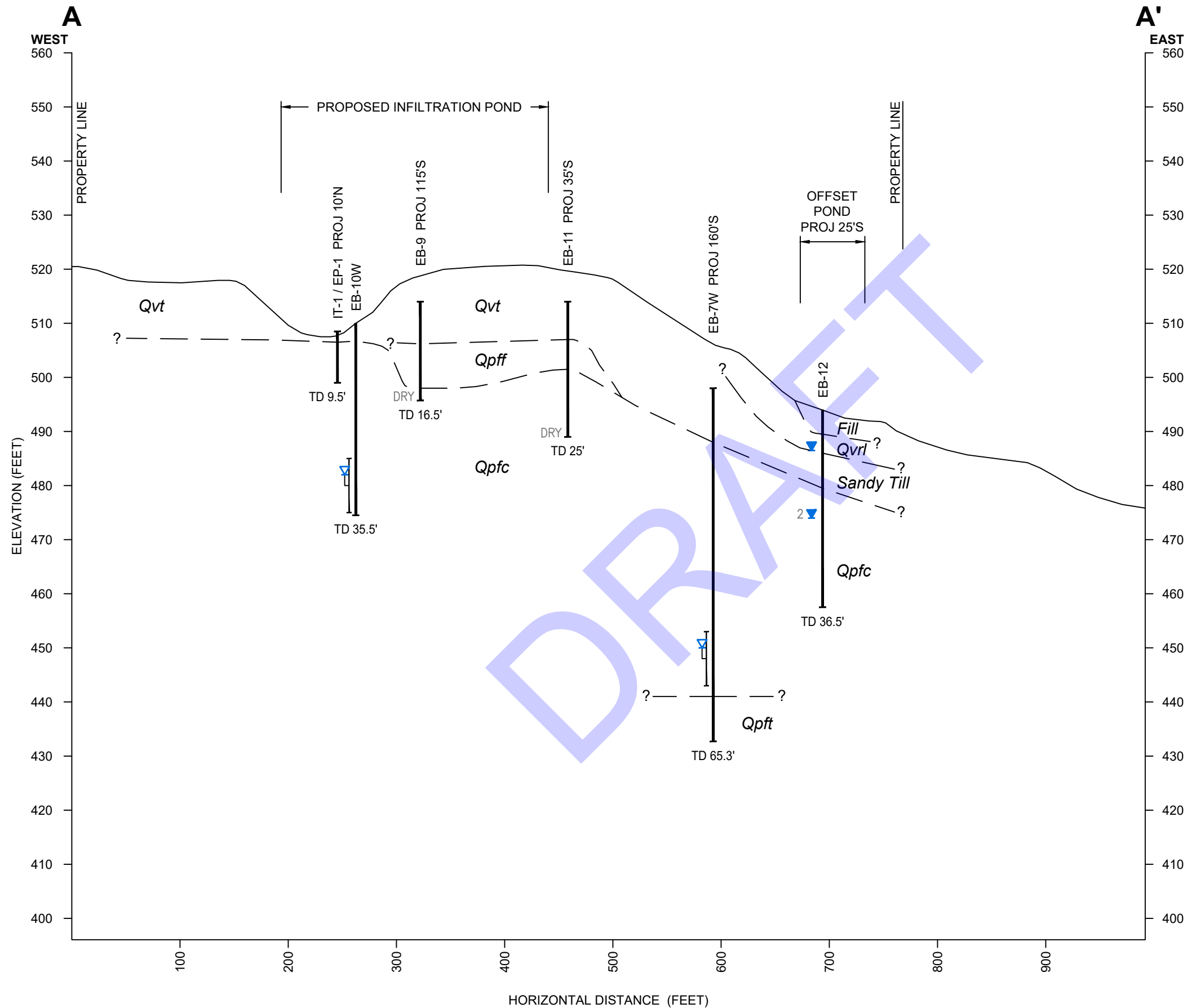
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PROPOSED SITE AND EXPLORATION PLAN

FERRUCCI JUNIOR HIGH ADDITION
PUYALLUP, WASHINGTON

PROJ NO. 20200128E001	DATE: 6/20	FIGURE: 3
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LEGEND:

Fill	FILL
Qvrl	VASHON RECESSONAL LACUSTRINE
Qvt	VASHON LODGEMENT TILL
Qpff	PRE-FRASER FINE-GRAINED DEPOSITS
Qpfc	PRE-FRASER COARSE-GRAINED DEPOSITS
Qpft	PRE-FRASER TILL
	EXPLORATION
	WATER LEVEL AT TIME OF DRILLING
	STATIC WATER LEVEL
	SCREENED INTERVAL
	TOTAL DEPTH OF BORING
	GEOLOGIC CONTACT

VERTICAL EXAGGERATION = 5X

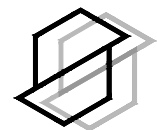
NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE

NOTES:

1. THE SUBSURFACE CONDITIONS PRESENTED IN THIS GEOLOGIC CROSS-SECTION ARE BASED ON AN INTERPRETATION OF CONDITIONS ENCOUNTERED IN WIDELY SPACED EXPLORATIONS COMPLETED AT THE SUBJECT SITE AND RELEVANT SITE INFORMATION DEVELOPED AND PROVIDED BY OTHERS. THE SUBSURFACE INTERPRETATIONS PRESENTED IN THIS GEOLOGIC CROSS-SECTION SHOULD NOT BE CONSTRUED AS A WARRANTY OF ACTUAL SUBSURFACE CONDITIONS AT THE SITE. OUR EXPERIENCE HAS SHOWN THAT SOIL AND GROUNDWATER CONDITIONS CAN VARY SIGNIFICANTLY OVER SMALL DISTANCES.

2. EB-12 ATD WATER LEVEL IS INTERPRETED TO BE ELEVATED BY DETENTION POND LEAKAGE THROUGH UNDERLYING SANDY TILL DEPOSITS.

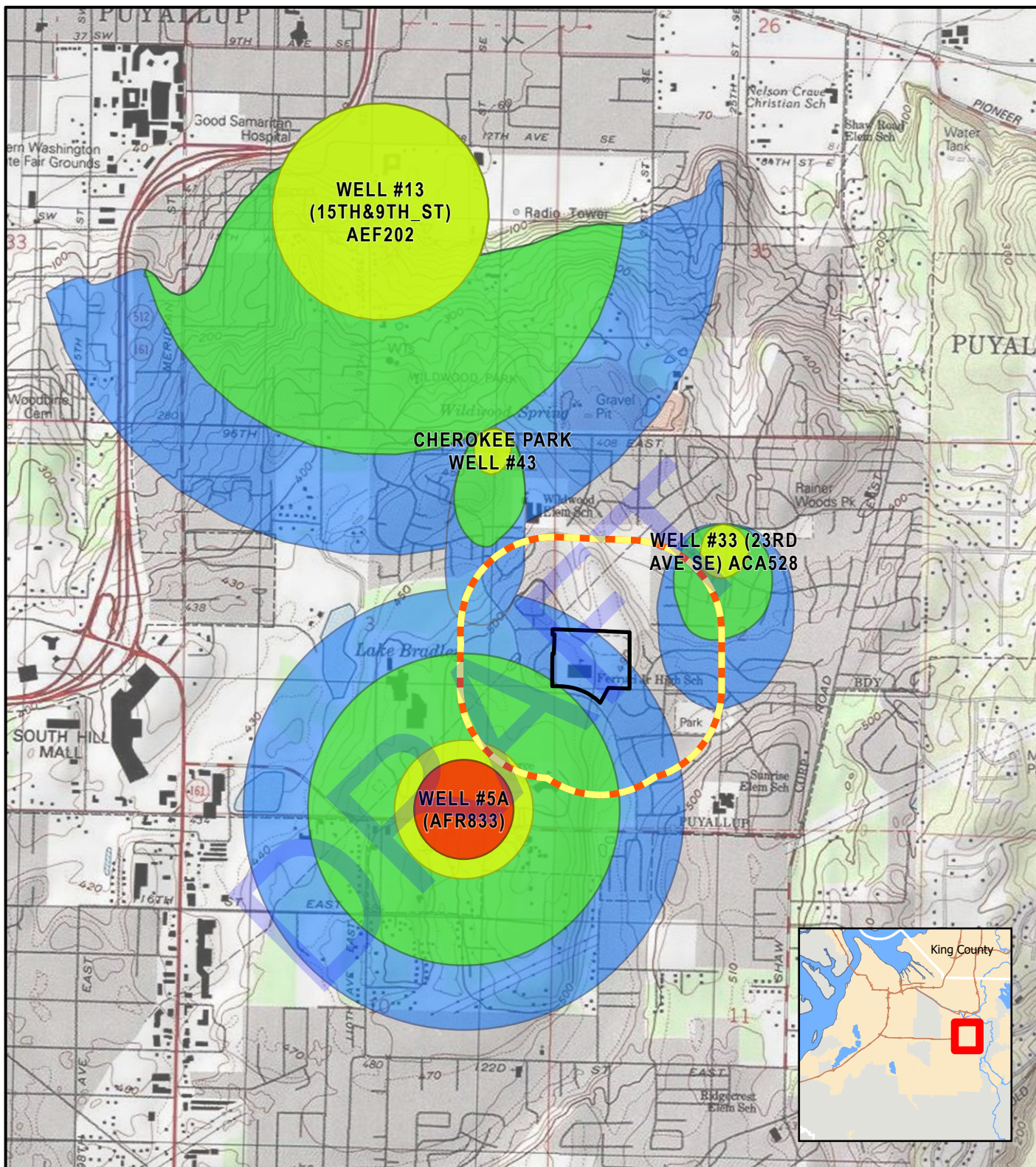
BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION



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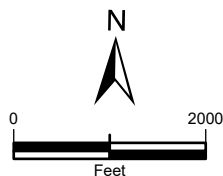
SCHEMATIC HYDROGEOLOGIC
CROSS-SECTION A - A'
FERRUCCI JUNIOR HIGH ADDITION
PUYALLUP, WASHINGTON

PROJ NO.	DATE:	FIGURE:
20200128E001	7/20	4



- SITE
- SITE BUFFER 1300'
- 6 MONTH TIME OF TRAVEL
- 1 YEAR TIME OF TRAVEL
- 5 YEAR TIME OF TRAVEL
- 10 YEAR TIME OF TRAVEL

DATA SOURCES / REFERENCES:
 DOH: SOURCE WATER ASSESSMENT PROGRAM 12/19
 USGS TOPO: COPYRIGHT: 2013 NATIONAL GEOGRAPHIC
 SOCIETY, I-CUBED
 LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE



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



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WELLHEAD PROTECTION ZONES

FERRUCCI JUNIOR HIGH ADDITION
 PUYALLUP, WASHINGTON

PROJ NO.
 20200128E001

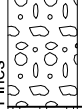
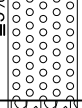
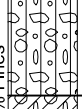
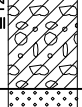
DATE:
 6/20

FIGURE:
 5

APPENDIX A

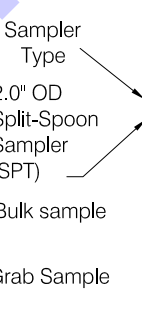
Exploration Boring/Well Logs

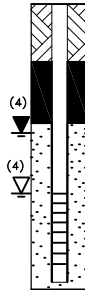
DRAFT

Coarse-Grained Soils - More than 50% ⁽¹⁾ Retained on No. 200 Sieve				Terms Describing Relative Density and Consistency			
Gravels - More than 50% ⁽¹⁾ of Coarse Fraction Retained on No. 4 Sieve		GW	Well-graded gravel and gravel with sand, little to no fines	Coarse-Grained Soils	Density	SPT ⁽²⁾ blows/foot	Test Symbols G = Grain Size M = Moisture Content A = Atterberg Limits C = Chemical DD = Dry Density K = Permeability
		GP	Poorly-graded gravel and gravel with sand, little to no fines		Very Loose	0 to 4	
		GM	Silty gravel and silty gravel with sand		Loose	4 to 10	
		GC	Clayey gravel and clayey gravel with sand		Medium Dense	10 to 30	
Sands - 50% ⁽¹⁾ or More of Coarse Fraction Passes No. 4 Sieve		SW	Well-graded sand and sand with gravel, little to no fines	Fine-Grained Soils	Consistency	SPT ⁽²⁾ blows/foot	
		SP	Poorly-graded sand and sand with gravel, little to no fines		Very Soft	0 to 2	
		SM	Silty sand and silty sand with gravel		Soft	2 to 4	
		SC	Clayey sand and clayey sand with gravel		Medium Stiff	4 to 8	
Silt 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				
		Silt and Clays Liquid Limit 50 or More					
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						
PT	Peat, muck and other highly organic soils						

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		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
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	

Symbols	
	Blows/6" or portion of 6" Sampler Type 2.0" OD Split-Spoon Sampler (SPT) Bulk sample Grab Sample Portion not recovered 3.0" OD Split-Spoon Sampler 3.25" OD Split-Spoon Ring Sampler 3.0" OD Thin-Wall Tube Sampler (including Shelby tube)
(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 LOG KEY

FIGURE A1



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Exploration Boring

Project Number
20200128E001

Exploration Number
EB-1

Sheet
1 of 1

Project Name Ferrucci Junior High Ground Surface Elevation (ft) ~512
Location Puyallup, WA Datum NAVD 88
Driller/Equipment Holocene Drilling / HSA w/ D-50 Track Drill Date Start/Finish 4/23/20, 4/23/20
Hammer Weight/Drop 140# / 30" Hole Diameter (in) 8

