

Associated Earth Sciences, Inc.



October 6, 2004  
Project No. KE04474A

Puyallup School District  
323 12<sup>th</sup> Street NW  
Puyallup, Washington 98371

Attention: Mr. David Johnson

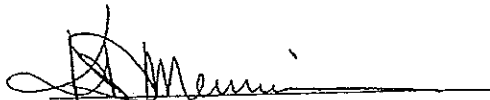
Subject: Subsurface Exploration, Geologic Hazard,  
and Final Geotechnical Engineering Report  
Fruitland Elementary School Additions  
1515 Fruitland Avenue East  
Puyallup, Washington

Dear Mr. Johnson:

Associated Earth Sciences, Inc. (AESI) is pleased to present the enclosed copies of the above-referenced final report. This report summarizes the results of our subsurface exploration, geologic hazard, and geotechnical engineering studies and offers recommendations for the design and development 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. If you should have any questions, or if we can be of additional help to you, please do not hesitate to call.

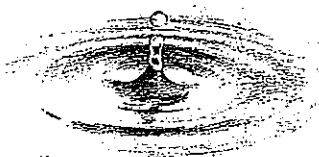
Sincerely,  
**ASSOCIATED EARTH SCIENCES, INC.**  
Kirkland, Washington

  
Kurt D. Merriman, P.E.  
Principal Engineer

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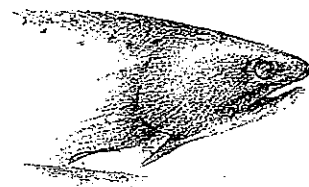
Geotechnical Engineering



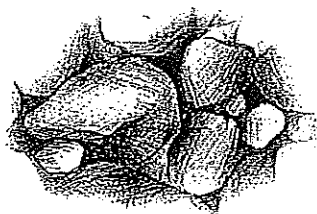
Water Resources



Solid and Hazardous Waste



Ecological/Biological Sciences



Geologic Assessments



# Associated Earth Sciences, Inc.

Subsurface Exploration, Geologic Hazard, and  
Final Geotechnical Engineering Report

## FRUITLAND ELEMENTARY SCHOOL ADDITIONS

Puyallup, Washington

Prepared for

Puyallup School District

Project No. KE04474A  
October 6, 2004

**SUBSURFACE EXPLORATION, GEOLOGIC HAZARD, AND  
FINAL GEOTECHNICAL ENGINEERING REPORT**

**FRUITLAND ELEMENATRY  
SCHOOL ADDITIONS**

**Puyallup, Washington**

*Prepared for:*  
**Puyallup School District**  
323 12<sup>th</sup> Street NW  
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October 6, 2004  
Project No. KE04474A

## **I. PROJECT AND SITE CONDITIONS**

### **1.0 INTRODUCTION**

This report presents the results of our subsurface exploration, geologic hazard, and final geotechnical engineering study for the proposed building additions to be constructed at Fruitland Elementary School located at 1515 Fruitland Avenue East in Puyallup, Washington. The location of the subject site is shown on the Vicinity Map, Figure 1. The addition locations, approximate locations of the explorations accomplished for this study, and other pertinent site features, are presented on the Site and Exploration Plan, Figure 2. In the event that any changes in the nature, design, or location of the structures are planned, the conclusions and recommendations contained in this report should be reviewed and modified, or verified, as necessary.

#### **1.1 Purpose and Scope**

The purpose of this study was to provide subsurface data to be used in the design and development of the above-mentioned project. Our study included a review of applicable geologic literature, drilling test borings, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow ground water conditions. Engineering studies were also conducted to assess the type of suitable foundation, allowable pile capacities, anticipated settlements, and drainage considerations. Our services were completed in accordance with our August 6, 2004 scope of work letter. Our preliminary findings and recommendations were presented in a summary letter dated September 15, 2004. This report summarizes our current fieldwork and offers final development recommendations based on our present understanding of the project and discussions with the project structural engineer.

#### **1.2 Authorization**

Authorization to proceed with this study was granted by Mr. David Johnson of the Puyallup School District. 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 site is an existing elementary school located east of Fruitland Avenue East and north of 23<sup>rd</sup> Avenue SW in Puyallup, Washington. The site is located on the eastern flank of the western ridge that slopes down to the Puyallup River valley.

Based on information provided to us, it is our understanding that two new additions are planned at the northwest and southeast corner of the main school building as shown on the Site and Exploration Plan, Figure 2. Based on discussions with the project structural engineer, we understand that slab-on-grade floors will support conventional pedestrian loads (i.e., no heavy equipment or concentrated loads) and that continuous perimeter foundations for the school buildings will be designed with line loads on the order of 1 kip per lineal foot with column loads on the order of 40 kips. The foundation recommendations presented in this report are based on these assumptions.

## 3.0 SUBSURFACE EXPLORATION

Our field study included drilling five exploration borings on August 28, 2004 with a trailer-mounted drill rig to gain subsurface information about the site. The boring logs are included in the Appendix of this report. The various types of sediments, as well as the depths where characteristics of the sediments changed, are indicated on the exploration logs presented with this report. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types in the field. If changes occurred between sample intervals in our borings, they were interpreted. Our explorations were approximately located in the field by measuring from known site features shown on the site plan dated July 26, 2004 by the Puyallup School District.

The conclusions and recommendations presented in this report are based on the five exploration borings completed for this study. 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 sometimes 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 any variations between the field explorations may not become fully evident until construction. If variations are observed at that time, it may be necessary to reevaluate specific recommendations in this report and make appropriate changes.

### 3.1 Exploration Borings

The exploration borings were completed by advancing a hollow-stem auger with a trailer-mounted drill rig. During the drilling process, samples were generally obtained at 5-foot depth intervals. The borings were continuously observed and logged by a geotechnical engineer

from our firm. The exploration logs presented in the Appendix are based on the field logs, drilling action, and inspection of the samples secured.

Disturbed but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with ASTM:D-1586. This test and sampling method consists of driving a standard 2-inch outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded and the number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance ("N") or blow count. If a total of 50 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 boring logs in the Appendix.

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.

#### 4.0 SUBSURFACE CONDITIONS

Review of the geology mapped in the site area as shown on the State of Washington Department of Conservation Division of Water Resources, Water Supply Bulletin No. 10: *Geology and Ground-Water Resources of Pierce County, Washington, Volume 2* (1966) indicates undifferentiated Vashon glacial drift. Actual geology observed on the site is more complex than is shown on the published map. For this reason, published geologic information for the project area provides a suitable background for this study, but does not provide specific information that is applicable to the specific project site.

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, visual reconnaissance of the site, and review of applicable geologic literature. 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 sometimes 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 any variations between the field explorations may not become fully evident until construction. If variations are observed at that time, it may be necessary to reevaluate specific recommendations in this report and make appropriate changes. The following sections present more detailed subsurface information.

