Geotechnical Engineering Report
Sumner Medical Building
16209 – 64th Street East
Sumner, Washington

Prepared for: Mr. Aaron Molen
c/o The Rush Companies
6622 Wollochet Drive NW
Gig Harbor, WA 98335

Attention: Mr. Chris Dewald

Prepared by: *South Sound* Geotechnical Consulting
P.O. Box 39500
Lakewood, WA 98496

March 12, 2015

South Sound Geotechnical Consulting

March 12, 2015

Mr. Aaron Molen
c/o Mr. Chris Dewald
The Rush Companies
Vice President of Development
6622 Wollochet Dr. NW
Gig Harbor, WA 98335

Subject: Report of Geotechnical Engineering Services
Sumner Medical Office Building
16209 - 64th Street East
Sumner, Washington
SSGC Project Number 15017

Mr. Molen:

South Sound Geotechnical Consulting (SSGC) has prepared this supplemental geotechnical engineering report regarding the above referenced development. SSGC completed a feasibility study of the property in 2014, report dated December 8, 2014. The purpose of our supplemental services was to further explore subsurface conditions on the project property to provide additional information relative to foundation support and reducing the risk of seismic induced liquefaction of site soils. Our supplemental scope of services included completing two borings on the site, engineering analyses, and preparation of this report. This report includes information from our December 8, 2014 report as well as the supplemental borings.

We appreciate the opportunity to work with you on this project. Please contact us if we can be of further assistance.

Respectfully,

South Sound Geotechnical Consulting

Timothy H. Roberts, P.E., R.G.
Member/Geotechnical Engineer

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EXECUTIVE SUMMARY

South Sound Geotechnical Consulting (SSGC) has completed a supplemental geotechnical evaluation to assist in design of the proposed Medical Office Building at 16209 – 64th Street East in Sumner, Washington. The following information is intended only as a summary of geotechnical considerations for development of the site:

- Site Conditions: An existing residence near the middle of the property is surrounded by landscaping. Driveway access from 64th Street east is along the western boundary of the property. The site is level with grade changes estimated at less than 3 feet.

- Soil Conditions: Soils below the surface consisted of silty sand to sandy silt alluvial deposits. These soils were in a generally loose to soft condition and extended to the maximum depth in the borings at 50 feet. Woody peat was observed in the borings at depths of about 13 to 20 feet.

- Groundwater: Groundwater was observed at shallow depths of about 2.5 to 3 feet below the surface in the test pits and borings.

- Suitability of Soils for Structural Fill: Site soils are not considered generally suitable for use as structural fill. They are typically fine-grained and very wet to saturated, making them difficult to compact to structural fill requirements.

- Foundations: Ground improvement methods (e.g. stone columns) or pile foundations will be required to control seismic induced settlement at this site. We understand that stone columns are currently being considered.

- Seismic Considerations: Site Class E would be used to classify the site per the 2012 International Building Code (IBC). Site soils are considered highly susceptible to liquefaction.

- Pavements: A geotextile separation fabric over native soils is considered warranted to prepare a suitable subgrade for pavements. Alternate asphalt concrete pavement sections are provided in this report.

This executive summary should not be used for design and/or construction purposes. The entire report must be read for a comprehensive understanding of the information and recommendations presented as specific details are not included or fully developed in this executive summary.

SSGC

PROJECT INFORMATION

A new medical office building is planned on the property located at 16209 – 64th Street East in Sumner, Washington. Site development and building plans have not been provided to us, but we anticipate the medical building would be a one- to two-story structure with asphalt paved parking areas. Based on subsurface conditions encountered during our feasibility assessment of the property in December 2014, the building will likely be supported on stone columns with a gravel pad for footings and floor slabs.

SITE CONDITIONS

The lot is about one acre and is currently occupied with a single-family residence located near the approximate middle of the lot. It is level with landscaped lawn surrounding the residence. Driveway access from 64th Street East is along the western property boundary.

SUBSURFACE CONDITIONS

Subsurface conditions on the site were characterized by excavating three (3) test pits on December 3, 2014, and drilling two (2) borings on February 5, 20115. Test pit were advanced to depths ranging from about 3.5 to 8 feet below surface grades. Borings were advanced to depths ranging from 36.5 to 51.5 feet. Approximate exploration locations are shown on Figures 1, Site Plan. A summary description of observed subgrade soils is provided below, with logs of the test pits provided in Appendix A.

Soil Conditions

Topsoil consisting of sandy silt with organics was observed below the surface and extended to depths of about 8 inches to 1 foot in the test pits and borings. Sand with silt, and silty sand to sandy silt were observed below the topsoil and extended to the bottom of the test pits. These soils were in a generally loose to soft condition. Test pits were limited in depth as sidewalls of the excavations sloughed (caved) into the pits with depth.

Similar soils were observed in the borings extending to a maximum depth of about 51.5 feet. A woody peat layer was observed in both borings in the 13 to 20 foot depth range. A grassy peat layer on the order of a couple feet thick was also observed in boring B-2 between 20 to 25 feet deep.

Groundwater Conditions

Groundwater was observed at shallow depths of about 2.5 to 3 feet in the explorations at the times of our field work on site. Groundwater levels are not anticipated to fluctuate significantly during the year at this site.

Geologic Setting

Geology of this area is depicted on the "Geologic Map of the Southern Half of the Tacoma Quadrangle, Washington" published by the Washington Department of Natural Resources in 1987. Soils mapped on the site are labeled as Quaternary Alluvium. These soils are described as "silt, sand, and gravel deposited in streambeds and fans; surface relatively undissected; includes some low level terraces and some lacustrine deposits". Soils observed in the test pits and borings appear to conform to an alluvial depositional environment.

The site is in a "Potential Liquefaction and/or Dynamic Settlement Hazard Area" per the Potential Seismic Hazard Areas Map by the Pierce County Department of Planning and Land Services, dated March, 2005.

