GEOTECHNICAL REPORT

GEOTECHNICAL RECOMMENDATIONS & GEOLOGICALLY HAZARDOUS AREAS ASSESSMENT

Proposed Parking Garage and Surface Parking
Saint Edward Seminary
Kenmore, Washington

PROJECT NO. 16-163
June 2016

Prepared for:

Daniels Real Estate

PanGEO INCORPORATED

Geotechnical & Earthquake Engineering Consultants

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June 29, 2016
PanGEO Project No. 16-163

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Subject: GEOTECHNICAL REPORT
GEOTECHNICAL RECOMMENDATIONS &
GEOLOGICALLY HAZARDOUS AREAS ASSESSMENT
Proposed Parking Garage and Surface Parking
Saint Edward Seminary
14445 Juanita Drive NE, Kenmore, Washington

Dear Ms. Wang:

As requested, PanGEO, Inc. is pleased to present the attached report to assist the project team with the design and construction of the proposed parking garage and surface parking adjacent to the Saint Edward Seminary in Kenmore, Washington.

In preparing this report, we completed 11 test borings to evaluate the subsurface conditions, conducted a reconnaissance of the geologic hazards at the site, conducted laboratory testing, performed our engineering analysis, and prepared this report. Based the results of our study, the site is underlain by glacially consolidated clay, silt, and silty sand with gravel. In our opinion, the proposed parking garage can be supported on conventional spread footings.

Saint Edward Park contains areas mapped by the City of Kenmore as geologic hazard areas due to erosion and landslide hazards. Based on our review of the City's mapping and a reconnaissance of the study area, it appears the planned improvements are located more than 150 feet from the mapped geologic hazards. As such, in our opinion, provided that the surface water will be properly managed, the potential for the planned improvements to affect these geologically hazardous areas is minimal. Discussions regarding surface water disposal are outlined in the attached report.

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We appreciate the opportunity to be of service. Should you have any questions, please do not hesitate to call.

Sincerely,

Siew L. Tan, P.E.
Principal Geotechnical Engineer

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SAINT EDWARD SEMINARY
KENMORE, WASHINGTON

1.0 GENERAL

PanGEO has completed this geotechnical engineering study and geologically hazardous areas assessment to assist the project team with the design and construction of the proposed parking garage and surface parking at Saint Edward Seminary in Kenmore, Washington. Our services were provided in general accordance with our proposal dated June 6, 2016. The purpose of our geotechnical study was to evaluate subsurface conditions at the site and, based on the conditions encountered; provide geotechnical engineering recommendations pertinent to the design and construction of the proposed below grade parking garage and surface parking and address the impacts of the proposed development on the nearby geologic hazard areas. Our services included a site reconnaissance, drilling 11 borings, performing laboratory tests on representative soil samples, and developing the conclusions and recommendations presented in this report.

2.0 SITE AND PROJECT DESCRIPTION

The proposed parking garage and surface parking will be located to the east and north east of the Saint Edward Seminary in the Saint Edward State Park in Kenmore, Washington. The approximate location of the site is shown on the enclosed Figure 1, Vicinity Map.

For the purposes of this study, we have defined a study area incorporating the area of the proposed improvements to the north and east and the existing access road along the south and west sides of the former seminary building. The extent of the study area along with the proposed improvements are shown on Figure 2, Site and Exploration Plan.

The study area consists of a gently rolling upland, with about 20 feet of elevation change across the length of the proposed improvement area. Slope gradients range from 10 to 20 percent, however in localized areas, slopes are as steep as 30 percent.

The area of the proposed improvements is occupied by asphalt paved parking and drive areas and lawn areas. Plates 1 through 3 on the next page illustrate the general site conditions.

We understand the proposed parking garage will consist of a one level below grade structure with a landscaped roof. The parking garage will extend about 150 feet in the north-south direction and 200 feet in the east-west direction. In order to achieve construction subgrade elevations for the parking garage, an excavation extending to a depth of 10 to 12 feet below grade is planned. We anticipate the parking garage will be of concrete frame construction with a concrete slab-on-grade floor.

Plate 1: View of proposed parking garage location. The former seminary building is located in the background. The Wald Pool is located on the left side of photo.

Plate 2: View of proposed parking area to the northwest of the existing seminary building.

Plate 3: View of planned parking area east of the former seminary. The below grade parking structure will be located just left of view in photo.

In the northeast, northwest and east portions of the study area, it is planned to construct surface grade asphalt paved parking and drive areas. It is planned to dispose of surface water from the impervious parking areas by using infiltration (if feasible) or surface dispersion.

Saint Edward Park contains steep slope areas that meet the City of Kenmore criteria for geologically hazardous areas due to erosion and landslide hazards. The approximate extend of the erosion and landslide hazard areas, relative to the proposed area of improvements, are shown on the attached Figure 3.

The conclusions and recommendations in this report are based on our understanding of the proposed improvements, which is in turn based on the project information provided. If the above project description is incorrect, or the project information changes, we should be consulted to review the recommendations contained in this study and make modifications, if needed. PanGEO is available to review the final design to confirm that our geotechnical recommendations have been correctly interpreted and adequately implemented in the construction documents.

3.0 SUBSURFACE EXPLORATIONS

3.1 SITE GEOLOGY AND SOILS

3.1.1 Geology Map

General geologic information for the project area was obtained by reviewing the Preliminary Geologic Map of Seattle and Vicinity, Washington (Waldron, 1962). Based on review of the geologic map, the primary geologic unit in the vicinity of the site is Vashon Till (Geologic Map Unit Qt). Vashon till consists of an unsorted (diamict) mixture of clay, silt, sand and gravel that has been directly deposited by a glacier. Till has been glacially overridden and is typically dense to very dense. A portion of the geologic map including the site and vicinity is provided as Figure 4, Geologic Map.

3.1.2 USDA Soil Map

The surface soils in the project area are mapped as Alderwood gravelly sandy loam, 8 to 15 percent slopes based on the United States Department of Agriculture (USDA) Soil Survey (USDA, 2016). Alderwood gravelly sandy loam consists of medium textured soils derived from glacial drift and or glacial outwash overlying dense glaciomarine deposits. This soil is moderately well drained, and has a moderate erosion hazard.

The surface soils in the drainages to the north and south of the study area are mapped as Alderwood-Kitsap soils, 25 to 75 percent slopes. This soil consists of gravelly to very gravelly sandy loam. These medium textured soils are formed in moraine and till plains and are derived from basal till with some volcanic ash. Alderwood-Kitsap soils, 25 to 75 percent slopes are moderately well drained and have a severe erosion hazard.

The approximate extent of these soils are shown on Figure 5, Soils Map.

3.2 Test Borings

Our subsurface exploration program consisted of drilling 11 borings (Borings PG-1 through PG-11). The borings were drilled on June 13, 2016 using an EC-55 limited access track mounted drill rig operated by Boretec, Inc. and subcontracted to PanGEO. The borings were drilled to a maximum depth of 16½ feet below existing grade. The approximate boring locations were measured from the existing site features and are shown on the attached Figure 2.

Standard Penetration Tests (SPT) were performed in the borings at 2½- and 5-foot depth intervals using a standard, 2-inch diameter split-spoon sampler. The sampler was advanced with a 140-pound drop hammer falling a distance of 30 inches for each strike, in general accordance with ASTM D-1586, *Standard Test Method for Penetration Test and Split Barrel Sampling of Soils*.

An engineer from PanGEO was present during the field exploration to observe the borehole drilling, obtain representative soil samples, and to describe and document the subsurface conditions encountered. The system used to classify the soils is summarized on Figure A-1, Terms and Symbols for Boring and Test Pit Logs. Summary boring logs are presented in Appendix A.

3.3 Subsurface Conditions

For a detailed description of the subsurface conditions encountered at each exploration location, please refer to our boring logs provided in Appendix A. The stratigraphic contacts indicated on the logs represent the approximate depth to boundaries between soil units. Actual transitions between soil units may be more gradual or occur at different elevations.

Where soil contacts were gradual or undulating, the average depth of the contact was recorded in the log. The descriptions of groundwater conditions and depths are likewise approximate. The following is a generalized description of the soils

Asphalt Pavement: Borings PG-2, PG-3, PG-8, PG-9, PG-10, and PG-11 were located in existing parking and drive areas. At these locations, we encountered a surficial layer of asphalt pavement. The asphalt pavement ranged from two to seven inches thick.

Topsoil: Borings PG-1, PG-4, PG-5, PG-6, PG-7 were located in existing lawn areas. At these locations, we encountered a surficial layer of topsoil and sod. The topsoil and sod consisted of loose silty sand soil with organics and was typically about 6 inches thick. The topsoil was characterized by its dark brown color and a dense mat of roots. This soil layer is not considered suitable for support of foundations, slab-on-grade floors, or pavements. In addition, it is not suitable for use as structural fill, nor should it be mixed with materials to be used as structural fill.

Fill: Below the pavement or topsoil at the locations of Borings PG-1, PG-2, PG-3, PG-4, PG-5, and PG-9, we encountered fill. The fill ranged from 2½ feet thick at Boring PG-9 to 7 feet thick at PG-4. The fill consisted of loose to medium dense silty sand with varying amounts of gravel and was characterized by the presence of organic debris including roots, wood chips, and charcoal.

The fill was primarily located along the perimeter of the study area was likely placed to achieve uniform grades for the parking, drive, and lawn areas.

Pre-Fraser Glacial Deposits (Qpf): The native soils underlying the topsoil, pavement and fill consist of interlayered deposits of medium to coarse grained till-like soil, outwash sand, and fine grained glaciolacustrine (glacial lake) sediments.

Till-like soils and outwash sand were encountered in Borings PG-1, PG-4, PG-6, PG-7, and PG-10. These soils consisted of medium dense to very dense silty sand with gravel and sand with varying amounts of silt. At the location of Boring PG-1, the outwash sand was weathered and ranged from loose to medium dense. In Borings PG-4, PG-6, PG-7 and PG-10, the till-like soils and outwash sand deposits were medium dense to very dense.

Fine-grained glacial deposits (silt and clay) were encountered at all of our boring locations except Boring PG-6. The fine-grained deposits consist of silt and clay and were typically stiff when initially encountered, grading to very stiff and hard at depth.

We classified the encountered native soils as pre-Fraser glacial deposits. Although the encountered soils are not consistent with the Vashon Till deposit mapped in this area, the geologic map for this area was prepared more than 50 years ago and additional mapping has refined these geologic units from the formerly more widely mapped Vashon Till.

Our descriptions of subsurface conditions are based on the conditions encountered at the time of our exploration. Soil conditions between our exploration locations may vary from those encountered. The nature and extent of variations between our exploratory locations may not become evident until construction. If variations do appear, PanGEO should be requested to reevaluate the recommendations in this report and to modify or verify them in writing prior to proceeding with earthwork and construction.

3.4 Groundwater

Perched groundwater seepage was encountered at the location of Boring PG-1 at 7½ to 9½ feet below grade. Perched seepage develops when surface water infiltrating through relatively permeable soils becomes trapped or perched on a layer of less permeable soil.

Groundwater was not encountered at our other 10 boring locations.

Based on the limited amount of groundwater seepage encountered, in our opinion, groundwater seepage will likely not be a significant construction related issue. However, the contractor should also be aware groundwater levels are not static. There will likely be fluctuations in the groundwater level depending on the season, amount of rainfall, surface water runoff, and other factors. Generally, the water level is higher and seepage rates are greater in the wetter, winter months (typically October through May).

4.0 LABORATORY TESTING

Natural moisture content tests and Atterberg Limits were conducted on selected representative soil samples obtained from the test borings. The test results from the moisture content tests and Atterberg limits are included in Figure B-1 in Appendix B. The test results are also represented in the boring logs at the sample depths. Details of these tests are discussed below.

4.1 Moisture Content Determinations

Moisture content determinations were performed on representative samples obtained from the explorations in order to aid in identification and correlation of soil types. The determinations were made in general accordance with the test procedures described in ASTM D2216 *Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass* Moisture contents. The test results are included on the boring logs in Appendix A of our final report.

4.2 Atterberg Limits

The liquid limit and the plastic limit tests ("Atterberg Limits") were conducted in general accordance with ASTM test designation D-4318 *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*. Atterberg plastic limit and liquid limit tests measure the moisture content at which a fine-grained soil changes from a semi-solid to plastic state and from a plastic to a liquid state, respectively. The plasticity index is the difference between the liquid and plastic limits. The plasticity index is a rough indication of the tendency of a soil to absorb water on the particle surfaces. Some clays have a strong affinity for water, and tend to swell when wetted and shrink when dried. The larger the plastic index, the greater the shrink-swell tendency. The test results will be included in our final report.