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/Foot				Other Tests
							10	20	30	40	
				Topsoil - 6 inches Moist, brown, silty, SAND, some organics, trace gravel; nonstratified (SM). Fill							
5		S-1		Moist, brownish orange grading downward to brown with iron oxide above 3.25 feet, very silty, fine to medium SAND to fine sandy, SILT, trace gravel, trace organics; nonstratified (SM/ML).		5 4 4	▲9				
		S-2		Vashon Recessional Lacustrine Moist, light greenish gray with iron oxide mottling, SILT, some sand, trace gravel; nonstratified (ML).		3 2 3	▲5				
		S-3		As above; very moist in places (ML).		3 5 15		▲20			
10		S-4		Vashon Lodgement Till Moist, light brownish olive with iron oxide, silty, fine SAND, some gravel; diamict fabric (SM). Driller notes gravelly drilling beginning at 9 feet. Moist, light brownish orange grading downward to light olive green with iron oxide above ~10.75 feet, SILT, trace sand, trace rounded gravel; massive to crudely bedded; gravel contents diminish downward (SM).		15 18 26					▲44
15		S-5		Pre-Fraser Coarse-Grained Deposits Moist, greenish gray, fine to coarse GRAVEL, some sand, some silt; massive (GW-GM). Bottom of exploration boring at 16.5 feet No groundwater encountered.		15 26 41					▲67
20											
25											

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture



3" OD Split Spoon Sampler (D & M)



Ring Sample

Water Level ()



Grab Sample



Shelby Tube Sample



Water Level at time of drilling (ATD)

Logged by: FSM

Approved by: JHS



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Exploration Boring

Project Number
20200128E001

Exploration Number
EB-2

Sheet
1 of 1

Project Name **Ferrucci Junior High**

Location **Puyallup, WA**

Driller/Equipment **Holocene Drilling / HSA w/ D-50 Track Drill**

Hammer Weight/Drop **140# / 30"**

Ground Surface Elevation (ft) **~515**

Datum **NAVD 88**

Date Start/Finish **4/22/20, 4/22/20**

Hole Diameter (in) **8**

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/Foot				Other Tests
							10	20	30	40	
		S-1		Topsoil - 9 inches Moist, brown, silty, SAND, some gravel; nonstratified (SM). Vashon Lodgement Till							
5		S-2		Moist, greenish olive with iron oxide, silty, fine to medium SAND, some fine to coarse gravel, trace coarse sand; nonstratified; diamict fabric (SM).		3 14 28			▲34		
		S-3		Recovered slough except for shoe of sampler, pounded coarse rock. Drill cuttings look generally to be as above (SM).		14 32 41					▲73
		S-4		Pre-Fraser Fine-Grained Deposits Very moist to wet, gray, SILT, trace fine sand; massive to faintly laminated (ML).	▼	9 10 15			▲25		
10		S-5		Becomes moist.		11 15 20			▲35		
15		S-6		Moist, gray, SILT to clayey, SILT, trace fine to coarse sand, trace coarse rounded gravel; mostly massive with occasional parting planes (CL-ML). Driller notes rocky/sandy drill action beginning at ~17 feet.		10 19 27					▲46
20		S-7		Moist to wet (perched) below ~21 feet, brownish olive, gravelly above 20.5 feet, fine to medium SAND, trace silt; stratified (SP). Shoe contains moist, brownish olive, SILT, trace fine to coarse sand; nonstratified (ML) at 21 feet.	▼	11 16 26					▲42
		S-8		Pre-Fraser Coarse-Grained Deposits (?) Very rocky drill action. Refusal drilling at ~24 feet. Sample SPT. Recovered rock chips (GM?).		50/5"					▲50/5"
25				Bottom of exploration boring at 24.5 feet Perched groundwater encountered at ~7.5 and 21 feet.							

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture



3" OD Split Spoon Sampler (D & M)



Ring Sample

▼ Water Level ()



Grab Sample



Shelby Tube Sample



Water Level at time of drilling (ATD)

Logged by: FSM

Approved by: JHS



Geologic & Monitoring Well Construction Log

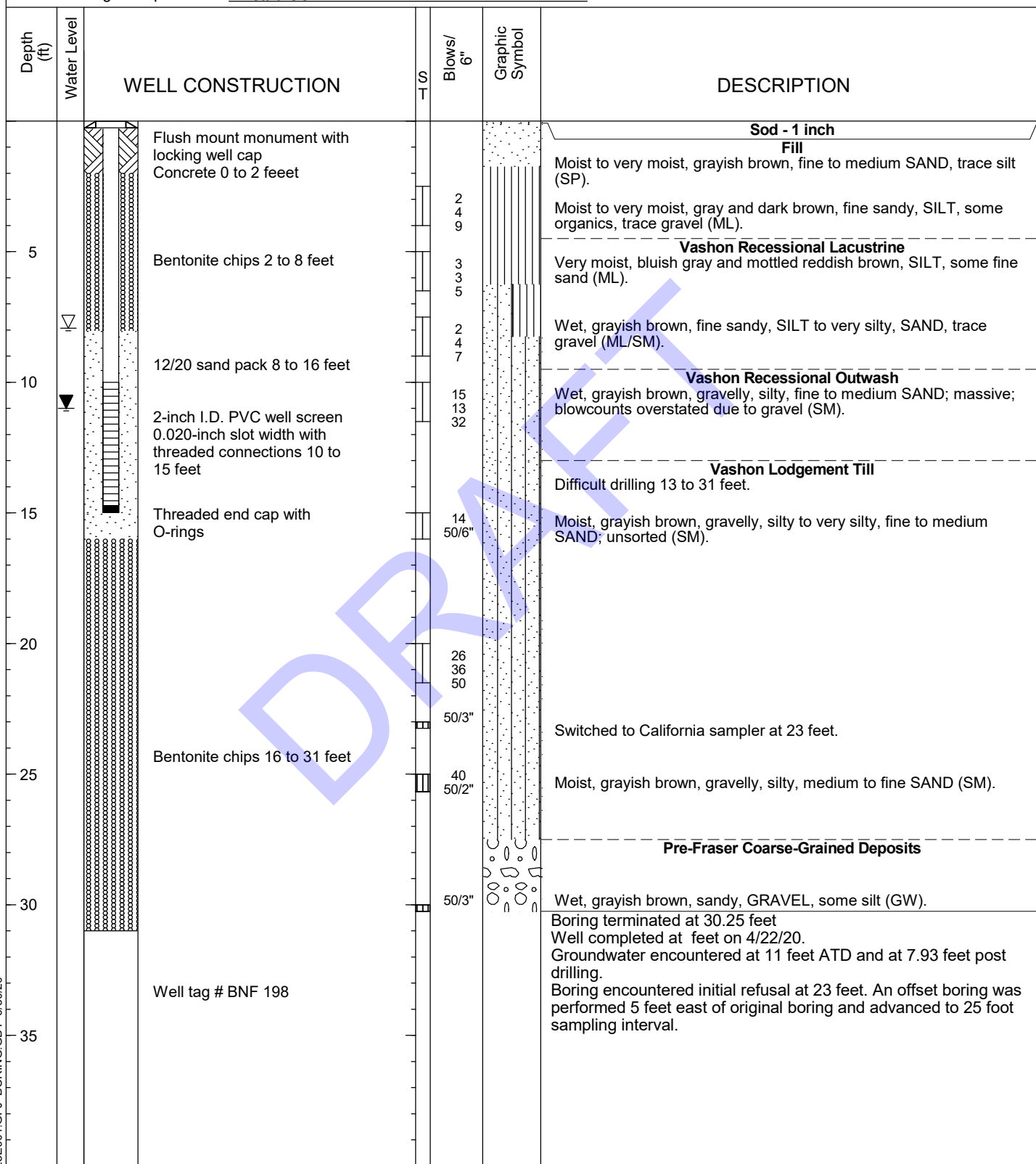
Project Number
20200128E001

Well Number
EB-3W

Sheet
1 of 1

Project Name **Ferrucci Junior High**
Elevation (Top of Well Casing) _____
Water Level Elevation _____
Drilling/Equipment **Holocene Drilling / HSA w/ D-50 Track Drill**
Hammer Weight/Drop **140# / 30"**

Location **Puyallup, WA**
Surface Elevation (ft) **~497**
Date Start/Finish **4/22/20, 4/22/20**
Hole Diameter (in) **8**



Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture

Logged by: BD



3" OD Split Spoon Sampler (D & M)



Ring Sample

Water Level (4/27/20)

Approved by: JHS



Grab Sample



Shelby Tube Sample

Water Level at time of drilling (ATD)



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Exploration Boring

Project Number
20200128E001

Exploration Number
EB-4

Sheet
1 of 1

Project Name **Ferrucci Junior High**

Location **Puyallup, WA**

Driller/Equipment **Holocene Drilling / HSA w/ D-50 Track Drill**

Hammer Weight/Drop **140# / 30"**

Ground Surface Elevation (ft) **~501**

Datum **NAVD 88**

Date Start/Finish **4/21/20, 4/21/20**

Hole Diameter (in) **8**

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot				Other Tests
								10	20	30	40	
				Fill Moist, brownish gray, silty, medium to fine SAND, some gravel, trace rootlets (SM). Hydrocarbon odor 0 to 3 feet.								
5		S-1		Vashon Recessional Outwash Becomes very moist, gray and brown, very silty, fine to medium SAND, trace gravel (SM).		10 10 14			▲24			
		S-2				5 7 9			▲16			
		S-3		Sampler wet. Wet, brown and gray, fine to medium SAND, some silt, trace gravel (SP).		5 12 23				▲35		
10		S-4		Vashon Lodgement Till Moist, grayish brown, silty, fine SAND, trace gravel; unsorted (SM).		23 50/6"						▲50/6"
15		S-5		Slightly moist, gray, silty, fine SAND, trace gravel; unsorted (SM).		37 50/4"						▲50/4"
				Pre-Fraser Coarse-Grained Deposits								
20		S-6		Moist to very moist, brown and gray, fine to coarse SAND, some silt, some gravel (SW-SM).		22 38 50/6"						▲50/6"
25		S-7		Becomes very moist.		17 41 50						▲91
				Bottom of exploration boring at 26.5 feet Perched groundwater encountered at 7.5 feet.								

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



3" OD Split Spoon Sampler (D & M)



Grab Sample



No Recovery



Ring Sample



Shelby Tube Sample

M - Moisture

▼ Water Level ()

▼ Water Level at time of drilling (ATD)

Logged by: BD

Approved by: JHS



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Exploration Boring

Project Number
20200128E001

Exploration Number
EB-5

Sheet
1 of 1

Project Name **Ferrucci Junior High**

Location **Puyallup, WA**

Driller/Equipment **Holocene Drilling / HSA w/ D-50 Track Drill**

Hammer Weight/Drop **140# / 30"**

Ground Surface Elevation (ft) **~502**

Datum **NAVD 88**

Date Start/Finish **4/21/20, 4/21/20**

Hole Diameter (in) **8**

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot				Other Tests
								10	20	30	40	
				Asphalt - 3 inches								
				Fill								
				Moist to very moist, grayish brown, very silty, fine to medium SAND, trace gravel (SM).								
				Vashon Recessional Outwash								
				Very moist to wet, brown, silty, fine to medium SAND, trace gravel (SM).								
5		S-1				8			▲15			
						8						
						7						
		S-2		Sampler wet (perched water). Moist, brown, silty, fine SAND, some gravel (SM).		7						▲75
				Vashon Lodgement Till		25						
						50						
		S-3		Very moist, brown, fine sandy, SILT, trace gravel; unsorted (ML).		50/6"						▲50/6"
10												
		S-4		Slightly moist, gray, silty, fine SAND, trace gravel; unsorted (SM).		22						▲50/5"
						42						
						50/5"						
15												
		S-5		Slightly moist, gray, silty, fine SAND, trace gravel; unsorted (SM).		26						▲50/6"
						50/6"						
				Pre-Fraser Coarse-Grained Deposits								
20												
		S-6		Very moist, brown, gravelly, fine to coarse SAND, some silt (SM-SW).		15						▲45
						22						
						23						
				Difficult drilling action 22 to 25.5 feet.								
25												
		S-7		As above.		50/6"						▲50/6"
				Bottom of exploration boring at 25.5 feet Perched groundwater encountered at 5 feet.								

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture



3" OD Split Spoon Sampler (D & M)



Ring Sample

Water Level ()



Grab Sample



Shelby Tube Sample

Water Level at time of drilling (ATD)

Logged by: BD

Approved by: JHS



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Exploration Boring

Project Number
20200128E001

Exploration Number
EB-6

Sheet
1 of 1

Project Name **Ferrucci Junior High**

Location **Puyallup, WA**

Driller/Equipment **Holocene Drilling / HSA w/ D-50 Track Drill**

Hammer Weight/Drop **140# / 30"**

Ground Surface Elevation (ft) **~497**

Datum **NAVD 88**

Date Start/Finish **4/21/20, 4/21/20**

Hole Diameter (in) **8**

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6" Blows/6"	Blows/Foot				Other Tests
								10	20	30	40	
				Sod / Topsoil - 1 inch Fill								
5		S-1		Very moist, brownish gray, fine to medium sandy, SILT (ML).		6 4 4	▲8					
		S-2		Becomes bluish gray.		2 2 3	▲5					
		S-3		Vashon Recessional Lacustrine Wet, bluish gray with brown mottling, very silty, fine SAND (SM).		2 3 3	▲6					
10		S-4		Wet, brown mottled gray and reddish brown, very silty, fine SAND to sandy, SILT (SM/ML).		3 4 3	▲7					
				Vashon Lodgement Till								
15		S-5		Moist to very moist, brown and gray, gravelly, silty, fine to medium SAND; unsorted (SM).		16 22 28						▲50
20		S-6		Very moist, brown, gravelly, silty, fine to coarse SAND (SM).		26 50/6"						▲50/6"
				Pre-Fraser Coarse-Grained Deposits								
25		S-7		Very moist, brown and gray, gravelly, fine to coarse SAND, some silt (SW).		18 50/6"						▲50/6"
				Bottom of exploration boring at 26 feet Perched groundwater at 11 feet.								

