Geotechnical Engineering Services Report

Pierce College Puyallup – STEM Building Design Study
Puyallup, Washington

for

Washington State Department of Enterprise Services

January 21, 2021

Provide copy on-site as sheet S0.21 notes to reference soil report per Engineer Theresa Daniel on foundation details.

GeoEngineers
Earth Science + Technology

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Prepared for:

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Table of Contents

1.0 INTRODUCTION AND PROJECT UNDERSTANDING 1

2.0 SCOPE OF SERVICES 1

3.0 SITE CONDITIONS 1

3.1. Surface Conditions 1
3.2. Literature Review 2
3.2.1. Geologic Maps 2
3.2.2. Soil Survey 2
3.2.3. Geotechnical Report Reviewed 2
3.3. Subsurface Conditions 2
3.3.1. Subsurface Explorations and Laboratory Testing 2
3.3.2. Soil and Groundwater Conditions 3

4.0 CONCLUSIONS AND RECOMMENDATIONS 3

4.1. Primary Geotechnical Considerations 3
4.2. Seismic Design Considerations 4
4.2.1. Seismic Design Parameters 4
4.2.2. Liquefaction 4
4.2.3. Lateral Spreading Potential 4
4.2.4. Surface Rupture Potential 5
4.3. Site Development and Earthwork 5
4.3.1. General 5
4.3.2. Clearing and Stripping 5
4.3.3. Erosion and Sedimentation Control 5
4.3.4. Temporary Excavations and Cut Slopes 6
4.3.5. Permanent Cut and Fill Slopes 6
4.3.6. Groundwater Handling Considerations 7
4.3.7. Surface Drainage 7
4.3.8. Subsurface Drainage 7
4.3.9. Subgrade Preparation 7
4.3.10. Subgrade Protection and Wet Weather Considerations 8
4.4. Fill Materials 8
4.4.1. Structural Fill 8
4.4.2. Select Granular Fill 9
4.4.3. Pipe Bedding 9
4.4.4. Trench Backfill 9
4.4.5. On-Site Soil 9
4.5. Fill Placement and Compaction 10
4.5.1. General 10
4.5.2. Area Fills and Pavement Bases 10
4.5.3. Backfill Behind Walls 10
4.5.4. Trench Backfill 10

4.6. Foundation Support ... 10
4.6.1. General ... 10
4.6.2. Foundation Bearing Surface Preparation ... 11
4.6.3. Allowable Soil Bearing Pressure ... 11
4.6.4. Foundation Settlement ... 12
4.6.5. Lateral Resistance ... 12
4.7. Slab-on-Grade Floors ... 12
4.8. Retaining Walls and Below-Grade Structures ... 13
4.8.1. Design Parameters ... 13
4.8.2. Drainage ... 14
4.9. Infiltration Feasibility Assessment ... 14
5.0 LIMITATIONS ... 14

LIST OF FIGURES

Figure 1. Vicinity Map
Figure 2. Site Plan

APPENDICES

Appendix A. Subsurface Explorations and Laboratory Testing
Figure A-1 – Key to Exploration Logs
Figures A-2 through A-7 – Logs of Test Pits
Figure A-8 – Sieve Analysis Results
Appendix B. Report Limitations and Guidelines for Use

1.0 INTRODUCTION AND PROJECT UNDERSTANDING

This report presents the results of our geotechnical engineering services for the Pierce College Puyallup – Science, Technology, Engineering, Mathematics (STEM) Building project. The project site is located at 1601 39th Avenue SE in Puyallup, Washington as shown on the Vicinity Map, Figure 1. This report is proceeded by a draft report dated December 7, 2020.

Our project understanding is based on review of the "NEW STEM BUILDING, Pierce College Puyallup, Predesign Report" dated August 24, 2020 (Predesign Report). We were also provided with the "Geotechnical Report, Pierce College Puyallup, Communication Arts/Allied Health Building, Puyallup, Washington" dated May 9, 2006 and prepared by HWA Geosciences Inc. (HWA Report).

The Predesign Report indicates that the proposed STEM building will be constructed at the east site (Alternate B) in the north-central portion of campus in a currently forested area. The proposed building location is located to the east-southeast of the existing Communication Arts and Allied Health building and to the west of campus Parking Lot C. The building is to consist of a 54,400-square-foot, three-story structure containing classrooms, laboratories, faculty offices and study spaces. We understand that the project is in the beginning stages and that the project team seeks to establish baseline geotechnical data and recommendations to support future planning and design. Baseline data requested and recommendations provided include a description of soil and groundwater conditions, seismic hazards, building foundation options, stormwater infiltration feasibility, re-use of on-site soil as structural fill and backfill and other recommended design parameters.

It is our understanding that this project will ultimately be contracted as progressive design-build delivery method. As such, in the spirit of the progressive design-build format, innovation in project design and builder risk can be incorporated into the final planning, design, and construction process, within reason. We provide the geotechnical recommendations included in this report as baseline conditions, upon which the contractor may rely on within the context that they are presented. Any design-builder innovations or risks that alter the provided recommendations or the context within which they are provided, are done so at the design-builder's sole risk and would need to be fully supported by a separate set of geotechnical engineering recommendations.

2.0 SCOPE OF SERVICES

Our services have been provided in general accordance with our proposal for this project dated July 13, 2020 and Signed Agreement No. 2020-148 T(3) dated on September 4, 2020. A complete list of our scope or services is provided in our proposal.

3.0 SITE CONDITIONS

3.1. Surface Conditions

The site is bounded by undeveloped, forested land to the north, campus Parking Lot C to the east, and existing Pierce College buildings, landscaped and hardscaped common areas to the west and south. The site is currently forested with mature coniferous and deciduous trees and a dense understory layer, including brush, small trees, fallen trees, and forest duff. Site topography generally slopes upward toward the west-southwest of the site from approximate Elevation 526 feet to Elevation 532 feet (NAVD88).

3.2. Literature Review

3.2.1. Geologic Maps

Our understanding of the site geology is based on review of the *Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington* (Schuster, et al. 2015). The geologic map indicates the site is underlain by "Vashon Till" (Q_{gt}). "Recessional outwash" (Q_{go}) is also mapped in the near project vicinity. Vashon Till is glacially consolidated and is described as a low permeability, highly compact mixture of sand, gravel, silt and clay that can contain cobbles and boulders dispersed throughout.

Recessional outwash is generally described as variably sorted silt, clay, sand and gravel deposited by receding glacial ice. The outwash is typically underlain at some depth by glacial till. Recessional outwash deposits are not glacially consolidated and are generally loose to medium dense.

3.2.2. Soil Survey

We reviewed the Natural Resources Conservation Service (NRCS) Web Soil Survey (accessed October 29, 2020). According to the survey, the site is underlain by Kapowsin gravelly ashy loam, 6 to 15 percent slopes. Kapowsin gravelly ashy loam is described as moderately well drained with a very low capacity of the most limiting layer to transmit water and categorized as Hydrologic Soil Group B.

3.2.3. Geotechnical Report Reviewed

We reviewed the following geotechnical report for this project.

- "Geotechnical Report, Pierce College Puyallup, Communication Arts/Allied Health Building, Puyallup, Washington" dated May 9, 2006 prepared by HWA Geosciences, Inc.

HWA Geosciences, Inc. completed four test pits for the Communication Arts/Allied Health building to the northwest of the project site. In HWA's explorations, they noted typical soil conditions consisted of about 1 foot of forest duff overlying medium dense, weathered glacial deposits on the order of 1 to 5 feet thick. The weathered glacial deposits were noted to overlie dense to very dense granular glacial outwash deposits with interbedded lenses of glacial till. Cobbles and boulders were also encountered in their explorations. No groundwater seepage was observed in their explorations at the time of excavations, and they noted mottling of soils and increased moisture typically below 9 to 10 feet depth.

3.3. Subsurface Conditions

3.3.1. Subsurface Explorations and Laboratory Testing

We explored subsurface conditions at the site by excavating six test pits (TP-1 through TP-6) at the approximate locations shown on the attached Site Plan, Figure 2. A description of our subsurface exploration program and summary exploration logs are provided in Appendix A.