5.0 GEOLOGICALLY HAZARDOUS AREAS CONSIDERATIONS

As part of our study, we conducted a review of potential geologic hazards within the subject site as defined in Kenmore Municipal Code (KMC) Chapter 18.55, Critical Areas. Saint Edward Park contains areas that meet the criteria for erosion and landslide hazards. However, based on our review of the City's Geologic Hazard Area map, these areas are located 150 to 200 feet from the area of proposed improvements. The attached Figure 5 shows the approximately extent of the mapped erosion and landslide hazard areas relative to the study area and planned improvements.

5.1 Erosion Hazard

Erosion hazard areas are defined in KMC Chapter 18.55.620A based on the following criteria:

> *Erosion hazard areas are those areas identified by the U.S. Department of Agriculture's Natural Resources Conservation Service or identified by a special study as having a "moderate to severe," "severe," or "very severe" erosion potential.*

Review of the soil map for the subject site indicates the soils in the area of the proposed improvements are mapped as AgC, Alderwood gravelly sandy loam, 8 to 15 percent slopes, which has a moderate erosion hazard and would not be considered an erosion hazard area.

The soils in the incised channels north and south of the study area are mapped as Alderwood Kitsap Series, 25 to 75 percent slopes (AkF), which have a severe erosion potential. The planned improvements will be located more than 150 feet from these areas, as such, in our opinion, the risk associated with the planned improvement is low. These soils do not have a severe limitation for building site development.

However, the design will need to consider controlling surface water runoff from the site both during construction and after completion of construction. The erosion control plan should include measures for reducing concentrated surface runoff and protecting disturbed or exposed surfaces by mulching and revegetation.

The temporary erosion and sedimentation control plan should include the following:

- Where practical, maintain vegetation buffers around cleared areas;
- Cover exposed soil stockpiles;
- Hydroseed or place straw mulch in areas where grading is completed;
- Divert water away from the top of slopes;
- Use silt fences and straw bales around the lower portions of the site perimeter; and
- Coordinate clearing, excavation and erosion control to reduce exposed areas.
- The erosion control measures should be reviewed on a regular basis to verify they are functioning as intended.

5.2 LANDSLIDE HAZARD AREAS

5.2.1 Review of Kenmore Municipal Codes

Landslide hazard areas are defined in KMC Chapter 18.55.630B based on the following criteria:

> *Landslide hazard areas are potentially subject to* landslides *based on a combination of geologic, topographic, and hydrologic factors. They include areas susceptible because of any combination of bedrock, soil, slope (gradient), slope aspect, structure, hydrology, or other factors. Examples of these may include, but are not limited to, the following:*

1. Areas of historic failures, such as:

> *a. Those areas delineated by the U.S. Department of Agriculture's Natural Resources Conservation Service as having a "severe" limitation for building site* development*; or*
>
> *b. Areas designated as Quaternary slumps, earthflows, mudflows, or* landslides *on maps published by the U.S. Geological Survey or State Department of Natural Resources;*

Our review of the Preliminary Geologic Map of Seattle and Vicinity, Washington (Waldron, 1962) does not indicate the presence of Quaternary slumps, earthflows, mudflows, or landslides in the vicinity of the site. A portion of the geologic map for the site and surrounding area is included as Figure 4.

2. Areas with all three of the following characteristics:

> *a. Slopes steeper than 15 percent; and*
>
> *b. Hillsides intersecting geologic contacts with a relatively permeable sediment overlying relatively impermeable sediment; and*
>
> *c. Springs or ground water seepage;*

The area of the proposed improvements does not contain slopes steeper than 15 percent.

> *3. Areas that have shown movement during the Holocene epoch (from 10,000 years ago to the present) or that are underlain or covered by mass wastage debris of that epoch;*

In preparing this study, we conducted a reconnaissance of the study area and the immediate surrounding area. Based on our reconnaissance, the area of the planned improvements does not contain areas that have shown movement during the Holocene period. No mass wasting deposits were encountered at our exploration locations.

> *4. Slopes that are parallel or subparallel to planes of weakness (such as bedding planes, joint systems, and fault planes) in subsurface materials;*

No planes of weakness, joint systems or fault planes were encountered at our exploration locations.

> *5. Areas potentially unstable because of rapid* stream *incision, stream bank* erosion*, and undercutting by wave action;*

The study area does not contain any streams or bodies of water that would cause undercutting by wave action.

> *6. Areas located in a canyon or on an active alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding; and*

The subject site is not located in a canyon or active alluvial fan.

> *7. Areas with a slope of 40 percent or steeper and with a vertical relief of 10 or more feet. A slope is delineated by establishing its toe and measured by averaging the inclination over at least 10 feet of vertical relief.*

The study area does not contain slopes steeper than 40 percent with a vertical relief of more than 10 feet.

5.2.2 Landslide Hazard Area Summary

Based on our review, the area of the proposed improvements does not contain areas meeting the City of Kenmore definition of a landslide hazard area. The slopes of the steeply incised stream channel to the north and south of the planned improvements would meet the criteria for landslide hazard areas, however, the planned improvements will be situated more than 150 feet from these areas. This distance exceeds the minimum landslide hazard area setback requirements of 50 feet identified in the KMC.

5.3 Seismic Hazard Areas

Seismic hazard areas are defined in the KMC as:

> *…locations subject to severe risk of damage as a result of earthquake-induced ground shaking, slope failure, settlement, soil liquefaction, lateral spreading, or surface faulting.*

The closest Class A seismic source to the project site is the South Whidbey Island Fault Zone. The South Whidbey Island Fault is located about 10½ miles northwest of the site and consists of a northwest-southeast trending fault. According to the USGS Quaternary Fault Database (Fault No. 572), this fault has been active within the last 15,000 years (Johnson, 2004). Based on the distance to the fault, in our opinion, the potential for ground rupture at the subject site during a future earthquake is negligible.

Liquefaction is a process that can occur when soils lose shear strength for short periods of time during a seismic event. Ground shaking of sufficient strength and duration can result in the loss of grain-to-grain contact and an increase in pore water pressure, causing the soil to behave as a fluid. Soils with a potential for liquefaction are typically cohesionless, predominately silt and sand sized, must be loose, and be below the groundwater table. The site is underlain by glacially consolidated medium dense to very dense silty sand with gravel and medium stiff to hard silt, and clay without a defined water table. Based on these conditions, in our opinion the liquefaction potential of the site is negligible and design considerations related to soil liquefaction is not necessary for this project.

Seismic design recommendations are provided in Section 6.1 of this report.

6.0 GEOTECHNICAL RECOMMENDATIONS

6.1 Seismic Design Parameters

The 2012 International Building Code (IBC) seismic design section provides a basis for seismic design of structures. Table 1, below provides seismic design parameters for the site that are in conformance with the 2012 IBC, which specifies a design earthquake having a 2% probability of occurrence in 50 years (return interval of 2,475 years), and the 2008 USGS seismic hazard maps.

Table 1 – IBC Seismic Design Parameters

Site Class	Spectral Acceleration at 0.2 sec. (g)	Spectral Acceleration at 1.0 sec. (g)	Site Coefficients		Design Spectral Response Parameters		Control Periods (sec.)	
	S_S	S_1	F_a	F_v	S_{DS}	S_{D1}	T_O	T_S
D	1.252	0.485	1.000	1.515	0.835	0.490	0.117	0.587

6.2 Garage Foundation Design

Based on the subsurface conditions encountered at our exploration locations, in our opinion a conventional foundation, consisting of a spread and continuous footings, is appropriate to support the proposed parking garage, provided the foundation bears upon the native and undisturbed very stiff silt or dense silty sand deposits underlying the site.

6.2.1 Allowable Bearing Pressure

For foundations bearing on the native and undisturbed very stiff silt or dense silty sand deposits underlying the site, we recommend that a maximum allowable soil bearing pressure of 5,000 pounds per square foot (psf) be used for sizing the footings. For allowable stress design, the recommended allowable bearing pressure may be increased by 1/3 for transient conditions such as wind and seismic loadings.

Total and differential settlements are anticipated to be within tolerable limits for foundations designed and constructed as discussed above. Footing settlement under static loading conditions is estimated to be less than approximately 1 inch, and differential settlement should be less than about ½ inch.

All foundation subgrades should be carefully prepared. If soft/loose subgrade soils are encountered or the subgrade soils are still loose or yielding after re-compaction, they should be over-excavated and replaced with compacted structural fill. It should be noted that the site soils are highly moisture sensitive, and should be protected from exposure to moisture. Foundation excavations should be observed and verified by a qualified individual to confirm that the exposed subgrade is consistent with the expected conditions and adequate to support the proposed parking garage.

6.2.2 Lateral Resistance

Lateral forces from wind or seismic loading may be resisted by a combination of passive earth pressures acting against the embedded portions of the foundations, and by friction acting on the base of the foundations. Passive resistance values may be determined using an equivalent fluid weight of 300 pounds per cubic foot (pcf). This value includes a factor safety of at least 1.5 assuming that properly compacted structural fill will be placed adjacent to the sides of the footings. A friction coefficient of 0.4 may be used to determine the frictional resistance at the base of the footings. This coefficient includes a factor safety of approximately 1.5.

6.3 FLOOR SLABS

The floor slabs for the proposed parking garage may be constructed using conventional concrete slab-on-grade floor construction. The floor slabs should be supported on competent native soil or on structural fill. Any overexcavation, if needed, should be backfilled with structural fill.

Within areas of parking stalls and drive aisles, capillary break and vapor barriers are not necessary below the slab.

If heated space or space that are sensitive to moisture intrusions will be present in the garage, concrete slab-on-grade floors should be underlain by a capillary break consisting of at least of 4 inches of pea gravel or compacted ¾-inch, clean crushed rock (less than 3 percent fines). The capillary break material should meet the gradational requirements provided in Table 2, below.

Table 2 – Capillary Break Gradation

Sieve Size	Percent Passing
¾-inch	100
No. 4	0 – 10
No. 100	0 – 5
No. 200	0 – 3

The capillary break should be placed on subgrade soils that have been compacted to a dense and unyielding condition.

A 10-mil polyethylene vapor barrier should also be placed directly below the slab. Construction joints should be incorporated into the floor slab to control cracking.

6.4 Retaining Wall Design Parameters

Cast-in-place concrete retaining and basement walls should be designed to resist the lateral earth pressures exerted by the soils behind the wall. Proper drainage provisions should also be provided to intercept and remove groundwater that may be present behind the walls.

Cantilever walls should be designed for an equivalent fluid pressure of 35 pcf for a level backfill condition and assuming the walls are free to rotate. If the walls are restrained at the top from free movement, such as basement walls with a floor diaphragm, an equivalent fluid pressure of 45 pcf should be used for a level backfill condition behind the walls. Permanent walls should be designed for an additional uniform lateral pressure of 7H psf for seismic loading, where H corresponds to the height of the buried portion of the wall.

The recommended lateral pressures assume the backfill behind the walls consists of a free draining and properly compacted fill with adequate drainage provisions.

6.4.1 Surcharge

Surcharge loads, where present, should also be included in the design of retaining walls. If the below-grade walls will be subjected to the influence of traffic surcharge loading within a horizontal distance equal to or less than the height of the walls, a uniform horizontal pressure of 80 psf may be used to represent the traffic surcharge. The above recommended earth pressures assume a level backslope condition.

6.4.2 Lateral Resistance

Lateral forces from seismic loading and unbalanced lateral earth pressures may be resisted by a combination of passive earth pressures acting against the embedded portions of the foundations and by friction acting on the base of the wall foundation. Passive resistance values may be determined using an equivalent fluid weight of 350 pcf above elevation 260 feet and 175 pcf below elevation 260 feet. This value includes a factor of safety of 1.5, assuming the footing is backfilled with structural fill. A friction coefficient of 0.35 may be used to determine the frictional resistance at the base of the footings. The coefficient includes a factor of safety of 1.5.

6.4.3 Wall Drainage

Provisions for wall drainage should consist of a 4-inch diameter perforated drainpipe placed behind and at the base of the wall footings, embedded in 12 to 18 inches of clean crushed rock or pea gravel wrapped with a layer of filter fabric. A minimum 18-inch wide zone of free draining granular soils (i.e. pea gravel or washed rock) is recommended to be placed adjacent to the wall for the full height of the wall. Alternatively, a composite drainage material, such as Miradrain 6000, may be used in lieu of the clean crushed rock or pea gravel. The drainpipe at the base of the wall should be graded to direct water to a suitable outlet.