GEOTECHNICAL DESIGN CONSIDERATIONS

Subgrade conditions at this site include overall saturated, loose to soft silty sand to sandy silt alluvial deposits that are considered highly susceptible to liquefaction during an earthquake. We understand that the current approach is to utilize ground improvement methods, specifically stone columns, to mitigate liquefaction potential based on subgrade conditions described in our December 2014 feasibility report. We recommend that foundations and floor slabs are supported on a zone of structural fill over the planned stone columns. Pavements could be supported on a zone of structural fill with underlying geotextile separation fabric.

Recommendations presented in the following sections are based upon the subsurface conditions observed in the test pits and borings and our current understanding of project plans. Our recommendations assume that finish site grades will be similar to existing grades and that stone columns will be used to support the planned building and mitigate seismic induced settlement. It should be noted that subsurface conditions across the site may vary from those depicted on the exploration logs and can change with time. Therefore, proper site preparation will depend upon the weather and soil conditions encountered at the time of construction. We recommend that SSGC review final plans to verify that plans and specifications conform to the recommendations of this report.

General Site Preparation

Preparation for site grading and earthwork should include procedures intended to drain ponded water and control surface water runoff. Grading the site without adequate drainage control measures may negatively impact site soils, resulting in increased export of impacted soil and import of fill materials, potentially increasing the cost of the earthwork and subgrade preparation phases of the project.

Site grading should include removal (stripping) of vegetation and topsoil in building and pavement areas. Stripping depths of topsoil will vary across the site, but should average on the order of about one-half to one foot. Localized deeper topsoil, unsuitable fill related to previous site development, or highly disturbed subgrades requiring deeper stripping depths should be accounted for at the time of earthwork.

General Subgrade Preparation

Exposed subgrades should consist of undisturbed native soils following stripping. We recommend that exposed subgrades in the building footprint are covered with a layer of coarse gravel, spalls, or shot-rock to provide a working surface and protect the loose subgrades from being disturbed during installation of stone columns. We recommend that subgrades in pavement areas are excavated to at least 1 foot below the planned finish pavement grade. Exposed subgrades should consist of native silty sand. Geotextile separation fabric as described in the pavement section of this report should be placed on native subgrades, followed by the recommended pavement section.

Grading and Drainage

Positive drainage should be provided during construction and maintained throughout the life of the development. Allowing surface water into fill areas, utility trenches, pavement subgrades, and building sites should be prevented. Concentrated surface water should not be allowed to flow onto site soils.

Groundwater was observed at shallow depths ranging from about 2.5 to 3 feet below the surface. Groundwater will need to be controlled (pumped) for deeper excavations such as utility lines.

Structural Fill Materials

The suitability of soil for use as structural fill depends primarily on the gradation and moisture content of the soil when it is placed. As the amount of fines (soil fraction passing the U.S. No. 200 sieve) increases, soils can become increasingly sensitive to small changes in moisture content. It is often difficult to achieve adequate compaction if soil moisture is outside of optimum condition for soils that contain more than about 5 percent fines.

Site Soils: Native soils are not considered suitable for structural fill as they are generally fine-grained and wet to saturated.

Import Fill Materials: We recommend that import structural fill placed during dry weather periods consist of material which meets the specifications for *Gravel Borrow* as described in Section 9-03.14(1) of the 2010 Washington State Department of Transportation (WSDOT) Specifications for Road, Bridge, and Municipal Construction (Publication M 41-10). Gravel Borrow should be placed in horizontal lifts not exceeding 10 inches in loose thickness. Each lift should be conditioned to the proper moisture content and uniformly compacted to a firm, unyielding condition using mechanical equipment. Gravel Borrow fill must be protected from disturbance if exposed to wet conditions after placement.

During wet weather, or for backfill on wet subgrades, import soil suitable for compaction in wet conditions should be provided. Imported fill for use in wet conditions should generally conform to specifications for *Select Borrow* as described in Section 9-03.14(2), or *Crushed Surfacing* per Section 9-03.9(3) of the 2010 WSDOT M-41 manual, with the modification that a maximum of 5 percent by weight shall pass the U.S. No. 200 sieve for these soil types.

It should be noted that the placement of structural fill is often weather-dependent. Delays due to inclement weather are common, even when using select granular fill. We recommend that site grading and earthwork be scheduled for the drier months of the year.

Structural Fill Placement

We recommend that structural fill is placed in lifts not exceeding 10 to 12 inches in loose measure. It may be necessary to adjust lift thickness based on site and fill conditions during placement and compaction. Structural fill should be compacted to attain the recommended levels presented in Table 1, Compaction Criteria. Structural fill in pavement areas should extend laterally at a 2H:1V (Horizontal:Vertical) incline from the base of the pavement section.

Table 1. Compaction Criteria

Fill Application	Compaction Criteria*
Footing areas (below structures and retaining walls)	95 %
Upper 2 feet in pavement areas, slabs and sidewalks, and utility trenches	95 %
Below 2 feet in pavement areas, slabs and sidewalks, and utility trenches	92 %
Utility trenches or general fill in non-paved or -building areas	90 %

*Per the ASTM D 1557 test method.

Trench backfill within about 2 feet of the utility line should not be over-compacted to reduce the risk of damage to the line. In some instances the top of the utility line may be within 2 feet of the surface. Backfill in these circumstances should be compacted to a firm and unyielding condition.

We recommend that all fill procedures include maintaining grades that promote drainage and do not allow for ponding of water within the fill area. The contractor should protect compacted fill subgrades from disturbance during wet weather. In the event of rain during structural fill placement, the exposed fill surface should be allowed to dry prior to placement of additional fill. Alternatively, the wet soil can be removed. We recommend that consideration be given to protecting haul routes and other high traffic areas with free-draining granular fill material (i.e. sand and gravel containing less than 5 percent fines) or

quarry spalls to reduce the potential for disturbance to the subgrade during inclement weather. Structural fill should not consist of frozen material.