Selected samples collected from our test pits were tested in our laboratory to confirm field classifications and to evaluate pertinent engineering properties. Our laboratory testing program included grain-size distribution analyses and moisture content determinations. A summary of our laboratory testing program and the test results are provided in Appendix A.

3.3.2. Soil and Groundwater Conditions

In our explorations, after partially clearing the surface with the excavator, we typically observed about 4 to 8 inches of forest duff and/or organic-rich soil. Undisturbed forest duff thickness was typically on the order of about 9 to 12 inches. The depths of soil units described below are with respect to the partially cleared areas of forest duff thickness.

Beneath the forest duff, we generally observed silty sand with varying gravel content in a loose to dense condition to a depth of about 2 to 4½ feet below ground surface (bgs). Abundant roots were noted to a depth of about 2 feet bgs. We interpret the soil directly underlying the forest duff to be weathered glacial till. Underlying the weathered glacial till we observed silty sand with gravel to silty gravel with sand and occasional cobbles in a dense to very dense condition, which we interpret to be glacial till, extending to the full depths explored. We also encountered occasional boulders in exploration TP-1.

We did not observe the regional groundwater table nor indications of perched groundwater in our explorations. However, based on our experience, it is not uncommon for glacial soils to contain isolated zones of perched groundwater. Though not observed in our explorations, we anticipate that perched groundwater could be present in other areas at the site depending on soil conditions, rainfall amounts, irrigation activities and other factors. We anticipate that perched groundwater levels will generally be highest during the wet season, typically October through May.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1. Primary Geotechnical Considerations

Based on our understanding of the project, the explorations performed for this study, review of subsurface information near or within the project vicinity and our experience, it is our opinion that the proposed improvements can be designed and constructed generally as envisioned with regard to geotechnical considerations. A summary of the primary geotechnical considerations for the project is provided below and is followed by our detailed recommendations.

- Proposed structures at the site can be supported using shallow foundations and slabs-on-grade, provided that the foundation bearing surfaces are prepared as recommended. We do not anticipate that significant overexcavation will be required, unless isolated areas of loose, or otherwise unsuitable areas are encountered near foundation grade.
- We did not identify soils that we interpret to be prone to liquefaction in our explorations. In our opinion, the risk of liquefaction occurring at this site is low.
- Clearing and stripping depths for forest duff at the site will typically be on the order of 9 to 12 inches. Abundant roots were observed to a depth of about 2 feet bgs, which may require greater clearing and stripping efforts when establishing bearing surfaces for structures on site.
- Near-surface soils observed at the site contain a significant quantity of fines and, therefore, could be difficult or impossible to work with when wet or become easily disturbed if exposed to wet weather. Depending on the intended use of the material and the moisture/weather conditions, it may be difficult to re-use near-surface soils as structural fill.

- Based on our observations, the infiltration capacity of the observed site soils is low. Additional field testing will be necessary to further evaluate the suitability of site soils for stormwater infiltration and to establish a design infiltration rate if infiltration is included in design.

4.2. Seismic Design Considerations

4.2.1. Seismic Design Parameters

We understand seismic design of proposed structures will be performed using procedures outlined in the 2018 International Building Code (IBC). The 2018 IBC states structures shall be designed and constructed to resist the effects of earthquake motions in accordance with American Society of Civil Engineers (ASCE) 7-16.

We used map-based values as recommended by the United States Geological Survey (USGS) to determine the seismic design spectrum in accordance with ASCE 7-16. Based on subsurface conditions observed in our explorations, our review of site geology and our experience in the area, we anticipate soils below our explorations and extending to depth are glacially consolidated and dense to very dense. For seismic design and analysis, we recommend using a response spectrum for Site Class C. We recommend the parameters provided in Table 1 below be used for design.

TABLE 1. SEISMIC DESIGN CRITERIA

2018 IBC (ASCE 7-16) Seismic Design Parameters	
Spectral Response Acceleration at Short Periods (S_S)	1.253g
Spectral Response Acceleration at 1-Second Periods (S_1)	0.432g
Site Class	C
Design Peak Ground Acceleration (PGA_M)	0.6g
Design Spectral Response Acceleration at Short Periods (S_{DS})	1.003g
Design Spectral Response Acceleration at 1-Second Periods (S_{D1})	0.432g

4.2.2. Liquefaction

Liquefaction refers to a condition where vibration or shaking of the ground, usually from earthquake forces, results in development of excess pore pressures in loose, saturated soils and subsequent loss of strength in the deposit of soil so affected. In general, soils that are susceptible to liquefaction include loose to medium dense sands to silty sands that are below the water table. The *Liquefaction Susceptibility Map of Pierce County, Washington* (Palmer, et al. 2004) indicates the site soils have a “very low” liquefaction potential. Based on the soil and groundwater conditions observed in our explorations and those documented in the report reviewed, we conclude that the potential for liquefaction at the site is low.

4.2.3. Lateral Spreading Potential

Lateral spreading related to seismic activity typically involves lateral displacement of large, surficial blocks of non-liquefied soil when a layer of underlying soil loses strength during seismic shaking. Lateral spreading usually develops in areas where sloping ground or large grade changes (including retaining walls) are present. Based on our understanding of the liquefaction risk at the site and the proposed improvements, it is our opinion that the risk of lateral spreading is low.

4.2.4. Surface Rupture Potential

According to the Washington State Department of Natural Resources Interactive Geologic Information Portal and the USGS Interactive Quaternary Faults Database (both accessed October 30, 2020), the nearest mapped fault is located about 6 miles north/northeast of the site. The fault is oriented in a northwest-southeast direction and is identified as part of the Tacoma fault zone system (USGS Fault ID No. 581; USGS Fault Class A). Based on the proximity of the site to this nearest mapped fault and fault information available at the time of this study, it is our opinion the risk for surface rupture at this site is low.

4.3. Site Development and Earthwork

4.3.1. General

We anticipate that site development and earthwork will include clearing and grubbing, site grading, excavating for shallow foundations, utilities and other improvements, establishing subgrades for foundations and roadways and placing and compacting fill and backfill materials. We expect that site grading and earthwork can be accomplished with conventional earthmoving equipment. The following sections provide specific recommendations for site development and earthwork.

4.3.2. Clearing and Stripping

We anticipate that clearing and stripping depths at the site will typically be on the order of 9 to 12 inches to remove forest duff. However, abundant roots were observed to about 2 feet bgs; therefore, it is likely that greater stripping depths will be required in areas of heavier vegetation or relatively lower lying areas.

During stripping operations excessive disturbance of surficial soils can occur, especially if left exposed to wet conditions. Glacial till soils expected to be exposed after clearing and stripping have a relatively high fines content and can be easily disturbed during wet weather. Clearing and stripping at the site should be performed during dry weather and/or exposed soils should be promptly covered and protected to avoid excessive disturbance. Disturbed soils may require additional compaction or remediation during construction and grading.

Cobbles were encountered in our explorations, and boulders were encountered in exploration TP-1. Cobbles and boulders are commonly present in glacial till soils in the project area. The contractor should be prepared to remove cobbles and boulders if encountered during grading or excavation. Boulders may be removed from the site or used in landscape areas. Voids caused by boulder removal should be backfilled with structural fill.

4.3.3. Erosion and Sedimentation Control

Erosion and sedimentation rates and quantities can be influenced by construction methods, slope length and gradient, amount of soil exposed and/or disturbed, soil type, construction sequencing and weather. Implementing an Erosion and Sedimentation Control Plan will reduce impacts to the project where erosion-prone areas are present. The plan should be designed in accordance with applicable city, county and/or state standards. The plan should incorporate basic planning principles, including:

- Scheduling grading and construction to reduce soil exposure;
- Re-vegetating or mulching denuded areas;
- Directing runoff away from exposed soils;

- Reducing the length and steepness of slopes with exposed soils;
- Decreasing runoff velocities;
- Preparing drainage ways and outlets to handle concentrated or increased runoff;
- Confining sediment to the project site; and
- Inspecting and maintaining control measures frequently.