6.4.4 Wall Backfill

Retaining wall backfill should consist of free draining granular material. The site soils consist of relatively fine sand with varying amounts of silt. We recommend importing a free draining granular material, such as Seattle Type 17 or a soil meeting the requirements of Gravel Borrow as defined in Section 9-03.14(1) of the WSDOT *Standard Specifications for Road, Bridge, and Municipal Construction* (WSDOT, 2016). In areas where space is limited between the wall and the face of excavation, pea gravel may be used as backfill without compaction.

Wall backfill should be properly moisture conditioned to near its optimum moisture content, placed in loose, horizontal lifts less than 8 to 12 inches in thickness, and systematically compacted to a dense and relatively unyielding condition and to at least 95 percent of the maximum dry density, as determined using test method ASTM D-1557

(Modified Proctor). Within 5 feet of the wall, the backfill should be compacted with hand-operated equipment to at least 90 percent of the maximum dry density.

7.0 INFILTRATION AND SURFACE WATER DISPERSION

In the northwest, northeast and east portions of the study area, it is currently planned to construct surface level asphalt paved parking and drive areas. It is planned to dispose of surface water from the parking areas by using an infiltration system or by dispersion.

7.1 INFILTRATION

As part of our study, we drilled seven borings (Borings PG-1 through PG7) in the three areas where it is planned to either infiltrate stormwater or use stormwater dispersion. Soils suitable for infiltration typically consist of loose to medium dense sand and gravel deposits that are relatively permeability.

At our boring locations, we typically encountered silt, clay and silty sand with gravel. Based on the relatively high silt and clay content of these soils, in our opinion, the infiltration of stormwater will not be feasible.

7.2 STORMWATER DISPERSION

Stormwater dispersion systems being considered for this site include surface water sheet flow off the edges of the surface level parking areas in the northeast and northwest portion of the study area and a dispersal trench in the southeast portion of the study area.

In our opinion, the dispersion of stormwater should be feasible in the northwest and southeast portions of the site. The proposed dispersion system in the northeast of the site appears to be located within about 50 feet of a descending slope. When the topographic survey is completed and the locations of the planned improvements are established, we should further review the use of dispersion in the northeast portion of the site.

The primary considerations with dispersion trenches is uniformly discharging the flow and reducing the potential for the dispersed flows to remerge downstream and become concentrated. In order to uniformly discharge the flow, the transition from the discharge location or dispersion trench should be level. A notched grade board or concrete curb should be used to provide a level transition and prevent the concentration of discharge.

To reduce the potential for the flows to remerge, a vegetated flow path that is uniformly sloped should be provided below the discharge locations. The vegetated flow path should have minimum width of 25 feet and be sloped at a gradient no steeper than 20 percent.

The dispersion systems should be set back at least 50 feet from any slopes steeper than 40 percent. If a setback of 50 feet cannot be achieved, then the surface water should be conveyed to the toe of the slope for discharge, or piped to a more suitable location for dispersion.

8.0 EARTHWORK CONSIDERATIONS

8.1 Stripping and Proofrolling

Areas to receive structural fill should be stripped and cleared of surface vegetation, organic matter, and other deleterious material. Existing utility pipes to be abandoned should be plugged or removed so they do not provide a conduit for water and cause soil saturation and stability problems.

Based on the thickness of the topsoil horizon encountered at our boring locations, we anticipate a stripping depth of six to eight inches across most of the site, with localized areas extending to 12 inches below grade. The actual stripping depth should be based on field observation at the time of construction.

Root balls from vines, brush, and trees should be grubbed to remove roots greater than about one-inch in diameter. The depth of grubbing to remove root balls could extend to 1½ to 2 feet below the existing ground surface. Depending on the grubbing methods used, disturbance and loosening of the subgrade could occur during grubbing. Soil disturbed during the grubbing process should be compacted in-place to the requirements of structural fill.

In no case should the stripped or grubbed materials be used as structural fill or mixed with material to be used as structural fill. The stripped materials may be “wasted” on site in non-structural landscaping areas or they should be exported.

Following the stripping operation and excavations necessary to achieve construction subgrade elevations, the ground surface where structural fill, foundations, slabs, or pavements are to be placed should be observed by a representative of PanGEO. Proofrolling may be necessary to identify soft or unstable areas. Proofrolling should be performed under the observation of a representative of PanGEO. Soil in loose or soft areas, if re-compacted and still yielding, should be overexcavated and replaced with structural fill to a depth that will provide a stable base beneath the general structural fill. The optional use of a geotextile fabric placed directly on the overexcavated surface may also help to bridge unstable areas.

8.2 Temporary Excavations

We understand an excavation extending to a depth of 10 to 12 feet below grade will be needed to achieve construction subgrade elevations for the parking garage. Based on our understanding of the subsurface conditions at the site, we anticipate the excavations should encounter dense to very dense silty sand with gravel soil. All temporary excavations should be performed in accordance with Part N of WAC (Washington Administrative Code) 296-155.

The contractor is responsible for maintaining safe excavation slopes and/or shoring. For planning purposes, the temporary excavations may be sloped as steep as 1H:1V, but should be re-evaluated in the field during construction based on actual observed soil conditions. During wet weather, the cut slopes may need to be flattened to reduce potential erosion.

8.3 Material Reuse

The contractor should be aware the native silt, clay and silty sand with gravel soils underlying the site are moisture sensitive, and will become disturbed and soft when exposed to inclement weather conditions and/or groundwater seepage. If the reuse of the existing soils is planned, the soil should be stockpiled and protected from precipitation with plastic sheeting.

8.4 Structural Fill and Compaction

Structural fill should be free of organic and inorganic debris, be near the optimum moisture content, and be capable of being compacted to the requirement of structural fill described below. If the on-site soils do not meet these criteria, or cannot be reworked, we recommend using an imported granular fill consisting of well graded soil that is free of organic material, with less than 5 percent fines (that portion of the soil that passes the US No. 200 sieve).

All structural fill soils should be properly moisture conditioned to near its optimum moisture content, placed in loose, horizontal lifts less than 8 to 12 inches in thickness, and compacted to at least 95 percent maximum density, determined using ASTM D 1557 (Modified Proctor). The procedure to achieve proper density of a compacted fill depends on the size and type of compacting equipment, the number of passes, thickness of the layer being compacted, and certain soil properties. In areas where the size of the excavation restricts the use of heavy equipment, smaller equipment can be used, but the soil must be placed in thin enough lifts to achieve the required relative compaction.

Generally, loosely compacted soils are a result of poor construction technique or improper moisture content. Soils with high fines contents are particularly susceptible to becoming too wet, and coarse-grained materials easily become too dry, for proper compaction. Silty or clayey soils with a moisture content too high for adequate compaction should be dried as necessary, or moisture conditioned by mixing with drier materials, or other methods.

8.5 Wet Weather Construction

General recommendations relative to earthwork performed in wet weather or in wet conditions are presented below. The following procedures are best management practices recommended for use in wet weather construction:

- Earthwork should be performed in small areas to minimize subgrade exposure to wet weather. Excavation or the removal of unsuitable soil should be followed promptly by the placement and compaction of clean structural fill. The size and type of construction equipment used may have to be limited to prevent soil disturbance.
- During wet weather, the allowable fines content of the structural fill should be reduced to no more than 5 percent by weight based on the portion passing the 0.75-inch sieve. The fines should be non-plastic.
- The ground surface within the construction area should be graded to promote run-off of surface water and to prevent the ponding of water.
- Bales of straw and/or geotextile silt fences should be installed at strategic locations around the site to control erosion and the movement of soil.

- Excavation slopes and soils stockpiled on site should be covered with plastic sheets.

9.0 UNCERTAINTY AND LIMITATIONS

We have prepared this report for use by Daniels Real Estate. Recommendations contained in this report are based on a site reconnaissance, a subsurface exploration program, review of pertinent geologic publications, and our understanding of the project. The study was performed using a mutually agreed-upon scope of work.

Variations in soil conditions may exist between the locations of the explorations and the actual conditions underlying the site. The nature and extent of soil variations may not be evident until construction occurs. If any soil conditions are encountered at the site that are different from those described in this report, we should be notified immediately to review the applicability of our recommendations. Additionally, we should also be notified to review the applicability of our recommendations if there are any changes in the project scope.

Our scope of services does not include those related to construction safety precautions. Our recommendations are not intended to direct the contractors' methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design. Additionally, the scope of our work specifically excludes the assessment of environmental characteristics, particularly those involving hazardous substances. We are not mold consultants nor are our recommendations to be interpreted as being preventative of mold development. A mold specialist should be consulted for all mold-related issues.

This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or other factors including advances in our understanding of applied science, may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 24 months from its issuance. PanGEO should be notified if the project is delayed by more than 24 months from the date of this report so that we may review the applicability of our conclusions considering the time lapse.

It is the client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk. Any party other than the client who wishes to use this report shall notify PanGEO of such intended use and for permission to copy this report. Based on the intended use of the report, PanGEO may require that additional work be performed and that an updated report be reissued. Noncompliance with any of these requirements will release PanGEO from any liability resulting from the use this report.

Within the limitation of scope, schedule and budget, PanGEO engages in the practice of geotechnical engineering and endeavors to perform its services in accordance with generally accepted professional principles and practices at the time the Report or its contents were prepared. No warranty, express or implied, is made.

We appreciate the opportunity to be of service to you on this project. Please feel free to contact our office with any questions you have regarding our study, this report, or any geotechnical engineering related project issues.

Sincerely,

Sincerely,

PanGEO, Inc.

Scott D. Dinkelman, LEG, LHG
Senior Engineering Geologist

Siew L. Tan, P.E.
Principal Geotechnical Engineer

10.0 REFERENCES

International Building Code (IBC), 2012, International Code Council.

Johnson, S.Y., Blakely, R.J., Brocher, T.M., Sherrod, B.L., Kelsey, H.M., and Lidke, D.J., compilers, 2004, Fault number 572, Southern Whidbey Island fault zone, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, http://earthquakes.usgs.gov/hazards/qfaults, accessed 06/21/2016 05:40 PM.