#### 4.1 Stratigraphy

##### *Fill*

The site appears to have been partially graded to provide the relatively level pad on which the existing structures and hardscape are now situated. Previous grading appears to have resulted in man-placed fill within the northern portion of the site. The fill materials appeared to consist of soil similar in gradation to the underlying native soils as discussed below. Where native soil was displaced by past earthwork activity on-site, it was difficult to distinguish from the undisturbed native soil in the exploration borings. In general, we assume that existing fill is present in the vicinity of the existing buildings and parking/drive areas and above buried utilities. The exploration logs might not accurately depict areas of existing fill since they were difficult to differentiate from underlying native soil.

Soil interpreted to be man-placed fill consisting of a mixture of sand, gravel, and silt in a damp, loose to very dense (probably overstated) condition was encountered to a depth of 10 feet in EB-1, 8 feet in EB-2, 9.5 feet in EB-3, and 2 feet in EB-4. No fill was encountered in EB-5. Because the existing fill was observed to vary in density, we recommend that the existing fill not be used for direct support of new foundations, floors, or paving without prior remediation. Portions of this fill may be used as structural fill if appropriately moisture-conditioned and compacted.

##### *Lacustrine Soil*

Below the fill in EB-2 a 3-foot-thick layer of damp to moist, stiff, silty clay was encountered. Below the fill in EB-4 corresponding to the location of the southeast building addition, a 12-foot-thick layer of moist to wet, soft to medium stiff clayey silt was encountered. These soils were interpreted to be lacustrine soils deposited within the last 10,000 years in a low-energy environment (lacustrine) such as a lake or slow-moving stream, which allowed the fine-grained particles to settle undisturbed. Being post glacial, lacustrine soils are normally consolidated and prone to consolidation (settlement) if stress levels increase above the current levels.

Lacustrine soil as encountered in our exploration borings is not, in existing condition, considered suitable for foundation support. With appropriate remedial treatment, the soil, where moisture content is within the compactable range, may be considered suitable for support of hardscape and paving.

In general, the soil where moisture content is within the compactable range is considered suitable for reuse as structural fill. It should be noted that where soils are above their optimum moisture content for compaction, their reuse as structural fill during all but the driest times of the year will be difficult. Existing lacustrine soil was observed to contain silt and is considered very moisture-sensitive.

## *Till*

Natural soils beneath the lacustrine deposit soil in EB-4 and near surface in EB-5 within the western and southern portions of the site consisted of glacially consolidated till. In EB-5, the upper horizon of the till, interpreted as weathered till, consisted of a medium dense, moist, light brown silt to clayey silt. The weathered zone was approximately 2.5 feet in thickness. Below the weathered zone in EB-5 and below the lacustrine deposit in EB-4, the till consisted of a 4.5-foot-thick layer of dense, moist, silty sand with gravel. Several thousand feet of ice consolidated this material during the last glacial advance. This process resulted in a compact soil possessing high strength, low compressibility, and low permeability characteristics. The unweathered till is suitable for foundation support. The unweathered till is anticipated to be difficult to excavate with conventional earthmoving equipment. Heavy-duty rippers will probably be suitable. Till soils typically contain a substantial fine-grained soil fraction, which makes them moisture-sensitive and susceptible to disturbance when wet site or weather conditions exist. Till soils may be suitable for reuse as structural fill where properly moisture-conditioned and compacted.

## *Ice Contact Deposits*

Underlying the fill in EB-1 and EB-3 and underlying the till in EB-5 was a medium dense to very dense, damp to wet mixture of gravel, sand, and silt. This material is interpreted as ice contact. Ice contact represents sediment which has been in contact with the margin of the ice sheet or stagnant blocks of ice and in some instances may not be as dense as sediment deposited directly under the ice sheet. This material will provide suitable foundation support for the proposed structures.

## *Advance Outwash*

Below the till in EB-4, very dense, damp, fine sand with trace silt interpreted as advance outwash was encountered. Advance outwash sediments were deposited as outwash from rivers flowing from the base of the southward advancing glacial front. Glacial till, which represents the ground moraine of the southward advancing glacier, is generally found above the advance outwash and may have been scoured away in other areas of the site. The advance outwash has been overridden by several thousand feet of ice resulting in a dense to very dense, competent soil mass. This process resulted in a compact soil possessing high strength and relatively low compressibility characteristics. The very dense advance outwash is considered to be suitable for foundation support.

## 4.2 Hydrology

No ground water seepage was observed in our borings during exploration. The encountered soils do not typically produce large volumes of water during the short length of time the explorations were open. An accurate evaluation of ground water levels would require the

installation of monitoring wells. It should be noted that the levels of ground water seepage beneath the site may vary in response to changes in such factors as season, precipitation, and site use. Perched ground water is likely to occur above dense soil layers such as the till during wet weather. The volume and duration of flow from a perched layer depends on soil grain size, topography, and season.

## **II. GEOLOGIC HAZARDS AND MITIGATIONS**

The following discussion of potential geologic hazards is based on the geologic, topographic, and shallow ground water conditions as observed and discussed herein.

### **5.0 SEISMIC HAZARDS AND RECOMMENDED MITIGATION**

Earthquakes occur in the Puget Lowland with great regularity. The vast majority of these events are small and are usually not felt by people. However, large earthquakes do occur as evidenced by the 1949, 7.2-magnitude event, the 2001, 6.8-magnitude event, and the 1965, 6.5-magnitude event. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

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

#### **5.1 Surficial Ground Rupture**

Generally, the largest earthquakes that have occurred in the Puget Sound area are sub-crustal events with epicenters ranging from 50 to 70 kilometers in depth. For this reason, no surficial faulting or earth rupture resulting from deep, seismic activity has been documented, to date, in the area of the subject site. Therefore, it is our opinion, based on existing geologic data, that the risk of surface rupture impacting the proposed project is low.

#### **5.2 Seismically Induced Landslides**

It is our opinion that the potential risk of damage to the proposed development by seismically induced landsliding is low due to the lack of steep slopes in the project area.

#### **5.3 Liquefaction**

The site soils have a low potential for liquefaction due to the lack of adverse groundwater conditions within the softer sediments and the relatively high strength of the glacial deposits.

#### 5.4 Ground Motion

It is our opinion that any earthquake damage to the proposed additions when founded as discussed in the *Design Recommendations* section of this report would be caused by the intensity and acceleration associated with the event and not any of the above-discussed impacts. Due to the thickness and consistency of the lacustrine sediments identified in EB-4 beneath the proposed southeast building addition, amplification of seismic motion upward through the soil column is possible. The approximate proposed building period should be compared to the estimated soil column period of vibration to check for resonant conditions. It is these conditions that result in our recommendation for the more stringent  $S_E$  soil type classification for use with the *Uniform Building Code* (UBC) standards and Site Class E for use with the *International Building Code* (IBC) as discussed below. However, for the northwest building addition, soil type  $S_c$  (UBC) and Site Class C (IBC) can be used for design.

