



July 31, 2024
ES-4556.02

Earth Solutions NW LLC

Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

Cascade Christian Schools
815 – 21st Street Southeast
Puyallup, Washington 98372

Attention: Ray Ossman

**Subject: Infiltration Evaluation
Cascade Christian School
819 – 21st Street Southeast
Puyallup, Washington**

Greetings:

As requested, Earth Solutions NW, LLC (ESNW) has prepared this infiltration evaluation for the proposed project. A summary of our fieldwork, laboratory analyses, and relevant geotechnical recommendations are provided in this letter report.

Project & Site Description

The subject site is located directly east of the intersection between 21st Street Southeast and 9th Avenue Southeast in Puyallup, Washington. The approximate site location is illustrated on the attached Vicinity Map (Plate 1). The site consists of a single tax parcel (Pierce County Parcel Number 042026-3083) and totals about 0.37 acres. The site is currently developed with a single-family residence, detached garage, and associated residential improvements. Topography on the subject site is relatively level, and in general, is approximately two to four feet lower than the surrounding parcels. Vegetation across the subject site consists of moderately sized trees and landscaping areas.

We understand the proposed project includes the demolition and removal of the existing single-family residence and site features. Subsequently, the site will be redeveloped with six portable classrooms and associated infrastructure improvements. A rain garden facility located along the western property frontage is currently proposed for post-construction stormwater management. Permeable surfaces may also be used within the plaza area on site. Based on review of the referenced site plan, we understand that the site will be raised about two feet.

Subsurface Conditions

An ESNW representative observed, logged, and sampled two test pits on June 17, 2024. The test pits were excavated at accessible areas of the site using a mini-trackhoe and operator retained by the client. The approximate locations of the test pits are depicted on Plate 2 (Test Pit Location Plan). Please refer to the attached soil logs for a more detailed description of the subsurface conditions. Representative soil samples collected during the test pit exploration were evaluated in general accordance with Unified Soil Classification System (USCS) and United States Department of Agriculture (USDA) methods and procedures. Additionally, two samples were submitted for organic content (OC) and cation exchange capacity (CEC).

Topsoil

Topsoil was observed extending to a depth of approximately 12 inches below the existing ground surface (bgs) at the test pit locations. The topsoil was characterized by dark brown color, minor root intrusions, and the presence of fine organic material.

Fill

Fill was not encountered at the test pit locations during the June 2024 subsurface exploration. Based on the topographic differences between the subject site and the surrounding area, we do not anticipate significant amounts of fill to be present on the subject site.

Native Soil

Underlying topsoil, native soil encountered at the test pit locations consisted primarily of silty sand (USCS: SM). An area of sandy silty (USCS: ML) was also encountered at test location TP-1 beginning at a depth of approximately seven and one-half feet bgs. In-situ soil density was generally characterized as loose to medium dense and in-situ soil moisture contents were characterized as moist to wet at the time of exploration. The maximum exploration depth was approximately nine and one-half feet bgs.

Geologic Setting

Geologic mapping identifies alluvium (Qa) across the site. Alluvium deposits consist primarily of loose, stratified fluvial silts, sands, and gravels deposited through fluvial events. The Web Soil Survey (WSS) indicates Briscot loam and Puyallup fine sandy loam as the primary soil units underlying the site. Both the Briscot and Puyallup series soils formed in alluvium settings. Based on our field observations, on-site native soils are representative of alluvium deposits.

Groundwater

The local groundwater table was observed at test location TP-2 at a depth of approximately nine and one-half feet bgs during the June 2024 fieldwork. The presence of groundwater (seepage and/or the local table), flow rates, and elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, the groundwater table is higher during the winter, spring, and early summer months. Based on our experience within the Puyallup River Valley, seasonal fluctuations and relatively shallow exposures of the groundwater table can be anticipated in the area.