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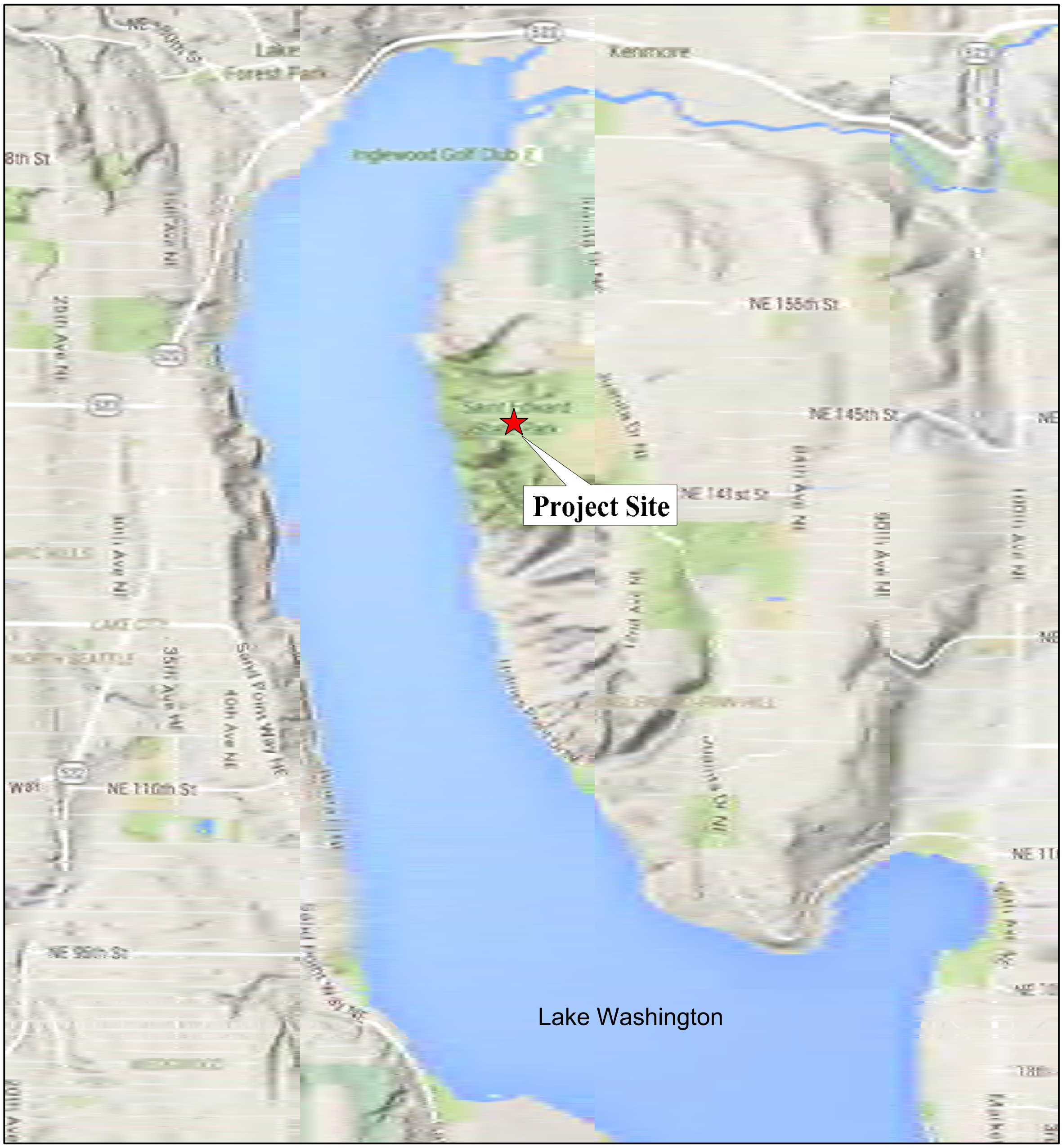
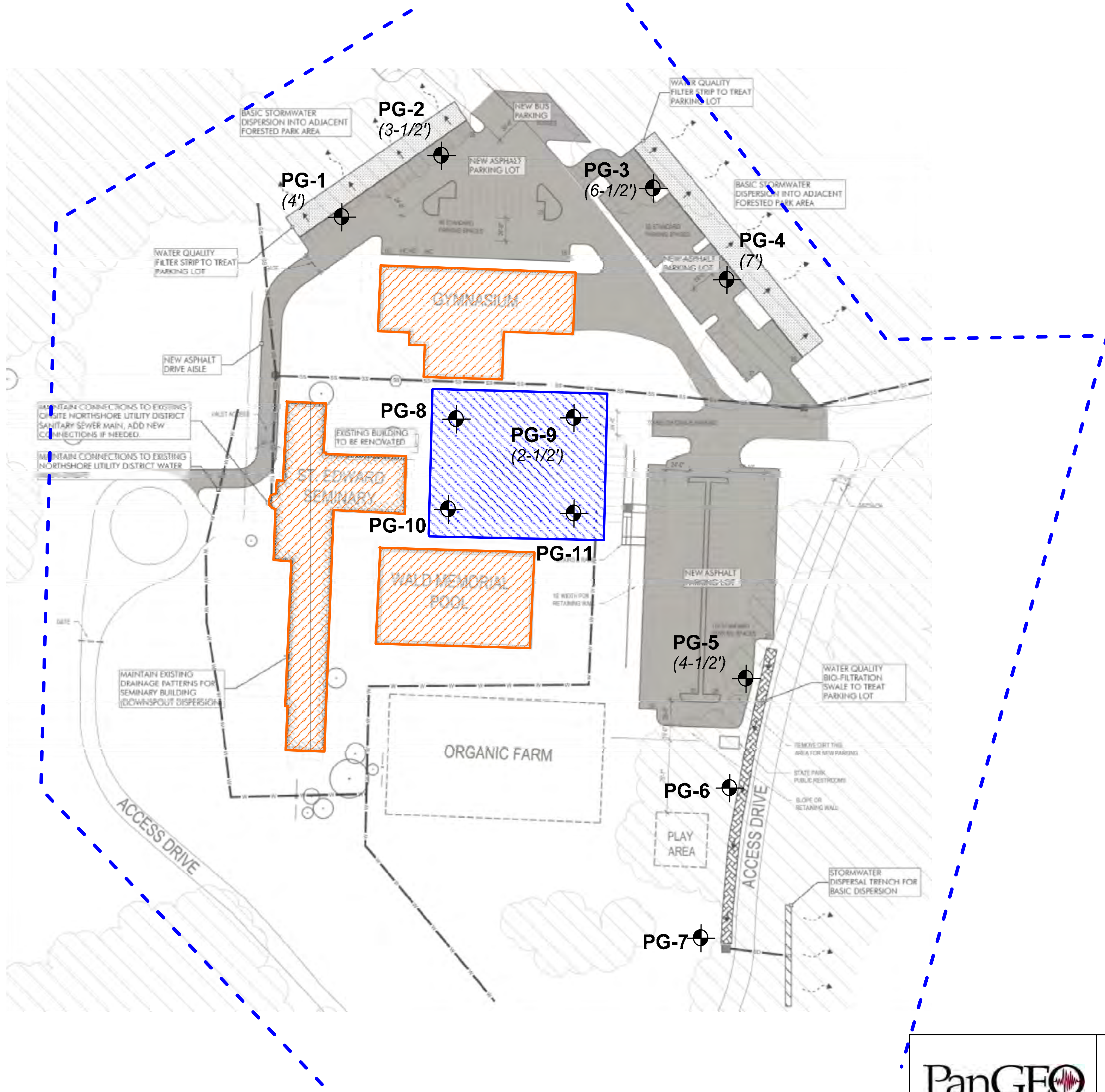
WSDOT, 2016, Standard Specifications for Road, Bridges, and Municipal Construction.



Not to Scale

Reference: Google Terrain Map

PanGEO INCORPORATED	**Saint Edward Seminary** **14445 Juanita Drive NE** **Kenmore, Washington**	**VICINITY MAP**	
		Project No. **16-163**	Figure No. **1**



EXPLANATION:

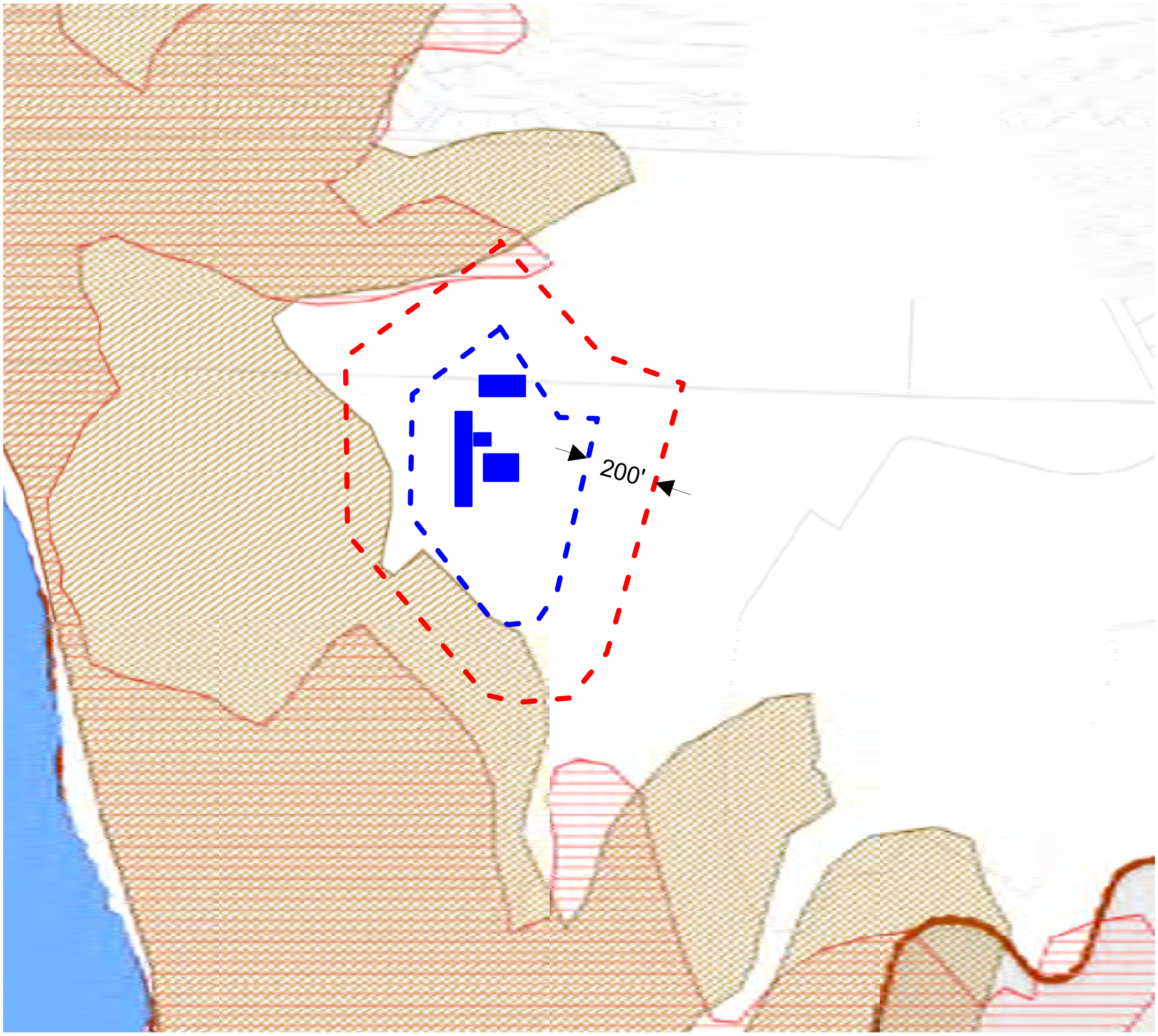
- Approximate Limits of Study Area
- Existing Structures
- Proposed Below Grade Parking Garage
- Proposed Asphalt Paved Surface Parking and Drive Areas
- PG-1 (7') — Approximate Boring Location PanGEO, Inc, June 2016 *(Fill Thickness in Feet)*

N

Approximate Scale:

0 50 100

PanGEO INCORPORATED	Saint Edward Seminary 14445 Juanita Drive NE Kenmore, Washington	SITE AND EXPLORATION PLAN
		Project No. 16-163 / Figure No. 2



Base Map: City of Kenmore

EXPLANATION:

Erosion Hazard Areas

Landslide Hazard Areas

Approximate Extent of Study Area

Approximate 200-Foot Radius Around Study Area

Existing Structures

NORTH

Approx. Scale:

0 250 500

PanGEO INCORPORATED

Saint Edward Seminary
14445 Juanita Drive NE
Kenmore, Washington

CITY OF KENMORE
GEOLOGIC HAZARD AREAS

Project No. **16-163**

Figure No. **3**

Base Map: USGS 1962

EXPLANATION:

GEOLOGIC UNITS

Qt - Vashon Till

Qc - Older clay, till and gravel, glaciolacustrine deposits

Qos - Older sand - advance outwash

Qyg - Younger gravel - alluvium

NORTH

Approx. Scale:
1" = 1,250'