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture



3" OD Split Spoon Sampler (D & M)



Ring Sample

Water Level ()



Grab Sample



Shelby Tube Sample



Water Level at time of drilling (ATD)

Logged by: BD

Approved by: JHS



Geologic & Monitoring Well Construction Log

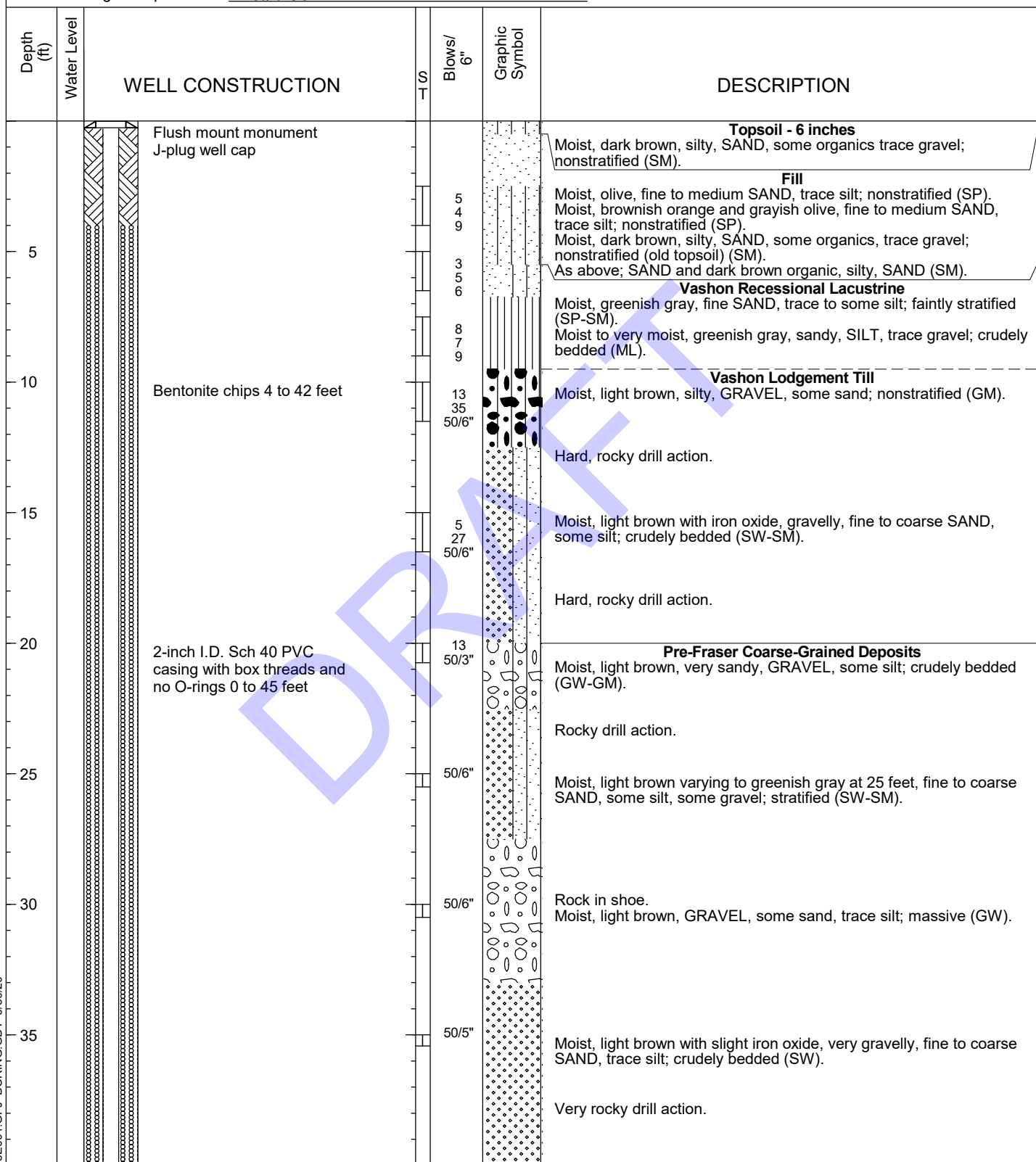
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20200128E001

Well Number
EB-7W

Sheet
1 of 2

Project Name **Ferrucci Junior High**
Elevation (Top of Well Casing) _____
Water Level Elevation _____
Drilling/Equipment **Holocene Drilling / HSA w/ D-50 Track Drill**
Hammer Weight/Drop **140# / 30"**

Location **Puyallup, WA**
Surface Elevation (ft) **~498**
Date Start/Finish **4/23/20, 4/23/20**
Hole Diameter (in) **8**



Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture

Logged by: FSM



3" OD Split Spoon Sampler (D & M)



Ring Sample



Water Level (4/27/20)

Approved by: JHS



Grab Sample



Shelby Tube Sample



Water Level at time of drilling (ATD)



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Geologic & Monitoring Well Construction Log

Project Number
20200128E001

Well Number
EB-7W

Sheet
2 of 2

Project Name **Ferrucci Junior High**

Elevation (Top of Well Casing) _____

Water Level Elevation _____

Drilling/Equipment **Holocene Drilling / HSA w/ D-50 Track Drill**

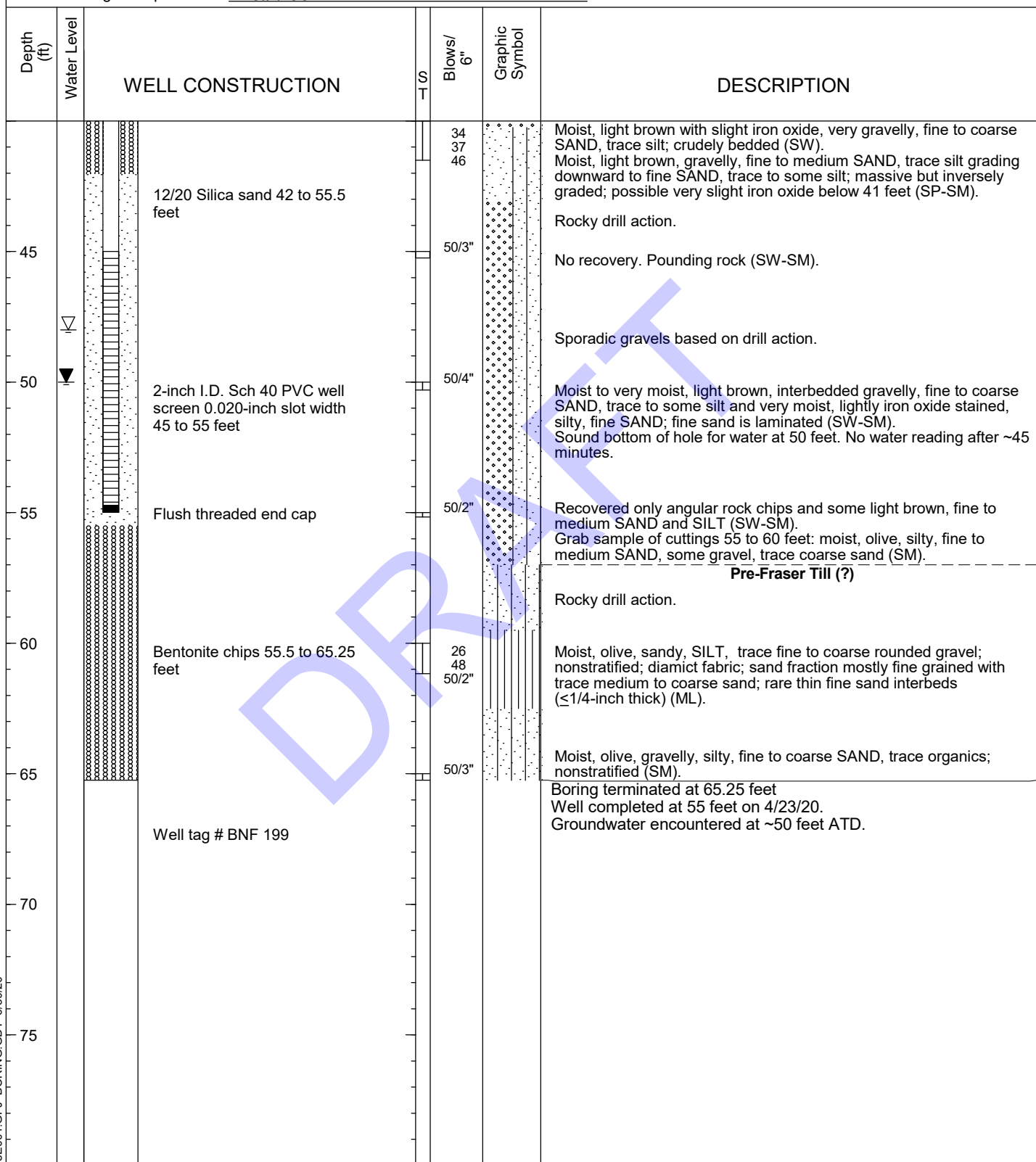
Hammer Weight/Drop **140# / 30"**

Location **Puyallup, WA**

Surface Elevation (ft) **~498**

Date Start/Finish **4/23/20, 4/23/20**

Hole Diameter (in) **8**



Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture

Logged by: FSM



3" OD Split Spoon Sampler (D & M)



Ring Sample



Water Level (4/27/20)

Approved by: JHS



Grab Sample



Shelby Tube Sample



Water Level at time of drilling (ATD)

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Exploration Boring

Project Number
20200128E001

Exploration Number
EB-8

Sheet
1 of 1

Project Name Ferrucci Junior High Ground Surface Elevation (ft) ~514
Location Puyallup, WA Datum NAVD 88
Driller/Equipment Holocene Drilling / HSA w/ D-50 Track Drill Date Start/Finish 4/21/20, 4/21/20
Hammer Weight/Drop 140# / 30" Hole Diameter (in) 8

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot				Other Tests
								10	20	30	40	
				Mulch - 1 inch Fill Moist, grayish brown, silty, fine to medium SAND, some gravel (SM).								
5		S-1		Vashon Lodgement Till		7 9 21				▲30		
		S-2		Very moist, grayish brown with reddish brown mottling, very silty, fine SAND, some gravel (SM).		7 16 26				▲42		
		S-3		Moist, gray, very silty, fine SAND, trace gravel; unsorted (SM).		12 18 26				▲44		
10		S-4		Pre-Fraser Fine-Grained Deposits Moist to very moist, grayish brown with mottled reddish brown, silty, fine SAND; massive (SM). Becomes moist and gray.		12 20 31				▲51		
15		S-5		Becomes slightly moist, reddish brown and gray, trace gravel.		15 30 50				▲80		
20		S-6		Little recovery, rock fragments only.		50/6"				▲50/6"		
				Pre-Fraser Coarse-Grained Deposits								
25		S-7		Moist to very moist, brown, gray and tan, gravelly, fine to coarse SAND, some silt (SW-SM). Bottom of exploration boring at 26 feet No groundwater encountered.		34 50/5"				▲50/5"		

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture



3" OD Split Spoon Sampler (D & M)



Ring Sample

Water Level ()



Grab Sample



Shelby Tube Sample



Water Level at time of drilling (ATD)

Logged by: BD

Approved by: JHS



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Exploration Boring

Project Number
20200128E001

Exploration Number
EB-9

Sheet
1 of 2

Project Name **Ferrucci Junior High**

Location **Puyallup, WA**

Driller/Equipment **Holocene Drilling / HSA w/ D-50 Track Drill**

Hammer Weight/Drop **140# / 30"**

Ground Surface Elevation (ft) **~514**

Datum **NAVD 88**

Date Start/Finish **4/24/20, 4/24/20**

Hole Diameter (in) **8**

Depth (ft)	S	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot				Other Tests
								10	20	30	40	
5				Concrete - 3.5 inches			5 8 13	▲21				
				Fill								
				Moist, light brown, PEA GRAVEL and fine to medium SAND, trace silt; nonstratified (GW).								
				Vashon Lodgement Till								
				Moist, light brown and light gray, SILT, trace sand, trace rounded gravel and clayey, SILT; interbedded; silt is massive; diamict fabric at ~3 feet (CL-ML).								
				Moist, light brown with iron oxide, sandy, SILT ranging to silty, fine to coarse SAND, some gravel; nonstratified; diamict fabric (SM-ML).			9 16 27	▲43				
				Upper 3": as above; contact is sharp (SM-ML).								
				Pre-Fraser Fine-Grained Deposits			9 11 19	▲30				
				Lower 15": moist, gray, SILT, some fine sand, trace fine to coarse rounded gravel, trace medium to coarse sand; dropstones; massive (ML).								