Earthwork Procedures

Conventional earthmoving equipment should be suitable for earthwork at this site. However, native soils are loose and wet and will be easily disturbed with wheeled construction equipment. We recommend that earthwork is accomplished using tracked equipment to reduce the risk of disturbing site soils. Earthwork may also be difficult during periods of wet weather or if elevated soil moisture is present. Subgrade soils that become disturbed due to elevated moisture conditions should be over-excavated to expose firm, non-yielding, non-organic soils and backfilled with compacted structural fill. We recommend that the earthwork portion of this project be completed during extended periods of dry weather. If earthwork is completed during the wet season (typically late October through May) it may be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork may require additional mitigative measures beyond that which would be expected during the drier months of the year.

If earthwork takes place during freezing conditions, we recommend that the exposed subgrade be allowed to thaw and be re-compacted prior to placing subsequent lifts of structural fill. Alternatively, the frozen soil can be removed by excavation to unfrozen soil and replaced with structural fill.

The contractor is responsible for designing and constructing stable, temporary excavations. Excavations should be sloped or shored in the interest of safety following local, state, and federal regulations, including current OSHA excavation and trench safety standards. Native soils had the tendency to cave into the test pit excavations. On a preliminary basis, we recommend that temporary cut slopes not exceed 3H:1V (Horizontal:Vertical). We expect that shoring will be required for deeper utility trenches.

A qualified geotechnical engineer should be retained during the construction phase of the project to observe earthwork operations and to perform necessary tests and observations during subgrade preparation, placement and compaction of structural fill, and backfilling of excavations.

Permanent Cut and Fill Slopes

Permanent cut and fill slopes should be graded at 2H:1V or shallower. Final cut and fill slopes should be covered with a thin layer of topsoil and erosion protection (such as jute-matting or other) and vegetated as soon as possible to reduce the risk of erosion. Vegetation should consist of native species of ground cover and low growth plants (brush, shrubs, and bushes).

Foundations

Mitigation of seismic settlement potential will require soil improvement of the saturated, loose (soft) native soils or pile support of the building. Stone column piers have been successfully used for similar soil conditions in this area of Sumner.

Soil improvement systems consisting of stone columns can be used to improve the strength and support characteristics of thick zones of saturated, loose or soft soils. These stone columns can also reduce static and seismic induced settlements. The design of these columns is typically completed by the pier contractor. On a preliminary basis we anticipate that these piers would average on the order of 20 to 30 feet deep, although deeper piers may be necessary. A layer of compacted structural fill, at least 18 inches thick, should be placed between the bottom of the footings (or floor slab) and the top of the stone columns to provide a uniform base.

Depending on the depth, size, and spacing of these columns, allowable bearing pressures of 3,000 psf or higher are expected. Static total and differential settlements would be less than 1-inch and ½-inch, respectively. Seismic settlements could be substantially reduced. We are available to assist in working with local stone column contractors in the design. We are also available to assist in the design of a pile-supported structure, if requested.

Conventional spread footing foundations can be placed on a structural fill zone above the stone columns. The following recommendations have been prepared for conventional spread footing foundations on a properly prepared .

Bearing Capacity (net allowable):	3,000 pounds per square foot (psf) for footings supported on a structural fill zone (at least 12 inches thick) over stone columns.
Footing Width (Minimum):	18 inches (Strip) 24 inches (Column)
Embedment Depth (Minimum):	18 inches (Exterior) 12 inches (Interior)
Settlement:	Total: < 1 inch Differential: < 1/2 inch (over 40 feet)
Allowable Lateral Passive Resistance:	325 psf/ft* (below 18 inches)
Allowable Coefficient of Friction:	0.35*

*These values include a factor of safety of approximately 1.5

The net allowable bearing pressures presented above may be increased by one-third to resist transient, dynamic loads such as wind or seismic forces. Lateral resistance to footings should be ignored in the upper 12-inches from exterior finish grade.

Foundation Construction Considerations

All foundation subgrades should be free of water and loose soil prior to placing concrete, and should be prepared as recommended in this report. Concrete should be placed soon after excavating and compaction to reduce disturbance to bearing soils. Should soils at foundation level become excessively dry, disturbed, saturated, or frozen, the affected soil should be removed prior to placing concrete. We recommend that SSGC observe all foundation subgrades prior to placement of concrete.

Foundation Drainage

We recommend that footing drains are installed around building foundations. Footing drains should include a minimum 4-inch diameter perforated rigid plastic or metal drain line installed at the base of the footing. The perforated drain lines should be connected to a tight line pipe that discharges to an approved storm drain receptor. The drain line should be surrounded by a zone of clean, free-draining granular material having less than 5 percent passing the No. 200 sieve or meeting the requirements of section 9-03.12(2) "Gravel Backfill for Walls" in the 2010 WSDOT Standard Specifications for Road, Bridge, and Municipal Construction manual (M41-10). The free-draining aggregate zone should be at least 12 inches wide and wrapped in filer fabric. The granular fill should extend to within 6 inches of final grade where it should be capped with compacted fill containing sufficient fines to reduce infiltration of surface water into the footing drains. Cleanouts are recommended for maintenance of the drain system.

Floor Slabs

Post-construction floor slab settlement should be anticipated to be similar to foundation settlements provided subgrades have been prepared as discussed in this report. We recommend a vertical subgrade soil modulus value of 250 kips per cubic foot (kcf) for structural fill compacted as described in this report. Soil modulus of stone column supported slabs with other types of fill should be supplied by the stone column designer.

We recommend that 4 inches of free-draining granular material be placed under the slab to serve as a capillary break. The fines content of the capillary break material should be limited to 3 percent or less, by weight, and at least 50 percent of the capillary break material should be retained on the No. 4 sieve.

We recommend that the slab be underlain by a vapor retarder. A puncture-resistant proprietary product such as RUFCO 3000B, Vapor Block VB 10, Stego Wrap, or an approved equivalent that is classified as a Class A vapor retarder in accordance with ASTM E 1745 should be used. To avoid puncturing of the vapor barrier, construction equipment should not be allowed to drive over any vapor retarder material. The slab designer and slab contractor should refer to ACI 302 for procedures and cautions regarding the use and placement of a vapor retarder. The moisture protection details should be reviewed by the architect and owner.