The project site is located within a Zone 3 rating for seismic activity on a scale of 1 (lowest) to 4 (highest) based on the *Seismic Zone Map of the United States*, Figure No. 16-2 in the 1997 edition of the UBC. This zonation is based on past earthquake activity in the Puget Sound region. As such, design recommendations in this report accommodate the possible effect of seismic activity in areas with a Zone 3 rating, corresponding to a peak ground acceleration of 0.3g (a Richter magnitude 7.5 earthquake occurring directly beneath the site), in accordance with UBC guidelines. For the reasons indicated in the previous paragraph, this seismic zone factor for the southeast building addition should be used with soil type  $S_E$ .

Alternatively, guidelines presented in the 2003 IBC, Section 1615, may be used. Information presented in Figure 1615(1) indicates a mapped spectral acceleration for short periods of  $S_s = 1.25$ . Information presented in Figure 1615(2) indicates a mapped spectral acceleration for a 1 second period of  $S_1 = 0.40$ . Based on the results of subsurface exploration and on an estimation of soil properties at depth utilizing available geologic data, Site Class "E" in conformance with Table 1615.1.1 may be used. Site coefficients  $F_a = 0.9$  and  $F_v = 2.4$  in conformance with IBC Tables 1615.1.2(1) and 1615(2), respectively, may be used. For the northwest building addition, Site Class "C" should be used with  $F_a = 1.0$  and  $F_v = 1.4$ .

#### 6.0 EROSION HAZARDS AND MITIGATION

The surficial fill and weathered till soils contain substantial quantities of silt and fine sand and will 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. Silt fencing should be placed around the lower perimeter of the cleared area(s). The fencing should be periodically inspected and maintained as necessary to ensure proper function.

2. If possible, construction should proceed during the drier periods of the year.
3. Areas stripped of vegetation during construction should be mulched and hydroseeded, replanted as soon as possible, or otherwise protected. During winter construction, hydroseeded areas should be covered with clear plastic to facilitate grass growth.
4. If excavated soils are to be stockpiled on the site for reuse or to await off-site transport, measures should be taken to reduce the potential for erosion from the stockpile. This could include, but is not limited to, covering the pile with plastic sheeting, the use of low stockpiles, and the use of straw bales/silt fences around pile perimeters.

### III. DESIGN RECOMMENDATIONS

#### 7.0 INTRODUCTION

Based on the soil types encountered in EB-4 (southeast addition) and EB-5 (northwest addition) and the light loads provided by the project structural engineer for the proposed structures, it is our opinion that supporting the structures on spread footing foundations over a properly prepared subgrade is appropriate. Our summary letter dated September 15, 2004 presented several options for supporting structures on deep foundations that extend through the soft to medium stiff lacustrine deposits. However, our current analysis predicts settlement within tolerable limits if the foundations are placed on 2 feet of compacted structural fill over the lacustrine sediments. For the northwest addition, spread footing foundations can be placed directly on medium dense to very dense glacial sediments.

#### 8.0 SITE PREPARATION

Preparation of existing ground will include removal of any existing structures, utilities, pavement, underground storage tanks (USTs), trees, brush, debris, and any other deleterious material within the building addition footprint. Resulting depressions should be backfilled with structural fill as discussed under the *Structural Fill* section of this report.

The on-site soils contain a high percentage of fine-grained material, which makes them moisture-sensitive and subject to disturbance when wet. The contractor must use care during site preparation operations so that the surficial soils are not softened resulting in an impassable site. Depending on the time of year construction commences, the ground surface within the construction area may require stabilization similar to that described below for staging areas to allow access.

To the extent that it is possible, we recommend that the existing paving be used for construction staging. Where existing pavement areas cannot be used, consideration should be given to protecting access and staging areas with an appropriate section of crushed rock or asphalt treated base (ATB). If crushed rock is considered for the access and staging areas it should be underlain by engineering stabilization fabric to reduce the potential of fine-grained materials "pumping up" through the rock and turning the area to mud. The fabric will also aid in supporting construction equipment, thus reducing the amount of crushed rock required. We recommend that at least 12 inches of 2- to 4-inch-diameter crushed, angular rock be placed over the fabric; however, due to the variable nature of the near-surface soils and differences in wheel loads, this thickness may have to be adjusted by the contractor in the field.

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction. For estimating purposes we anticipate that

temporary, unsupported cut slopes in the lacustrine deposits can be made at a maximum slope of 1.5H:1V (Horizontal:Vertical). Temporary, unsupported cuts in weathered or unweathered glacial soils can be made at a maximum slope of 1H:1V. 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.

## 9.0 STRUCTURAL FILL

Structural fill will be necessary beneath footings for the southeast building addition and may be necessary to backfill voids created during site preparation, backfill utility trenches, and/or to establish proper drainage across the construction area. 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.

The upper 12 inches of exposed ground in any areas to receive structural fill should be recompacted to 90 percent of the modified Proctor maximum density using ASTM:D-1557 as the standard. If the subgrade contains too much moisture, adequate recompaction may be difficult or impossible to obtain and should probably not be attempted. In lieu of recompaction, the area to receive fill should be blanketed with washed rock or granular fill to act as a capillary break between the new fill and the wet subgrade. Where the exposed ground remains soft and further overexcavation is impractical, placement of an engineering stabilization fabric (such as Mirafi 500X or equivalent) may be necessary to prevent contamination of the free-draining layer by silt migration from below. After the recompacted exposed ground is tested and approved, or a free-draining rock course is laid, structural fill may be placed to attain desired grades.

Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts with each lift being compacted to at least 95 percent of the modified Proctor maximum density using ASTM:D-1557 as the standard. In the case of roadway and utility trench filling, the backfill should be placed and compacted in accordance with current local or county codes and standards. The top of the compacted fill should extend horizontally outward a minimum distance of 3 feet beyond the location of the perimeter footings or pavement edges before sloping down at a maximum angle of 2H:1V.

Excavated site soil may not be suitable for reuse as structural fill due to the relatively high moisture and silt content. Imported soil may be needed for all structural fill applications. Our settlement calculations assume a minimum in-place compacted unit weight of 135 pounds per cubic foot (pcf) for the 2 feet of structural fill to be placed beneath footings for the southeast building addition. This fill should be either 1 1/4-inch minus crushed rock, 2-inch ballast, or crushed recycled concrete.

The contractor should note that any proposed fill soils must be evaluated by Associated Earth Sciences, Inc. (AESI) prior to their use in fills. This would require that we have a sample of the material 72 hours in advance to perform a Proctor test and/or sieve analyses for compliance with the project specifications. 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. Use of moisture-sensitive soil in structural fills should be limited to favorable dry weather conditions. 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, with at least 30 percent of the sample greater than the No. 4 sieve.

A representative from our firm should observe the stripped subgrade and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests where appropriate. 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.