Infiltration Evaluation

ESNW completed a small-scale Pilot Infiltration Test (PIT) to evaluate the feasibility of pursuing on-site infiltration, from a geotechnical standpoint. In our opinion, based on the results of in-situ infiltration testing, field observations, and laboratory analyses, the proposed rain garden infiltration system is feasible from a geotechnical standpoint.

The infiltration test was completed at TP-1 in general accordance with the Department of Ecology Stormwater Management Manual for Western Washington, as adopted by the City of Puyallup. The PIT was completed at a depth of roughly three feet bgs and within a representative section of native silty sand. For infiltration facilities interfacing with the silty sand, the following design values (as based on the result of the PIT) may be used:

Location	Test Depth	K _{sat} initial	CF _V	CF _T	CF _M	K _{sat} design
TP-1	3.0 ft	1.5 in/hr.	0.55	0.5	0.9	0.35 in/hr.

Care should be taken while working in the proposed rain garden so as to not inadvertently compact or alter the infiltration characteristics of the native soil to be exposed at the facility subgrade. Furthermore, the rain garden should not be used for temporary erosion control or as a sediment pond unless the area is left high or other means of subgrade protection is incorporated into the sediment pond design. Given the relatively low design infiltration rate, it is our opinion that an overflow be incorporated into the facility design. ESNW should review final drainage plans as well as observe the infiltration facility excavation to confirm anticipated soil types are exposed at the facility subgrade.

As noted in the *Groundwater* section of this letter, the local groundwater table was observed at a depth of approximately nine and one-half feet bgs during the time of testing. A minimum vertical separation (dependent on the stormwater mitigation system to be implemented) should be maintained from the seasonal high groundwater elevation. As such, completion of a groundwater monitoring program may be prudent as part of the facility design. ESNW would be pleased to provide groundwater monitoring services, when requested.

Soil Treatment Capacity

Two representative soil samples were collected and submitted for OC and CEC testing to determine if the native soil can effectively serve as a treatment layer for the rain garden facility. The results of the soil quality testing are provided in the following table.

Sample Location and Depth	Depth (Ft.)	OC Results (Percent)	CEC Results (meq/100g)
TP-1	3.0	1.4	5.0
TP-2	2.5	1.0	3.8

In general, an OC percentage of at least 1.0 and a CEC result of at least 5.0 meq/100g are considered the minimum target standards for soils to be considered acceptable for stormwater treatment. Based on the results of the laboratory testing, it appears that the native soils have the potential to provide adequate treatment of stormwater runoff. ESNW should be contacted to further evaluate soils intended for use as stormwater treatment during construction.

Limitations

This report has been prepared for the exclusive use of Cascade Christian Schools and its representatives. The recommendations and conclusions provided in this letter are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. A warranty is not expressed or implied. Variations in the soil and groundwater conditions observed at the test pit locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions in this report if variations are encountered.

Additional Services

ESNW should be retained to provide additional geotechnical services in. sociation with this project, including testing and consulting services during construction. ESNW should have an opportunity to review final project plans with respect to the geotechnical recommendations provided in this letter.

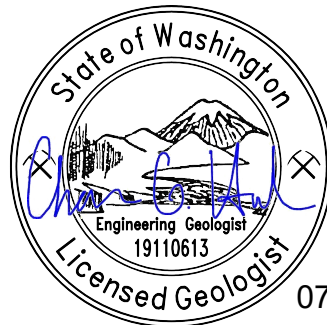
We appreciate the opportunity to be of service to you and trust this letter meets your current needs. Should you have any questions, or require additional information, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC



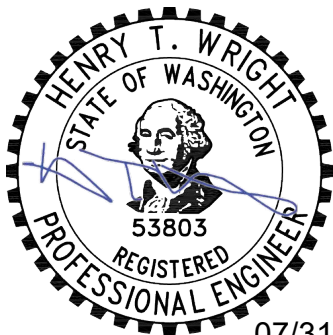
Samuel E. Suruda, L.G.
Senior Staff Geologist