Seismic Considerations

The following seismic parameters and values are recommended based on the 2012 International Building Code (IBC).

PARAMETER	VALUE
2012 International Building Code (IBC) Site Classification[1]	E[2]
Site Latitude	N 47.19934°
Site Longitude	W 122.21320°
S_s Spectral Acceleration for a Short Period	1.252g
S_1 Spectral Acceleration for a 1-Second Period	0.471g
F_a Site Coefficient for a Short Period	0.9
F_v Site Coefficient for a 1-Second Period	2.4

[1] Note: In general accordance with *2012 International Building Code*, Section 1613.3.2 for risk categories I,II,III. IBC Site Class is based on the specified characteristics of the upper 100 feet of the subsurface profile. S_s, S_1, F_a, and F_v values based on the USGS US Seismic Design Maps website using referenced site latitude and longitude. The 2012 IBC requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. Borings completed on the site do not satisfy the required 100 foot soil profile determination. The recommended seismic site class considers that a soft soil profile continues below the maximum depth of the test pits and is based on the referenced maps in this report and other geologic information in the area.

Liquefaction

Soil liquefaction is a condition where loose, typically granular soils located below the groundwater surface lose strength during ground shaking, and is often associated with earthquakes. Native soils observed in the test pits consist of loose sand with variable silt. Groundwater was observed within about 2.5 to 3 feet of surface. The condition of the soils and high groundwater table suggest that these soils are moderately to highly susceptible to liquefaction during a design level earthquake. We estimate that differential ground deformations over 6 inches could occur during a design level earthquake based our analyses of subgrade conditions in the borings. Planned ground improvements (stone columns) should reduce the potential seismic settlement to levels similar to static settlement.

Pavements

We anticipate that conventional asphalt pavements will be used in access and parking areas. Subgrades for pavement areas should be prepared as described in the "*General Subgrade Preparation*" and structural fill sections of this report. Subgrades below pavement sections should be graded or crowned to promote drainage and not allow for ponding of water beneath the section. If drainage is not provided and ponding occurs, the subgrade soils could become saturated, lose strength, and result in premature distress to the

pavement. In addition, the pavement surfacing should also be graded to promote drainage and reduce the potential for ponding of water on the pavement surface.

We recommend that consideration is given to placing a separation geotextile between the native loose silty sand/sandy silt subgrades and any granular structural (or pavement base) fill. The purpose of the separation fabric is to maintain segregation between the structural fill and fine grained native soil. Without this fabric, coarser fill materials can migrate into the looser/softer native soils and can compromise the structural integrity of the fill over time. We recommend that a separation fabric (such as Mirafi 140N, or similar) is placed on fine grained subgrades below pavements where granular sand and gravel fill is placed.

Design traffic loads have not been provided to us for the development. We have estimated traffic to include light weight vehicles (cars and light trucks) with up to 2 delivery trucks per day. We have prepared preliminary pavement sections based on AASHTO design guidelines and the following assumed design parameters:

- 20-year life span;
- Estimated pavement design life Equivalent Single Axle Loads (18 kips) of 10,000;
- Estimated subgrade CBR of 2;
- Terminal serviceability of 2.0; and,
- Level of reliability 80 percent.

Minimum recommended pavement sections for conventional pavement areas over a suitable geotextile separation fabric include:

Traffic Area	Preliminary Recommended Minimum Pavement Section Thickness (inches)			
	Asphalt Concrete Surface[1]	Aggregate Top Course[2,4]	Aggregate Subbase[3,4]	Total
Light Duty	2	2	8	12
Alternate Section	3	6	-	9

[1] 1/2 –inch nominal aggregate hot-mix asphalt per WSDOT 9-03.8(1)

[2] Top course per WSDOT 9-03.9(3)

[3]Aggregate subbase should conform to Select Borrow per WSDOT 9-03.14(2)

[4]Top course and aggregate subbase may be substituted with 10-inches of crushed base course per WSDOT 9-03.9(3)

The above recommended pavement section should only be considered for preliminary design purposes. Final pavement sections should be based on actual traffic design loads, final grades, and subgrade materials. The estimated CBR value may not be suitable depending on final subgrades which could affect

the preliminary pavement sections. When traffic loads and final pavement subgrade elevations are known, SSGC should review and verify or modify the preliminary pavement sections.

Pavement Maintenance

The performance and lifespan of pavements can be significantly impacted by future maintenance. The above pavement section represents minimum recommended thicknesses and, as such, periodic maintenance should be completed. Proper maintenance activities will slow the rate of pavement deterioration, and will improve pavement performance and life. Preventive maintenance consists of both localized maintenance (crack and joint sealing and patching) and global maintenance (surface sealing). Added maintenance measures should be anticipated over the lifetime of the pavement section if any existing fill or organic rich soils are left in-place beneath pavement sections.

REPORT CONDITIONS

This report has been prepared for the exclusive use of Mr. Aaron Molen as discussed and has been prepared in accordance with generally accepted geotechnical engineering practices in the area. No warranties, either express or implied, are intended or made. Site safety and earthwork construction procedures are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless SSGC reviews the changes and either verifies or modifies the conclusions of this report in writing.

The analysis and recommendations presented in this report are based upon the data obtained from the subsurface explorations completed at the indicated locations and from other information as discussed. This report does not reflect variations of subsurface conditions that may occur between explorations, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided, as warranted. Additional geotechnical explorations are warranted in the southern portion of the site (wetland area) once access can be obtained to verify or amend the recommendations in this report, as necessary.

The scope of services for this project does not include any environmental or biological assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for contamination or pollution, other studies should be completed.