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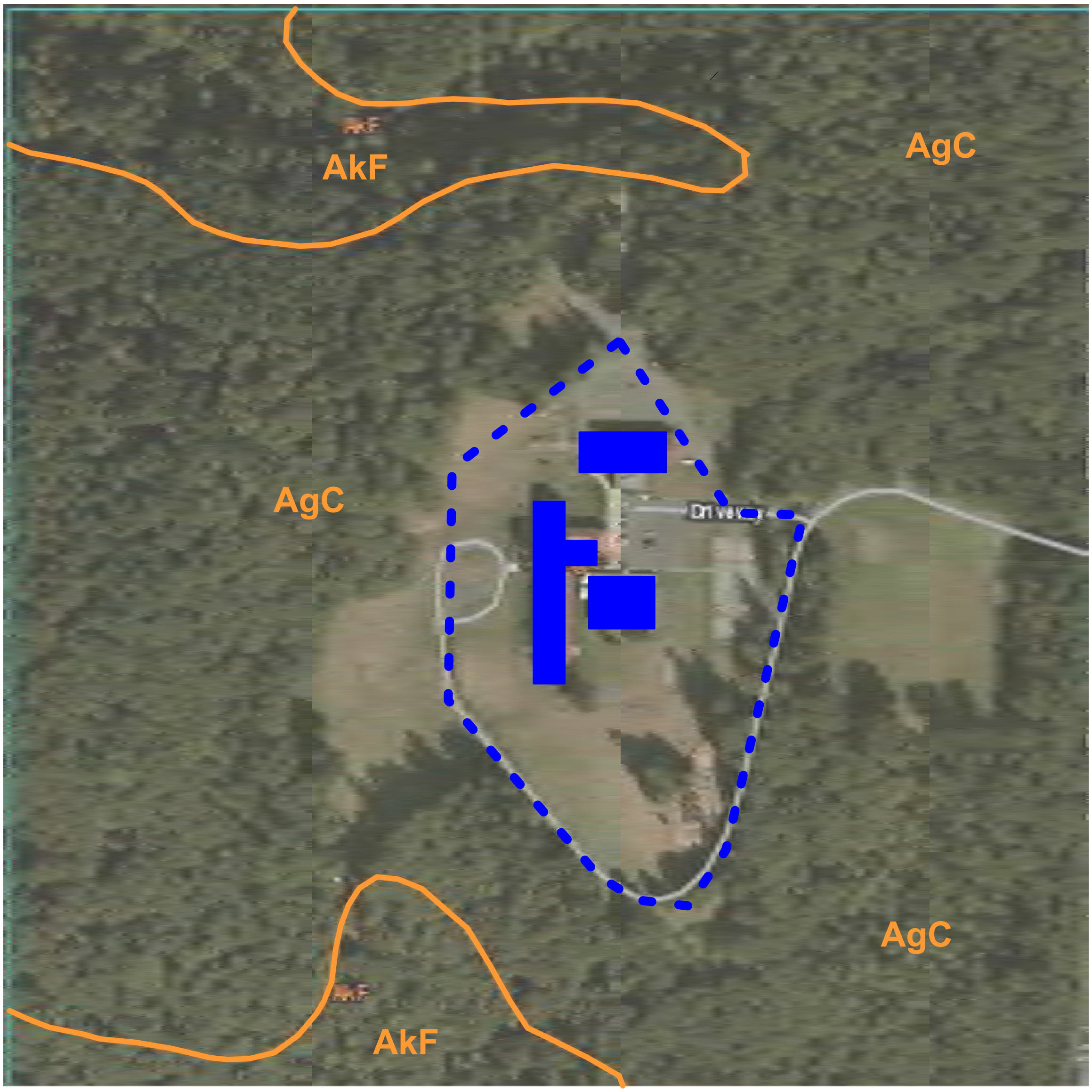
Saint Edward Seminary
14445 Juanita Drive NE
Kenmore, Washington

GEOLOGIC MAP

Project No.	Figure No.
16-163	4



Base Map: USDA NRCS

EXPLANATION:

Approximate Extent of Study Area

Existing Structures

Contacts Between Soil Units

AkF -- Alderwood Kitsap Soils
25 to 75 Percent Slopes

AgC -- Alderwood Gravelley
Sandy Loam,
8 to 15 Percent Slopes

NORTH

Approx. Scale:
1" = 40'

PanGEO INCORPORATED	Saint Edward Seminary 14445 Juanita Drive NE Kenmore, Washington	SOILS MAP	
		Project No. **16-163**	Figure No. **5**

APPENDIX A

SUMMARY BORING LOGS

RELATIVE DENSITY / CONSISTENCY

SAND / GRAVEL			SILT / CLAY		
Density	SPT N-values	Approx. Relative Density (%)	Consistency	SPT N-values	Approx. Undrained Shear Strength (psf)
Very Loose	<4	<15	Very Soft	<2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Med. Dense	10 to 30	35 - 65	Med. Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	>50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	>30	>4000

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		GROUP DESCRIPTIONS	
Gravel 50% or more of the coarse fraction retained on the #4 sieve. Use dual symbols (eg. GP-GM) for 5% to 12% fines.	GRAVEL (<5% fines)	GW	Well-graded GRAVEL
		GP	Poorly-graded GRAVEL
	GRAVEL (>12% fines)	GM	Silty GRAVEL
		GC	Clayey GRAVEL
Sand 50% or more of the coarse fraction passing the #4 sieve. Use dual symbols (eg. SP-SM) for 5% to 12% fines.	SAND (<5% fines)	SW	Well-graded SAND
		SP	Poorly-graded SAND
	SAND (>12% fines)	SM	Silty SAND
		SC	Clayey SAND
Silt and Clay 50%or more passing #200 sieve	Liquid Limit < 50	ML	SILT
		CL	Lean CLAY
		OL	Organic SILT or CLAY
	Liquid Limit > 50	MH	Elastic SILT
		CH	Fat CLAY
		OH	Organic SILT or CLAY
Highly Organic Soils		PT	PEAT

Notes:

1. Soil exploration logs contain material descriptions based on visual observation and field tests using a system modified from the Uniform Soil Classification System (USCS). Where necessary laboratory tests have been conducted (as noted in the "Other Tests" column), unit descriptions may include a classification. Please refer to the discussions in the report text for a more complete description of the subsurface conditions.

2. The graphic symbols given above are not inclusive of all symbols that may appear on the borehole logs. Other symbols may be used where field observations indicated mixed soil constituents or dual constituent materials.

DESCRIPTIONS OF SOIL STRUCTURES

Layered:	Units of material distinguished by color and/or composition from material units above and below
Laminated:	Layers of soil typically 0.05 to 1mm thick, max. 1 cm
Lens:	Layer of soil that pinches out laterally
Interlayered:	Alternating layers of differing soil material
Pocket:	Erratic, discontinuous deposit of limited extent
Homogeneous:	Soil with uniform color and composition throughout
Fissured:	Breaks along defined planes
Slickensided:	Fracture planes that are polished or glossy
Blocky:	Angular soil lumps that resist breakdown
Disrupted:	Soil that is broken and mixed
Scattered:	Less than one per foot
Numerous:	More than one per foot
BCN:	Angle between bedding plane and a plane normal to core axis

COMPONENT DEFINITIONS

COMPONENT	SIZE / SIEVE RANGE	COMPONENT	SIZE / SIEVE RANGE
Boulder:	> 12 inches	Sand	
Cobbles:	3 to 12 inches	Coarse Sand:	#4 to #10 sieve (4.5 to 2.0 mm)
Gravel		Medium Sand:	#10 to #40 sieve (2.0 to 0.42 mm)
Coarse Gravel:	3 to 3/4 inches	Fine Sand:	#40 to #200 sieve (0.42 to 0.074 mm)
Fine Gravel:	3/4 inches to #4 sieve	Silt	0.074 to 0.002 mm
		Clay	<0.002 mm

TEST SYMBOLS

for In Situ and Laboratory Tests listed in "Other Tests" column.

ATT	Atterberg Limit Test
Comp	Compaction Tests
Con	Consolidation
DD	Dry Density
DS	Direct Shear
%F	Fines Content
GS	Grain Size
Perm	Permeability
PP	Pocket Penetrometer
R	R-value
SG	Specific Gravity
TV	Torvane
TXC	Triaxial Compression
UCC	Unconfined Compression

SYMBOLS

Sample/In Situ test types and intervals

- 2-inch OD Split Spoon, SPT (140-lb. hammer, 30" drop)
- 3.25-inch OD Spilt Spoon (300-lb hammer, 30" drop)
- Non-standard penetration test (see boring log for details)
- Thin wall (Shelby) tube
- Grab
- Rock core
- Vane Shear

MONITORING WELL

- Groundwater Level at time of drilling (ATD)
- Static Groundwater Level
- Cement / Concrete Seal
- Bentonite grout / seal
- Silica sand backfill
- Slotted tip
- Slough
- Bottom of Boring

MOISTURE CONTENT

Dry	Dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

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Phone: 206.262.0370

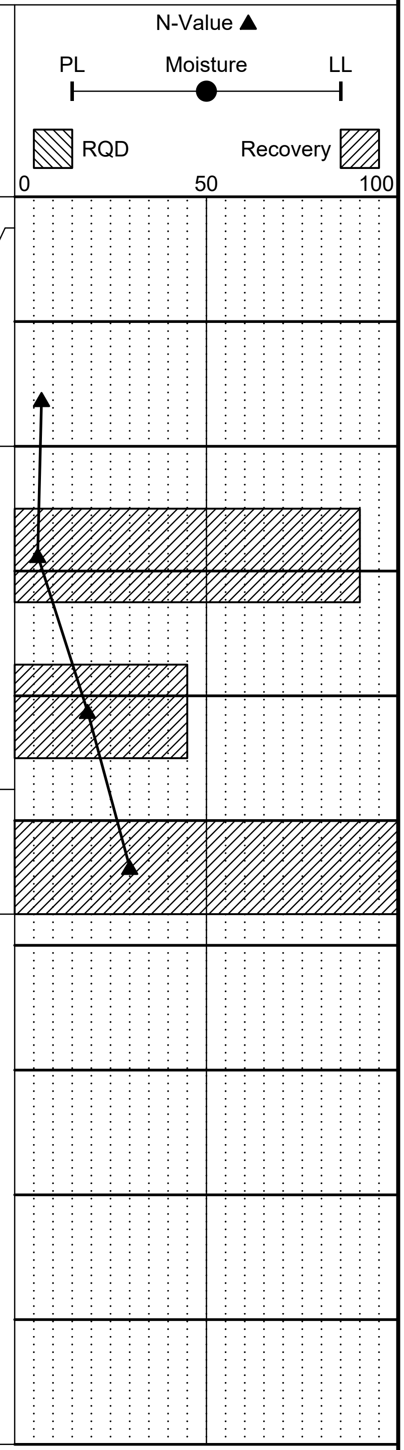
Terms and Symbols for Boring and Test Pit Logs

Figure A-1

LOG KEY 13-113 LOG.GPJ PANGEO.GDT 9/18/13

Project:	Saint Edward Seminary	Surface Elevation:	Approx. 356 feet
Job Number:	16-163	Top of Casing Elev.:	
Location:	14445 Juanita Drive NE, Kenmore, Washington	Drilling Method:	Hollow-Stem Auger
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						Topsoil and Sod, dark brown silty fine to medium SAND with organics [TOPSOIL].
						Loose, moist, brown, silty SAND with small gravel (SM); organics and rootlets present. **[FILL].**
2	S-1		8, 5, 2			- No recovery for sample S-1.
4						Loose, very moist, light brown to light gray, silty SAND with gravel (SM); fine sand, pockets of very silty sand, iron oxide staining, mottled. **[QUATERNARY PRE FRASER - OUTWASH].**
6	S-2		4, 3, 3			
8	S-3		9, 5, 14			- Becomes medium dense and wet in sample S-3.
10	S-4		8, 13, 17			Very stiff, moist, gray, SILT (ML); massive. **[QUATERNARY PRE FRASER - GLACIOLACUSTRINE].**
12						Borehole terminated at 11.5 feet below grade. Perched groundwater seepage encountered from about 7.5 to 9.5 feet below grade.
14						
16						
18						
20						



Completion Depth:	11.5ft
Date Borehole Started:	6/13/16
Date Borehole Completed:	6/13/16
Logged By:	B. Townsend
Drilling Company:	Bortec1, Inc.

Remarks: Drilling was performed using an EC-55 drill rig. Standard Penetration Test (STP) sampler driven with a 140 lb hammer using a rope and cathead dropping 30 inches. Approxicate ground surface elevation from Google Earth.