07/31/2024

Chase G. Halsen

Chase G. Halsen, L.G., L.E.G.
Project Manager



07/31/2024

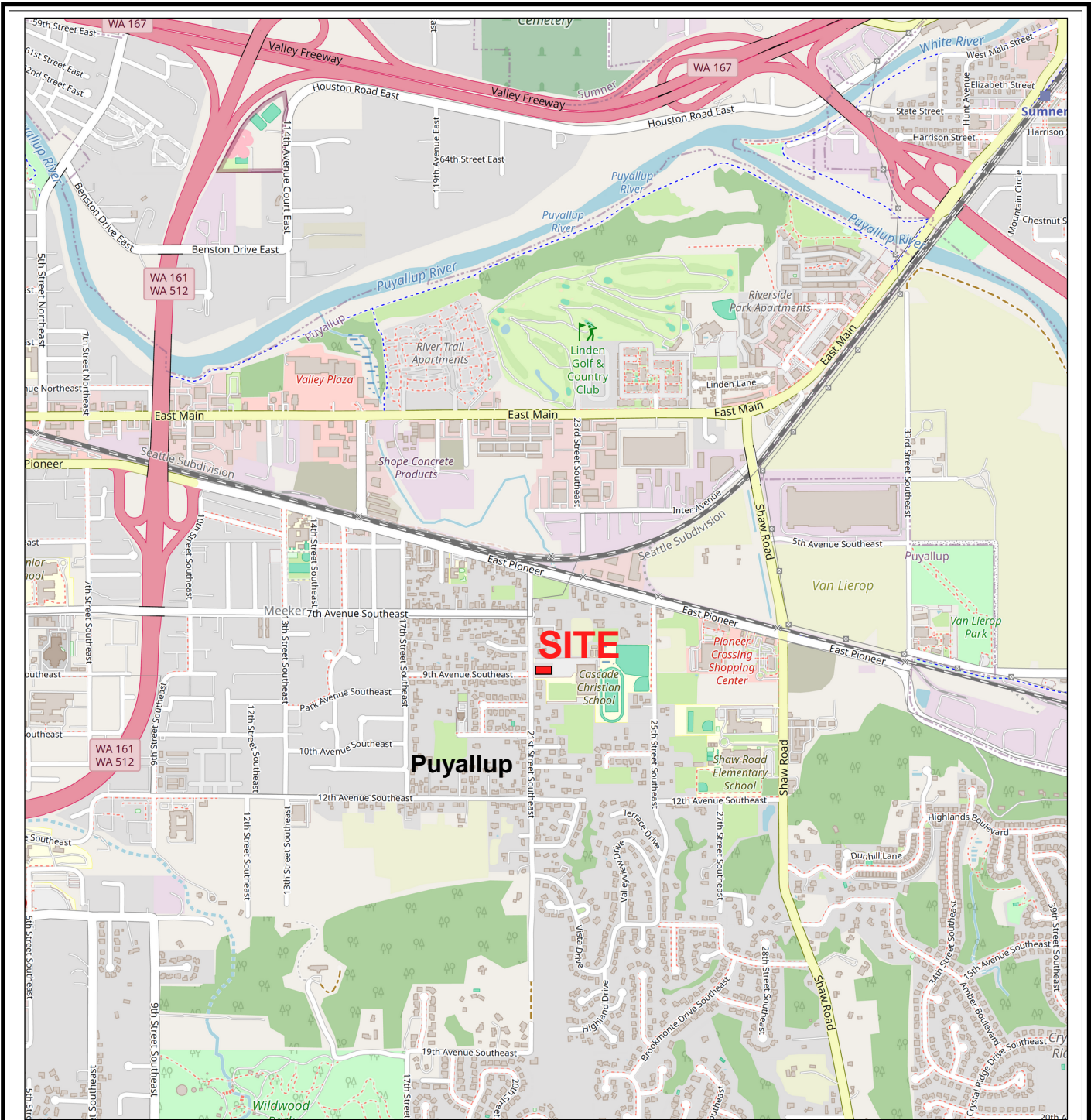
Henry T. Wright, P.E.
Associate Principal Engineer