N

Legend

TP - 1 — **Approximate Test Pit Location**

B - 1 — **Approximate Boring Location**

Scale: NTS

Base map from Google Maps

South Sound Geotechnical Consulting
P.O. Box 39500
Lakewood, WA 98496
(253) 973-0515

Figure 1 – Site Plan

Proposed Medical Office Bldg – 64th Street East
Sumner, WA

SSGC Project #15017

Appendix A

Field Exploration Procedures and Exploration Logs

Field Exploration Procedures

Our field exploration for this project included three (3) test pits completed on December 3, 2014, and two (2) borings completed on February 5, 2015. Approximate exploration locations are shown on the Site Plan (Figure 1). The exploration locations were determined by measuring distances from existing site features by tape measurements or pacing. Ground surface elevations referenced on the logs were inferred from USGS 7.5 minute quadrangle maps of the area. Exploration locations and elevations should be considered accurate only to the degree implied by the means and methods used.

Test pits were excavated by and independent excavation contractor subcontracted to SSGC. Borings were drilled by an independent driller subcontracted to SSGC. Soil samples were collected during excavation/drilling and stored in moisture tight containers. Explorations were backfilled with excavated soils and tamped when completed. Please note that backfill in the explorations will likely settle with time. Should test pits be discovered in building or pavement areas, the backfilled material should be re-excavated and re-compacted, or replaced with structural fill.

The following logs indicate the observed lithology of soils and other materials observed in the explorations at the time of excavation. Where a soil contact was observed to be gradational, our logs indicate the average contact depth. Our logs also indicate the approximate depth to groundwater (where observed at the time of excavation), along with sample numbers and approximate sample depths. Soil descriptions on the logs are based on the Unified Soil Classification System.

Test Pit TP-1

Depth (feet)	Material Description
0 – 0.75	**Topsoil:** Sandy SILT with organics: Very soft, wet, dark brown.
0.75 – 1.5	SAND with silt: Loose, wet, brown. (Sample S-1 @ 1.5 feet)
1.5 - 7	Silty fine SAND/Fine sandy SILT: Loose to soft, moist, gray/brown mottled. (Sample S-2 @ 2 feet; S-3 @ 7 feet)
	Test pit completed at approximately 7 feet on 12/3/14. Groundwater seepage observed at about 2.5 feet at time of excavation. Severe caving observed below 3 feet at time of excavation, limited depth of test pit. Approximate surface elevation: 75 feet

Test Pit TP-2

Depth (feet)	Material Description
0 – 1	**Topsoil:** Sandy SILT with organics: Very soft, wet, dark brown.
1 – 3.5	Silty fine SAND/Fine sandy SILT: Loose to soft, moist, gray/brown with some orange mottling.
	Test pit completed at approximately 3.5 feet on 12/3/14. Groundwater seepage observed at about 3 feet at time of excavation. Caving observed at time of excavation. Approximate surface elevation: 75 feet

Test Pit TP-3

Depth (feet)	Material Description
0 – 1	**Topsoil:** Sandy SILT with organics: Very soft, wet, dark brown.
1 – 8	Silty fine SAND/Fine sandy SILT: Loose to soft, moist, gray/brown. (Sample S-1 @ 8 feet)

Test pit completed at approximately 8 feet on 12/3/14.
Groundwater seepage observed at about 3 feet at time of excavation.
Severe caving observed below 3 feet at time of excavation, limited depth of test pit.
Approximate surface elevation: 75 feet

PROJECT: Proposed Sumner Medical Building **JOB NO.** 15017 **BORING** B-1 **PAGE 1 OF 3**

Location: 16209 - 64th Street E., Sumner, Washington **Approximate Elevation:** 75 feet

Depth (ft)	Soil Description	Sample Interval	Sample Number	Ground Water	Penetration Resistance (▲ Standard, △ Other; Blows per foot: 0 10 20 30 40 50)	N-values	Testing
	Sod/Topsoil: Silty SAND with organics.						
	Silty fine SAND /Sandy SILT: Very loose to loose, wet, light brown.			▼ ATD			
5	**Silty SAND with some organics:** Very loose, wet, gray.	I	S-1		▲	4	
10	**SILT with fine sand:** Very soft, wet, gray.	I	S-2		▲	2	
15	**Peat (woody):** Very soft, wet, brown.	I	S-3		▲	3	
20	**Fine SAND with silt:** Medium dense, wet, gray.	I	S-4		▲	11	
25							

Explanation

- I — 2-inch O.D. split spoon sample
- II — 3-inch I.D Shelby tube sample
- ⊗ — No Recovery
- ▼ ATD — Groundwater level at time of drilling or date of measurement

Monitoring Well Key

- Clean Sand
- Cuttings
- Bentonite
- Grout
- Screened Casing

Moisture Content

Plastic Limit — Natural — Liquid Limit

South Sound Geotechnical Consulting	**BORING LOG**	**Boring B-1**
	Date Drilled: 2/5/15	**Logged By: THR**

PROJECT: Proposed Sumner Medical Building **JOB NO.** 15017 **BORING** B-1 **PAGE 2 OF 3**

Location: 16209 - 64th Street E., Sumner, Washington **Approximate Elevation:** 75 feet

Depth (ft)	Soil Description	Sample Interval	Sample Number	Ground Water	Penetration Resistance (▲ Standard, △ Other; Blows per foot 0 10 20 30 40 50)	N-values	Testing
	Silty SAND with some fine gravel and organics: Very loose, wet, gray.		S-5			3	
30	**Silty SAND with some wood chips:** Very loose, wet, gray.		S-6			3	
35	**Silty SAND with trace fine gravel:** Loose, wet, gray.		S-7			5	
40			S-8			5	
45	**SAND (fine to medium) with silt :** Loose, wet, gray.		S-9			7	
50							

Explanation

- 2-inch O.D. split spoon sample
- 3-inch I.D Shelby tube sample
- No Recovery
- ATD — Groundwater level at time of drilling or date of measurement