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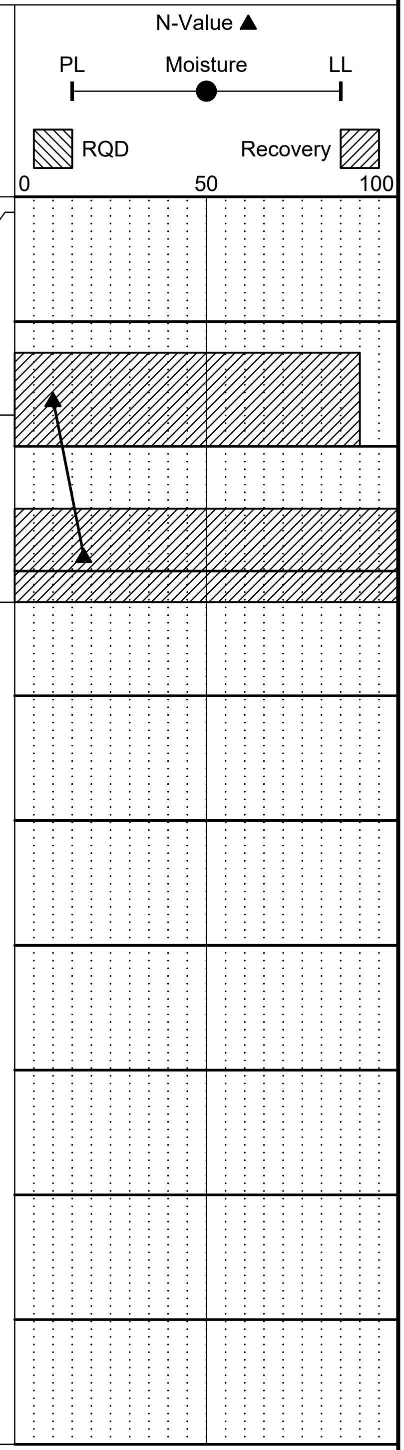
LOG OF TEST BORING PG-1

Figure A-2

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Saint Edward Seminary	Surface Elevation:	Approx. 356 feet
Job Number:	16-163	Top of Casing Elev.:	
Location:	14445 Juanita Drive NE, Kenmore, Washington	Drilling Method:	Hollow-Stem Auger
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						Asphalt Pavement - 2 inches thick.
						Medium dense, moist, brown, silty SAND (SM); trace gravel and organics. **[FILL].**
2						
	S-1		8 5 5			- Top 12 inches of sample S-1 encountered FILL, overlying bottom 4 inches of native SILT.
4						Stiff, moist, light brown, SILT with sand (ML); massive, iron oxide staining, mottled. **[QUATERNARY PRE FRASER - GLACIOLACUSTRINE].**
6	S-2		7 7 11			
						Borehole terminated at 6.5 feet below grade. No groundwater encountered during drilling.
8						
10						
12						
14						
16						
18						
20						



Completion Depth:	6.5ft	Remarks: Drilling was performed using an EC-55 drill rig. Standard Penetration Test (STP) sampler driven with a 140 lb hammer using a rope and cathead dropping 30 inches. Approxicate ground surface elevation from Google Earth.
Date Borehole Started:	6/13/16	
Date Borehole Completed:	6/13/16	
Logged By:	B. Townsend	
Drilling Company:	Bortec1, Inc.	

PanGEO INCORPORATED

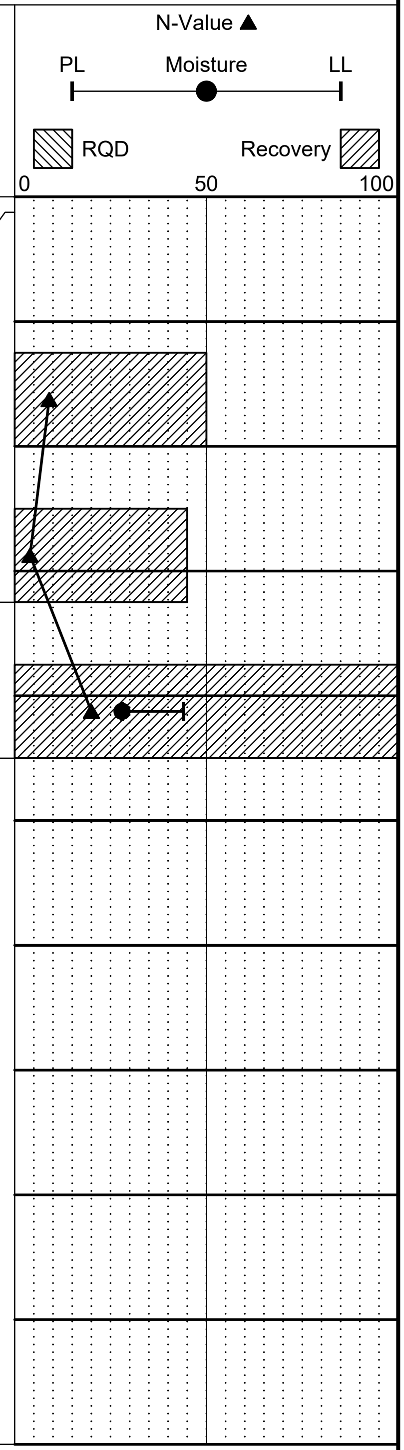
LOG OF TEST BORING PG-2

Figure A-3

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Saint Edward Seminary	Surface Elevation:	Approx. 356 feet
Job Number:	16-163	Top of Casing Elev.:	
Location:	14445 Juanita Drive NE, Kenmore, Washington	Drilling Method:	Hollow-Stem Auger
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						Asphalt Pavement - 3 inches thick.
						Loose, moist, brown, silty SAND with gravel (SM); fine sand, rootlets and wood chips present. **[FILL].**
2						
	S-1		7 4 5			
4						
	S-2		2 1 3			- Becomes very loose in sample S-2. - Sandy SILT in tip of sample S-2.
6						
						Very stiff, moist, gray-brown, SILT with sand (ML); very fine sand, massive, blocky texture, some pockets of light gray, iron oxides staining. **[QUATERNARY PRE FRASER - GLACIOLACUSTRINE].**
8	S-3		6 8 12	ATT		LL=44%, PL=28%, Natural Moisture 28%.
						Borehole terminated at 9 feet below grade. No groundwater encountered during drilling.
10						
12						
14						
16						
18						
20						



Completion Depth:	9.0ft
Date Borehole Started:	6/13/16
Date Borehole Completed:	6/13/16
Logged By:	B. Townsend
Drilling Company:	Bortec1, Inc.

Remarks: Drilling was performed using an EC-55 drill rig. Standard Penetration Test (STP) sampler driven with a 140 lb hammer using a rope and cathead dropping 30 inches. Approxicate ground surface elevation from Google Earth.

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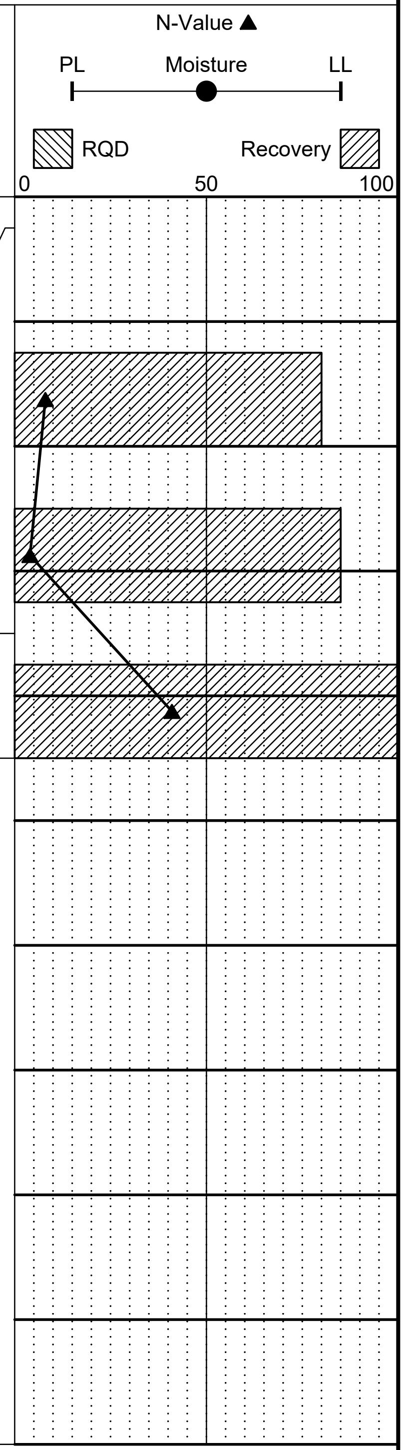
LOG OF TEST BORING PG-3

Figure A-4

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Saint Edward Seminary	Surface Elevation:	Approx. 349 feet
Job Number:	16-163	Top of Casing Elev.:	
Location:	14445 Juanita Drive NE, Kenmore, Washington	Drilling Method:	Hollow-Stem Auger
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						Topsoil and Sod, dark brown silty fine to medium SAND with organics [TOPSOIL].
						Loose, moist, light brown-gray, silty SAND with gravel (SM); intermixed with sandy silt pockets, charcoal and organics presetn, mottled iron oxide staining. **[FILL].**
2	S-1		3 4 4			
4						
6	S-2		2 2 2			- Becomes very loose, moist, blue, very silty SAND with gravel and black orgaincs, organic odor present in sample S-2.
8	S-3		11 17 24			Hard, moist, light brown, SILT (ML); trace fine sand, massive, blocky texture, some iron oxides. **[QUATERNARY PRE FRASER - GLACIOLACUSTRINE].**
10						Borehole terminated at 9 feet below grade. No groundwater encountered during drilling.
12						
14						
16						
18						
20						



Completion Depth:	9.0ft
Date Borehole Started:	6/13/16
Date Borehole Completed:	6/13/16
Logged By:	B. Townsend
Drilling Company:	Bortec1, Inc.

Remarks: Drilling was performed using an EC-55 drill rig. Standard Penetration Test (STP) sampler driven with a 140 lb hammer using a rope and cathead dropping 30 inches. Approxicate ground surface elevation from Google Earth.

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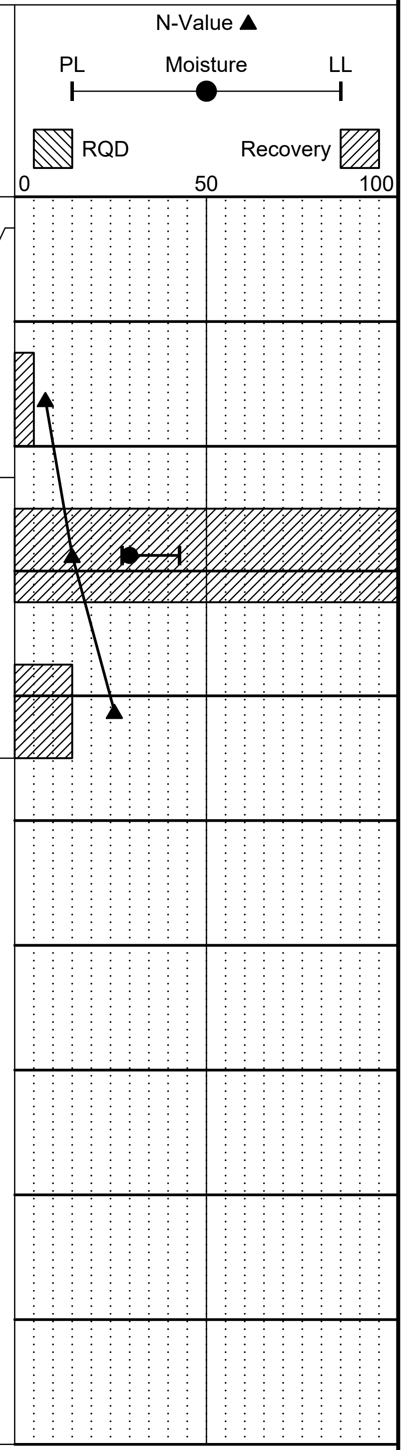
LOG OF TEST BORING PG-4

Figure A-5

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Saint Edward Seminary	Surface Elevation:	Approx. 347 feet
Job Number:	16-163	Top of Casing Elev.:	
Location:	14445 Juanita Drive NE, Kenmore, Washington	Drilling Method:	Hollow-Stem Auger
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						Topsoil and Sod, dark brown silty fine to medium SAND with organics [TOPSOIL].
						Loose, moist, brown, silty SAND (SM); fine sand. **[FILL].**
2						
	S-1		4 4 4			- About 1" recovery in sample S-1.
4						
						Stiff, moist, light brown, SILT (ML); trace fine sand, some iron oxides, massive. **[QUATERNARY PRE FRASER - GLACIOLACUSTRINE].**
6	S-2		3 6 9	ATT		LL=43%, PL=28%, Natural Moisture 30%.
8	S-3		10 12 14			- Becomes very stiff in sample S-3.
						Borehole terminated at 9 feet below grade. No groundwater encountered during drilling.
10						
12						
14						
16						
18						
20						



Completion Depth:	9.0ft
Date Borehole Started:	6/13/16
Date Borehole Completed:	6/13/16
Logged By:	B. Townsend
Drilling Company:	Bortec1, Inc.

Remarks: Drilling was performed using an EC-55 drill rig. Standard Penetration Test (STP) sampler driven with a 140 lb hammer using a rope and cathead dropping 30 inches. Approxicate ground surface elevation from Google Earth.