- Attachments: Plate 1 – Vicinity Map
Plate 2 – Test Pit Location Plan
Subsurface Exploration Logs
Grain Size Distribution

cc: JBA, LLC
Attention: Songyi Cho

References:

- 2019 Stormwater Management Manual for Western Washington, prepared by the Washington State Department of Ecology, dated July 2019
- Geologic Map of the Tacoma 1:100,000-scale Quadrangle, produced by J.E. Schuster, A.A. Cabibbo, J.F. Schilter, and I.J. Hubert, Washington
- Phase 5 – Site Plan, produced by Vader Engineering, dated May 27, 2024
- Soil Survey of Pierce County Area, endorsed by the USDA Soil Conservation Service, issued February 1979
- WSS, maintained by the Natural Resources Conservation Service under the USDA



Reference:
Pierce County, Washington
OpenStreetMap.org



NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

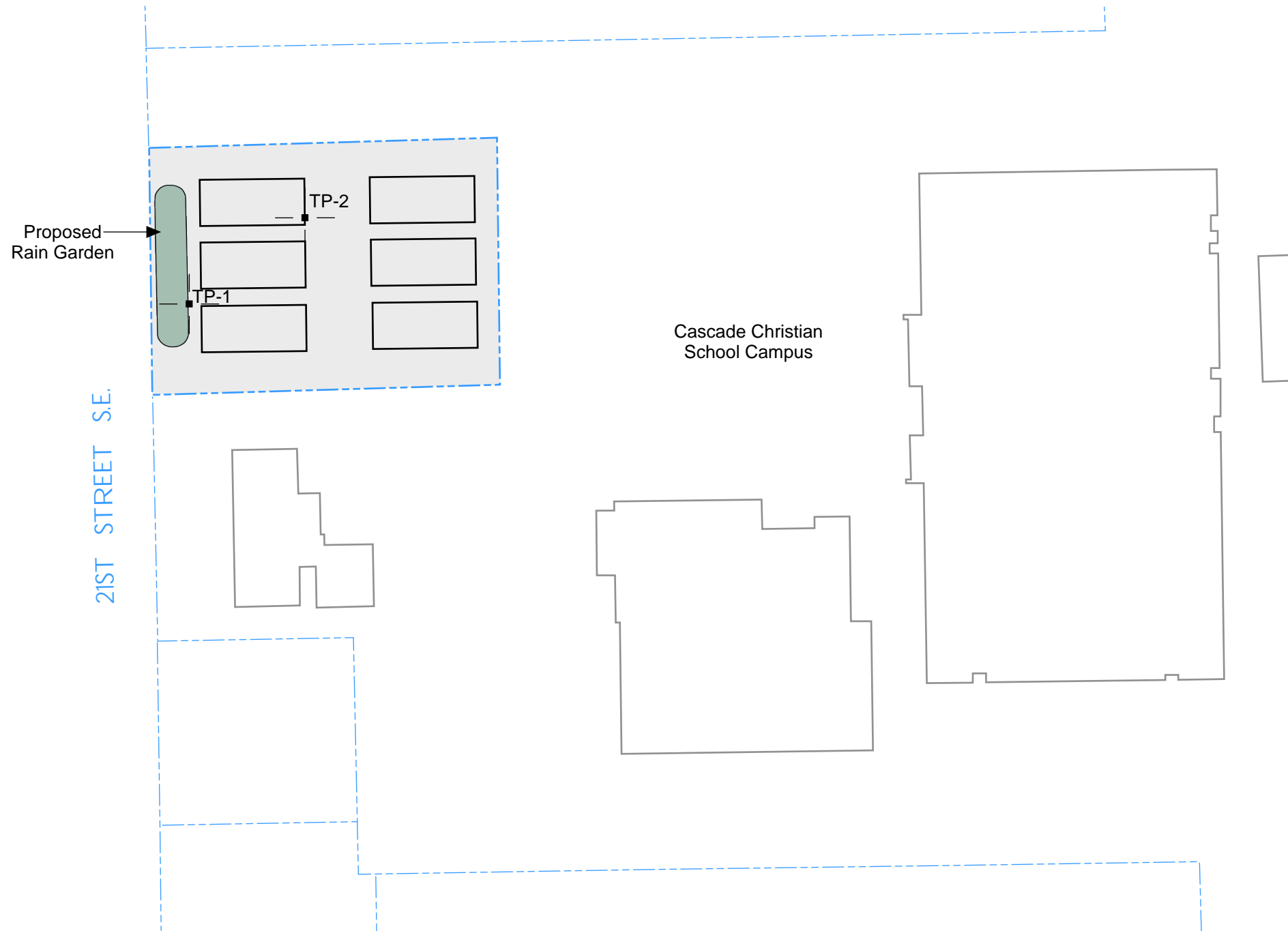


Earth Solutions NW LLC

Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

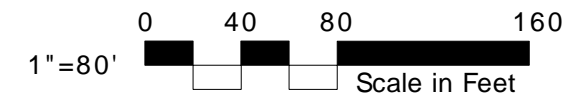
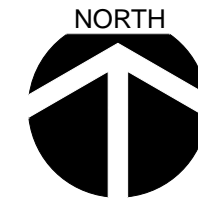
Vicinity Map
Cascade Christian School
Puyallup, Washington

Drawn CAM	Date 07/09/2024	Proj. No. 4556.02
Checked SES	Date July 2024	Plate 1



LEGEND

- TP-1 | — ■ — | Approximate Location of ESNW Test Pit, Proj. No. ES-4556.02, June 2024
- ▭ (dashed blue border) | Subject Area
- ▭ (black border) | Proposed Portable Structures
- ▭ (grey fill) | Existing Building



NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.



Drawn CAM
Checked SES
Date 07/09/2024
Proj. No. 4556.02
Plate 2

Coarse-Grained Soils - More Than 50% Retained on No. 200 Sieve		Moisture Content		Symbols		
Gravels - More Than 50% of Coarse Fraction Retained on No. 4 Sieve		GW	Well-graded gravel with or without sand, little to no fines	Dry - Absence of moisture, dusty, dry to the touch		
		GP	Poorly graded gravel with or without sand, little to no fines	Damp - Perceptible moisture, likely below optimum MC		
Sands - 50% or More of Coarse Fraction Passes No. 4 Sieve		GM	Silty gravel with or without sand	Moist - Damp but no visible water, likely at/near optimum MC		
		GC	Clayey gravel with or without sand	Wet - Water visible but not free draining, likely above optimum MC		