Temporary erosion protection should be used and maintained in areas with exposed or disturbed soils to help reduce erosion and reduce transport of sediment to adjacent areas and receiving waters. Permanent erosion protection should be provided by paving, structure construction or landscape planting.

Until the permanent erosion protection is established, and the site is stabilized, site monitoring may be required by qualified personnel to evaluate the effectiveness of the erosion control measures and to repair and/or modify them as appropriate. Provisions for modifications to the erosion control system based on monitoring observations should be included in the erosion and sedimentation control plan. Where sloped areas are present, some sloughing and raveling of exposed or disturbed soil on slopes should be expected. We recommend that disturbed soil be restored promptly so that surface runoff does not become channeled.

4.3.4. Temporary Excavations and Cut Slopes

Based on observations made during excavation of our test pits and our experience with other projects in similar soil conditions, we anticipate that shallow or even moderately deep (about 10-foot) excavations could maintain vertical slopes for extended periods of time with only minor caving. However, excavations deeper than 4 feet should be shored or laid back at a stable slope if workers are required to enter. Shoring and temporary slope inclinations must conform to the provisions of Title 296 Washington Administrative Code (WAC), Part N, “Excavation, Trenching and Shoring.” Regardless of the soil type encountered in the excavation shoring, trench boxes or sloped sidewalls will be required under Washington Industrial Safety and Health Act (WISHA). We recommend contract documents specify that the contractor is responsible for selecting excavation and dewatering methods, monitoring the excavations for safety and providing shoring, as required, to protect personnel and structures.

In general, we recommend that for planning purposes all temporary cut slopes be inclined no steeper than about 1½H to 1V (horizontal to vertical) if workers are required to enter the excavation. This guideline assumes all surface loads are kept at a minimum distance of at least one-half the depth of the cut away from the top of the slope and that seepage is not present on the slope face. Flatter cut slopes will be necessary where seepage occurs or if surface surcharge loads are anticipated. Temporary covering with heavy plastic sheeting should be used to protect these slopes during periods of wet weather.

4.3.5. Permanent Cut and Fill Slopes

We recommend permanent slopes be constructed at a maximum inclination of 2H to 1V to manage erosion. Where 2H to 1V permanent slopes are not feasible, protective facings and/or retaining structures should be considered.

To achieve uniform compaction, we recommend fill slopes be overbuilt and subsequently cut back to expose well-compacted fill. Fill placement on existing slopes steeper than 5H to 1V should be benched into the slope face. The configuration of benches depends on the equipment being used and the inclination of the existing slope. Bench excavations should be level and extend into the slope face at least half the width of the compaction equipment used.

Exposed areas should be re-vegetated as soon as practical to reduce surface erosion and sloughing. Temporary protection should be used until permanent protection is established.

4.3.6. Groundwater Handling Considerations

Based on our understanding of the proposed site improvements, we do not anticipate that the regional groundwater table will be encountered during excavations for this project.

Although not encountered in our explorations, areas of perched groundwater could be encountered at the site. The interface between more permeable and less permeable zones such as the contact between weathered glacial till and glacial till are likely locations for accumulation of perched groundwater. Groundwater handling needs will typically be lower during the summer and early fall months. We anticipate that shallow perched groundwater can be handled adequately with sumps, pumps, and/or diversion ditches, as necessary. Ultimately, we recommend that the contractor performing the work be made responsible for controlling and collecting groundwater encountered.

4.3.7. Surface Drainage

Surface water from roof downspouts, driveways and landscape areas should be collected and controlled. Curbs or other appropriate measures such as sloping pavements, sidewalks and landscape areas should be used to direct surface flow away from buildings, erosion sensitive areas and from behind retaining structures. Roof and catchment drains should not be connected to wall or foundation drains.

4.3.8. Subsurface Drainage

Based on our subsurface explorations, the site generally consists of low permeable, undisturbed glacial till soils at relatively shallow depths (on the order of 2 to 4½ feet bgs). Excavations that extend into undisturbed glacial till, such as foundation excavations, will likely create a perched groundwater condition. Utility trenches that extend into undisturbed glacial till and are backfilled with structural fill could also create perched groundwater due to difference in permeability between trench backfill and undisturbed glacial till.

Based on our explorations, we recommend that perimeter foundation drains be considered in the project design. It is our opinion that the building slab does not need to be drained unless excessive water is encountered during excavation and grade development for the building slab. To manage perched groundwater within site excavations and where groundwater or high moisture would be detrimental to other site improvements, other special drainage details could be required. For example, to clear groundwater accumulation in utility trenches and other excavations backfilled with permeable material and where also located near structures.

4.3.9. Subgrade Preparation

Subgrades that will support structures and roadways should be thoroughly compacted to a uniformly firm and unyielding condition on completion of stripping and before placing structural fill. We recommend that subgrades for structures and roadways be evaluated, as appropriate, to identify areas of yielding or soft soil. Probing with a steel probe rod or proof-rolling with a heavy piece of wheeled construction equipment are appropriate methods of evaluation.

If soft or otherwise unsuitable subgrade areas are revealed during evaluation that cannot be compacted to a stable and uniformly firm condition, we recommend that: (1) the unsuitable soils be scarified (e.g., with a ripper or farmer's disc), aerated and recompacted, if practical; or (2) the unsuitable soils be removed and replaced with compacted structural fill, as needed.

4.3.10. Subgrade Protection and Wet Weather Considerations

Near-surface soils observed at the site contain a significant quantity of fines and will be susceptible to disturbance during periods of wet weather. The wet weather season generally begins in October and continues through May in western Washington; however, periods of wet weather can occur during any month of the year. It may be possible to conduct earthwork at the site during wet weather months provided appropriate measures are implemented to protect exposed soil. If earthwork is scheduled during the wet weather months, we offer the following recommendations:

- Measures should be implemented to remove or eliminate the accumulation of surface water from work areas. The ground surface in and around the work area should be sloped so that surface water is directed away and graded so that areas of ponded water do not develop. Measures should be taken by the contractor to prevent surface water from collecting in excavations and trenches.
- Earthwork activities should not take place during periods of heavy precipitation.
- Slopes with exposed soils should be covered with plastic sheeting.
- The contractor should take necessary measures to prevent on-site soils and other soils to be used as fill from becoming wet or unstable. These measures may include the use of plastic sheeting, sumps with pumps and grading. The site soils should not be left uncompacted and exposed to moisture. Sealing exposed soils by rolling with a smooth-drum roller prior to periods of precipitation will help reduce the extent to which these soils become wet or unstable.
- Construction traffic should be restricted to specific areas of the site, preferably areas that are surfaced with working pad materials not susceptible to wet weather disturbance.
- Construction activities should be scheduled so that the length of time that soils are left exposed to moisture is reduced to the extent practical.
- Protective surfacing such as placing asphalt-treated base (ATB) or haul roads made of quarry spalls or a layer of free-draining material such as well-graded pit-run sand and gravel may be considered to limit disturbance to completed areas. Minimum quarry spall thicknesses should be on the order of 12 to 18 inches. Typically, minimum gravel thicknesses on the order of 24 inches are necessary to provide adequate subgrade protection.

4.4. Fill Materials

4.4.1. Structural Fill

The workability of material for use as structural fill will depend on the gradation and moisture content of the soil. Material used for structural fill should be free of debris, organic contaminants and rock fragments larger than 6 inches. For most applications, structural fill consisting of material similar to "Select Borrow" or "Gravel Borrow" as described in Section 9-03.14 of the Washington State Department of Transportation (WSDOT) Standard Specifications will be appropriate.

Weather and site conditions should be considered when determining the type of import fill materials purchased and brought to the site for use as structural fill. If earthwork activities are scheduled during the wet weather months or during prolonged periods of wet weather, we recommend that washed crushed rock or select granular fill, as described below, be used for structural fill.

If prolonged dry weather prevails during the earthwork phase of construction, materials with a somewhat higher fines content may be acceptable.