PanGEO INCORPORATED

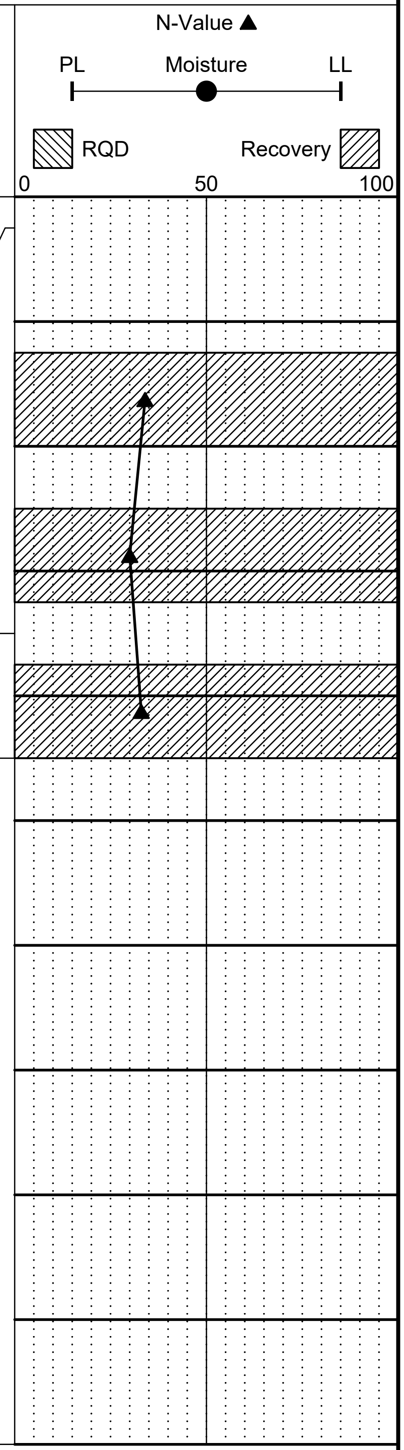
LOG OF TEST BORING PG-5

Figure A-6

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Saint Edward Seminary	Surface Elevation:	Approx. 353 feet
Job Number:	16-163	Top of Casing Elev.:	
Location:	14445 Juanita Drive NE, Kenmore, Washington	Drilling Method:	Hollow-Stem Auger
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						Topsoil and Sod, dark brown silty fine to medium SAND with organics [TOPSOIL].
0.5						Dense, moist, gray, silty SAND with gravel (SM); fine sand, pockets of sandy silt present, some diamict texture, iron oxides present. **[QUATERNARY PRE FRASER - TILL].**
2.5–4	S-1		12 16 18			
5–6.5	S-2		9 14 16			- Becomes very silty in sample S-2.
7						Dense, moist, gray, SAND with silt (SM); trace small gravel, fine sand, pockets of silt present throughout. **[QUATERNARY PRE FRASER - OUTWASH].**
7.5–9	S-3		8 13 20			
9						Borehole terminated at 9 feet below grade. No groundwater encountered during drilling.



Completion Depth:	9.0ft
Date Borehole Started:	6/13/16
Date Borehole Completed:	6/13/16
Logged By:	B. Townsend
Drilling Company:	Bortec1, Inc.

Remarks: Drilling was performed using an EC-55 drill rig. Standard Penetration Test (STP) sampler driven with a 140 lb hammer using a rope and cathead dropping 30 inches. Approxicate ground surface elevation from Google Earth.

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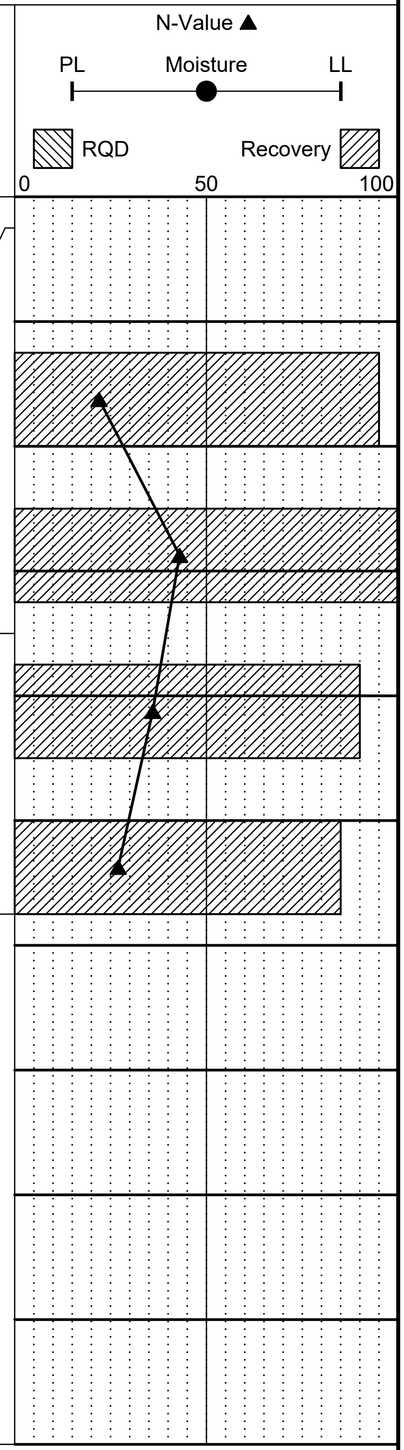
LOG OF TEST BORING PG-6

Figure A-7

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Saint Edward Seminary	Surface Elevation:	Approx. 351 feet
Job Number:	16-163	Top of Casing Elev.:	
Location:	14445 Juanita Drive NE, Kenmore, Washington	Drilling Method:	Hollow-Stem Auger
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						Topsoil and Sod, dark brown silty fine to medium SAND with organics [TOPSOIL].
						Very stiff, moist, light brown-gray, SILT with fine sand (ML); massive, iron oxide staining, mottled. **[QUATERNARY PRE FRASER - GLACIOLACUSTRINE].**
2						
	S-1		6 / 9 / 13			
4						
6	S-2		11 / 18 / 25			- Becomes hard with trace gravel and pockets of very silty SAND present near bottom of sample S-2.
						Dense, moist, brown-gray, silty SAND (SM); fine to medium sand, some laminated layers. **[QUATERNARY PRE FRASER - OUTWASH].**
8	S-3		13 / 18 / 18			
10						
	S-4		9 / 11 / 16			- Becomes medium dense, SAND with silt (SM); trace gravel, laminated in sample S-4.
						Borehole terminated at 11.5 feet below grade. No groundwater encountered during drilling.
12						
14						
16						
18						
20						



Completion Depth:	11.5ft
Date Borehole Started:	6/13/16
Date Borehole Completed:	6/13/16
Logged By:	B. Townsend
Drilling Company:	Bortec1, Inc.

Remarks: Drilling was performed using an EC-55 drill rig. Standard Penetration Test (STP) sampler driven with a 140 lb hammer using a rope and cathead dropping 30 inches. Approxicate ground surface elevation from Google Earth.

PanGEO INCORPORATED

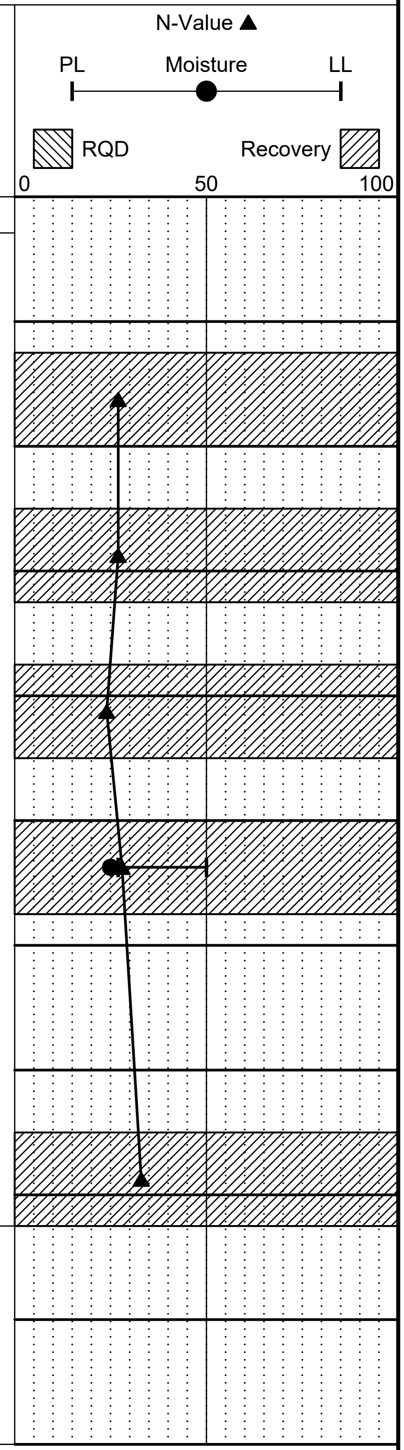
LOG OF TEST BORING PG-7

Figure A-8

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Saint Edward Seminary	Surface Elevation:	Approx. 356 feet
Job Number:	16-163	Top of Casing Elev.:	
Location:	14445 Juanita Drive NE, Kenmore, Washington	Drilling Method:	Hollow-Stem Auger
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						Asphalt Pavement - 7 inches thick.
						Very stiff, moist, blue-gray, fat CLAY (CH); massive, some iron oxides present. **[QUATERNARY PRE FRASER - GLACIOLACUSTRINE].**
2						
	S-1		9 11 16			
4						
6	S-2		7 12 15			- Becomes intermixed blue-gray and brown-gray with trace fine sand in sample S-2.
8	S-3		9 11 13			- Becomes fully blue-gray with blocky textures in sample S-3 to the bottom of the boring.
10	S-4		9 16 12	ATT		LL=50%, PL=27%, Natural Moisture 25%.
12						
14						
16	S-5		10 13 20			- Becomes hard in sample S-5.
						Borehole terminated at 16.5 feet below grade. No groundwater encountered during drilling.
18						
20						



Completion Depth:	16.5ft
Date Borehole Started:	6/13/16
Date Borehole Completed:	6/13/16
Logged By:	B. Townsend
Drilling Company:	Bortec1, Inc.

Remarks: Drilling was performed using an EC-55 drill rig. Standard Penetration Test (STP) sampler driven with a 140 lb hammer using a rope and cathead dropping 30 inches. Approxicate ground surface elevation from Google Earth.

PanGEO INCORPORATED

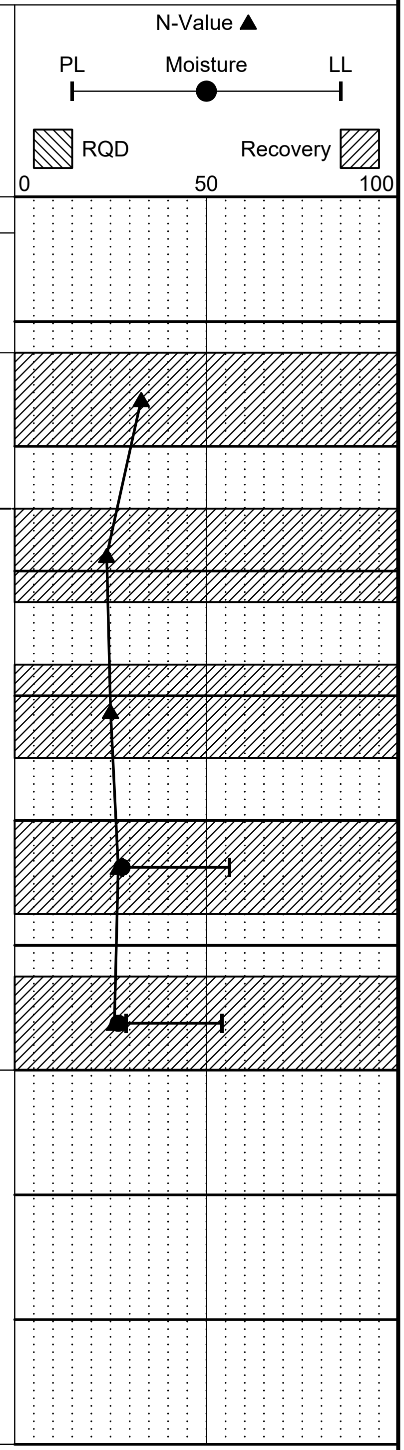
LOG OF TEST BORING PG-8

Figure A-9

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Saint Edward Seminary	Surface Elevation:	Approx. 350 feet
Job Number:	16-163	Top of Casing Elev.:	
Location:	14445 Juanita Drive NE, Kenmore, Washington	Drilling Method:	Hollow-Stem Auger
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						Asphalt Pavement - 7 inches thick.
						Gray brown, silty SAND with gravel in top of sample S-1. Likely sloughed soils between 0 and 2.5 feet deep. **[FILL].**
2.5–4	S-1	SPT	19, 16, 17			Hard, moist, gray, SILT with fine sand (ML); massive. **[QUATERNARY PRE FRASER - GLACIOLACUSTRINE].**
5–6.5	S-2	SPT	8, 11, 13			Very stiff, blue-gray, fat CLAY (CH); massive.
7.5–9	S-3	SPT	6, 11, 14			- Some blocky texture present in sample S-3.
10–11.5	S-4	SPT	9, 12, 15	ATT		- Some thin laminated layers present in sample S-4. LL=56%, PL=28%, Natural Moisture 28%.
12.5–14	S-5	SPT	8, 12, 14	ATT		LL=54%, PL=29%, Natural Moisture 27%.
14						Borehole terminated at 14 feet below grade. No groundwater encountered during drilling.