## 10.0 FOUNDATIONS

It is our opinion that building elements may be supported by a conventional foundation system consisting of spread and continuous footings founded entirely on medium dense to dense glacial deposits (northwest building addition) or 2 feet of structural fill compacted to 95 percent of ASTM:D-1557, over lacustrine deposits (southeast building addition). The 2 feet of structural fill should be crushed rock, ballast, or crushed recycled concrete. The fill should extend laterally 2 feet away from all sides of the footings. A bearing value of 3,000 pounds per square foot (psf) may be used in areas where all footings are placed entirely on medium dense to very dense glacial sediments. For footings placed on structural fill over lacustrine sediments, a bearing capacity of 1,000 psf should be used. An increase of one-third may be used for short-term wind or seismic loading.

Footings placed entirely on glacial deposits will have an estimated total settlement of less than 1 inch, with approximately one-half this amount of estimated differential settlement under both static and seismic conditions. Footings placed entirely on 2 feet of compacted structural fill overlying lacustrine deposits will have an estimated total short-term settlement (including immediate elastic settlement and primary consolidation of the lacustrine silt) of 1 inch, with approximately one-half this amount of estimated differential settlement under both static and seismic conditions. Elastic settlement will occur quickly upon dead load application and is likely to be complete prior to the installation of finished surfaces. Secondary consolidation of the lacustrine silt is estimated on the order of an additional 1 inch over the life of the

structures. However, disturbed soil not removed from footing excavations prior to footing placement could result in increased settlements. All footing areas should be inspected by AESI prior to placing structural fill to verify that the design bearing capacity of the soils has been attained and that construction conforms to the recommendations contained in this report. The governing municipality may require such inspections. Perimeter footing drains should be provided as discussed under the section on *Drainage Considerations*. Exterior spread footings should have a minimum width of 2 feet.

Lateral loads for conventional shallow footings may be designed using a combination of lateral sliding resistance along the bottom of footings and passive earth pressure against the sides of footings. Lateral sliding resistance for footings on the recommended granular structural fill mat may be determined by multiplying the dead load by a coefficient of friction of 0.3. Passive earth pressure should be assumed to be zero at the ground surface and may be assumed to increase with depth at the rate of 100 psf per foot of depth. The foundations must be backfilled with structural fill, compacted to at least 95 percent of the maximum dry density, to achieve the minimum passive resistance indicated. The presented values are allowable and include a safety factor of at least 1.5. Lateral bearing and lateral sliding resistance may be combined.

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 which has not been compacted to at least 95 percent of ASTM:D-1557. In addition, a 1.5H:1V line extending down from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus, footings should not be placed near the edge of steps or cuts in the bearing soils. In addition, the structural fill pad beneath the footings should extend out from the edge of the footings at least one footing width in all directions.

Care should be exercised where new foundations are to be constructed adjacent to existing building footings. New foundation subgrade elevations should match existing, when practical. New foundations placed at a higher elevation than existing footings will impose a vertical and horizontal surcharge to the existing foundations and vice versa. We recommend the project structural engineer review the impacts, in any, of new foundations or existing foundations.

## 11.0 FLOOR SUPPORT

Slabs or pavement to be supported on grade above lacustrine sediments should be supported on a 2-foot-thick structural fill mat. All fill beneath slabs or pavement must be compacted to at least 95 percent of ASTM:D-1557. Floors and pavements can be supported at grade where medium dense to very dense glacial deposits exist. The floor slabs should be cast atop a minimum of 4 inches of washed granolithic material or pea gravel to act as a capillary break. Areas of subgrade that are disturbed (loosened) during construction should be compacted to a non-yielding condition prior to placement of capillary break material. It should also be

protected from dampness by an impervious moisture barrier at least 10 mils thick. The impervious barrier should be placed between the capillary break material and the concrete slab.

## 12.0 DRAINAGE CONSIDERATIONS

The on-site surficial soils are highly moisture-sensitive and will not provide good drainage during heavy precipitation events. Therefore, some method should be in place to contain any storm water runoff and discharge it to a suitable collection system during the earthwork portion of construction. Prior to site work and during construction, the contractor should be prepared to provide temporary storm water storage or discharge mechanisms as necessary.

All footings should be provided with a drain at the footing elevation. Drains should consist of rigid, perforated, PVC pipe surrounded by washed pea gravel. The level of the perforations in the pipe should be set at the bottom of the footing at all locations and the drains should be constructed with sufficient gradient to allow gravity discharge away from the buildings. Roof and surface runoff should not discharge into the footing drain system but should be handled by a separate, rigid, tightline drain. In planning, exterior grades adjacent to walls should be sloped downward away from the structures to achieve surface drainage.

## 13.0 PAVEMENT RECOMMENDATIONS

Site preparation for areas to be paved should consist of overexcavating to remove the existing vegetation, topsoil, and any loose/soft upper soils to expose the underlying stable soils. In areas underlain by lacustrine deposits, the upper 2 feet of soil should be removed and replaced with a 2-foot section of granular structural fill compacted to 95 percent of ASTM:D-1557. An approved engineering stabilization fabric should be placed between the underlying lacustrine sediments and the structural fill. Since the density of the upper soils is variable, random loose/soft areas may exist and the depth and extent of stripping can best be determined in the field by the geotechnical engineer. In addition, along the centerline of parking areas, the subgrade should be slightly inverted to drain toward the catch basins.

After the area to be paved is overexcavated, the exposed ground should be recompacted to 95 percent of ASTM:D-1557. Where required, structural fill should then be placed to achieve desired subbase grades. Upon completion of the recompaction and structural fill placement, the recommended minimum pavement section is 2 inches of asphalt concrete pavement (ACP) underlain by 4 inches of 1½-inch crushed surfacing base course. In delivery truck areas or fire lanes, a minimum 3 inches of ACP and 4 inches of crushed surfacing base course is recommended. The crushed rock courses must be compacted to 95 percent of the maximum density.

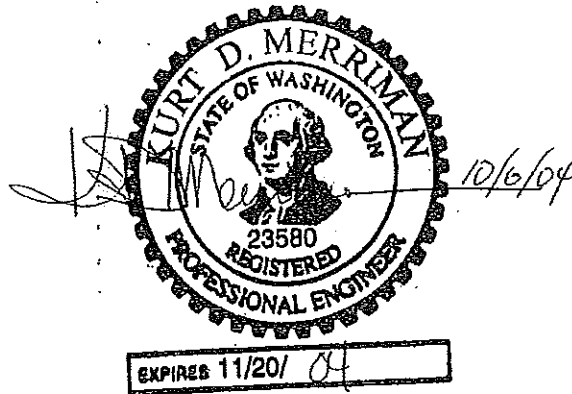
#### 14.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

We are available to provide additional geotechnical consultation as the project design develops and possibly changes from that upon which this report is based. We recommend that we perform a geotechnical review of the plans prior to final design completion. In this way, our earthwork and foundation recommendations will be properly interpreted and implemented in the design. This review is not included in the current scope of work and budget.