4.4.2. Select Granular Fill

Select granular fill should consist of well-graded sand and gravel or crushed rock with a maximum particle size of 6 inches and less than 5 percent fines by weight based on the minus ¾-inch fraction. Organic matter, debris or other deleterious material should not be present. In our opinion, material with gradation characteristics similar to WSDOT Specification 9-03.9 (Aggregates for Ballast and Crushed Surfacing), or 9-03.14 (Borrow) is suitable for use as select granular fill, provided that the fines content is less than 5 percent (based on the minus ¾-inch fraction) and the maximum particle size is 6 inches.

4.4.3. Pipe Bedding

Trench backfill for the bedding and pipe zone should consist of well-graded granular material similar to "Gravel Backfill for Pipe Zone Bedding" described in Section 9-03.12(3) of the WSDOT Standard Specifications. The material must be free of roots, debris, organic matter and other deleterious material. Other materials may be appropriate depending on manufacturer specifications and/or local jurisdiction requirements.

4.4.4. Trench Backfill

Trench backfill must be free of debris, organic material and rock fragments larger than 6 inches. We recommend that trench backfill material consist of material similar to "Select Borrow" or "Gravel Borrow" as described in Section 9-03.14 of the WSDOT Standard Specifications.

4.4.5. On-Site Soil

Based on our subsurface explorations and experience, it is our opinion that existing site soils, excluding the forest duff, may be considered for use as structural fill and trench backfill, provided that it can be adequately moisture conditioned, placed and compacted as recommended and does not contain organic or other deleterious material. Based on our experience, the glacial till and weathered glacial till at the site are extremely moisture sensitive and will be very difficult or impossible to properly compact when wet.

In addition, it is likely that existing soils will be above optimum moisture content (OMC) when excavated, unless earthwork activities take place in the middle of summer. Even then, the soil could still be above OMC when excavated. Soils placed and compacted above OMC are typically difficult to work with and may have trouble achieving adequate compaction. If earthwork occurs during a typical wet season, or if the soils are persistently wet and cannot be dried back due to prevailing wet weather conditions or lack of drying space/time, we recommend the use of imported structural fill or select granular fill, as described above.

4.5. Fill Placement and Compaction

4.5.1. General

To obtain proper compaction, fill and backfill soil should be compacted near the OMC and in uniform horizontal lifts. Lift thickness and compaction procedures will depend on the moisture content and gradation characteristics of the soil and the type of equipment used. The maximum allowable moisture content varies with the soil gradation and should be evaluated during construction. Generally, 8- to 12-inch loose lifts are appropriate for steel-drum vibratory roller compaction equipment. Compaction should be achieved by mechanical means. During fill and backfill placement, sufficient testing of in-place density should be conducted to check that adequate compaction is being achieved.

4.5.2. Area Fills and Pavement Bases

Fill placed to raise site grades and materials under pavements and structural areas should be placed on subgrades prepared as previously recommended. Fill material placed below structures and footings should be compacted to at least 95 percent of the theoretical maximum dry density (MDD) per ASTM International (ASTM) D 1557. Fill material placed shallower than 2 feet below pavement sections should be compacted to at least 95 percent of the MDD. Fill placed deeper than 2 feet below pavement sections should be compacted to at least 90 percent of the MDD. Fill material placed in landscaping areas should be compacted to a firm condition that will support construction equipment, as necessary, typically around 85 to 90 percent of the MDD.

4.5.3. Backfill Behind Walls

Backfill behind retaining walls or below-grade structure walls should be compacted to between 90 and 92 percent of the MDD. Overcompaction of fill placed directly behind walls should be avoided. We recommend use of hand-operated compaction equipment and maximum 6-inch loose lift thickness when compacting fill within about 5 feet behind walls.

4.5.4. Trench Backfill

For utility excavations, we recommend that the initial lift of fill over the pipe be thick enough to reduce the potential for damage during compaction, but generally should not be greater than about 18 inches above the pipe. In addition, rock fragments greater than about 1 inch in maximum dimension should be excluded from this lift.

Trench backfill material placed below structures and footings should be compacted to at least 95 percent of the MDD. In paved areas, trench backfill should be uniformly compacted in horizontal lifts to at least 95 percent of the MDD in the upper 2 feet below subgrade. Fill placed below a depth of 2 feet from subgrade in paved areas must be compacted to at least 90 percent of the MDD. In non-structural areas, trench backfill should be compacted to a firm condition that will support construction equipment as necessary.

4.6. Foundation Support

4.6.1. General

In our opinion, the proposed structures at the site can be satisfactorily supported on continuous wall and isolated column footings. Exterior footings should be established at least 18 inches below the lowest adjacent grade. Interior footings can be founded a minimum of 12 inches below the bottom of the floor slab. Isolated column and continuous wall footings should have minimum widths of 24 and 18 inches, respectively.

Based on the groundwater conditions in our explorations and our understanding of the proposed footing elevations (bottom of footings established within a few feet of existing site grade), it is our opinion footing drains are not necessary to maintain bearing support as provided in this report. However, it is possible and even likely that perched groundwater zones will develop within fill placed over native glacial till soils at the site. Footing drains or perimeter drains are recommended to reduce the potential for perched groundwater accumulation in the fill around building foundations.

The sections below provide our recommendations for foundation bearing surface preparation and foundation design parameters.

4.6.2. Foundation Bearing Surface Preparation

Shallow footing excavations should be performed using a smooth-edged bucket to limit bearing disturbance. Foundations should bear on inert mineral native glacial till soils (weathered or unweathered) or on structural fill extending to these soils. The forest duff layer and any roots/organics should be completely removed from below proposed footing areas. It should be noted that abundant roots were observed to a depth of about 2 feet bgs in our explorations. Depending on bearing surface elevations, up to 2 feet of removal may be required below foundation areas. The bearing surface should be compacted as necessary to a firm, unyielding condition. Loose or disturbed materials present at the base of footing excavations should be removed or compacted.

If structural fill is placed below footings as either replacement of overexcavated soils or to establish a bearing pad, we recommend the structural fill extend laterally beyond the foundation perimeter a distance equal to the depth of fill (measured from the base of the footing where necessary), or 3 feet, whichever is less.

Foundation bearing surfaces should not be exposed to standing water. If water is present in the excavation, it must be removed before placing formwork and reinforcing steel. Protection of exposed soil, such as placing a 6-inch thick layer of crushed rock or a 3- to 4-inch layer of lean-mix concrete, could be used to limit disturbance to bearing surfaces.

We understand that areas containing soft, unsuitable site soils were encountered during site preparation for the nearby Communication Arts and Allied Health building, which resulted in overexcavation and replacement with import structural fill to depths up to about 3 to 4 feet. It should be noted that on-site material will become easily disturbed if stripped and left exposed to wet weather. Additional overexcavation depths may be required for this project depending on earthwork sequencing and how well exposed site soils are protected.

4.6.3. Allowable Soil Bearing Pressure

Shallow foundations bearing on subgrades prepared as recommended may be designed using an allowable soil bearing pressure of 3,500 pounds per square foot (psf). This bearing pressure applies to the total of dead and long-term live loads and may be increased by one-third when considering total loads, including earthquake or wind loads. These are net bearing pressures. The weight of the footing and overlying backfill can be ignored in calculating footing sizes.

It is possible that higher bearing pressures are attainable at the site, especially for structures well founded in the dense glacial till or on structural fill placed on this material. Additional considerations such as building load, foundation size, and settlement tolerances should also be considered to support higher bearing pressures.

4.6.4. Foundation Settlement

Disturbed soil must be removed from the base of footing excavations and the bearing surface should be prepared as recommended. Provided these measures are taken, we estimate the total static settlement of shallow foundations will be on the order of 1 inch or less for the bearing pressures presented above. Differential settlements could be on the order of ¼ to ½ inch between similarly loaded foundations or over a distance of 50 feet of continuous footings. The settlements should occur rapidly, essentially as loads are applied. Settlements could be greater than estimated if disturbed or saturated soil conditions are present below footings.