Monitoring Well Key

- Clean Sand
- Cuttings
- Bentonite
- Grout
- Screened Casing

Moisture Content

Plastic Limit — Natural — Liquid Limit

South Sound Geotechnical Consulting	BORING LOG	Boring B-1
	Date Drilled: 2/12/15	Logged By: THR

PROJECT: Proposed Sumner Medical Building **JOB NO.** 15017 **BORING** B-1 **PAGE 3 OF 3**

Location: 16209 - 64th Street E., Sumner, Washington **Approximate Elevation:** 75 feet

Depth (ft)	Soil Description	Sample Type	Sample Number	Ground Water	Penetration Resistance (▲ Standard, △ Other; Blows per foot: 0 10 20 30 40 50)	N-values	Testing
	SAND (fine to medium) with silt: Loose, wet, gray.	⊗	S-10		▲	12	
	Boring completed at 51.5 feet on 2/12/15. Groundwater observed at approximately 3 feet at time of drilling.						
55							
60							
65							
70							
75							

Explanation

- I — 2-inch O.D. split spoon sample
- II — 3-inch I.D Shelby tube sample
- ⊗ — No Recovery
- ▼ ATD — Groundwater level at time of drilling or date of measurement

Monitoring Well Key

- Clean Sand
- Cuttings
- Bentonite
- Grout
- Screened Casing

Moisture Content

Plastic Limit — Natural — Liquid Limit

South Sound Geotechnical Consulting	BORING LOG	Boring B-1
	Date Drilled: 2/12/15	Logged By: THR

PROJECT: Proposed Sumner Medical Building **JOB NO.** 15017 **BORING** B-2 **PAGE 1 OF 2**

Location: 16209 - 64th Street E., Sumner, Washington **Approximate Elevation:** 75 feet

Depth (ft)	Soil Description	Sample Interval	Sample Number	Ground Water	Penetration Resistance (▲ Standard, △ Other; Blows per foot: 0 10 20 30 40 50)	N-values	Testing
	Sod/Topsoil: Silty SAND with organics.						
	Silty fine SAND /Sandy SILT: Very loose to loose, wet, brown.			▼ ATD			
5	**Fine SAND with some silt:** Very loose, wet, gray.		S-1		▲	4	
10	**SILT with some sand and wood pieces:** Very soft, wet, gray.		S-2		▲	2	
15	**Peat (woody):** Very soft, wet, brown.		S-3		▲	3	
20	**SAND with trace to some silt:** Medium dense, wet, gray.		S-4		▲	10	
	Peat (grassy): Very soft, wet, brown.						
25	**SAND with silt:** Loose, wet, gray.						

Explanation

- 2-inch O.D. split spoon sample
- 3-inch I.D Shelby tube sample
- ⊗ No Recovery
- ▼ ATD — Groundwater level at time of drilling or date of measurement

Monitoring Well Key

- Clean Sand
- Cuttings
- Bentonite
- Grout
- Screened Casing

Moisture Content

Plastic Limit — Natural — Liquid Limit

South Sound Geotechnical Consulting	**BORING LOG**	**Boring B-2**
	Date Drilled: 2/5/15	**Logged By: THR**

PROJECT: Proposed Sumner Medical Building **JOB NO.** 15017 **BORING** B-2 **PAGE 2 OF 2**

Location: 16209 - 64th Street E., Sumner, Washington **Approximate Elevation:** 75 feet

Depth (ft)	Soil Description	Sample Interval	Sample Number	Ground Water	Penetration Resistance (▲ Standard, △ Other; Blows per foot: 0 10 20 30 40 50)	N-values	Testing
	SAND with silt: Loose, wet, gray.		S-5			3	
30	**Silty SAND:** Very loose, wet, gray.		S-6			3	
35			S-7			5	
40	Boring completed at 36.5 feet on 2/12/15. Groundwater observed at approximately 3 feet at time of drilling.						
45							
50							

Explanation

- 2-inch O.D. split spoon sample
- 3-inch I.D Shelby tube sample
- ⊗ No Recovery
- ▼ ATD — Groundwater level at time of drilling or date of measurement

Monitoring Well Key

- Clean Sand
- Cuttings
- Bentonite
- Grout
- Screened Casing

0 10 20 30 40 50

Moisture Content

Plastic Limit — Natural — Liquid Limit

South Sound Geotechnical Consulting	BORING LOG	Boring B-2
	Date Drilled: 2/12/15	Logged By: THR