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Exploration Boring

Project Number
20200128E001

Exploration Number
EB-9

Sheet
2 of 2

Project Name Ferrucci Junior High

Location Puyallup, WA

Driller/Equipment Holocene Drilling / HSA w/ D-50 Track Drill

Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft) ~514

Datum NAVD 88

Date Start/Finish 4/24/20, 4/24/20

Hole Diameter (in) 8

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot				Other Tests
								10	20	30	40	
		S-4		Moist, light brown, SILT, trace to some fine to coarse sand, trace gravel; massive; laminated iron oxide stained silt interbed (~3 inches thick) at top of sample (ML).			9 19 30					▲49
15		S-5		Upper 12": moist, gray, SILT, trace to some fine to coarse rounded gravel, trace medium to coarse sand, trace fine sand; laminated to massive; contact at 16 feet is sharp (ML).			14 30 50/5"					▲50/5"
				Pre-Fraser Coarse-Grained Deposits - Moist, dark brownish orange to light brown w/ iron oxide staining 16-16.25'; gravelly, fine to coarse SAND, some silt to sandy, GRAVEL, trace silt; crudely bedded (SW-SM/GW).								
				Bottom of exploration boring at 16.5 feet No groundwater encountered.								

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture



3" OD Split Spoon Sampler (D & M)



Ring Sample

▽ Water Level ()



Grab Sample



Shelby Tube Sample



Water Level at time of drilling (ATD)

Logged by: FSM

Approved by: JHS



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Geologic & Monitoring Well Construction Log

Project Number
20200128E001

Well Number
EB-10W

Sheet
1 of 1

Project Name **Ferrucci Junior High**

Elevation (Top of Well Casing)

Water Level Elevation

Drilling/Equipment **Holocene Drilling / HSA w/ D-50 Track Drill**

Hammer Weight/Drop **140# / 30"**

Location **Puyallup, WA**

Surface Elevation (ft) **~510**

Date Start/Finish **4/23/20, 4/24/20**

Hole Diameter (in) **8**

Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/6"	Graphic Symbol	DESCRIPTION
		Above ground surface stick up -1 to 0 feet Flush mount monument J plug Cement 0 to 1.5 feet	6 28 40		Topsoil Moist to very moist, dark brown, silty, SAND, some gravel; nonstratified (SM).
5		Bentonite chips 1.5 to 6 feet	5 21 33		Vashon Lodgement Till Moist, olive, SILT, trace sand; massive; diamict fabric (ML). Contact at 3.25 feet is sharp.
10		Caved soils 6 to 19 feet	6 28 50/4"		Pre-Fraser Coarse-Grained Deposits Moist, brownish gray, sandy, GRAVEL, trace silt; crudely bedded (GW). Moist, olive, very gravelly, SAND, some silt; crudely bedded; thin silt interbed (<1 inch thick) at ~5 feet (SW-SM/ML). Moist, light brown, sandy, GRAVEL to gravelly, SAND, some silt; crudely bedded (GW-GM/W-SM).
15		2-inch I.D. Sch 40 PVC casing with box threaded connections, some with O-rings 0 to 25 feet	6 47 50/3"		Moist, brownish olive, very silty, SAND, trace to some gravel; diamict fabric (SM). Moist, brownish olive, GRAVEL, some sand, trace to some silt; nonstratified (GW-GM).
20		Bentonite 19 to 22 feet	16 50/2"		No recovery, pounded rock. Recovered only slough/redrill, bagged sample (GW-GM). Rocky drill action 15 to 20 feet.
25		Slough/caved soil 22 to 23 feet 12/20 Silica sand 23 to 35.5 feet	50/6"		Moist, light olive with slight iron oxide, sandy, GRAVEL, some silt; crudely bedded; sand is predominantly fine to medium grained (GW-GM). Rocky drill action.
30		2-inch I.D. Sch 40 PVC well screen 0.020-inch slot width 25 to 35 feet	50/4"		Moist to very moist, light olive gray, sandy, GRAVEL, some silt; moisture in sample interpreted to be from standing water in boring, not in situ groundwater; crudely bedded (GW-GM).
35		Flush box threaded end cap with O-ring	50/6"		Rocky drill action.
40		Well tag # BNF 200	50/6"		No recovery, pounded rock. Recovered gravel pieces with a little fine to coarse sand (GW-GM).
45					Moist, brownish olive, sandy, GRAVEL, some silt; crudely stratified (GW-GM). Boring terminated at 35.5 feet Well completed at 35 feet on 4/24/20. Dry at time of drilling. Driller called condition of drilling refusal. Observed very gravelly, muddy cuttings at ground surface flush down hole while drilling/attempting to clear cuttings from borehole near 35 feet. Driller noted that coarse gravels are widening out borehole diameter and 8-inch diameter auger is not able to transport cuttings up hole. There was a high risk that this condition could cause auger to become stuck in borehole. ATD water level at 1.5 feet with bottom of boring at 15 feet prior to drilling on 4/24/20. Bottom of auger was open at time of ATD water level. Interpreted as perched flowing down auger.

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture

Logged by: FSM



3" OD Split Spoon Sampler (D & M)



Ring Sample



Water Level (4/27/20)

Approved by: JHS



Grab Sample



Shelby Tube Sample



Water Level at time of drilling (ATD)

NWELL-B 20200128E001.GPJ BORING.GDT 6/30/20



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Exploration Boring

Project Number
20200128E001

Exploration Number
EB-11

Sheet
1 of 1

Project Name Ferrucci Junior High Ground Surface Elevation (ft) ~514
Location Puyallup, WA Datum NAVD 88
Driller/Equipment Holocene Drilling / HSA w/ D-50 Track Drill Date Start/Finish 4/21/20, 4/21/20
Hammer Weight/Drop 140# / 30" Hole Diameter (in) 8

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6" Blows/ft	Blows/Foot				Other Tests
								10	20	30	40	
5				Sod - 1 inch Vashon Lodgement Till								
		S-1		Moist, grayish brown, silty, fine to medium SAND; unsorted (SM).		7 8 32					▲40	
		S-2		As above; trace gravel.		12 17 34					▲51	
10				Pre-Fraser Fine-Grained Deposits Moist to very moist, gray, fine sandy, SILT (ML).		8 10 21				▲31		
		S-3										
		S-4		Becomes slightly moist.		18 23 50					▲73	
15				Pre-Fraser Coarse-Grained Deposits								
		S-5		Very moist, brownish gray, fine to medium SAND, some gravel, trace silt; massive (SP).		10 22 35					▲57	
20		S-6		Moist, brownish gray, sandy, GRAVEL; low recovery due to gravel (GW). Difficult drilling action 21 to 25 feet.		50/6"					▲50/6"	
25		S-7		No recovery. Bottom of exploration boring at 25 feet No groundwater encountered.		50/2"					▲50/2"	

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture



3" OD Split Spoon Sampler (D & M)



Ring Sample



Water Level ()



Grab Sample



Shelby Tube Sample



Water Level at time of drilling (ATD)

Logged by: BD

Approved by: JHS



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Exploration Boring

Project Number
20200128E001

Exploration Number
EB-12

Sheet
1 of 1

Project Name
Ferrucci Junior High

Location
Puyallup, WA

Driller/Equipment
Holocene Drilling / HSA w/ D-50 Track Drill

Hammer Weight/Drop
140# / 30"

Ground Surface Elevation (ft) **~494**

Datum **NAVD 88**

Date Start/Finish **4/24/20, 4/24/20**

Hole Diameter (in) **8**

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot				Other Tests
								10	20	30	40	
5		S-1		Topsoil Moist, dark brown, silty, SAND, some organics, trace gravel; nonstratified (SM).								
				Fill Moist, dark brown and brownish orange, fine SAND, some silt, trace to some organics, trace fine gravel; nonstratified (SP-SM).		3 3 4	▲7					
				Vashon Recessional Lacustrine Moist, brownish orange with faint iron oxide mottling, fine SAND, some silt to silty, trace organic (rootlets); massive to faintly stratified (SP-SM).		3 3 4	▲7					
10		S-2		As above; wet (SP-SM).		9 12 8			▲20			
				Weathered Vashon Lodgement Till Moist, light brown with iron oxide, very gravelly, silty, SAND; crudely bedded (SM).		6 5 12		▲17				
				Moist to very moist, olive with iron oxide, very silty, fine to coarse SAND, trace to some gravel; nonstratified; till like fabric (SM).								
15		S-3		Vashon Lodgement Till Moist, olive, silty, fine SAND, some gravel; occasional thin interbeds (<3 inches thick) of moist, fine sand, trace silt; diamict fabric (SM).		29 28 29						▲57
				Pre-Fraser Coarse-Grained Deposits Moist, olive, very gravelly, fine SAND, some silt, trace gravel; massive to faintly stratified (SP-SM).		12 25 39						▲64
				Moist, olive, very gravelly, fine to coarse SAND, trace silt; crudely bedded (SW).								
20		S-4		Wet, olive, gravelly, fine to coarse SAND, trace to some silt; crudely bedded (SW-SM).		22 50/3"						▲50/3"
				Driller notes smooth drill action below ~23 feet.								
				Moist to wet, light brownish olive with iron oxide staining throughout becoming stronger at ~26.5 feet, SILT and fine SAND, trace to some silt; interbedded, laminated; silt is moist while fine sand is wet (ML/SP-SM).		5 7 14		▲21				
25		S-5		Wet but moist to very moist in some areas, brownish olive, fine to coarse SAND, some gravel, trace silt; crudely bedded (SW).		20 30 36						▲66
				Wet, brownish olive, fine SAND, trace medium to coarse sand, trace gravel, trace silt and fine to coarse SAND, trace gravel, trace silt; interbedded (SP/SW).		12 25 50/6"						▲50/6"
				Bottom of exploration boring at 36.5 feet Groundwater encountered at 7.5 (perched) and at 20 feet with auger in hole while tripping out 20.5 and rising. Boring located adjacent to detention pond.								

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



3" OD Split Spoon Sampler (D & M)



Grab Sample



No Recovery



Ring Sample



Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

Logged by: FSM

Approved by: JHS

AE5IBOR 20200128E001.GPJ June 30, 2020



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Geologic & Monitoring Well Construction Log

Project Number
20200128E001

Well Number
EB-13W

Sheet
1 of 3

Project Name **Ferrucci Junior High**

Elevation (Top of Well Casing)

Water Level Elevation **Dry**

Drilling/Equipment **Holocene / Rotosonic**

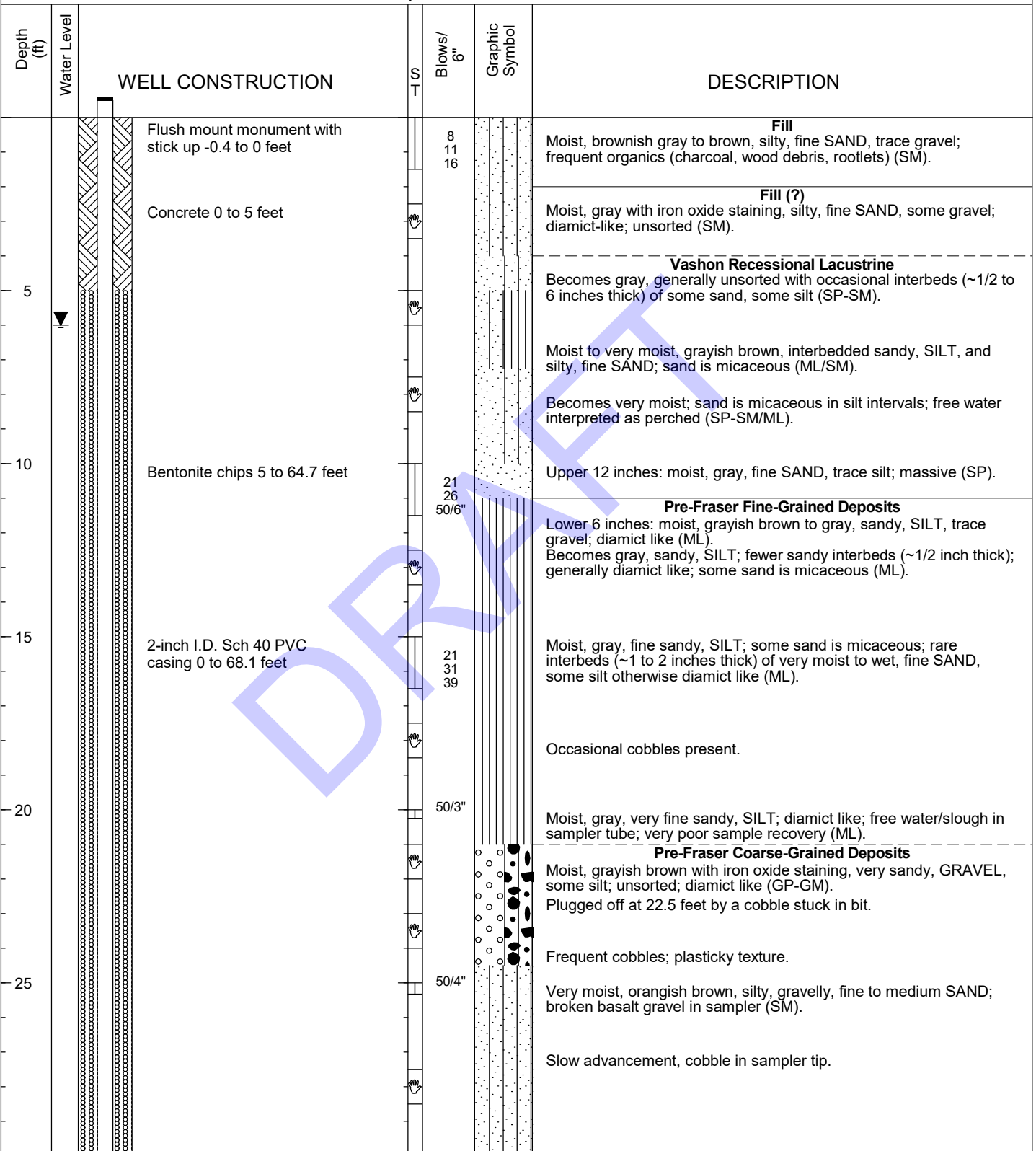
Hammer Weight/Drop **140# / 30"; Core Samples**