4.6.5. Lateral Resistance

The ability of the soil to resist lateral loads is a function of the base friction, which develops on the base of foundations and slabs, and the passive resistance, which develops on the face of below-grade elements of the structure as these elements move into the soil. For cast-in-place foundations supported in accordance with the recommendations presented above, the allowable frictional resistance on the base of the foundation may be computed using a coefficient of friction of 0.40 applied to the vertical dead-load forces. If precast foundations are included as part of project plans, we can provide specific recommendations for base friction resistance for precast foundations. The allowable passive resistance on the face of the foundation or other embedded foundation elements may be computed using an equivalent fluid density of 290 pounds per cubic foot (pcf).

These values include a factor of safety of about 1.5. The passive earth pressure and friction components may be combined provided that the passive component does not exceed two-thirds of the total. The top foot of soil should be neglected when calculating passive lateral earth pressure unless the area adjacent to the foundation is covered with pavement or a slab-on-grade.

4.7. Slab-on-Grade Floors

Slab-on-grade floors should bear on native glacial till soils or on structural fill extending to these soils and should be prepared as recommended in the "4.3.8 Subgrade Preparation" section of this report. Disturbed areas should be compacted, if possible, or removed and replaced with compacted structural fill. In all cases, the exposed soil should be compacted to a firm and unyielding condition.

We recommend the slab-on-grade floors be underlain by a minimum 6-inch-thick capillary break layer consisting of clean sand and gravel, crushed rock, or washed rock. The capillary break material should contain less than 3 percent fine material based on the percent passing the ¾-inch sieve size. Provided that loose soil is removed, and the subgrade is prepared as recommended, we recommend slabs-on-grade be designed using a modulus of subgrade reaction of 250 pounds per cubic inch (pci). We estimate that settlement for slabs-on-grade constructed as recommended will be less than ¾-inch for a floor load of up to 500 psf.

Based on our understanding of subsurface conditions at the site, it is our opinion that an underslab drain system is not necessary. If dry slabs are required (e.g., where adhesives are used to anchor carpet or tile to slab), a waterproof liner may be placed as a vapor barrier below the slab.

4.8. Retaining Walls and Below-Grade Structures

4.8.1. Design Parameters

We recommend the following lateral earth pressures be used for design of conventional retaining walls and below-grade structures. Our design pressures assume that the ground surface around the retaining structures will be level or near level. If drained design parameters are used, drainage systems must be included in the design in accordance with the recommendations presented in the "4.8.2 Drainage" section below.

- Active soil pressure may be estimated using an equivalent fluid density of 35 pcf for the drained condition.
- Active soil pressure may be estimated using an equivalent fluid density of 80 pcf for the undrained condition; this value includes hydrostatic pressures.
- At-rest soil pressure may be estimated using an equivalent fluid density of 55 pcf for the drained condition.
- At-rest soil pressure may be estimated using an equivalent fluid density of 90 pcf for the undrained condition; this value includes hydrostatic pressures.
- For seismic considerations, a uniform lateral pressure of 13*H psf (where H is the height of the retaining structure or the depth of a structure below ground surface) should be added to the lateral earth pressure.
- An additional 2 feet of fill representing a typical traffic surcharge of 250 psf should be included if vehicles are allowed to operate within ½ the height of the retaining walls. Other surcharge loads should be considered on a case-by-case basis.

The active soil pressure condition assumes the wall is free to move laterally 0.001 H, where H is the wall height. The at-rest condition is applicable where walls are restrained from movement. The above-recommended lateral soil pressures do not include surcharge loads other than described or the effects of sloping backfill surfaces. Overcompaction of fill placed directly behind retaining walls or below-grade structures must be avoided. We recommend use of hand-operated compaction equipment and maximum 6-inch loose lift thickness when compacting fill within about 5 feet of retaining walls and below-grade structures.

Retaining wall foundation bearing surfaces should be prepared following the "4.6 Foundation Support" section of this report. Provided bearing surfaces are prepared as recommended, retaining wall foundations may be designed using the allowable soil bearing values and lateral resistance values presented above for building foundation design. We estimate settlement of retaining structures will be similar to the values previously presented for building foundations.

4.8.2. Drainage

If retaining walls or below-grade structures are designed using drained parameters, a drainage system behind the structure must be constructed to collect water and prevent the buildup of hydrostatic pressure against the structure. We recommend the drainage system include a zone of free-draining backfill a minimum of 18 inches in width against the back of the wall. The drainage material should consist of coarse sand and gravel containing less than 5 percent fines by weight based on the fraction of material passing the ¾-inch sieve.

A perforated, rigid, smooth-walled drain pipe with a minimum diameter of 4 inches should be placed along the base of the structure within the free-draining backfill and extend for the entire wall length. The drain pipe should be metal or rigid PVC pipe and be sloped to drain by gravity. Discharge should be routed to appropriate discharge areas and to reduce erosion potential. Cleanouts should be provided to allow routine maintenance. We recommend roof downspouts or other types of drainage systems not be connected to retaining wall drain systems.

4.9. Infiltration Feasibility Assessment

We anticipate that stormwater facilities on site, if planned, will be designed in accordance with the 2014 Washington State Department of Ecology Stormwater Management Manual for Western Washington (SWMMWW), as adopted by the City of Puyallup. According to the SWMMWW, measured infiltration rates in soils consolidated by glacial advance (i.e., glacial till) shall be determined using in-situ field tests such as a Pilot Infiltration Test (PIT). The manual does not allow the use of soil grain-size analysis to determine design infiltration rates for glacially consolidated soils. Additionally, detailed infiltration analyses including performance testing and groundwater mounding analysis are noted in the SWMMWW. Based on our explorations, we do not expect groundwater will be a factor in stormwater design for construction and excavations extending to the depths explored in this report.

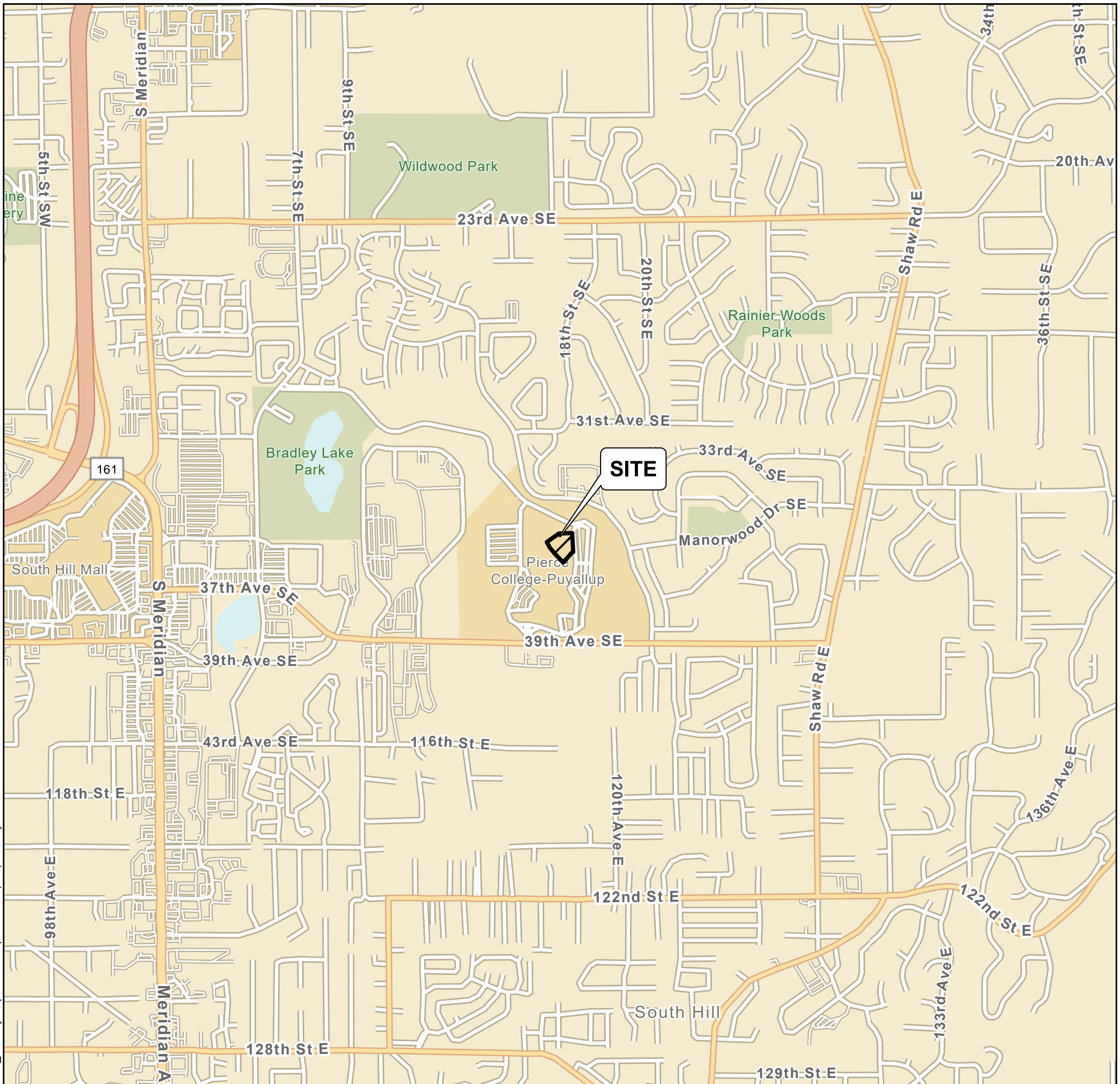
The site is generally underlain by undisturbed glacial till at relatively shallow depths (on the order of 2 to 4½ feet bgs). In our experience with similar soil and density conditions (undisturbed glacial till), PITs typically measure very slow infiltration rates, on the order of 0.05 to 0.25 inches per hour with correction factors and in some cases, no infiltration can be measured. We suggest this range be considered for preliminary design of facilities, then followed up with final rates determined by completing PITs.