We are also available to provide geotechnical engineering and monitoring services during construction. The integrity of the foundations 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 that these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,  
ASSOCIATED EARTH SCIENCES, INC.  
Kirkland, Washington



Susan G. Beckham  
Susan G. Beckham, P.E.  
Project Engineer

Kurt D. Merriman, P.E.  
Principal Engineer

Attachments: Figure 1: Vicinity Map  
Figure 2: Site and Exploration Plan  
Appendix: Exploration Logs

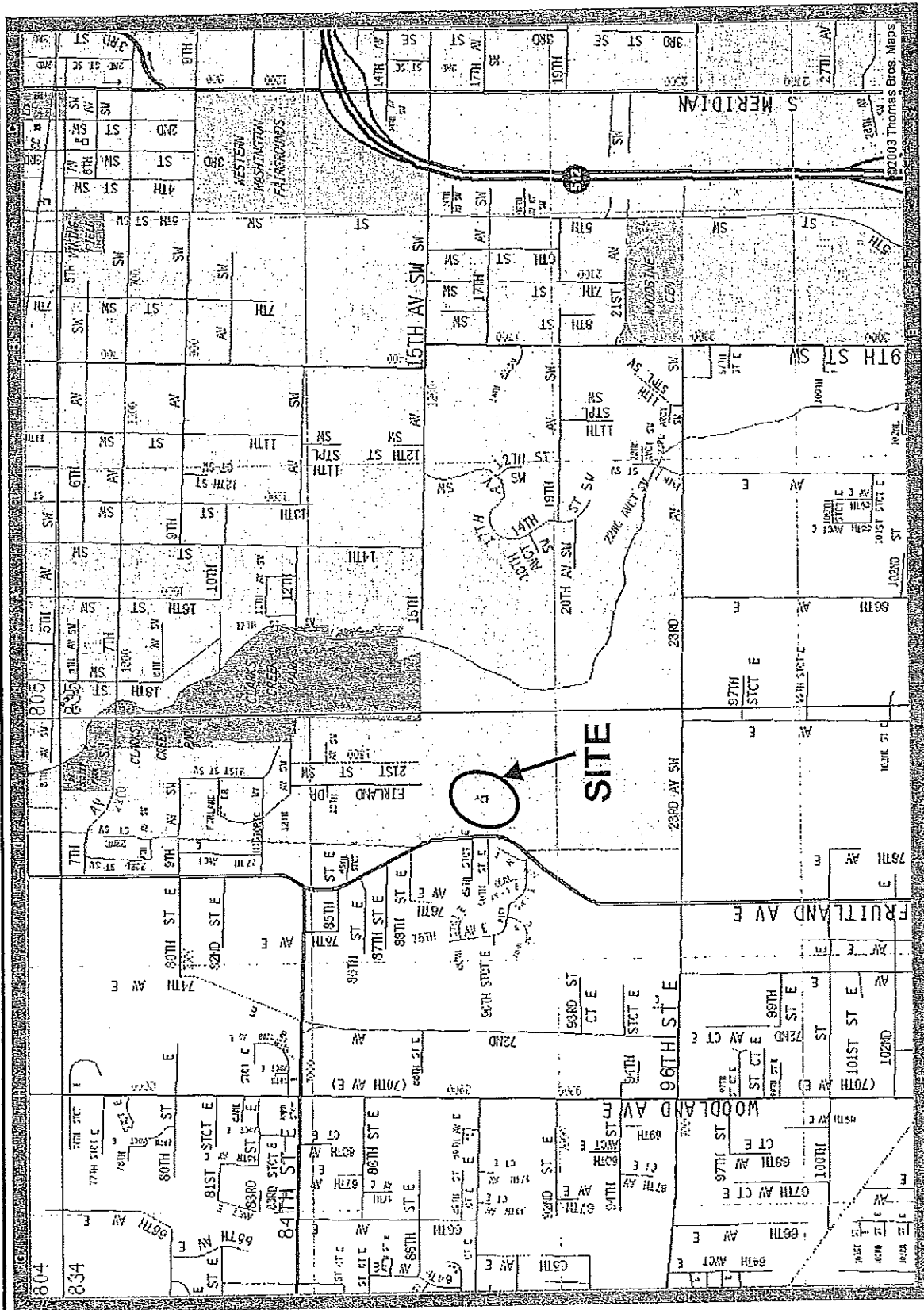
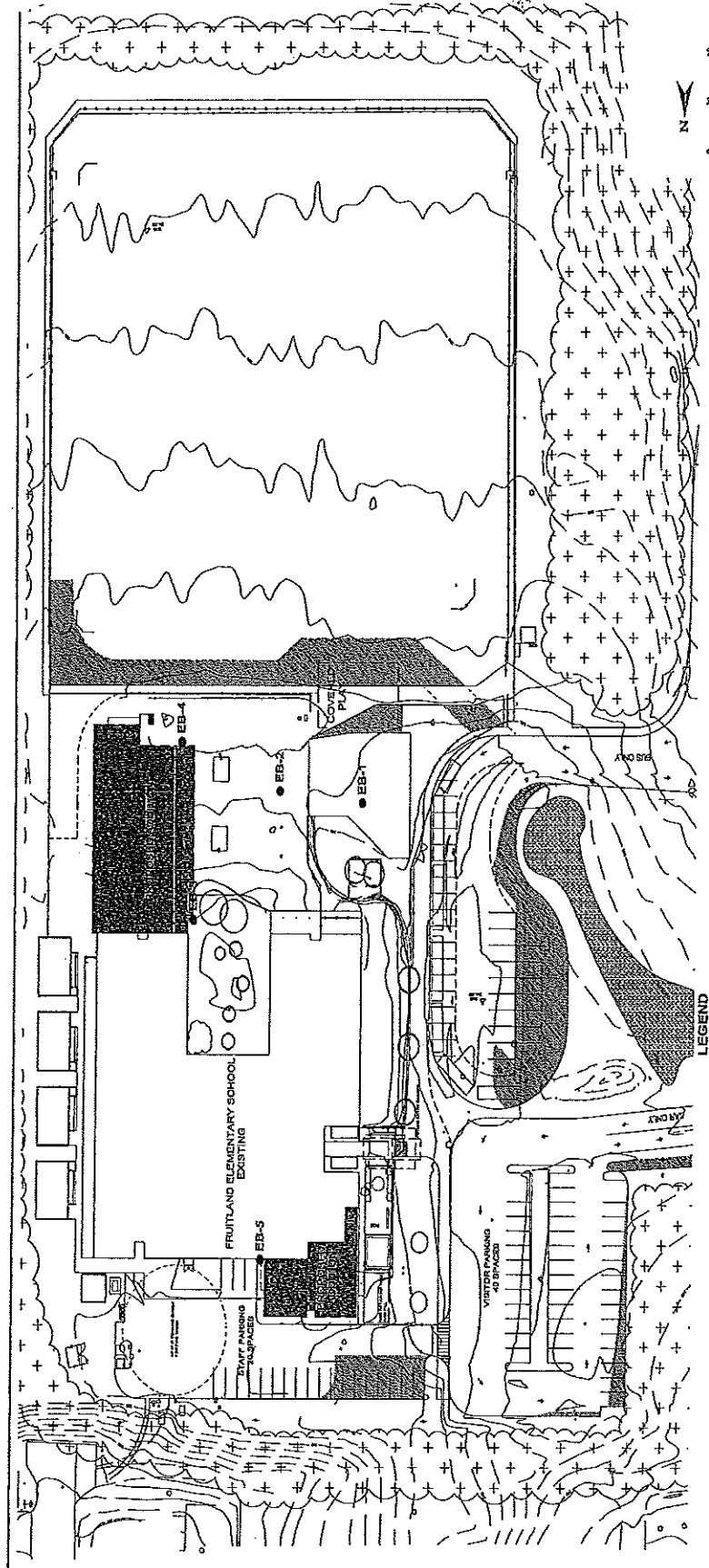