Location **Puyallup, WA**

Surface Elevation (ft) **~497**

Date Start/Finish **6/1/20, 6/1/20**

Hole Diameter (in) **8, 6-inch core barrel**



Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture

Logged by: ALG



3" OD Split Spoon Sampler (D & M)



Ring Sample

Water Level ()

Approved by: JHS



Grab Sample



Shelby Tube Sample

Water Level at time of drilling (ATD)

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Geologic & Monitoring Well Construction Log

Project Number
20200128E001

Well Number
EB-13W

Sheet
2 of 3

Project Name **Ferrucci Junior High**

Elevation (Top of Well Casing)

Water Level Elevation

Drilling/Equipment

Hammer Weight/Drop

Dry

Holocene / Rotosonic

140# / 30"; Core Samples

Location

Puyallup, WA

Surface Elevation (ft)

~497

Date Start/Finish

6/1/20, 6/1/20

Hole Diameter (in)

8, 6-inch core barrel

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
						As above; zones of plasticky texture; some grains appear silt coated.
35		Bentonite chips 5 to 64.7 feet				Moist, grayish brown, silty, very gravelly, fine to coarse SAND; unsorted with plasticky texture; some grains appear silt coated; sample came up hot to the touch (SM). Interval (~6 inches thick) of slightly moist gravel; possible zone of powdered gravel due to drill action at 34 feet.
						Moist, grayish brown, silty, fine SAND, some gravel to gravelly; diamict like; slow advancement (SM).
						Moist to very moist, orangish brown, gravelly, fine SAND, some silt; massive; unsorted (SP-SM).
40		2-inch I.D. Sch 40 PVC casing 0 to 68.1 feet				Moist, grayish brown, very silty, sandy, fine to coarse GRAVEL; frequent cobbles; zones of plasticky texture; massive; unsorted; diamict like (GM).
						Interval of powdered gravel due to drill action at 42 feet.
						Moist to very moist, grayish brown with some iron oxide staining, gravelly, silty, medium SAND; some zones of plasticky texture; unsorted (SM).
45						Moist, grayish brown, silty, gravelly, fine to coarse SAND; gradationally stratified; increased moisture and plasticky texture noted in coarser intervals (SM).
						Gradationally stratified, sands and gravel with rare silty interbeds; fewer cobbles from 50 to 80 feet.
						Moist, grayish brown, fine to medium SAND, some gravel, some silt; occasional interbeds (2 to 5 inches thick) of silty, sand with diamict like appearance; samples are hot to the touch (SP-SM). Interbed (5 inches thick) of moist, grayish brown, silty, fine to medium SAND, some gravel; some sand is micaceous; diamict like (SM).
50						Moist, grayish brown, fine to medium SAND, some gravel, some silt; massive (SP-SM).
55						As above; zones of very moist, plasticky texture; rare silty interbeds otherwise massive (SP-SM).

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture

Logged by: ALG



3" OD Split Spoon Sampler (D & M)



Ring Sample



Water Level ()

Approved by: JHS



Grab Sample



Shelby Tube Sample



Water Level at time of drilling (ATD)



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Geologic & Monitoring Well Construction Log

Project Number
20200128E001

Well Number
EB-13W

Sheet
3 of 3

Project Name **Ferrucci Junior High**

Elevation (Top of Well Casing)

Water Level Elevation

Drilling/Equipment

Hammer Weight/Drop

Dry

Holocene / Rotosonic

140# / 30"; Core Samples

Location

Puyallup, WA

Surface Elevation (ft)

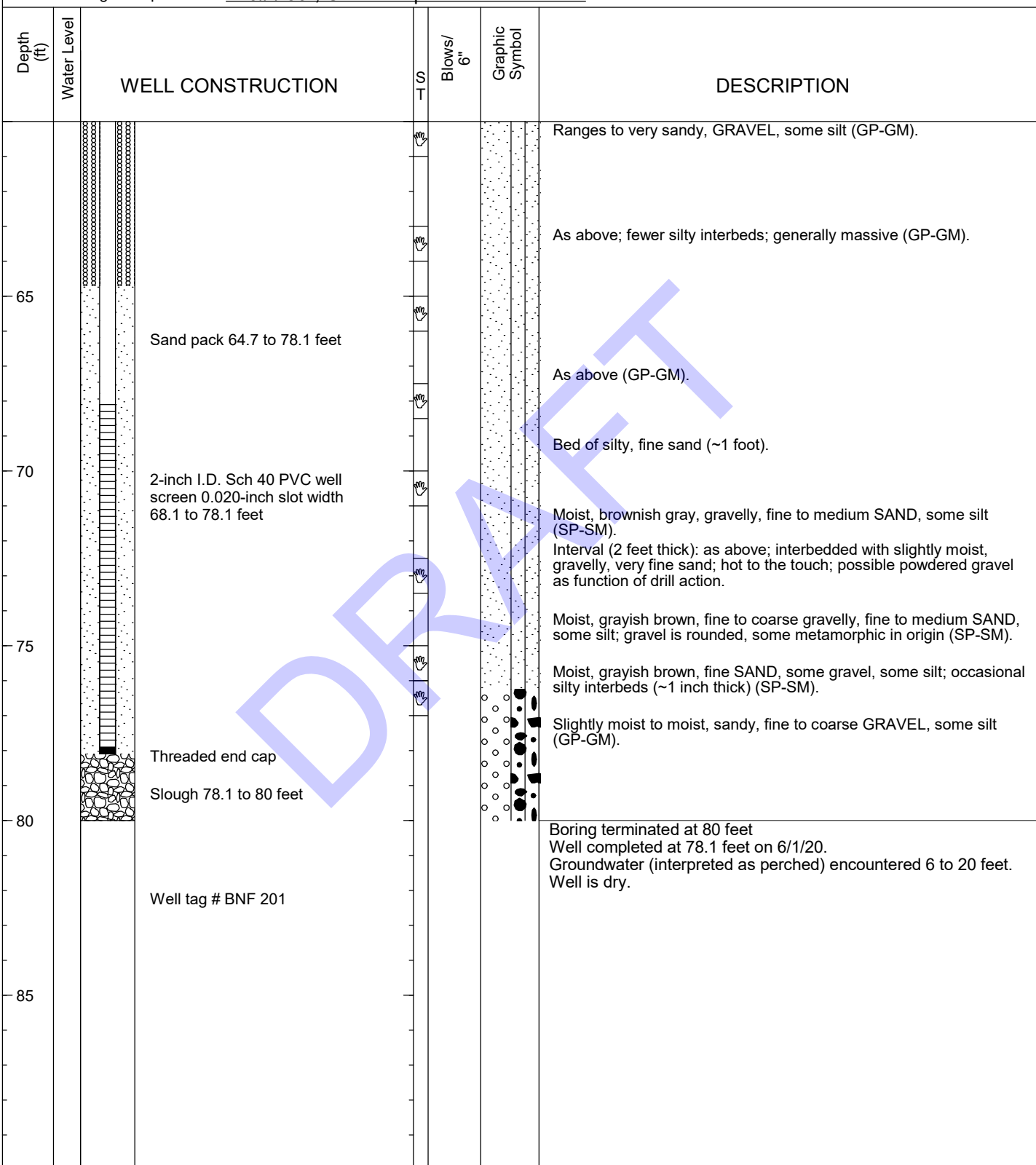
~497

Date Start/Finish

6/1/20, 6/1/20

Hole Diameter (in)

8, 6-inch core barrel



Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture

Logged by: ALG



3" OD Split Spoon Sampler (D & M)



Ring Sample



Water Level ()

Approved by: JHS



Grab Sample



Shelby Tube Sample



Water Level at time of drilling (ATD)

NWELL-B 20200128E001.GPJ BORING.GDT 7/1/20

APPENDIX B

Exploration Pit Logs

DRAFT

EXPLORATION PIT NO. EP-1

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.
	DESCRIPTION Elev: ~510 ft
	Topsoil - 6 inches
1	Loose, very moist to wet, brown, silty, fine SAND, some gravel; abundant rootlets (SM).
	Vashon Lodgement Till
2	Dense, moist, brownish gray, silty, fine SAND, some gravel; unsorted (SM).
3	
	Pre-Fraser Coarse-Grained Deposits
4	Layer of cobbles at transition zone; possible lag deposit. Dense, moist, brownish gray, fine to medium SAND, some silt to silty, some gravel to gravelly (SP-SM/SM).
5	Becomes silty.
	Becomes very moist.
6	
7	
8	Dense, very moist, grayish brown, silty to very silty, gravelly, fine SAND; gravel is rounded (SM).
9	Dense, very moist, very silty/clayey, sandy, fine to coarse GRAVEL; occasional cobbles/boulders; gravel is rounded (GM).
10	Bottom of exploration pit at depth 9.5 feet
	Light seepage at ~0.5 feet (perched). No caving.
11	
12	
13	
14	
15	

Ferrucci Junior High School Puyallup, WA

Logged by: ALG
Approved by: JHS



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Project No. 20200128H001
4/30/20

EXPLORATION PIT NO. EP-2

Depth (ft)	DESCRIPTION	Elev: ~497 ft
	Sod - 3 inches	
	Playfield Sand	
1	Loose, moist, grayish brown, fine SAND, trace silt (SP).	
	Fill	
2	Loose, moist, bluish gray, sandy, SILT, some gravel, trace organics (rootlets/branches) (ML).	
3	Becomes dark gray.	
4		
	Old Topsoil / Organic Fill	
5	Becomes brown with abundant organics (branches/rootlets). Root mat (~3 to 6 inches thick) observed on all side walls. Organic odor 4.5 to 5 feet.	
	Vashon Recessional Lacustrine Deposit	
6	Medium stiff, moist, greenish gray with iron oxide mottling, sandy, SILT, trace to some gravel (ML).	
7	Becomes light gray with some fine laminae.	
8	Becomes very moist and bluish gray.	
9		
	Very mottled with iron oxide.	
	Vashon Recessional Outwash	
10	Loose, wet, gray, medium SAND, trace to some silt (SP).	
11	Bottom of exploration pit at depth 10.1 feet Seepage at ~9.7 feet (perched in sand). Minor caving ~7.8 to 10.1 feet.	
12		
13		
14		
15		

Ferrucci Junior High School Puyallup, WA

Logged by: ALG
Approved by: JHS



a s s o c i a t e d
e a r t h s c i e n c e s
i n c o r p o r a t e d

Project No. 20200128H001

4/30/20

EXPLORATION PIT NO. IT-1

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.	Elev: ~510 ft
	DESCRIPTION	
	Topsoil - 6 inches	
	Loose, wet, brown, topsoil.	
1	Vashon Lodgement Till	
	Dense, moist, brownish gray, silty, fine SAND, some gravel; unsorted (SM).	
2	Pre-Fraser Coarse-Grained Deposits	
	Dense, moist, silty, gravelly, fine to medium SAND (SM) to silty, GRAVEL with sand (GM); occasional boulders; frequent cobbles.	
3		
4	Becomes wet (post infiltration test) at 3.5 feet.	
	Becomes moist to very moist, roughly stratified, SAND and GRAVEL.	
5	Heavy seepage (post infiltration test) at 4.4 feet increasing moisture in lower samples.	
6	Dense, wet, grayish brown, silty, sandy, fine to coarse GRAVEL; occasional boulders; frequent cobbles (GM).	
7		
8		
9		
10	Bottom of exploration pit at depth 9.5 feet Light seepage at ~0.5 feet. Post infiltration test seepage ~3.5 to 9.5 feet with zones of heavy seepage at 4.4 and at 6.6 feet. Minor caving 6.5 to 9.5 feet. Infiltration test performed at 3.3 feet.	
11		
12		
13		
14		
15		

Ferrucci Junior High School Puyallup, WA

Logged by: ALG
Approved by: JHS



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Project No. 20200128H001

4/30/20

EXPLORATION PIT NO. IT-2

Depth (ft)	DESCRIPTION	Elev: ~497 ft
	Sod - 3 inches	
	Playfield Sand	
1	Loose, moist, grayish brown, fine SAND, trace silt (SP).	
	Fill	
2	Loose, moist, gray to bluish gray with some iron oxide staining, sandy, SILT, some gravel (ML).	
3		
4		
	Vashon Recessional Lacustrine	
5	Medium stiff, moist, light brownish gray with iron oxide staining, sandy, SILT, trace gravel (ML) ranging to loose to medium dense, very silty, fine SAND (SM).	
6		
7		
8		
	Vashon Recessional Outwash	
9	Loose to medium dense, wet, gray, fine SAND, trace silt, trace gravel; vaguely gradationally stratified (SP). Becomes medium sand.	
10	Moist, light brown with iron oxide staining to brownish gray, sandy, SILT, trace gravel (ML); interbed (~6 inches thick).	
11	Medium dense, wet, brown, fine SAND, trace silt, trace gravel (SP).	
12		
13	Bottom of exploration pit at depth 11.9 feet Post infiltration test moderate seepage at 10.3 feet. Minor caving 10.3 to 11.9 feet. Infiltration test performed at 5.7 feet.	
14		
15		