Sands - 50% or More of Coarse Fraction Passes No. 4 Sieve		SW	Well-graded sand with or without gravel, little to no fines	Saturated/Water Bearing - Visible free water, typically below groundwater table		
		SP	Poorly graded sand with or without gravel, little to no fines			
		SM	Silty sand with or without gravel			
		SC	Clayey sand with or without gravel			
Fine-Grained Soils - 50% or More Passes No. 200 Sieve		Terms Describing Relative Density and Consistency				
Silt and Clays Liquid Limit Less Than 50		ML	Silt with or without sand or gravel; sandy or gravelly silt	Coarse-Grained Soils:		
		CL	Clay of low to medium plasticity; lean clay with or without sand or gravel; sandy or gravelly lean clay	Test Symbols & Units		
Silt and Clays Liquid Limit 50 or More		OL	Organic clay or silt of low plasticity	Density	SPT blows/foot	Fines = Fines Content (%)
		MH	Elastic silt with or without sand or gravel; sandy or gravelly elastic silt	Very Loose	< 4	MC = Moisture Content (%)
		CH	Clay of high plasticity; fat clay with or without sand or gravel; sandy or gravelly fat clay	Loose	4 to 9	DD = Dry Density (pcf)
		OH	Organic clay or silt of medium to high plasticity	Medium Dense	10 to 29	Str = Shear Strength (tsf)
Highly Organic Soils		PT	Peat, muck, and other highly organic soils	Dense	30 to 49	PID = Photoionization Detector (ppm)
		FILL	Made Ground	Very Dense	≥ 50	OC = Organic Content (%)
Fill		FILL	Made Ground	Component Definitions		
				Modifier Definitions		
				Consistency		
				Size Range and Sieve Number		
				Percentage by Weight (Approx.)		
				Modifier		
				Classification		
				Soil Type		
				Soil Description		
				Soil Classification		
				Soil Identification		
				Soil Properties		
				Soil Behavior		
				Soil Testing		
				Soil Analysis		
				Soil Report		
				Soil Summary		
				Soil Conclusion		
				Soil Recommendation		
				Soil Notes		
				Soil Appendix		
				Soil References		
				Soil Bibliography		
				Soil Index		
				Soil Glossary		
				Soil Acronyms		
				Soil Symbols		
				Soil Diagrams		
				Soil Tables		
				Soil Figures		
				Soil Charts		
				Soil Graphs		
				Soil Photographs		
				Soil Videos		
				Soil Audio		
				Soil Other		
				Soil Final		
				Soil End		