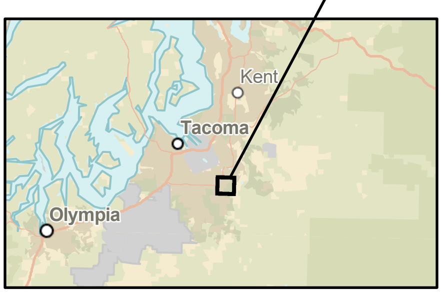
5.0 LIMITATIONS

We have prepared this report for the Washington State Department of Enterprise Services (DES) for the Pierce College Puyallup – STEM Building Design Study project located in Puyallup, Washington. DES may distribute copies of this report to owner's authorized agents and regulatory agencies as may be required for the Project.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices for geotechnical engineering in this area at the time this report was prepared. The conclusions, recommendations, and opinions presented in this report are based on our professional knowledge, judgment and experience. No warranty, express or implied, applies to the services or this report.

Please refer to Appendix B titled "Report Limitations and Guidelines for Use" for additional information pertaining to use of this report.





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Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI

Projection:

Vicinity Map

Pierce College Puyallup –
STEM Building Design Study
Puyallup, Washington

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Figure 1

P:\21\21342002\GIS\21342002_Project\21342002_Project.aprx\2134200200_F01_VicinityMap Date Exported: 01/21/21 by ccabrera

PRCNC20221036

P:\21\21342002\CAD\00\Geotech\2134200200_F02_Site Plan.dwg TAB:F02 - Site Plan Date Exported: 01/21/21 - 12:22 by kcook

Legend

TP-1 Test Pit, by GeoEngineers, Inc., 2020

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Aerial from Bing Imagery, dated 07/2019.

Projection: NAD83 Washington State Planes, South Zone, US Foot

N E S W

100 0 100

Feet

Site Plan

Pierce College Puyallup -
STEM Building Design Study
Puyallup, Washington

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Figure 2

APPENDIX A
Subsurface Explorations and Laboratory Testing

APPENDIX A
SUBSURFACE EXPLORATIONS AND LABORATORY TESTING

Subsurface Explorations

Subsurface conditions for the proposed Pierce College Puyallup – STEM Building Design Study project were explored by excavating six test pits on October 5, 2020 at the approximate locations shown on the Site Plan, Figure 2. The test pits were excavated to depths between about 8 and 10¼ feet bgs using an excavator provided and operated by Kelly's Excavating, Inc. under subcontract to GeoEngineers. After each test pit was completed, the excavation was backfilled using the generated material and compacted using the bucket of the excavator.

During the exploration program, our field representative obtained soil samples, classified the soils encountered, and maintained a detailed log of each exploration. The relative densities noted on the test pit logs are based on the difficulty of excavation and our experience and judgment. The samples were collected and retained in sealed plastic bags and then transported back to our office. The soils were classified visually in general accordance with the system described in Figure A-1, which includes a key to the exploration logs. Summary logs of the explorations are included as Figures A-2 through A-7.

The locations of the test pits were determined using an electronic tablet equipped with global positioning system (GPS) software. The locations of the explorations should be considered approximate.

Laboratory Testing

Soil samples obtained from the borings were transported to GeoEngineers' laboratory. Representative soil samples were selected for laboratory tests to evaluate the pertinent geotechnical engineering characteristics of the site soils and to confirm our field classifications.

Our testing program consisted of the following:

- Four grain-size distribution analyses (sieve analyses [SA])
- Five moisture content determinations (MC)

Tests were performed in general accordance with test methods of ASTM International (ASTM) or other applicable procedures. The following sections provide a general description of the tests performed.

Sieve Analysis (SA)

Grain-size distribution analyses were completed on selected samples in general accordance with ASTM Test Method C 136. This test method covers the quantitative determination of the distribution of particle sizes in soils. Typically, the distribution of particle sizes larger than 75 micrometers (μm) is determined by sieving. The results of the tests were used to verify field soil classifications and determine pertinent engineering characteristics. Figure A-8 presents the results of our sieve analyses.

Moisture Content (MC)

The moisture content of selected samples was determined in general accordance with ASTM Test Method D 2216. The test results are used to aid in soil classification and correlation with other pertinent engineering soil properties. The results are presented on the test pit logs at the depth tested.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS: GRAPH	SYMBOLS: LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS: GRAPH	SYMBOLS: LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Sampler Symbol Descriptions

- 2.4-inch I.D. split barrel
- Standard Penetration Test (SPT)
- Shelby tube
- Piston
- Direct-Push
- Bulk or grab
- Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

"P" indicates sampler pushed using the weight of the drill rig.

"WOH" indicates sampler pushed using the weight of the hammer.

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PL	Point load test
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

Key to Exploration Logs

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Figure A-1

Date Excavated	10/5/2020	Total Depth (ft)	10.25	Logged By	CRN	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	DJT	Equipment	Komatsu PC120 Excavator	Caving not observed

Surface Elevation (ft)	526	Easting (X)	1199743	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	670480	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
526	0			SM	Brown silty fine to medium sand with organic matter (roots) and occasional gravel (loose, moist) (weathered glacial till)			Fine roots and roots up to approximately 1¼-inch diameter
525	1			SM	Gray-brown with occasional iron-oxide staining silty fine to medium sand with occasional gravel and organic matter (roots) (loose, moist)			Boulder observed in SE corner of test pit sidewall at approximately 1 foot bgs
524	2				Grades to without roots			
523	3	▯	1 / MC		Grades to dense	14		
522	4			SM	Gray with occasional iron-oxide staining silty fine to medium sand with gravel and occasional cobbles and includes pods of sandy silt with gravel (dense, moist) (glacial till)			
521	5							
520	6	▯	2 / SA			15	41	
519	7				Grades to very dense			
518	8							Boulder encountered at approximately 8 to 9 feet bgs
517	9							
516	10	▯	3					

Notes: See Figure B-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Test Pit TP-1

GEOENGINEERS

Project: Pierce College Puyallup - STEM Building Design Study
Project Location: Puyallup, Washington
Project Number: 21342-002-00