Ferrucci Junior High School Puyallup, WA

Logged by: ALG
Approved by: JHS



a s s o c i a t e d
e a r t h s c i e n c e s
i n c o r p o r a t e d

Project No. 20200128H001

4/30/20

APPENDIX C

Historical Exploration Logs (AESI 2005 and 2006)

DRAFT



Exploration Log

Project Number
KE05618AExploration Number
EB-1Sheet
1 of 1

Project Name Ferrucci Junior High School
 Location Puyallup, WA
 Driller/Equipment Davies/HSA
 Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft) _____
 Datum N/A
 Date Start/Finish 10/19/05, 10/19/05
 Hole Diameter (in) _____

Depth (ft)	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot				Other Tests
							10	20	30	40	
	S-1		1 3/4" AC/2" Crushed (1/2" minus) Fill Moist, blue-gray, silty SAND/sandy SILT with wood debris. Moist to wet, black, silty SAND, organic (wood fragments).			9 8 6	▲14				
	S-2		Recessional Outwash Moist, red-brown, fine to medium SAND			10 5 10	▲15				
5	S-3		Wet, light blue-gray, silty fine SAND to sandy SILT, 1 rounded gravel.			3 5 5	▲10				
	S-4		Wet, light gray, SILT, orange oxidation.			5 8 15		▲23			
10	S-5		Moist, light gray, SILT, orange oxidation on tight fracture surfaces.			25 17 24				▲41	
			Bottom of exploration boring at 11.5 feet								
15											
20											
25											
30											
35											

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture



3" OD Split Spoon Sampler (D & M)



Ring Sample

Water Level ()



Grab Sample



Shelby Tube Sample

Water Level at time of drilling (ATD)

Logged by: MT

Approved by:



Exploration Log

Project Number
KE05618BExploration Number
EB-1Sheet
1 of 1Project Name
Ferrucci Junior High School

Ground Surface Elevation (ft)

Location
Puyallup, WADatum
N/ADriller/Equipment
Davies/HSADate Start/Finish
1/4/06, 1/4/06Hammer Weight/Drop
140# / 30"

Hole Diameter (in)

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot				Other Tests
								10	20	30	40	
		S-1		2" to 4" sod in standing water. Fill Wet, brown-gray, silty fine SAND, root hairs, slightly organic, few fine to medium gravel.		5 9 7			▲ 16			
		S-2		Wet to very wet, brown-gray, silty fine SAND.		4 5 10			▲ 15			
5		S-3		Moist to very moist, brown-gray, silty fine SAND.		4 6 8			▲ 14			
		S-4		Till Moist, blue-gray, fine sandy SILT, few gravel.		50/5 5"						▲ 50/5 5"
10		S-5		Moist, blue-gray, fine sandy SILT, few gravel.		50/6"						▲ 50/6"
				Bottom of exploration boring at 10.5 feet No ground water seepage.								
15												
20												
25												
30												
35												

Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture



3" OD Split Spoon Sampler (D & M)



Ring Sample

☒ Water Level ()



Grab Sample



Shelby Tube Sample

▼ Water Level at time of drilling (ATD)

Logged by: MT

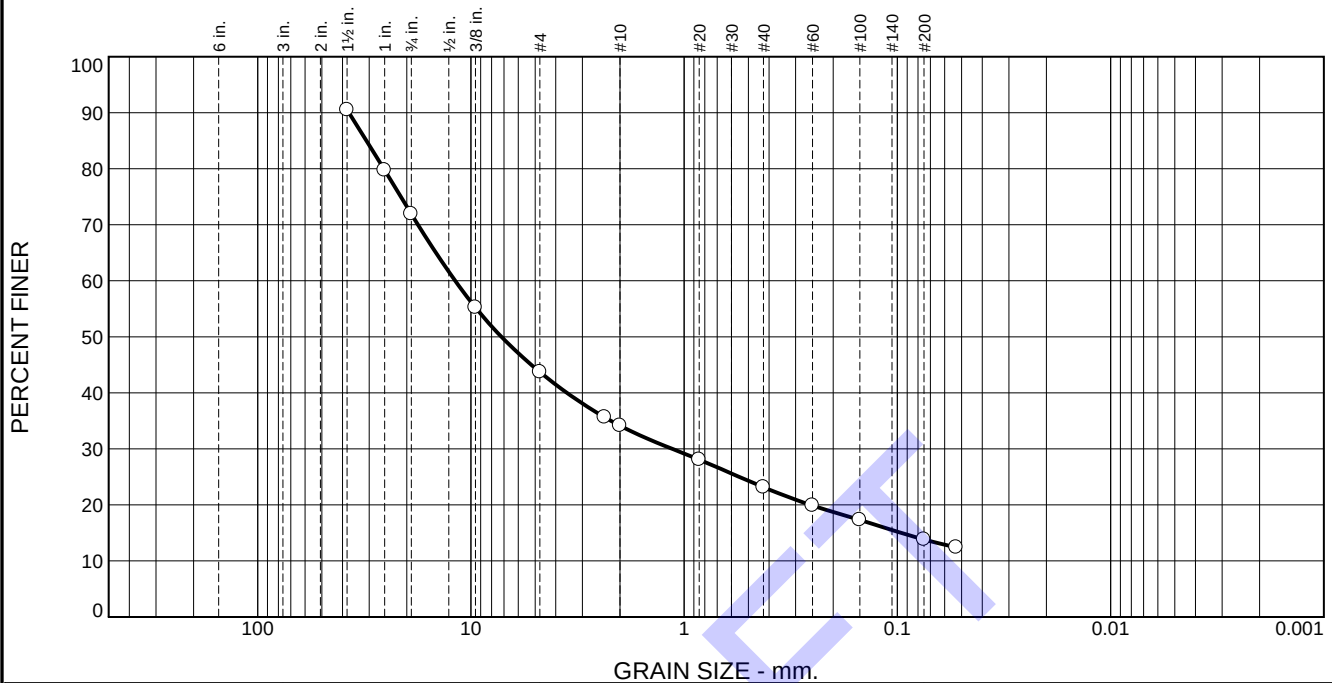
Approved by:

APPENDIX D

Laboratory Test Results

DRAFT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
		28.2	9.6	10.9	9.4	13.8	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1-1/2"	90.5		
1"	79.8		
3/4"	71.9		
3/8"	55.2		
#4	43.7		
#8	35.6		
#10	34.1		
#20	28.1		
#40	23.2		
#60	19.9		
#100	17.3		
#200	13.8		
#270	12.4		

* (no specification provided)

Material Description

silty gravel with sand

Atterberg Limits (ASTM D 4318)

PL= NP

LL= NV

PI=

Classification

USCS (D 2487)= GM

AASHTO (M 145)= A-1-a

Coefficients

D₉₀= 37.3706

D₈₅= 30.9120

D₆₀= 11.8552

D₅₀= 7.1928

D₃₀= 1.1374

D₁₅= 0.0959

D₁₀=

C_u=

C_c=

Remarks

Rocks larger than 2-inches were removed from sample, sieve result shows 2-inch minus material.

Date Received: 5/1/20

Date Tested: 5/15/20

Tested By: CC

Checked By: JS

Title:

Source of Sample: Onsite
Sample Number: IT-1

Depth: 3.3'

Date Sampled: 4/30/20



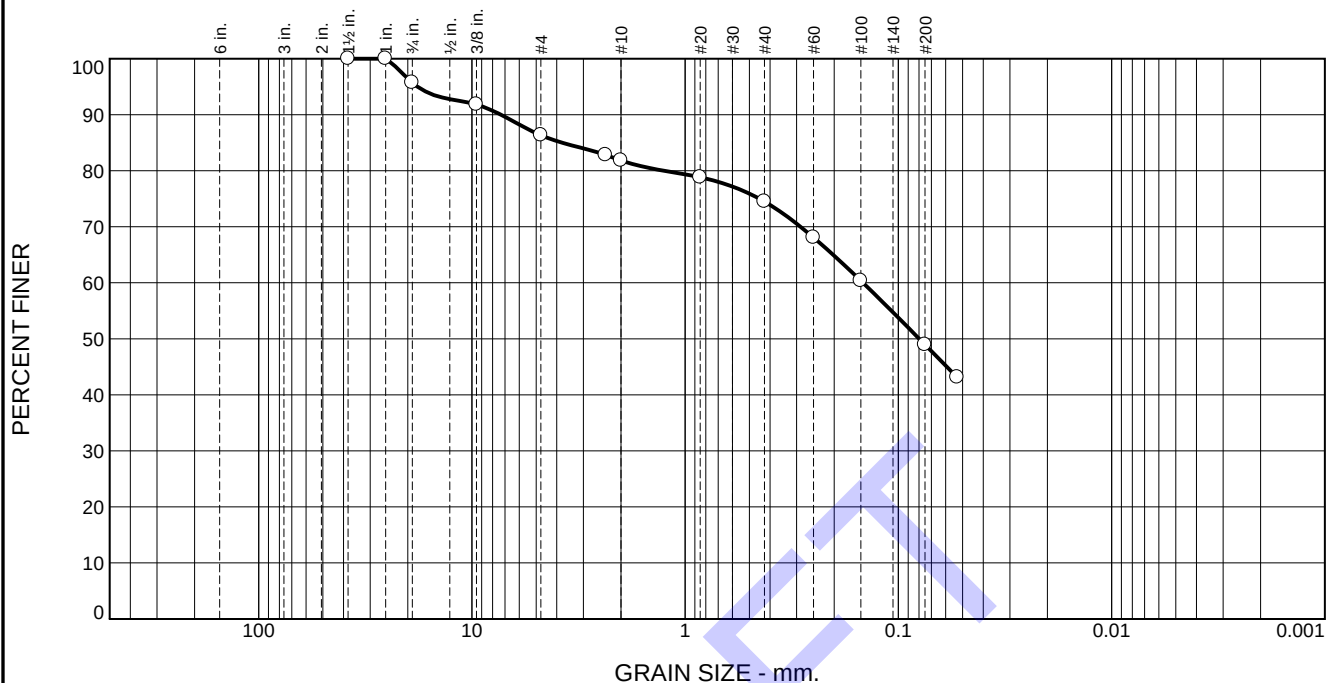
associated
earth sciences
incorporated

Client: Puyallup School District
Project: FERRUCCI JUNIOR HIGH

Project No: 20200128E001

Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.3	9.4	4.5	7.3	25.5	49.0	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1-1/2"	100.0		
1"	100.0		
3/4"	95.7		
3/8"	91.8		
#4	86.3		
#8	82.8		
#10	81.8		
#20	78.8		
#40	74.5		
#60	68.1		
#100	60.4		
#200	49.0		
#270	43.1		

* (no specification provided)

Material Description
silty sand

Atterberg Limits (ASTM D 4318)
PL= NP LL= NV PI=

Classification
USCS (D 2487)= SM AASHTO (M 145)= A-4(0)

Coefficients
D₉₀= 7.3203 D₈₅= 3.7762 D₆₀= 0.1466
D₅₀= 0.0798 D₃₀= C_u= D₁₅= C_c=

Remarks

Date Received: 5/1/20 Date Tested: 5/15/20
Tested By: CC
Checked By: JS
Title:

Source of Sample: Onsite Depth: 5.7'
Sample Number: IT-2

Date Sampled: 4/30/20



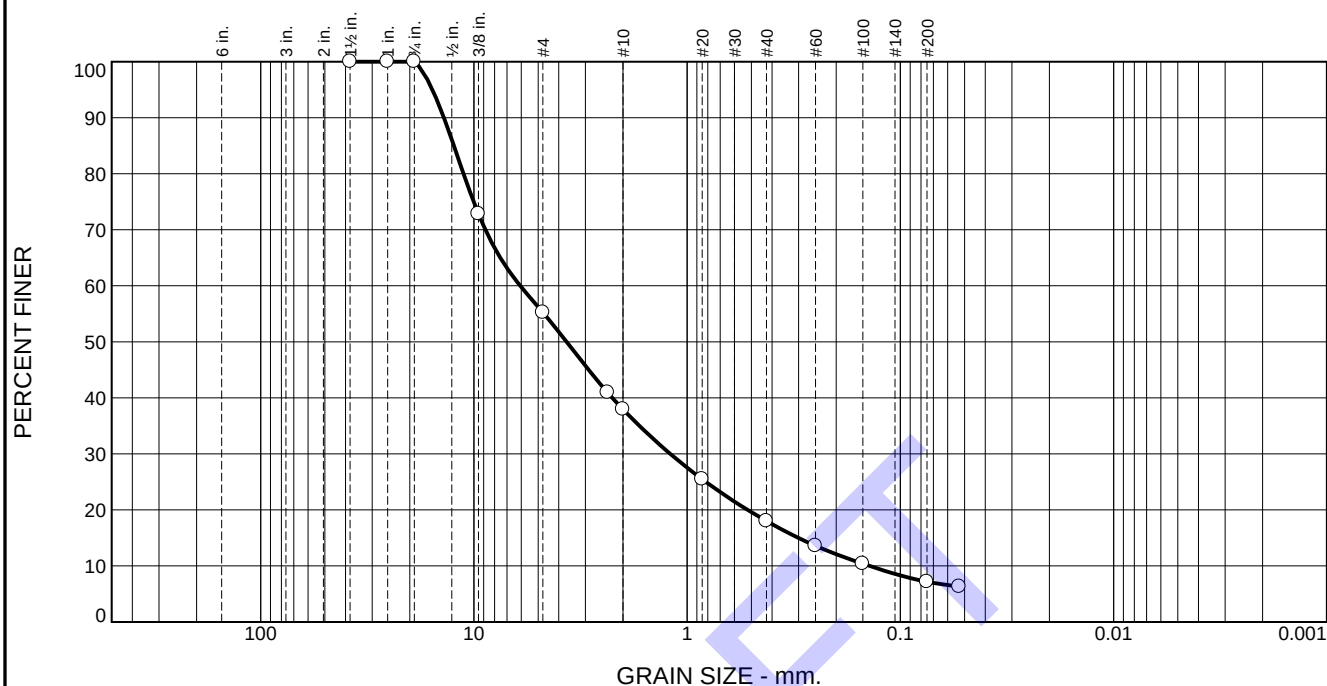
associated
earth sciences
incorporated

Client: Puyallup School District
Project: FERRUCCI JUNIOR HIGH

Project No: 20200128E001

Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	44.8	17.2	20.0	10.8	7.2	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1-1/2"	100.0		
1"	100.0		
3/4"	100.0		
3/8"	72.8		
#4	55.2		
#8	40.9		
#10	38.0		
#20	25.5		
#40	18.0		
#60	13.6		
#100	10.4		
#200	7.2		
#270	6.3		