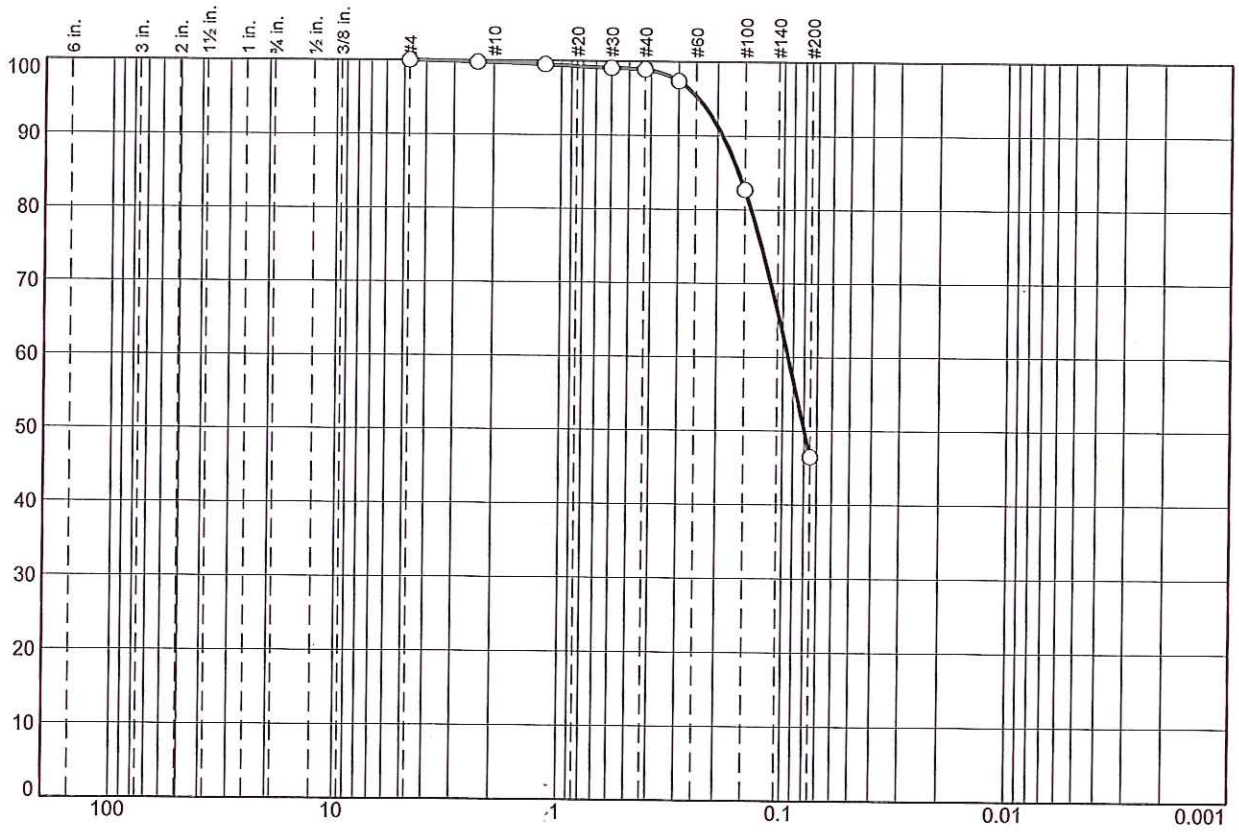
Appendix B

Laboratory Testing

Laboratory Testing

Select soil samples were tested to measure grain-size (gradation) distribution. Construction Testing Laboratories (CTL) of Puyallup, Washington completed the gradation tests. Results of the laboratory testing are included in this appendix.

Particle Size Distribution Report ASTM C-117,C136



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	1	53	46	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	100		
#16	100		
#30	99		
#40	99		
#50	97		
#100	83		
#200	46		

* (no specification provided)

Material Description

B1, S1
Sampled from B1, S1 at 5.5'-6.5'

Atterberg Limits

PL= LL= PI=

Classification

USCS= AASHTO=

Remarks

Report: #1

Sampled by: Client

Source of Sample: B-1, S1
Sample Number: 15-129

Date: 02-12-15

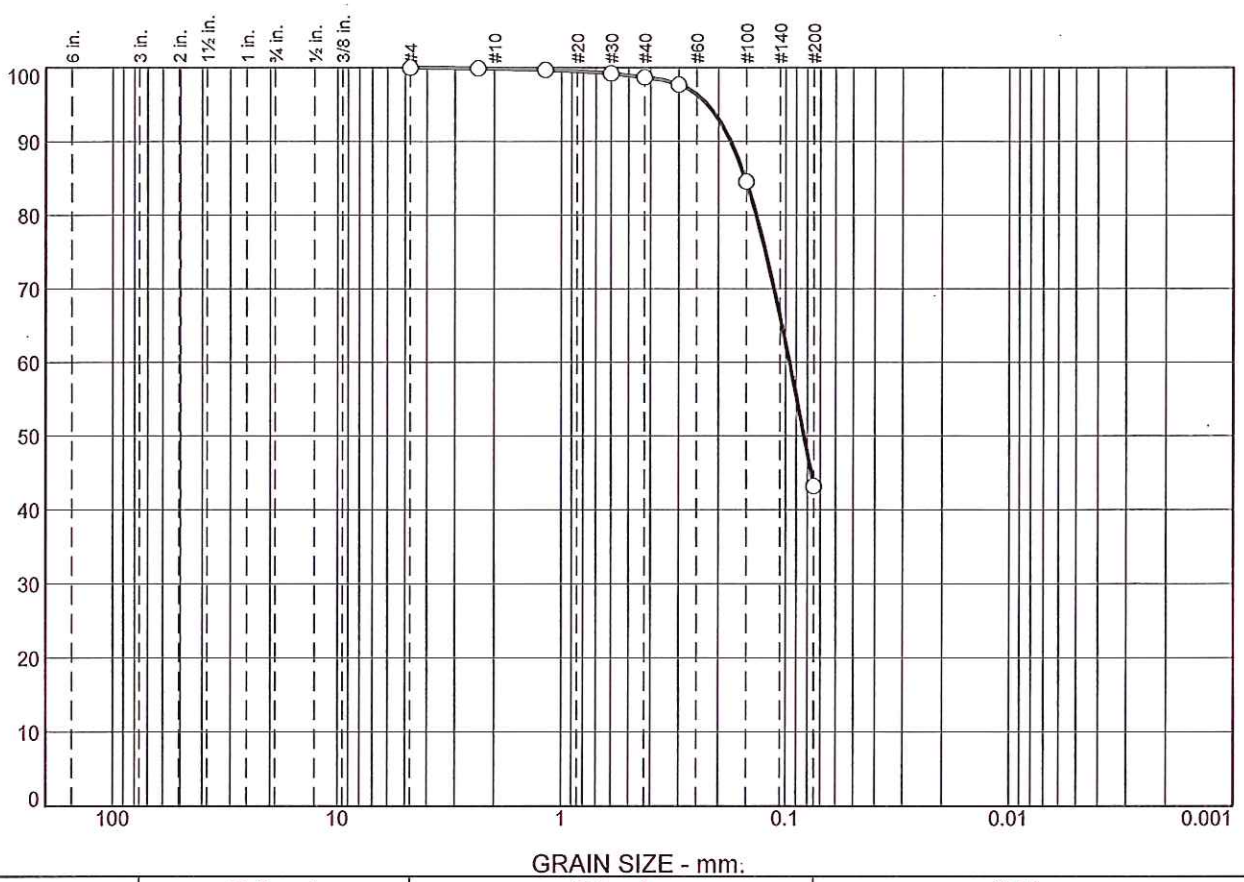
Construction Testing Laboratories
400 Valley Ave. NE, Suite #102
Puyallup WA, 98372 Tel. (253) 383-8778