Figure B-2
Sheet 1 of 1

Date Excavated: 10/5/2020	Total Depth (ft): 8.75	Logged By: CRN Checked By: DJT	Excavator: Kelly's Excavating Equipment: Komatsu PC120 Excavator
Groundwater not observed Caving not observed			

Surface Elevation (ft): 529 Vertical Datum: NAVD88	Easting (X): 1199604 Northing (Y): 670477	Coordinate System: WA State Plane South Horizontal Datum: NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample / Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0			DUFF	Approximately 4 inches forest duff			The forest duff layer thickness indicated on this test pit log is after the surface had been partially cleared by the excavator. The undisturbed forest duff layer thickness was on the order of about 9 to 12 inches.
528	1			SM	Gray-brown with occasional iron-oxide staining silty fine to medium sand with organic matter (roots) (loose, moist) (weathered glacial till)			Fine roots and roots up to approximately 1-inch diameter
527	2				Grades to with occasional organic matter (roots)			
526	3				Grades to dense			
525	4	1						
524	4.5	2 SA		GM	Gray with occasional iron-oxide staining silty fine to coarse gravel with sand and occasional cobbles (dense, moist) (glacial till)	9	26	
523	6				Grades to very dense			
522	7							
521	8							
	8.5	3						

Notes: See Figure B-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Test Pit TP-2

GEOENGINEERS

Project: Pierce College Puyallup - STEM Building Design Study
Project Location: Puyallup, Washington
Project Number: 21342-002-00

Figure B-3
Sheet 1 of 1

Date Excavated 10/5/2020	Total Depth (ft) 8	Logged By CRN Checked By DJT	Excavator Kelly's Excavating Equipment Komatsu PC120 Excavator	Groundwater not observed Caving not observed

Surface Elevation (ft) 532 Vertical Datum NAVD88	Easting (X) 1199570 Northing (Y) 670341	Coordinate System WA State Plane South Horizontal Datum NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
532	0				DUFF	Approximately 4 inches forest duff			The forest duff layer thickness indicated on this test pit log is after the surface had been partially cleared by the excavator. The undisturbed forest duff layer thickness was on the order of about 9 to 12 inches.
					SM	Gray-brown silty fine to medium sand with organic matter (roots) and occasional gravel and cobbles (loose, moist) (weathered glacial till)			
531	1		1 MC				10		Fine roots and roots up to approximately ¾-inch diameter
530	2					Grades to with occasional organic matter (roots)			
					SM	Gray with occasional iron-oxide staining silty fine sand with gravel (very dense, moist) (glacial till)			
529	3								
			2 SA				8	47	
528	4					Grades to with occasional cobbles			
527	5								
526	6								
525	7								
524	8		3						

Notes: See Figure B-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Test Pit TP-3

GEOENGINEERS

Project: Pierce College Puyallup - STEM Building Design Study
Project Location: Puyallup, Washington
Project Number: 21342-002-00

Date Excavated	10/5/2020	Total Depth (ft)	8	Logged By	CRN	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	DJT	Equipment	Komatsu PC120 Excavator	Caving not observed

Surface Elevation (ft)	526	Easting (X)	1199738	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	670377	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				DUFF	Approximately 8 inches forest duff			The forest duff layer thickness indicated on this test pit log is after the surface had been partially cleared by the excavator. The undisturbed forest duff layer thickness was on the order of about 9 to 12 inches.
525	1		1 / MC		SM	Gray-brown silty fine to medium sand with organic matter (roots) and occasional gravel (loose, moist) (weathered glacial till)	15		Fine roots and roots up to approximately 1½-inch diameter
524	2					Grades to with occasional organic matter (roots)			
523	3		2		SM	Brown-gray with occasional iron-oxide staining silty fine to medium sand with gravel and occasional organic matter (fine roots) (dense, moist) (glacial till)			
522	4		3			Grades to gray with occasional cobbles and very dense			
521	5								
520	6								
519	7		4						
518	8								

Notes: See Figure B-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Test Pit TP-4

GeoEngineers

Project: Pierce College Puyallup - STEM Building Design Study
Project Location: Puyallup, Washington
Project Number: 21342-002-00

Figure B-5
Sheet 1 of 1

Date Excavated	10/5/2020	Total Depth (ft)	8.25	Logged By	CRN	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	DJT	Equipment	Komatsu PC120 Excavator	Caving not observed

Surface Elevation (ft)	531	Easting (X)	1199668	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	670234	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0				DUFF	Approximately 8 inches forest duff			The forest duff layer thickness indicated on this test pit log is after the surface had been partially cleared by the excavator. The undisturbed forest duff layer thickness was on the order of about 9 to 12 inches.
530	1				SM	Gray-brown silty fine to medium sand with gravel and organic matter (roots) (loose to medium dense, moist) (weathered glacial till)			Fine roots and roots up to approximately 1¾-inch diameter
529	2	▯	1 / MC			Grades to with occasional organic matter (roots)	11		
528	3				SM	Gray silty fine to medium sand with gravel and occasional cobbles (dense, moist) (glacial till)			
527	4	▯	2			Grades to very dense			
526	5								
525	6					Grades to fine to coarse sand grains			
524	7								
523	8	▯	3						

Notes: See Figure B-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Test Pit TP-5

GeoEngineers

Project: Pierce College Puyallup - STEM Building Design Study
Project Location: Puyallup, Washington
Project Number: 21342-002-00

Date Excavated	10/5/2020	Total Depth (ft)	8.25	Logged By	OA	Excavator	Kelly's Excavating	Groundwater not observed
				Checked By	CRN	Equipment	Komatsu PC120 Excavator	Caving not observed

Surface Elevation (ft)	526	Easting (X)	1199777	Coordinate System	WA State Plane South
Vertical Datum	NAVD88	Northing (Y)	670327	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
526	0				DUFF	Approximately 8 inches forest duff			The forest duff layer thickness indicated on this test pit log is after the surface had been partially cleared by the excavator. The undisturbed forest duff layer thickness was on the order of about 9 to 12 inches.
525	1		1 / MC		SM	Gray-brown silty fine to medium sand with gravel and organic matter (roots) (loose to medium dense, moist) (weathered glacial till)	12		Fine roots and roots up to approximately 1-inch diameter
524	2				SM	Gray with occasional iron-oxide staining silty fine to coarse sand with gravel and occasional cobbles (dense, moist) (glacial till)			
523	3								
522	4		2 / SA			Grades to fine sand grains	10	42	
						Grades to very dense			
521	5								
520	6								
519	7								
518	8		3						

Notes: See Figure B-1 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Test Pit TP-6