* (no specification provided)

Material Description

well-graded sand with silt and gravel

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI=

Classification

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

Coefficients

D₉₀= 13.8365 D₈₅= 12.4211 D₆₀= 6.0686
D₅₀= 3.6767 D₃₀= 1.2001 D₁₅= 0.3011
D₁₀= 0.1395 C_u= 43.51 C_c= 1.70

Remarks

Date Received: 4/28/20 Date Tested: 5/8/20

Tested By: CC

Checked By: BD

Title: _____

Source of Sample: Onsite Depth: 20-21.5'
Sample Number: EB-4

Date Sampled: 4/21/20



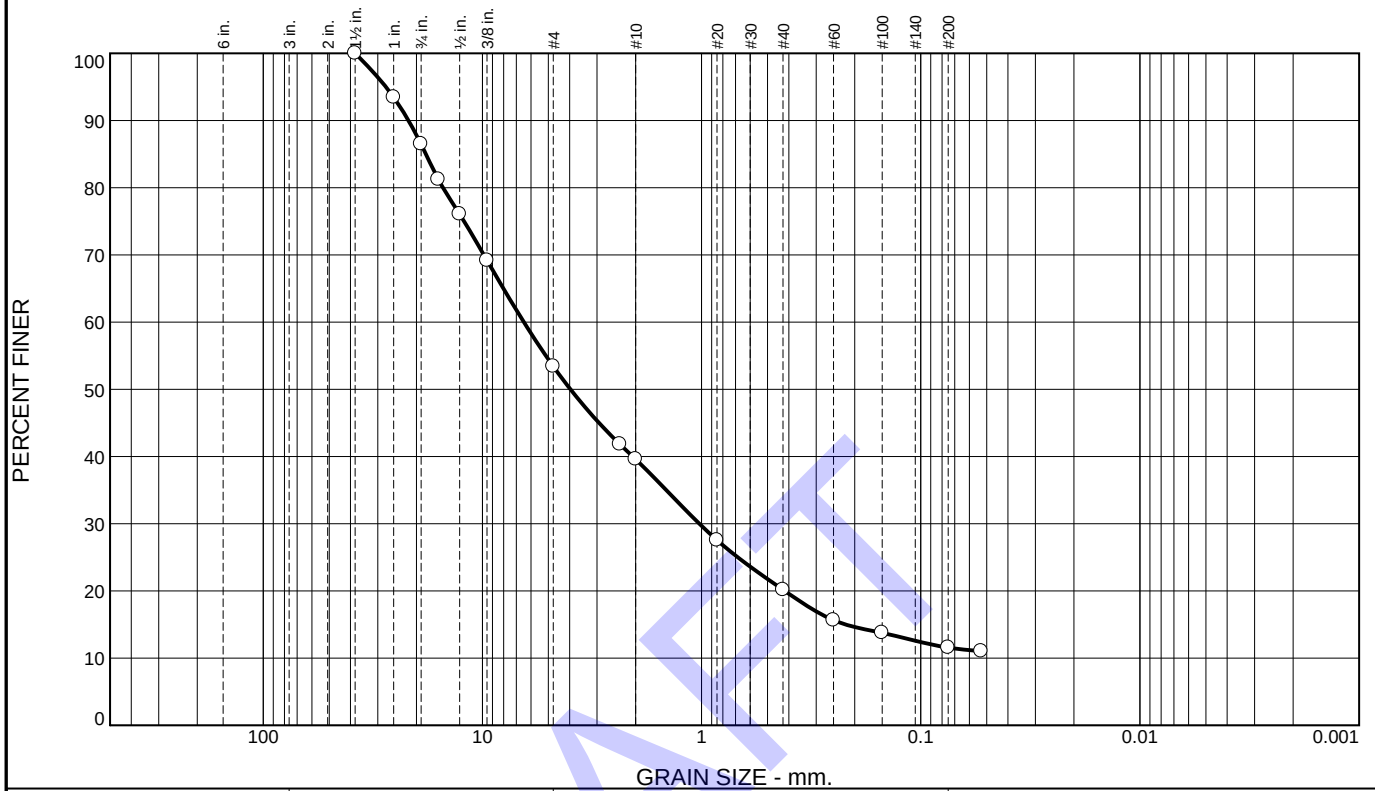
associated
earth sciences
incorporated

Client: Puyallup School District
Project: FERRUCCI JUNIOR HIGH

Project No: 20200128E001

Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	13.5	33.1	13.8	19.4	8.6	11.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	93.5		
.75	86.5		
0.625	81.2		
0.50	76.1		
.375	69.2		
#4	53.4		
#8	41.8		
#10	39.6		
#20	27.6		
#40	20.2		
#60	15.6		
#100	13.8		
#200	11.6		
#270	11.0		

* (no specification provided)

Material Description

very sandy GRAVEL, some silt

PL= NA **Atterberg Limits** LL= NA PI= NA

Coefficients
D₉₀= 21.7416 D₈₅= 18.1068 D₆₀= 6.4699
D₅₀= 3.9666 D₃₀= 1.0233 D₁₅= 0.2200
D₁₀= C_u= C_c=

Classification
USCS= AASHTO=

Remarks

Collected by: ALG

Source of Sample: Onsite
Sample Number: EB-13W

Depth: Composite 21' & 24'

Date: 06/08/2020



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Client: Puyallup School District
Project: FERRUCCI JUNIOR HIGH

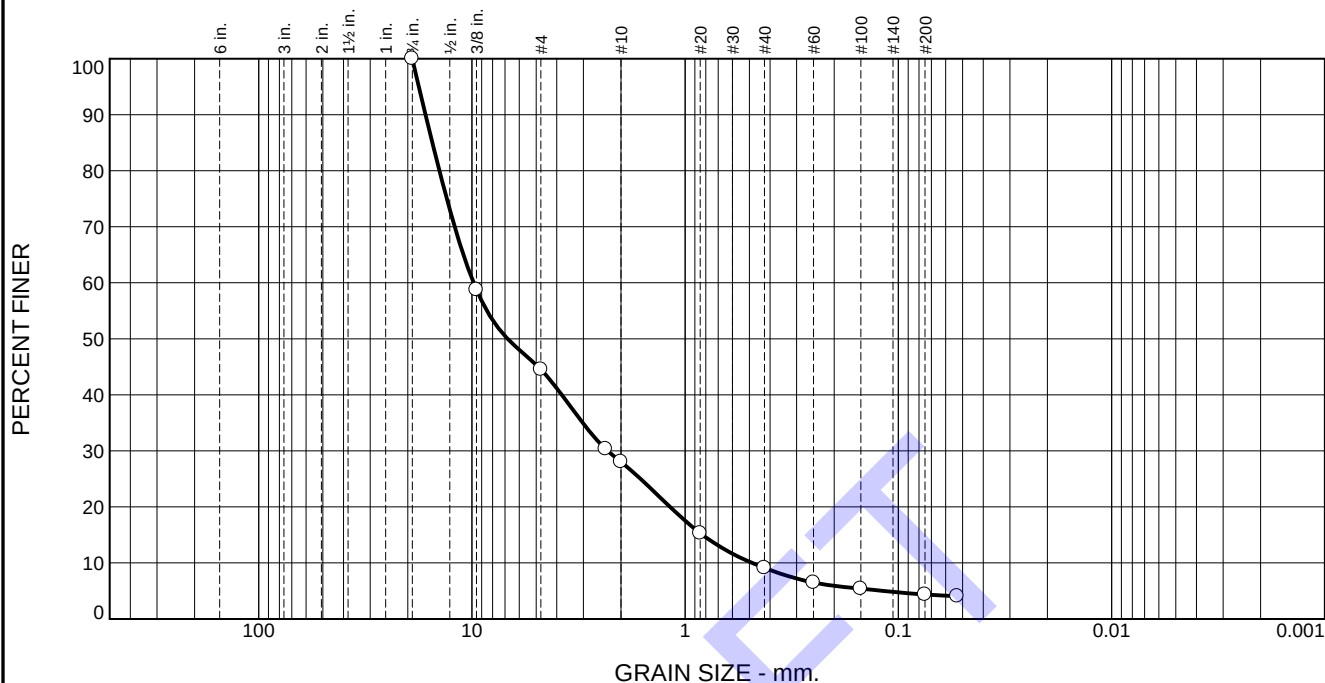
Project No: 20200128E001

Figure

Tested By: BSP

Checked By: BD

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	55.5	16.5	18.9	4.7	4.4	

TEST RESULTS (ASTM D 422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4"	100.0		
3/8"	58.8		
#4	44.5		
#8	30.3		
#10	28.0		
#20	15.3		
#40	9.1		
#60	6.5		
#100	5.4		
#200	4.4		
#270	4.1		

* (no specification provided)

Material Description
very sandy gravel, some silt

Atterberg Limits (ASTM D 4318)
PL= LL= PI=

Classification
USCS (D 2487)= GW AASHTO (M 145)=

Coefficients
D₉₀= 16.5032 D₈₅= 15.3324 D₆₀= 9.8263
D₅₀= 6.8013 D₃₀= 2.3109 D₁₅= 0.8295
D₁₀= 0.4855 C_u= 20.24 C_c= 1.12

Remarks
Collected by: ALG

Date Received: 06/02/2020 Date Tested: 06/05/2020

Tested By: BSP

Checked By: BPN

Title: _____

Source of Sample: Onsite Depth: 48'

Sample Number: EB-13W

Date Sampled: 06/01/2020



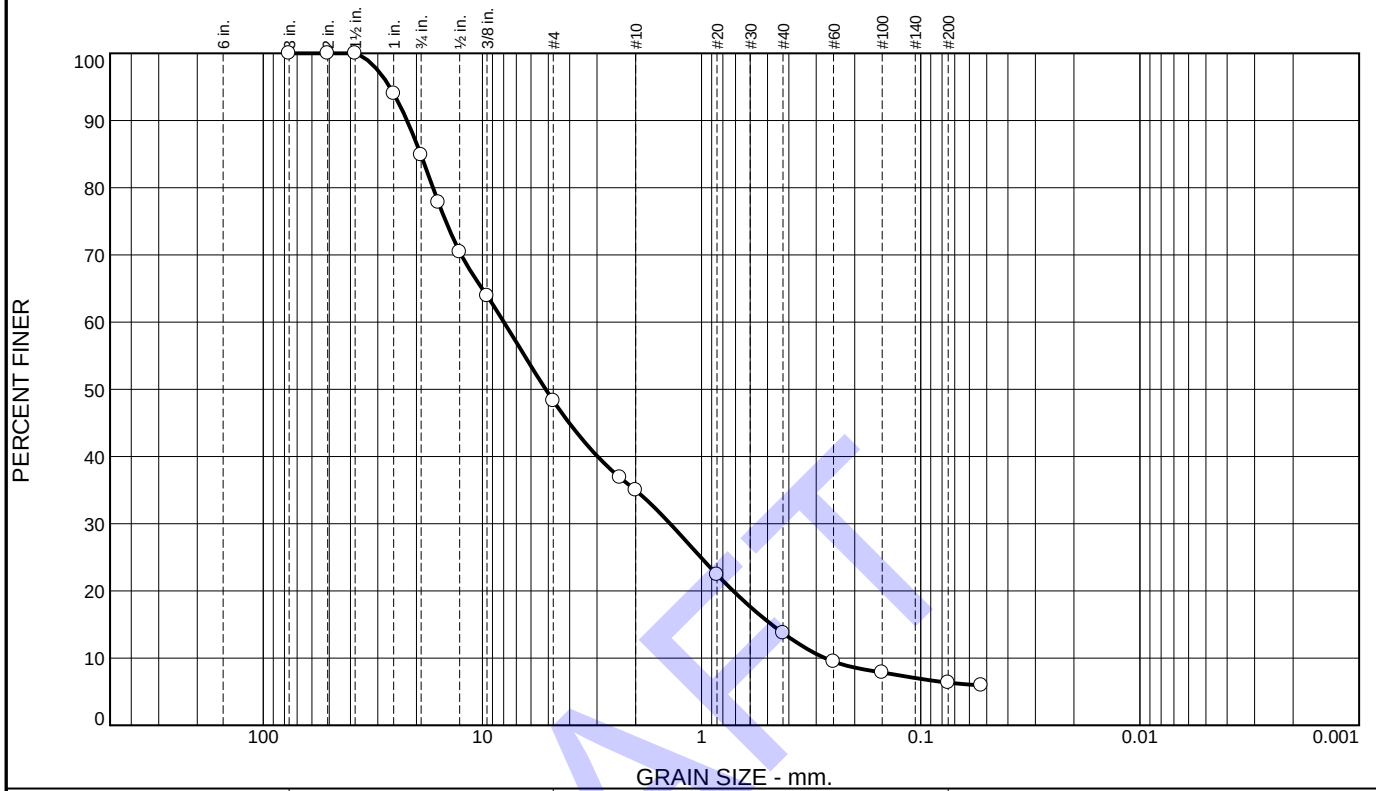
associated
earth sciences
incorporated

Client: Puyallup School District
Project: FERRUCCI JUNIOR HIGH

Project No: 20200128E001

Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	15.1	36.6	13.3	21.3	7.3	6.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	100.0		
1.5	100.0		
1	94.0		
0.75	84.9		
0.625	77.8		
0.5	70.4		
.375	63.9		
#4	48.3		
#8	36.9		
#10	35.0		
#20	22.4		
#40	13.7		
#60	9.5		
#100	7.9		
#200	6.4		
#270	5.9		