Earth Solutions NW LLC

Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

EXPLORATION LOG KEY



15365 NE 90th Street, Suite 100
 Redmond, WA 98052
 Office (425) 449-4704 | esnw.com
 Branch Office: Pasco, WA

TEST PIT NUMBER TP-1

PROJECT NUMBER ES-4556.02 PROJECT NAME Cascade Christian School
 DATE STARTED 6/17/24 COMPLETED 6/17/24 GROUND ELEVATION _____
 EXCAVATION CONTRACTOR Client Provided LATITUDE 47.18441 LONGITUDE -122.26666
 LOGGED BY SES CHECKED BY CGH GROUND WATER LEVEL:
 NOTES _____ ∇ AT TIME OF EXCAVATION _____
 SURFACE CONDITIONS Grass AFTER EXCAVATION _____

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					
			TPSL		Dark brown TOPSOIL, minimal root intrusions
				1.0	
					Dark brown silty SAND, medium dense, moist
2.5					
	GB	MC = 14.1 Fines = 23.9 OC = 1.4			-infiltration test at 3' [USDA Classification: slightly gravelly loamy SAND] -becomes wet (post-test)
			SM		
5.0	GB	MC = 25.2 Fines = 27.4			[USDA Classification: loamy SAND]
7.5					
			ML		Gray sandy SILT, medium dense, wet
	GB	MC = 30.1 Fines = 62.2			[USDA Classification: LOAM]
				8.5	

Test pit terminated at 8.5 feet below existing grade. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.



15365 NE 90th Street, Suite 100
 Redmond, WA 98052
 Office (425) 449-4704 | esnw.com
 Branch Office: Pasco, WA

TEST PIT NUMBER TP-2

PROJECT NUMBER ES-4556.02 PROJECT NAME Cascade Christian School
 DATE STARTED 6/17/24 COMPLETED 6/17/24 GROUND ELEVATION _____
 EXCAVATION CONTRACTOR Client Provided LATITUDE 47.18457 LONGITUDE -122.26647
 LOGGED BY SES CHECKED BY CGH GROUND WATER LEVEL:
 NOTES _____ ∇ AT TIME OF EXCAVATION 9.5 ft
 SURFACE CONDITIONS Grass AFTER EXCAVATION _____

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					
			TPSL		Dark brown TOPSOIL, shallow root intrusions
				1.0	
					Dark brown silty SAND, loose to medium dense, damp
2.5	GB	MC = 12.4 Fines = 21.8 OC = 1.0			[USDA Classification: loamy SAND]
					-becomes gray
					-becomes wet
5.0	GB	MC = 35.6	SM		
7.5					
	GB	MC = 24.3			
				9.5	∇ -groundwater table at 9.5'

Test pit terminated at 9.5 feet below existing grade. Groundwater table encountered at 9.5 feet during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