Completion Depth:	14.0ft
Date Borehole Started:	6/13/16
Date Borehole Completed:	6/13/16
Logged By:	B. Townsend
Drilling Company:	Bortec1, Inc.

Remarks: Drilling was performed using an EC-55 drill rig. Standard Penetration Test (STP) sampler driven with a 140 lb hammer using a rope and cathead dropping 30 inches. Approxicate ground surface elevation from Google Earth.

PanGEO INCORPORATED

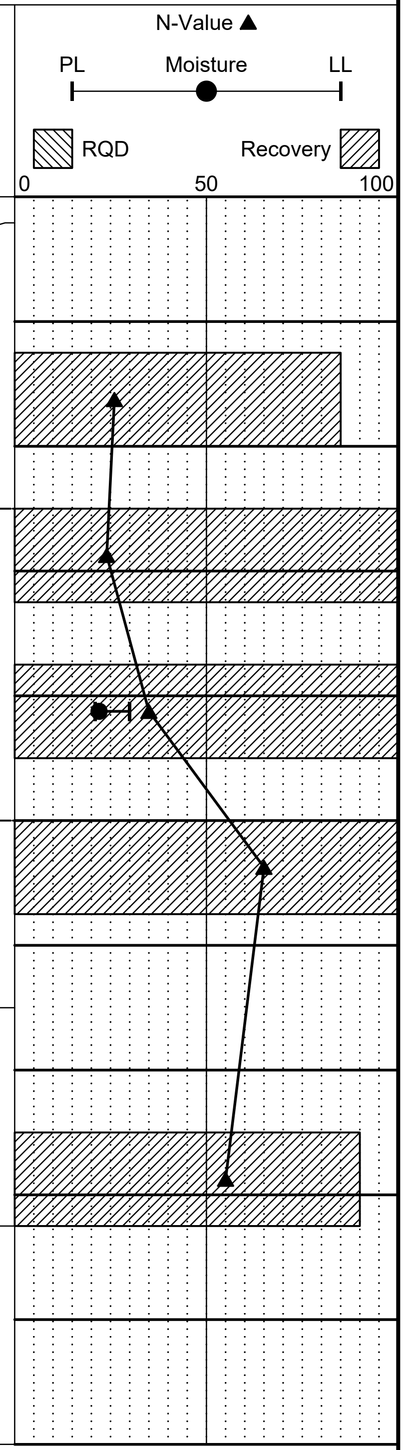
LOG OF TEST BORING PG-9

Figure A-10

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Saint Edward Seminary	Surface Elevation:	Approx. 356 feet
Job Number:	16-163	Top of Casing Elev.:	
Location:	14445 Juanita Drive NE, Kenmore, Washington	Drilling Method:	Hollow-Stem Auger
Coordinates:	Northing: , Easting:	Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						Asphalt Pavement - 7 inches thick.
						Very stiff, moist, light brown, SILT with fine sand (ML); massive, iron oxides staining. **[QUATERNARY PRE FRASER - GLACIOLACUSTRINE].**
2						
	S-1		13 12 14			
4						
	S-2		7 10 14			Very stiff, moist, light brown and blue-gray, lean CLAY (CL); trace fine sand, massive.
6						
8	S-3		9 14 21	ATT		- Becomes hard, lean CLAY, some laminated layers in sample S-3. LL=30%, PL=21%, Natural Moisture 22%.
10	S-4		12 20 45			Hard, moist, light brown to brown, SILT with sand (ML); intermixed 0.5- to 1-inch lenses of SAND with silt, laminated brown coloring in silt.
12						
						Very dense, moist, light-gray, SAND (SP); trace silt, poorly graded fine sand. **[QUATERNARY PRE FRASER - OUTWASH].**
14						
16	S-5		14 24 31			
						Borehole terminated at 16.5 feet below grade. No groundwater encountered during drilling.
18						
20						



Completion Depth:	16.5ft
Date Borehole Started:	6/13/16
Date Borehole Completed:	6/13/16
Logged By:	B. Townsend
Drilling Company:	Bortec1, Inc.

Remarks: Drilling was performed using an EC-55 drill rig. Standard Penetration Test (STP) sampler driven with a 140 lb hammer using a rope and cathead dropping 30 inches. Approxicate ground surface elevation from Google Earth.

PanGEO INCORPORATED

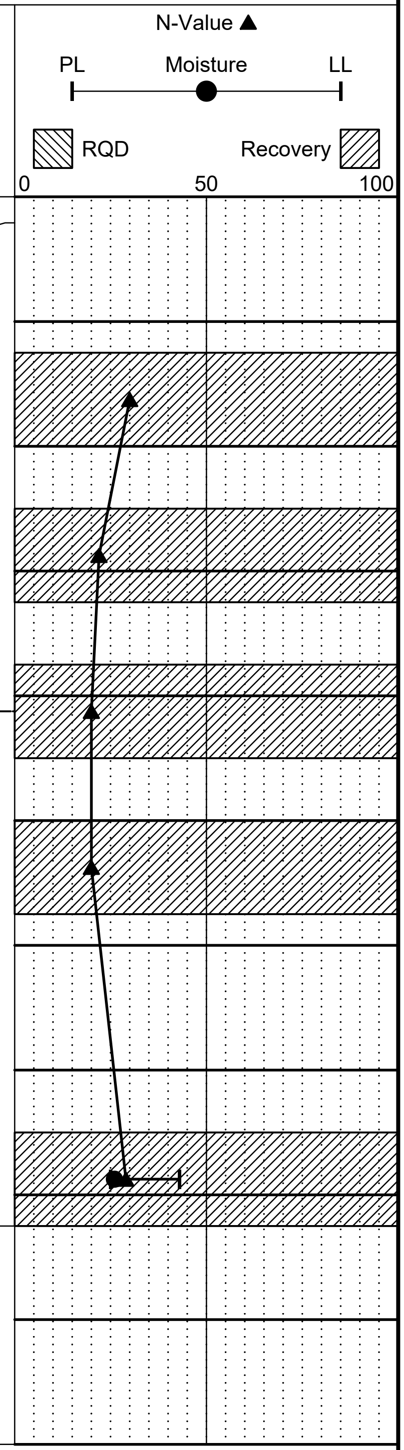
LOG OF TEST BORING PG-10

Figure A-11

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	Saint Edward Seminary
Job Number:	16-163
Location:	14445 Juanita Drive NE, Kenmore, Washington
Coordinates:	Northing: , Easting:
Surface Elevation:	Approx. 356 feet
Top of Casing Elev.:	
Drilling Method:	Hollow-Stem Auger
Sampling Method:	SPT

Depth, (ft)	Sample No.	Sample Type	Blows / 6 in.	Other Tests	Symbol	MATERIAL DESCRIPTION
0						Asphalt Pavement - 7 inches thick.
						Very stiff, moist, light brown, SILT with sand (ML); fine sand seams throughout, laminated with brown silt layers, iron oxide staining, mottled. **[QUATERNARY PRE FRASER - GLACIOLACUSTRINE].**
2						
3	S-1		11 14 16			
4						
6	S-2		4 10 12			
8	S-3		6 10 10			- Becomes blue-gray and massive in bottom 6 inches of sample S-3.
						Very stiff, moist, blue-gray, lean CLAY (ML); trace fine sand, massive.
10	S-4		7 10 10			
12						
14						
16	S-5		8 12 17	ATT		- Becomes SILT with very fine sand in sample S-5. Blocky texture in tip of sample. LL=43%, PL=25%, Natural Moisture 26%.
						Borehole terminated at 16.5 feet below grade. No groundwater encountered during drilling.
18						
20						



Completion Depth:	16.5ft
Date Borehole Started:	6/13/16
Date Borehole Completed:	6/13/16
Logged By:	B. Townsend
Drilling Company:	Bortec1, Inc.

Remarks: Drilling was performed using an EC-55 drill rig. Standard Penetration Test (STP) sampler driven with a 140 lb hammer using a rope and cathead dropping 30 inches. Approxicate ground surface elevation from Google Earth.

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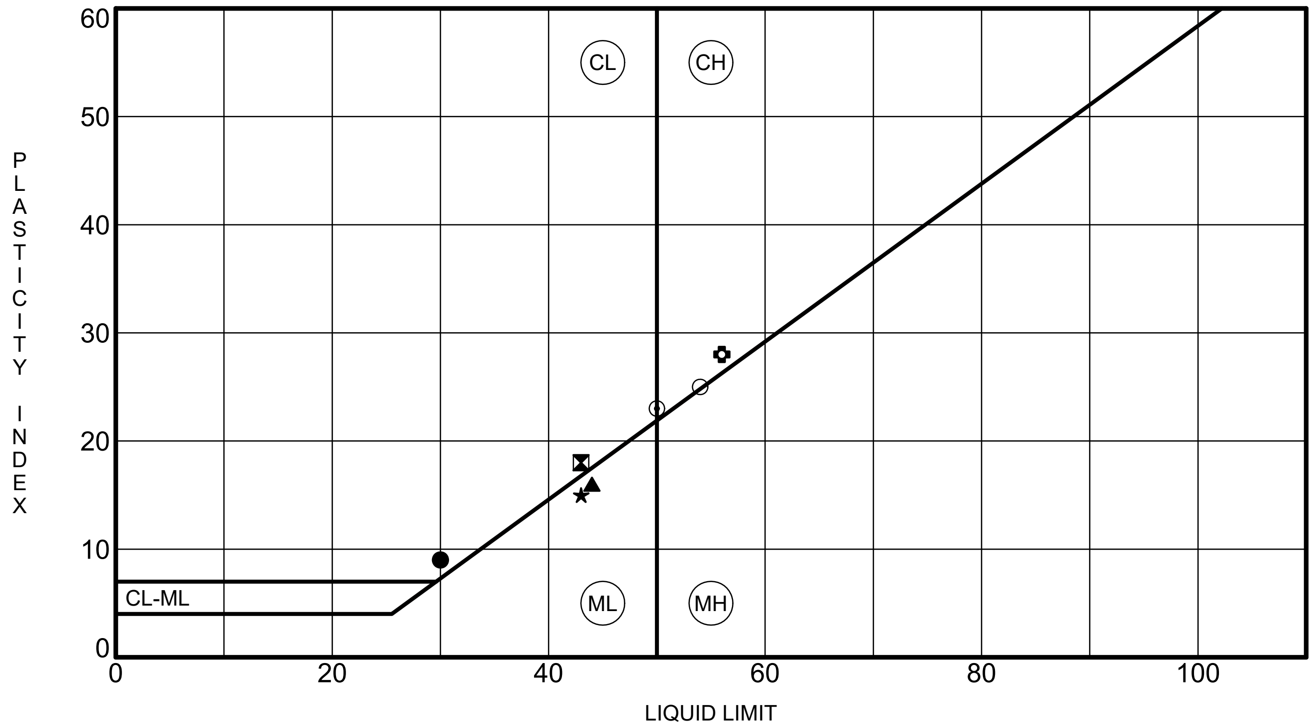
LOG OF TEST BORING PG-11

Figure A-12

The stratification lines represent approximate boundaries. The transition may be gradual.

APPENDIX B

LABORATORY TEST RESULTS



Symbol	Specimen Identification		M	LL	PL	PI	Fines	Classification
●	**PG-10**	**7.5**	**22**	**30**	**21**	**9**		
⧗	**PG-11**	**15.0**	**26**	**43**	**25**	**18**		
▲	**PG-3**	**7.5**	**28**	**44**	**28**	**16**		
★	**PG-5**	**5.0**	**30**	**43**	**28**	**15**		
⊙	**PG-8**	**10.0**	**25**	**50**	**27**	**23**		
✿	**PG-9**	**10.0**	**28**	**56**	**28**	**28**		
○	**PG-9**	**12.5**	**27**	**54**	**29**	**25**		

PanGEO INCORPORATED
Phone: 206.262.0370

ATTERBERG LIMITS

Project: Saint Edward Seminary
Job Number: 16-163
Location: 14445 Juanita Drive NE, Kenmore, Washington

Figure B-1