* (no specification provided)

Material Description

Very sandy GRAVEL, some silt

PL= NP **Atterberg Limits** LL= NV PI=

Coefficients
D₉₀= 22.0789 D₈₅= 19.1202 D₆₀= 7.9773
D₅₀= 5.1453 D₃₀= 1.3914 D₁₅= 0.4793
D₁₀= 0.2733 C_u= 29.19 C_c= 0.89

Classification
USCS= GP-GM AASHTO= A-1-a

Remarks

Collected by: ALG

Source of Sample: Onsite Depth: Composite 63' & 65'
Sample Number: EB-13W

Date: 06/09/2020



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Client: Puyallup School District
Project: FERRUCCI JUNIOR HIGH

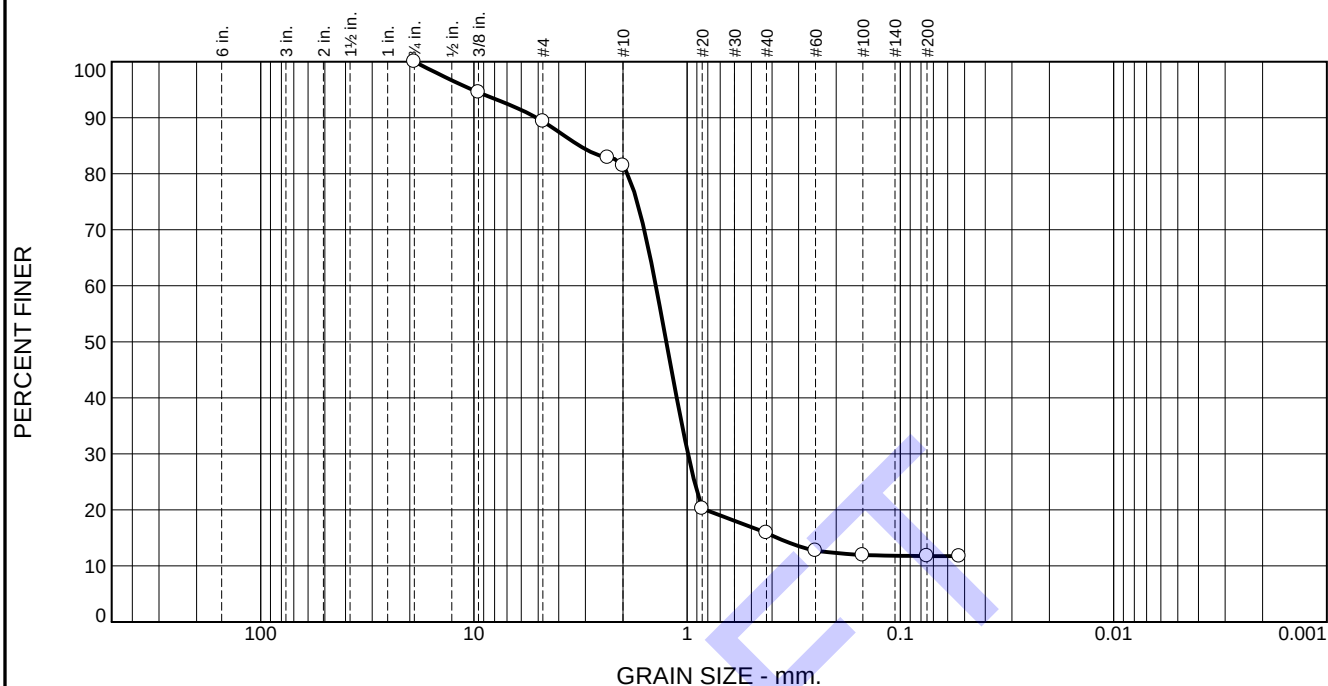
Project No: 20200128E001

Figure

Tested By: BSP

Checked By: BD

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.7	7.8	65.6	4.1	11.8	

TEST RESULTS (ASTM D 422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4"	100.0		
3/8"	94.5		
#4	89.3		
#8	82.9		
#10	81.5		
#20	20.2		
#40	15.9		
#60	12.7		
#100	11.9		
#200	11.8		
#270	11.7		

* (no specification provided)

Material Description

Sand, some silt some gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

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

Coefficients

D₉₀= 5.0912 D₈₅= 3.1993 D₆₀= 1.4025
D₅₀= 1.2525 D₃₀= 0.9914 D₁₅= 0.3781
D₁₀= C_u= C_c=

Remarks

Collected by: ALG

Date Received: 06/02/2020 Date Tested: 06/05/2020

Tested By: BSP

Checked By: BPN

Title:

Source of Sample: Onsite Depth: 76'
Sample Number: EB-13W

Date Sampled: 06/01/2020



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Client: Puyallup School District
Project: FERRUCCI JUNIOR HIGH

Project No: 20200128E001

Figure

APPENDIX E

Infiltration Test Data Sheets

DRAFT

Project Name:	Ferrucci JH Additions	Water Source:	House Bibb
Project Number:	20200128 E001	Meter:	AESI FM#1
Date:	4/30/2020	Pit Area (sq. feet):	4.6' x 3'
Weather:	Mostly Cloudy, 60's	Ring Area (sq. feet):	NA
Test No.:	IT-1	Test Depth (feet):	3.3'
Performed By:	BPN/AG	Receptor Soils:	Pre-Fraser Coarse-Grained Deposits

Time (24-hr)	Flow Rate (gpm)	Stage (feet)	Totalizer (gallons)	Comments
10:00	0.00	0	0.0	Flow on
10:02	3.50	0.18	0.0	
10:03	3.51	0.22	6.9	
10:04	3.50	0.28	10.5	
10:05	3.50	0.30	14.1	
10:06	3.52	0.34	17.3	
10:07	3.52	0.42		slight caving
10:10	4.10	0.46	32.4	
10:15	4.10	0.64	52.8	flow down to 3 gpm
10:20	2.96	0.74	68.2	flow down to 2 gpm
10:25	1.85	0.80	78.6	flow down to 1 gpm
10:30	1.00	0.82	84.1	flow up to 2 gpm
10:35	1.97	0.88	93.7	
10:40	2.00	0.92	103.7	
10:45	1.96	0.97	113.5	flow down to 0.75
11:00	0.75	0.98	125.2	light ran (5 minutes)
11:15	0.74	0.99	136.5	flow down to 0.70 gpm
11:30	0.69	0.99	146.9	11:20 heavier ran start end 11:30
11:45	0.69	1.00	157.2	flow down to 0.65 gpm
12:00	0.64	1.00	167.1	
12:15	0.65	1.00	177.3	
12:30	0.64	1.00	186.6	
12:45	0.64	1.01	196.4	flow down to 0.60 gpm
13:00	0.60	1.02	205.4	flow down to 0.50 gpm
13:15	0.50	1.01	213.0	rain for 10 minutes non-measurable accumulation
13:30	0.50	1.00	220.5	flow up to 0.55 gpm
13:47	0.56	1.00	230.0	
13:48		1.00		water off, bucket test
13:52		0.97		water on end bucket test
14:00	0.60	0.97	236.8	
14:15	0.60	0.97	245.7	
14:30	0.60	0.97	254.7	
14:45	0.60	0.97	263.8	
15:00	0.60	0.98	272.8	
15:15	0.61	0.98	281.9	
15:30	0.60	0.98	291.0	
15:45	0.60	0.99	300.1	
16:00	0.60	0.99	309.2	
16:15	0.60	1.00	318.3	
16:35	0.60	1.00	330.4	
16:45	0.60	1.00	336.5	

Project Name:	Ferrucci JH Additions	Water Source:	House Bibb
Project Number:	20200128 E001	Meter:	AESI FM#1
Date:	4/30/2020	Pit Area (sq. feet):	4.6' x 3'
Weather:	Mostly Cloudy, 60's	Ring Area (sq. feet):	NA
Test No.:	IT-1	Test Depth (feet):	3.3'
Performed By:	BPN/AG	Receptor Soils:	Pre-Fraser Coarse-Grained Deposits

17:00	0.60	1.00	345.6	
17:05		0.99		Flow off, begin falling head
17:10		0.97		
17:15		0.95		
17:30		0.90		
17:45		0.85		
18:00		0.80		

	Average Infiltration Rate (in/hr) during last hour of inflow:	4.1
	Average Infiltration Rate (in/hr) during falling head:	2.5

Note: Meter zeroed at start of test.

DRAFT

Project Name:	Ferrucci JH Additions	Water Source:	Hose Bibb
Project Number:	20200128 E001	Meter:	AESI FM#10
Date:	4/30/2020	Pit Area (sq. feet):	3.2'X3.8'
Weather:	Mostly Cloudy, 60's	Ring Area (sq. feet):	NA
Test No.:	IT-2	Test Depth (feet):	5.7'
Performed By:	BPN/AG	Receptor Soils:	Recessional Lacustrine Deposits

Time (24-hr)	Flow Rate (gpm)	Stage (feet)	Totalizer (gallons)	Comments
9:21	0.00	0	0.0	Flow on
9:25	3.04	0.18	8.4	
9:30	3.20	0.40	24.0	
9:35	1.02	0.48	31.3	
9:40	0.50	0.50	34.0	
9:45	0.32	0.52	35.7	
10:00	0.32	0.58	40.6	
10:15	0.19	0.62	43.6	
10:30	0.19	0.66	46.6	
10:45	0.20	0.69	49.7	
11:00	0.11	0.73	51.6	
11:05		0.73		
11:10		0.72		
11:15		0.72		
11:30		0.71		
11:50		0.71		
11:55		0.71		
12:15		0.70		
12:45		0.68		
13:00		0.67		
13:30		0.65		
13:50		0.64		
14:10		0.63		
14:30		0.61		
14:40		0.60		
14:50		0.60		
15:00		0.59		
15:15		0.58		
15:30		0.57		
15:45		0.56		
16:00		0.55		
16:10		0.55		
16:30		0.54		

	Average Infiltration Rate (in/hr) during last hour of inflow:	not obtained
	Average Infiltration Rate (in/hr) during falling head:	0.36

Note: Meter zeroed at start of test.

APPENDIX F

Environmental Specialties Laboratory Test Results

DRAFT

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Arina Podnozova, B.S.
Eric Young, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282
fbi@isomedia.com
www.friedmanandbruya.com

May 6, 2020

Bob Simons, Project Manager
CMSI
4227 S Meridian, Ste C, No. 625
Puyallup, WA 98373

Dear Mr Simons:

Included are the results from the testing of material submitted on May 1, 2020 from the PSD Ballou, F&BI 005017 project. There are 3 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days, or as directed by the Chain of Custody document. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.



Michael Erdahl
Project Manager

Enclosures
CMS0506R.DOC

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

CASE NARRATIVE

This case narrative encompasses samples received on May 1, 2020 by Friedman & Bruya, Inc. from the CMSI PSD Ballou, F&BI 005017 project. Samples were logged in under the laboratory ID's listed below.

<u>Laboratory ID</u>	<u>CMSI</u>
005017 -01	1

All quality control requirements were acceptable.

DRAFT

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 05/06/20
Date Received: 05/01/20
Project: PSD Ballou, F&BI 005017
Date Extracted: 05/04/20
Date Analyzed: 05/04/20

**RESULTS FROM THE ANALYSIS OF SOIL SAMPLES
FOR GASOLINE, DIESEL AND HEAVY OIL BY NWTPH-HCID**

Results Reported on a Dry Weight Basis
Results Reported as Not Detected (ND) or Detected (D)

THE DATA PROVIDED BELOW WAS PERFORMED PER THE GUIDELINES ESTABLISHED BY THE
WASHINGTON DEPARTMENT OF ECOLOGY AND WERE NOT DESIGNED TO PROVIDE INFORMATION
WITH REGARDS TO THE ACTUAL IDENTIFICATION OF ANY MATERIAL PRESENT

<u>Sample ID</u> Laboratory ID	<u>Gasoline</u>	<u>Diesel</u>	<u>Heavy Oil</u>	Surrogate (% Recovery) (Limit 56-165)
1 005017-01	ND	ND	ND	97
Method Blank 00-1021 MB	ND	ND	ND	98

ND - Material not detected at or above 20 mg/kg gas, 50 mg/kg diesel and 250 mg/kg heavy oil.

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The analyte is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht - The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits due to sample matrix effects.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

10201

Phone _____ Email _____

~~Default: Dispose after 30 days~~

Project specific PLS? - Yes / No

Run if
Detect

[illegible]

TIME

Ph. (206) 285-8282

Received by:

5/1/80	1500
--------	------