Client: South Sound Geotechnical Consulting
Project: Sumner Medical Building
Project No: 5603

Figure

Tested By: R Rowden **Checked By:** C Pedersen

Particle Size Distribution Report ASTM C-117,C136



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	1	56	43	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	100		
#16	100		
#30	99		
#40	99		
#50	98		
#100	85		
#200	43		

* (no specification provided)

Material Description

B1, S4
Sampled from B1, S4 at 20.5'-21.5'

Atterberg Limits

PL= LL= PI=

Classification

USCS= AASHTO=

Remarks

Report: #2

Sampled by: Client

Source of Sample: B1, S4
Sample Number: 15-130

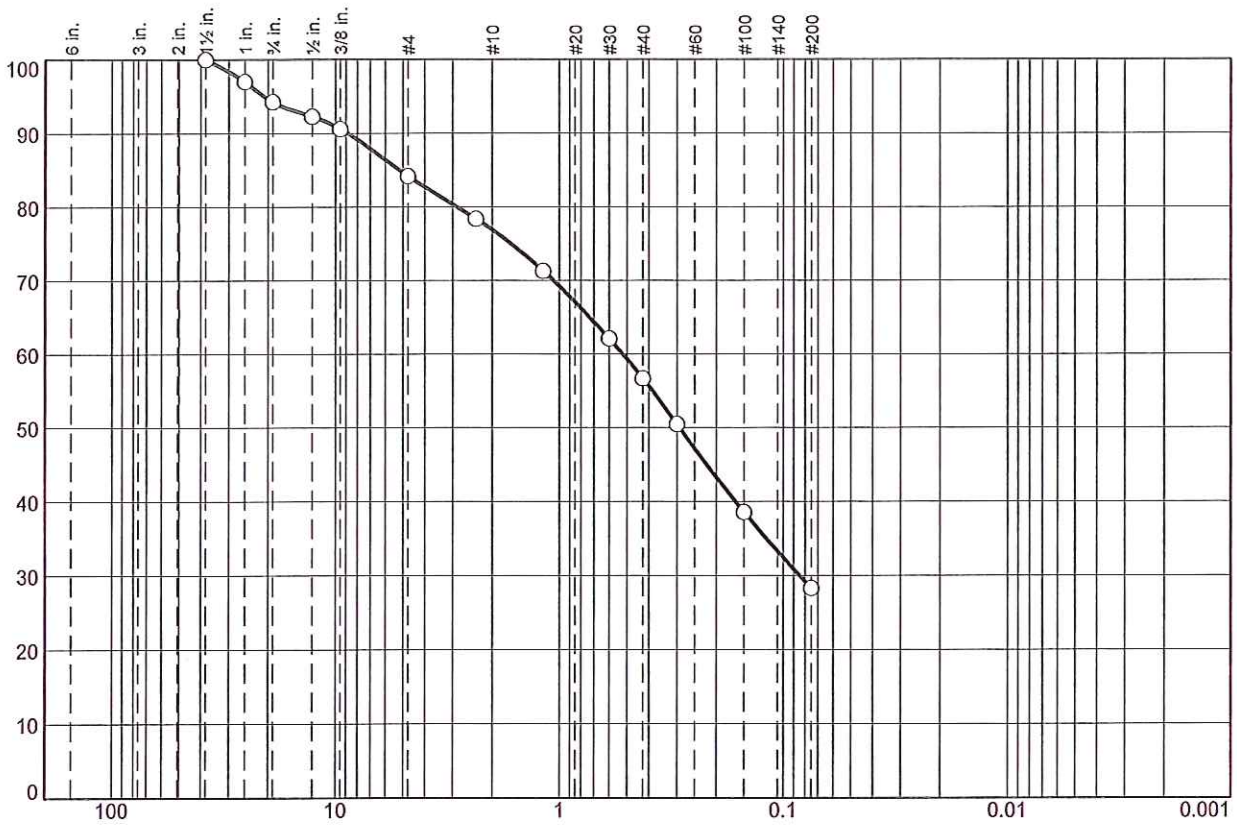
Date: 02-13-15

Construction Testing Laboratories
400 Valley Ave. NE, Suite #102
Puyallup WA, 98372 Tel. (253) 383-8778

Client: South Sound Geotechnical Consulting
Project: Sumner Medical Building
Project No: 5603 **Figure**

Tested By: R Rowden **Checked By:** C Pedersen

Particle Size Distribution Report ASTM C-117,C136



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.7	10.1	7.3	20.2	28.4	28.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2"	100.0		
1"	97.0		
3/4"	94.3		
1/2"	92.3		
3/8"	90.6		
#4	84.2		
#8	78.4		
#16	71.3		
#30	62.1		
#40	56.7		
#50	50.5		
#100	38.6		
#200	28.3		

* (no specification provided)

Material Description

B1 S6
Sampled from B1 S-6 at 30.5'-31.5'

Atterberg Limits

PL= LL= PI=

Classification

USCS= AASHTO=

Remarks

Report: #3

Sampled by: Client

Source of Sample: B1, S6
Sample Number: 15-131

Date: 02-12-15

Construction Testing Laboratories
400 Valley Ave. NE, Suite #102
Puyallup WA, 98372 Tel. (253) 383-8778

Client: South Sound Geotechnical Consulting
Project: Sumner Medical Building
Project No: 5603

Figure

Tested By: R Rowden **Checked By:** C Pedersen

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E]		GW	Well-graded gravel [F]
			Cu < 4 and/or 1 > Cc > 3 [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E]		SW	Well-graded sand [I]
			Cu < 6 and/or 1 > Cc > 3 [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay [K,L,M,N] / Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay [K,L,M,P] / Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.