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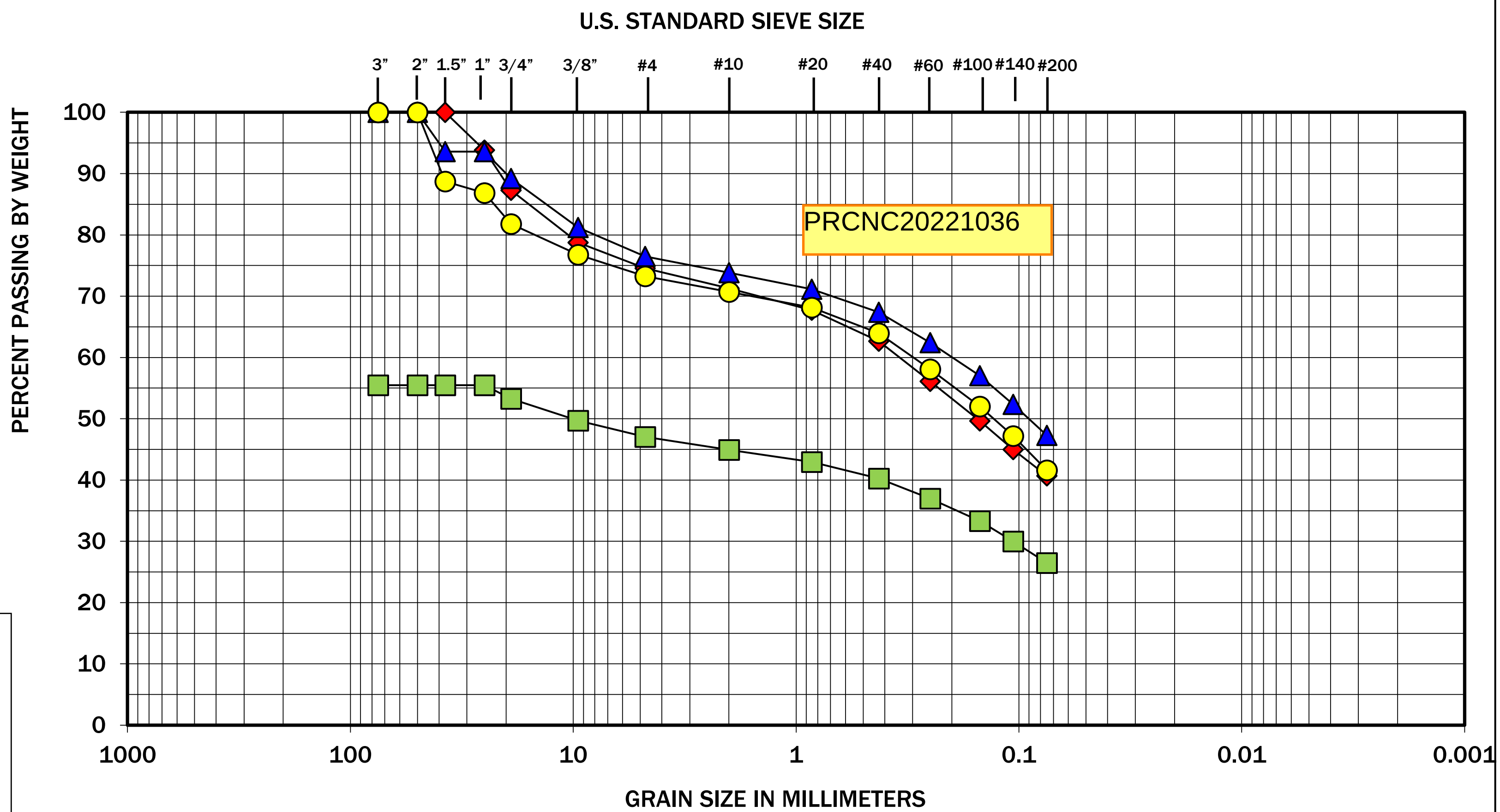
Project: Pierce College Puyallup - STEM Building Design Study
Project Location: Puyallup, Washington
Project Number: 21342-002-00

Figure B-7
Sheet 1 of 1



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Test Pit Number	Depth (feet)	Moisture (%)	Soil Description
◆	TP-1	5.75	15	Silty sand with gravel (SM)
■	TP-2	4.5	9	Silty gravel with sand (GM)
▲	TP-3	3.5	8	Silty sand with gravel (SM)
●	TP-6	3.5	10	Silty sand with gravel (SM)

Note: This report may not be reproduced, except in full, without written approval of GeoEngineers, Inc. Test results are applicable only to the specific sample on which they were performed, and should not be interpreted as representative of any other samples obtained at other times, depths or locations, or generated by separate operations or processes.

The grain size analysis results were obtained in general accordance with ASTM C 136. GeoEngineers 17425 NE Union Hill Road Ste 250, Redmond, WA 98052

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Sieve Analysis Results

Pierce College Puyallup-STEM Building Design Study
Puyallup, Washington

Figure A-8

APPENDIX B
Report Limitations and Guidelines for Use

PRCNC20221036

APPENDIX B
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

Read These Provisions Closely

It is important to recognize that the geoscience practices (geotechnical engineering, geology and environmental science) rely on professional judgment and opinion to a greater extent than other engineering and natural science disciplines, where more precise and/or readily observable data may exist. To help clients better understand how this difference pertains to our services, GeoEngineers includes the following explanatory "limitations" provisions in its reports. Please confer with GeoEngineers if you need to know more how these "Report Limitations and Guidelines for Use" apply to your project or site.

Geotechnical Services are Performed for Specific Purposes, Persons and Projects

This report has been prepared for Washington State Department of Enterprise Services (WSDES) and for the Project(s) specifically identified in the report. The information contained herein is not applicable to other sites or projects.

GeoEngineers structures its services to meet the specific needs of its clients. No party other than the party to whom this report is addressed may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of the agreed scope of services for the Project, and its schedule and budget, our services have been executed in accordance with our Agreement with WSDES signed on September 4, 2020 and generally accepted geotechnical practices in this area at the time this report was prepared. We do not authorize, and will not be responsible for, the use of this report for any purposes or projects other than those identified in the report.

A Geotechnical Engineering or Geologic Report is based on a Unique Set of Project-Specific Factors

This report has been prepared for the Pierce College Puyallup – STEM Building Design Study project in Puyallup, Washington. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

For example, changes that can affect the applicability of this report include those that affect:

[1] Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

- the function of the proposed structure;
- elevation, configuration, location, orientation or weight of the proposed structure;
- composition of the design team; or
- project ownership.

If changes occur after the date of this report, GeoEngineers cannot be responsible for any consequences of such changes in relation to this report unless we have been given the opportunity to review our interpretations and recommendations. Based on that review, we can provide written modifications or confirmation, as appropriate.

Environmental Concerns are Not Covered

Unless environmental services were specifically included in our scope of services, this report does not provide any environmental findings, conclusions, or recommendations, including but not limited to, the likelihood of encountering underground storage tanks or regulated contaminants.

Information Provided by Others

GeoEngineers has relied upon certain data or information provided or compiled by others in the performance of our services. Although we use sources that we reasonably believe to be trustworthy, GeoEngineers cannot warrant or guarantee the accuracy or completeness of information provided or compiled by others.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the site, new information or technology that becomes available subsequent to the report date, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Information Provided by Others

GeoEngineers has relied upon certain data or information provided or compiled by others in the performance of our services. Although we use sources that we reasonably believe to be trustworthy, GeoEngineers cannot warrant or guarantee the accuracy or completeness of information provided or compiled by others.

Geotechnical and Geologic Findings are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies the specific subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied its professional judgment to render an informed opinion about subsurface conditions at other locations. Actual subsurface conditions may differ, sometimes significantly, from the opinions presented in this report. Our report, conclusions and interpretations are not a warranty of the actual subsurface conditions.

Geotechnical Engineering Report Recommendations are Not Final

We have developed the following recommendations based on data gathered from subsurface investigation(s). These investigations sample just a small percentage of a site to create a snapshot of the subsurface conditions elsewhere on the site. Such sampling on its own cannot provide a complete and accurate view of subsurface conditions for the entire site. Therefore, the recommendations included in this report are preliminary and should not be considered final. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers cannot assume responsibility or liability for the recommendations in this report if we do not perform construction observation.

We recommend that you allow sufficient monitoring, testing and consultation during construction by GeoEngineers to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective means of managing the risks associated with unanticipated conditions. If another party performs field observation and confirms our expectations, the other party must take full responsibility for both the observations and recommendations. Please note, however, that another party would lack our project-specific knowledge and resources.

A Geotechnical Engineering or Geologic Report Could Be Subject to Misinterpretation

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. The logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Photographic or electronic reproduction is acceptable, but separating logs from the report can create a risk of misinterpretation.

Give Contractors a Complete Report and Guidance

To help reduce the risk of problems associated with unanticipated subsurface conditions, GeoEngineers recommends giving contractors the complete geotechnical engineering or geologic report, including these "Report Limitations and Guidelines for Use." When providing the report, you should preface it with a clearly written letter of transmittal that:

- advises contractors that the report was not prepared for purposes of bid development and that its accuracy is limited; and

- encourages contractors to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer.

Contractors are Responsible for Site Safety on Their Own Construction Projects

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and adjacent properties.

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants, and no conclusions or inferences should be drawn regarding Biological Pollutants as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria and viruses, and/or any of their byproducts.

A Client that desires these specialized services is advised to obtain them from a consultant who offers services in this specialized field.