**FIGURE 1**

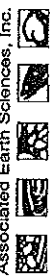
PROJ. NO. KE04474A

**Associated Earth Sciences, Inc.**



Reference: Northwest Architectural Company

Associated Earth Sciences, Inc.



EB-1 ● Approximate location of exploration boring

SITE AND EXPLORATION PLAN  
FRUITLAND ELEMENTARY SCHOOL ADDITIONS  
PUYALLUP, WASHINGTON

FIGURE 2

DATE 08/04

PROJECT NO. KED417A

## APPENDIX

blocks\log\_kay.dwg 11/02/01

## FIGURE

A-1

| Associated Earth Sciences, Inc.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |                                      |                | Exploration Log                                                                                                                                                                                                      |                               |                   |          |            |    |         |                |             |                 |             |          |            |  |  |  |             |             |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   | Project Number<br>KE04474A           |                | Exploration Number<br>EB-1                                                                                                                                                                                           |                               | Sheet<br>1 of 1   |          |            |    |         |                |             |                 |             |          |            |  |  |  |             |             |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Project Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   | Fruitland Elementary School Addition |                |                                                                                                                                                                                                                      | Ground Surface Elevation (ft) |                   |          |            |    |         |                |             |                 |             |          |            |  |  |  |             |             |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Location                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   | Puyallup, WA                         |                |                                                                                                                                                                                                                      | Datum                         |                   |          |            |    |         |                |             |                 |             |          |            |  |  |  |             |             |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Driller/Equipment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   | Boretec / Trailer Rig                |                |                                                                                                                                                                                                                      | Date Start/Finish             |                   |          |            |    |         |                |             |                 |             |          |            |  |  |  |             |             |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hammer Weight/Drop                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   | 140# / 30"                           |                |                                                                                                                                                                                                                      | Hole Diameter (in)            |                   |          |            |    |         |                |             |                 |             |          |            |  |  |  |             |             |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">Depth (ft)</th> <th rowspan="2">S</th> <th rowspan="2">Samples</th> <th rowspan="2">Graphic Symbol</th> <th rowspan="2">DESCRIPTION</th> <th rowspan="2">Well Completion</th> <th rowspan="2">Water Level</th> <th rowspan="2">Blows/6"</th> <th colspan="4">Blows/Foot</th> <th rowspan="2">Other Tests</th> </tr> <tr> <th>10</th> <th>20</th> <th>30</th> <th>40</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> <td>           Sod ( ~4" thick )<br/>           Fill<br/>           Damp, light olive, silty fine to coarse SAND, few fine to coarse subrounded to rounded gravel, trace wood. ( SM )<br/>           Rootlets begin at 18" below ground surface.<br/>           Ice Contact Deposit         </td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>5</td> <td></td> <td>S-1</td> <td></td> <td>Medium dense, damp, light olive-brown, silty fine to medium SAND, few fine to coarse subrounded gravel, trace organics. ( SM )</td> <td></td> <td>7<br/>9<br/>16</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>10</td> <td></td> <td>S-2</td> <td></td> <td>           Ice Contact Deposit<br/>           Very dense, damp, light olive-brown, fine to coarse GRAVEL with little fine to coarse sand, few silt. ( GW )<br/>           At 12' less than 12" sandy interbed.         </td> <td></td> <td>49<br/>34<br/>50/3"</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>▲ 50/3"</td> </tr> <tr> <td>15</td> <td></td> <td>S-3</td> <td></td> <td>At ~15' ranges to moist to wet, fine to coarse SAND, few gravel, trace silt. ( SW )</td> <td></td> <td>19<br/>43<br/>50/5"</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>▲ 50/5"</td> </tr> <tr> <td>20</td> <td></td> <td></td> <td></td> <td>Bottom of exploration boring at 16.5 feet</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>25</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>30</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>35</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> |   |                                      |                |                                                                                                                                                                                                                      |                               |                   |          | Depth (ft) | S  | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot |  |  |  | Other Tests | 10          | 20 | 30 | 40 |  |  |  |  | Sod ( ~4" thick )<br>Fill<br>Damp, light olive, silty fine to coarse SAND, few fine to coarse subrounded to rounded gravel, trace wood. ( SM )<br>Rootlets begin at 18" below ground surface.<br>Ice Contact Deposit |  |  |  |  |  |  |  |  | 5 |  | S-1 |  | Medium dense, damp, light olive-brown, silty fine to medium SAND, few fine to coarse subrounded gravel, trace organics. ( SM ) |  | 7<br>9<br>16 |  |  |  |  |  |  |  | 10 |  | S-2 |  | Ice Contact Deposit<br>Very dense, damp, light olive-brown, fine to coarse GRAVEL with little fine to coarse sand, few silt. ( GW )<br>At 12' less than 12" sandy interbed. |  | 49<br>34<br>50/3" |  |  |  |  |  |  | ▲ 50/3" | 15 |  | S-3 |  | At ~15' ranges to moist to wet, fine to coarse SAND, few gravel, trace silt. ( SW ) |  | 19<br>43<br>50/5" |  |  |  |  |  |  | ▲ 50/5" | 20 |  |  |  | Bottom of exploration boring at 16.5 feet |  |  |  |  |  |  |  |  |  | 25 |  |  |  |  |  |  |  |  |  |  |  |  |  | 30 |  |  |  |  |  |  |  |  |  |  |  |  |  | 35 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Depth (ft)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | S | Samples                              | Graphic Symbol | DESCRIPTION                                                                                                                                                                                                          | Well Completion               | Water Level       | Blows/6" |            |    |         |                |             |                 |             |          | Blows/Foot |  |  |  |             | Other Tests |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   | S-1                                  |                | Medium dense, damp, light olive-brown, silty fine to medium SAND, few fine to coarse subrounded gravel, trace organics. ( SM )                                                                                       |                               | 7<br>9<br>16      |          |            |    |         |                |             |                 |             |          |            |  |  |  |             |             |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   | S-2                                  |                | Ice Contact Deposit<br>Very dense, damp, light olive-brown, fine to coarse GRAVEL with little fine to coarse sand, few silt. ( GW )<br>At 12' less than 12" sandy interbed.                                          |                               | 49<br>34<br>50/3" |          |            |    |         |                |             | ▲ 50/3"         |             |          |            |  |  |  |             |             |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   | S-3                                  |                | At ~15' ranges to moist to wet, fine to coarse SAND, few gravel, trace silt. ( SW )                                                                                                                                  |                               | 19<br>43<br>50/5" |          |            |    |         |                |             | ▲ 50/5"         |             |          |            |  |  |  |             |             |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |                                      |                | Bottom of exploration boring at 16.5 feet                                                                                                                                                                            |                               |                   |          |            |    |         |                |             |                 |             |          |            |  |  |  |             |             |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |                                      |                |                                                                                                                                                                                                                      |                               |                   |          |            |    |         |                |             |                 |             |          |            |  |  |  |             |             |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |                                      |                |                                                                                                                                                                                                                      |                               |                   |          |            |    |         |                |             |                 |             |          |            |  |  |  |             |             |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |                                      |                |                                                                                                                                                                                                                      |                               |                   |          |            |    |         |                |             |                 |             |          |            |  |  |  |             |             |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <div style="display: flex; justify-content: space-between;"> <div> <p><b>Sampler Type (ST):</b></p> <div style="display: flex; flex-wrap: wrap;"> <div style="width: 30%;"> <input type="checkbox"/> 2" OD Split Spoon Sampler (SPT)<br/> <input type="checkbox"/> 3" OD Split Spoon Sampler (D &amp; M)<br/> <input checked="" type="checkbox"/> Grab Sample         </div> <div style="width: 30%;"> <input type="checkbox"/> No Recovery<br/> <input type="checkbox"/> Ring Sample<br/> <input checked="" type="checkbox"/> Shelby Tube Sample         </div> <div style="width: 30%;"> <p>M - Moisture</p> <p>▽ Water Level ( )</p> <p>▽ Water Level at time of drilling (ATD)</p> </div> </div> </div> <div style="text-align: right;"> <p>Logged by:</p> <p>Approved by:</p> </div> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |                                      |                |                                                                                                                                                                                                                      |                               |                   |          |            |    |         |                |             |                 |             |          |            |  |  |  |             |             |    |    |    |  |  |  |  |                                                                                                                                                                                                                      |  |  |  |  |  |  |  |  |   |  |     |  |                                                                                                                                |  |              |  |  |  |  |  |  |  |    |  |     |  |                                                                                                                                                                             |  |                   |  |  |  |  |  |  |         |    |  |     |  |                                                                                     |  |                   |  |  |  |  |  |  |         |    |  |  |  |                                           |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |



## Exploration Log

Project Number  
KE04474AExploration Number  
EB-2Sheet  
1 of 1Project Name Fruitland Elementary School AdditionLocation Puyallup, WADriller/Equipment Boretec / Trailer RigHammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft) \_\_\_\_\_

Datum N/A

Date Start/Finish \_\_\_\_\_

Hole Diameter (in) 6"

| Depth (ft) | S<br>T | Samples | Graphic<br>Symbol | DESCRIPTION                                                                                                                                                                                                  | Well<br>Completion | Water<br>Level | Blows/6"<br>Blows/ft | Blows/Foot |     |     |    | Other Tests |
|------------|--------|---------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------|----------------------|------------|-----|-----|----|-------------|
|            |        |         |                   |                                                                                                                                                                                                              |                    |                |                      | 10         | 20  | 30  | 40 |             |
|            |        |         |                   | Asphalt (~2.5" thick) over crushed rock (~2")<br>Fill                                                                                                                                                        |                    |                |                      |            |     |     |    |             |
|            |        |         |                   | Dry, damp, tan, fine SAND, few silt, trace fine to coarse rounded to angular gravel, trace asphalt, becomes gravelly with depth. ( SP )                                                                      |                    |                |                      |            |     |     |    |             |
|            |        |         |                   | Fill                                                                                                                                                                                                         |                    |                |                      |            |     |     |    |             |
| 5          |        | S-1     |                   | Stiff, damp, mottled, light green and light olive-brown, CLAYEY SILT, trace wood, few sand.                                                                                                                  |                    | 6<br>5<br>7    |                      | ▲12        |     |     |    |             |
|            |        |         |                   | Lacustrine Deposit                                                                                                                                                                                           |                    |                |                      |            |     |     |    |             |
| 10         |        | S-2     |                   | Stiff, damp to moist, light green and tan, iron oxide stained, SILTY CLAY, trace rootlets. ( CL-ML )                                                                                                         |                    | 3<br>4<br>5    |                      | ▲9         |     |     |    |             |
|            |        |         |                   | Fluvial Deposit                                                                                                                                                                                              |                    |                |                      |            |     |     |    |             |
| 15         |        | S-3     |                   | Medium dense, moist, light olive-brown, fine SAND, trace to few silt, trace rounded gravel grading downward to dense, wet, light olive-brown, fine to coarse SAND, trace silt, few rounded gravel. ( SP/SW ) |                    | 6<br>8<br>13   |                      |            | ▲21 |     |    |             |
| 20         |        | S-4     |                   |                                                                                                                                                                                                              |                    | 2<br>12<br>21  |                      |            |     | ▲33 |    |             |
|            |        |         |                   | Bottom of exploration boring at 21.5 feet                                                                                                                                                                    |                    |                |                      |            |     |     |    |             |
| 25         |        |         |                   |                                                                                                                                                                                                              |                    |                |                      |            |     |     |    |             |
| 30         |        |         |                   |                                                                                                                                                                                                              |                    |                |                      |            |     |     |    |             |
| 35         |        |         |                   |                                                                                                                                                                                                              |                    |                |                      |            |     |     |    |             |

## Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture



3" OD Split Spoon Sampler (D &amp; M)



Ring Sample



Water Level ( )



Grab Sample



Shelby Tube Sample



Water Level at time of drilling (ATD)

Logged by: \_\_\_\_\_

Approved by: \_\_\_\_\_

Project Name  
Fruitland Elementary School Addition

Location  
Puyallup, WA

Driller/Equipment  
Boretec / Trailer Rig

Hammer Weight/Drop  
140# / 30"

Ground Surface Elevation (ft)  
Datum  
N/A

Date Start/Finish  
Hole Diameter (in)  
6"

| Depth (ft) | Samples | Graphic Symbol | DESCRIPTION                                                                                                                                                                                                                                                                  | Well Completion | Water Level | Blows/6"      | Blows/Foot |     |     |    | Other Tests |
|------------|---------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------|---------------|------------|-----|-----|----|-------------|
|            |         |                |                                                                                                                                                                                                                                                                              |                 |             |               | 10         | 20  | 30  | 40 |             |
| 5          | S-1     |                | <div>Fill</div> <div>Damp, tan, fine SAND, few silt, trace roots.</div> <div>Fill</div> <div>Damp, light olive-brown, fine to coarse, subangular to rounded GRAVEL, little fine sand, few silt.</div> <div>Cuttings are gravel as above drill action suggests gravels.</div> |                 |             | 35<br>60/4"   |            |     |     |    | ▲50/4"      |
| 10         | S-2     |                | <div>Smoother drill action at 9.5'</div> <div>Ice Contact Deposit</div>                                                                                                                                                                                                      |                 |             | 31<br>7<br>7  |            | ▲14 |     |    |             |
| 15         | S-3     |                | <div>Medium dense, moist, light olive-brown and light greenish gray, silty fine to medium SAND. ( SM ) Few rounded fine to coarse gravel, contains thin (&lt;1") interbeds of fine to medium SAND trace silt.</div> <div>Bottom of exploration boring at 16.5 feet</div>     |                 |             | 4<br>10<br>17 |            |     | ▲27 |    |             |
| 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:

Approved by:



## Exploration Log

Project Number  
KE04474AExploration Number  
EB-4Sheet  
1 of 1Project Name  
Fruitland Elementary School AdditionLocation  
Puyallup, WADriller/Equipment  
Boretac / Trailer RigHammer Weight/Drop  
140# / 30"

Ground Surface Elevation (ft)

Datum  
N/A

Date Start/Finish

Hole Diameter (in)  
.6"

| Depth (ft) | S-T | Samples | Graphic Symbol | DESCRIPTION                                                                                                                                                       | Well Completion | Water Level | Blows/6"       | Blows/Foot |    |    |    | Other Tests |
|------------|-----|---------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------|----------------|------------|----|----|----|-------------|
|            |     |         |                |                                                                                                                                                                   |                 |             |                | 10         | 20 | 30 | 40 |             |
|            |     |         |                | Asphalt (~3" thick) over ~3" crushed rock<br>Fill                                                                                                                 |                 |             |                |            |    |    |    |             |
|            |     |         |                | Moist, mottled, light brown and green, SILT, fine to coarse sand, few gravel. ( ML )                                                                              |                 |             |                |            |    |    |    |             |
|            |     |         |                | Lacustrine Deposit                                                                                                                                                |                 |             |                |            |    |    |    |             |
| 5          |     | S-1     |                | Medium stiff, moist to wet, light brown and greenish gray, CLAYEY SILT, few fine sand, trace rootlets, near top of sample ( CL-ML ), ice loading joints observed. |                 |             | 2<br>3<br>3    | ▲6         |    |    |    |             |
| 10         |     | S-2     |                | Grades downward to soft to medium stiff, wet, light olive-brown, SILT with some iron oxide staining. ( ML )                                                       |                 |             | 1<br>2<br>2    | ▲4         |    |    |    |             |
| 15         |     | S-3     |                | Till<br>Very dense, moist, light olive-brown, SILTY SAND, few rounded gravel. ( SM )                                                                              |                 |             | 10<br>30<br>35 |            |    |    |    | ▲65         |
| 20         |     | S-4     |                | Vashon Advance Outwash Deposit<br>Very dense, damp, light olive-brown, stratified, fine SAND, trace to little silt. ( SP )                                        |                 |             | 16<br>19<br>37 |            |    |    |    | ▲56         |
| 25         |     |         |                | Bottom of exploration boring at 21.5 feet                                                                                                                         |                 |             |                |            |    |    |    |             |
| 30         |     |         |                |                                                                                                                                                                   |                 |             |                |            |    |    |    |             |
| 35         |     |         |                |                                                                                                                                                                   |                 |             |                |            |    |    |    |             |

## Sampler Type (ST):

☐ 2" OD Split Spoon Sampler (SPT)☐ No Recovery

M - Moisture

Logged by:

☐ 3" OD Split Spoon Sampler (D & M)☐ Ring Sample

▽ Water Level ( )

Approved by:

☒ Grab Sample☒ Shelby Tube Sample

▽ Water Level at time of drilling (ATD)



## Exploration Log

Project Number  
KE04474AExploration Number  
EB-5Sheet  
1 of 1Project Name Fruitland Elementary School AdditionLocation Puyallup, WADriller/Equipment Boretec / Traller RigHammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft) \_\_\_\_\_

Datum N/A

Date Start/Finish \_\_\_\_\_

Hole Diameter (in) .6"

| Depth (ft) | S<br>T | Samples | Graphic<br>Symbol | DESCRIPTION                                                                                                                                                                   | Well<br>Completion | Water Level    | Blows/5' | Blows/Foot |    |     |    | Other Tests |
|------------|--------|---------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------|----------|------------|----|-----|----|-------------|
|            |        |         |                   |                                                                                                                                                                               |                    |                |          | 10         | 20 | 30  | 40 |             |
|            |        |         |                   | Asphalt (~3" thick) over ~6" sand and gravel.                                                                                                                                 |                    |                |          |            |    |     |    |             |
|            |        |         |                   | Weathered Till                                                                                                                                                                |                    |                |          |            |    |     |    |             |
|            |        |         |                   | Damp to moist, tan, iron oxide stained, SILT ranging to CLAYEY SILT, trace sand (CL-ML)                                                                                       |                    |                |          |            |    |     |    |             |
|            |        |         |                   | Till                                                                                                                                                                          |                    |                |          |            |    |     |    |             |
| 5          |        | S-1     |                   | Medium dense, moist, light olive-brown, SILT, little sand, few fine to coarse subrounded to rounded gravel (ML), contains thin (<1") interbeds of fine SAND, little silt (SP) |                    | 10<br>19<br>12 |          |            |    | ▲31 |    |             |
|            |        |         |                   | Ice Contact Deposit                                                                                                                                                           |                    |                |          |            |    |     |    |             |
| 10         |        | S-2     |                   | Very dense, moist, olive brown and gray, nonstratified, sandy, fine to coarse GRAVEL, few silt.<br>Drill action suggest coarse gravelly soils below sample #1.                |                    | 37<br>50/5"    |          |            |    |     |    | ▲50/5"      |
| 15         |        | S-3     |                   |                                                                                                                                                                               |                    | 18<br>29<br>33 |          |            |    |     |    | ▲62         |
| 20         |        | S-4     |                   | Ranges to medium dense, light olive brown, stratified, fine SAND, little silt, little gravel, at 20'.<br><br>Bottom of exploration boring at 21.5 feet                        |                    | 16<br>11<br>7  |          |            |    | ▲18 |    |             |
| 25         |        |         |                   |                                                                                                                                                                               |                    |                |          |            |    |     |    |             |
| 30         |        |         |                   |                                                                                                                                                                               |                    |                |          |            |    |     |    |             |
| 35         |        |         |                   |                                                                                                                                                                               |                    |                |          |            |    |     |    |             |

## Sampler Type (ST):



2" OD Split Spoon Sampler (SPT)



No Recovery

M - Moisture



3" OD Split Spoon Sampler (D &amp; M)



Ring Sample



Water Level ( )



Grab Sample



Shelby Tube Sample



Water Level at time of drilling (ATD)

Logged by:

Approved by: