Revision 2– December 6, 2022
Project No. 20-0424

Rod Schenk
Profile Construction, Inc.
2950 Newmarket St, Suite 101-254
Bellingham, WA 98226

Cc: **Jack Bloss**
AVT Consulting

Regarding: Stormwater Infiltration Feasibility Letter – *Revision 2 (12.6.22)*
2500 Block E McLeod Rd
(TPN: 3803165042430000)
Bellingham, WA 98226

Dear Mr. Schenk:

As requested, GeoTest Services, Inc. (GeoTest) is pleased to submit the following geotechnical letter concerning the feasibility of stormwater infiltration for the proposed residential plat development located at the 2500 Block of East McLeod Road in Bellingham, Washington. This letter has been prepared in general accordance with the terms and conditions established in our professional services agreement dated April 2, 2020.

PROJECT DESCRIPTION

The subject property contains 5.5 acres of densely forested land within a single, roughly wedge-shaped parcel on the eastern margins of Bellingham, WA. Topography is relatively gently dipping to the northwest from the southeast corner of the property. Based on topographic surveys and *City of Bellingham CityIQ* mapping, gradients are commonly at or less than 30% trending to the northwest. The property is surround by residential developments on the south, east, and west sides, with Squalicum High School directly to the north.

The owner intends to develop the site with a 36-lot residential plat including associated exterior improvements such as a central activity court, access roadways and flatworks, and other landscape features. The project design team has informed GeoTest that the project requires investigation and evaluation for onsite stormwater controls under modern Department of Ecology Stormwater Management Manual for Western Washington (SMMWW 2019) requirements. Based on the preliminary stormwater plan, we understand that stormwater management will likely include the use of a detention pond and possible LID infiltration features, depending on feasibility results to be addressed in this study. The project team have also

requested that GeoTest evaluate the property for potential geological hazard concerns and address these concerns if present.

Our current work has been conducted in order to assess the feasibility of incorporating stormwater infiltration facilities into the planned site development. GeoTest Services performed this infiltration feasibility assessment in accordance with the Washington State Department of Ecology *Stormwater Management Manual of Western Washington* (SMMWW 2019) requirement for site suitability characterization.

SITE CONDITIONS

This section discusses the general surface and subsurface conditions observed at the project site at the time of our field investigation. Interpretations of the site conditions are based on our observations at the time of our field investigation and a review of the available information.

Surface Conditions

The vacant subject property is among a residential neighborhood, located to the northwest of the Barkley area in Bellingham, WA. The property is bound to the north by East McLeod Road with Squalicum High School property farther north. The south and western boundaries of the property are adjacent to residential subdivision developments with increased population density toward the southwest. The east side of the property is bordered by a public trail that provides access to a park to the south with moderate density residential development farther to the east. Within the property, land is completely undeveloped and forested with few indications of historic logging including stumps and downed trees. Mature trees include fir, cedar, alder and maple with numerous vine maples and other juvenile tree growth. The understory of the site includes dense native growth of ferns, oceanspray, and blackberry brambles. The site is crossed in multiple locations by footpaths from animals and human activity. Topography on the property generally descends from the southeastern corner of the site to the northwestern corner at the low point. Several small undulations were observed among the site but in general gradient was consistent and was approximately 30% or less on average. Surface conditions were generally moist and no surface water ponding was observed throughout the property during our site visit in early May 2020.

Subsurface Conditions

Subsurface conditions were investigated on May 5th, 2020 by excavation of 9 machine-assisted test pits broadly spaced throughout the project site to evaluate stormwater infiltration feasibility. Test pit locations were selected by the project team and were field located by GeoTest personnel during our field investigation. Test pits TP-1, TP-2, and TP-3 were excavated along the southern portion of the site. Test pits TP-4 and TP-5 were excavated on the eastern boundary and northeastern corner respectively. Test pit PT-6 was excavated along the north-central boundary and TP-7 was excavated near the center of the project site. Test pit TP-8 was excavated near the

western boundary and TP-9 was excavated near the northwest corner of the site, in the vicinity of the planned stormwater tract. These explorations were advanced to maximum equipment reach or until contact with stiff to hard native soil conditions or bedrock.

Subsurface conditions were relatively consistent among the among the nine test pit locations with variations in relative thickness of the units observed. Subsurface conditions among the site consisted of approximately 0.5 to 1 foot of organic topsoil. Shallow topsoil was typically sandy silt with trace to no gravel content, moist, and dark brown in color. Below the surface topsoil, a thin medium stiff, reddish medium brown moist, sandy silt subsoil horizon was observed in several test pit locations. Below topsoil and subsoil, where present, glaciomarine drift deposits were sandy silt to very silty sand with trace fine gravel and ranged in consistency from stiff to hard or medium dense to dense. Glacial drift deposits were moist, light brown to gray and exhibited orange mottling at the upper interface. At the location of TP-1, the weathered glaciomarine horizon was observed to be slightly thicker, over 1-foot. The glaciomarine drift soils were typically semi-consolidated and were blocky in hand sample. Atterberg Limits analysis performed on glaciomarine drift soils resulted in non-plastic results on the two samples run.

At all test locations, excepting TP-1, Chuckanut Formation bedrock was found to underlying glaciomarine drift deposits. Bedrock ranged from massive sandstone to thinly bedded and fractured siltstone. Chuckanut bedrock was consistently moderately hard, medium to light brown, and dry with slightly elevated moisture at the upper interface. Depths to bedrock ranged from approximately 2 feet below ground surface (BGS) to approximately 4 feet BGS and was not observed at the location of TP-1 to depths of 6.5 feet BGS.

No perched or pervasive groundwater horizons were observed during our field investigation conducted in early May, following a period of dry weather. Slight to moderate orange colored mottling and oxidation was observed within shallow glaciomarine drift soils that typically indicates prolonged exposure to perched water conditions.

Image 1 *– Typical surface conditions of site interior. View facing north with test pit TP-9 in progress.*

General Geologic Conditions

Geologic information for the subject property was obtained from the *Geologic Map of Bellingham 1:100,000 quadrangle, Washington* (Lapen, 2000), published by the Washington State Department of Natural Resources. According to the referenced map, the site falls wholly within the Padden Member of the Eocene Chuckanut Formation (Ec_{cp}). Although Glaciomarine Drift ($Qgdm_e$) was not mapped on the project site, it is common to have relatively thin mantling of glacial soils overlying Chuckanut Sandstone within the lower foothills of Western Washington.

The Padden Member of the Chuckanut Formation is a continental sedimentary deposit formed in the Tertiary. This unit is commonly observed as massive sandstone to thinly bedded siltstone with local coal seams. The glaciomarine drift in the vicinity of the subject site generally consists of unsorted, unstratified pebbly, sandy silt and clay with common dropstones up to boulder size. Glaciomarine drift soils are derived from rock debris melted out of floating ice and deposited in still ocean waters. Observed conditions were consistent with mantling Glacial Drift deposits with underlying sandstone bedrock at depths ranging from less than 2 feet to greater than 6 feet.

Geohazard Review

City of Bellingham Municipal Code (BMC) Section 16.55.410 designates geologically hazardous areas for the use of critical area review and investigation. Erosion hazard areas are defined by this section as "Specifically these areas include any area where the soil type is predominantly (greater than 50 percent) comprised of sand, clay, silt, and/or organic matter and slope is greater than 30 percent". Based on our site investigation, the general gradient of the project site is less than the 30 percent threshold with very minor areas that undulate over 30 percent. In addition, ground surfaces throughout the property are covered with well established vegetation and dense understory growth with a developed topsoil horizon as seen in all test locations. Based on the BMC code definitions and observations among the project site, it is our opinion that the site does **not** meet the designation as an erosion hazard area.

Stormwater Infiltration Potential

Based on the presence of relatively shallow stiff to hard Glaciomarine Drift soils, underlying Chuckanut Formation bedrock, and the indication of shallow perched groundwater conditions in the wet season, GeoTest does not recommend that on-site infiltration be incorporated as part of stormwater design for the proposed development. It is our opinion that the on-site native soils meet the criteria for a shallow restrictive horizon per the SMMWW (2012, 2019). On-site infiltration of stormwater on this site is not considered feasible through traditional measures. We recommend that the design team consider implementing surface dispersion or detention features as permitted by local municipalities. We understand that preliminary civil design includes the implementation of a stormwater detention pond within the northwest corner of the project site.

Detention Pond Liner Considerations

Due to the lack of onsite infiltration potential at the project site, we understand that detention may be implemented in the project design. Shallow bedrock surfaces through the property and among the potential detention area in the northwest corner may present challenges for detention pond construction and functionality. The Chuckanut Formation commonly expresses as large, variably porous and fractured sandstone and siltstone and hence would need to be lined in order to limit pond leakage and potential failure. Mantling glaciomarine drift deposits found shallowly throughout the project site were assessed via laboratory analysis for qualification in use as low-permeability pond liners.

Pond liner specifications are controlled by SMMWW 2019 guidelines and include either clay or low permeability (Till) liners. Atterberg Limits plasticity analysis of onsite glaciomarine soils yielded non-plastic results for all samples, therefore clay liner specifications are not applicable. Section V-1.3.3 of the SMMWW (2019) contains design criteria for low permeability liners with compacted till liners being applicable to the subject property. Table V-1.3 below shows the gradation requirements for compacted till liners.

Table V-1.3: Soil Gradation for Compacted Till Liners

Sieve Size	Percent Passing
6-inch	100
4-inch	90
#4	70 - 100
#200	20

Grain size analysis performed on glaciomarine drift soils found shallowly throughout the project site indicate that the soils are adequate for use as compacted till liner. In addition to gradation requirements the following are required for proper installation of compacted till liners.

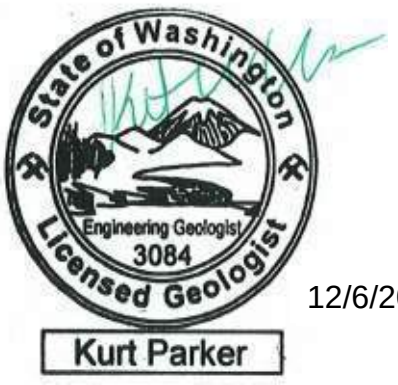
- Liner thickness shall be 18 inches after compaction.
- Soil shall be compacted to 95% minimum dry density, modified proctor method (ASTM D 1557).
- A different depth and density sufficient to retard the infiltration rate to 2.4 x 10^{-5} inches per minute (1 x 10^{-6} cm/s) may also be used instead of bullets 1 and 2 above.
- Soil should be placed in 6-inch lifts.

USE OF THIS REPORT

GeoTest Services Inc. has prepared this report for the exclusive use of Rod Schenk and his consultants for specific application to the design of the proposed residential plat development located on East McLeod Road in Bellingham, Washington. Use of this report by others is at the user's sole risk. This report is not applicable to other site locations. Our services are conducted in accordance with accepted practices of the geotechnical engineering profession; no other warranty, express or implied, is made as to the professional advice included in this report.

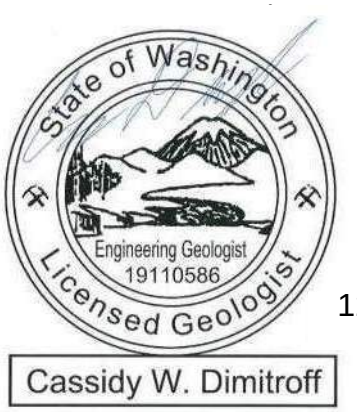
We appreciate the opportunity to provide geotechnical services for this project and look forward to assisting you further during the design and construction phase. Should you have any further questions regarding the information contained within the letter, or if we may be of service in other regards, please contact the undersigned.

Respectfully,
GeoTest Services, Inc.



12/6/2022

Kurt Parker, L.E.G.
Geotechnical Department Manager



12/6/2022

Cass Dimitroff, L.E.G.
Geotechnical Project Manager

Attachments:

Figure 1	Vicinity Map
Figure 2	Site and Exploration Plan
Figure 3	Soil Classification System and Key
Figures 4-8	Test Pit Logs
Figure 9	Grain Size Test Data
Attached	Report Limitations and Guidelines

References

Bakeman, S., Dan, G., Howie, D., Killelea, J., Labib, F., & Ed, O. (n.d.) 2012. *Stormwater Management Manual for Western Washington*, as Amended in December 2014 (2012/2014 SWMMWW) (pp. 1-1042) (United States, Washington State Department of Ecology).

Bellingham Municipal Code – Critical Areas Ordinance, §§ 16.55.410 (2020).

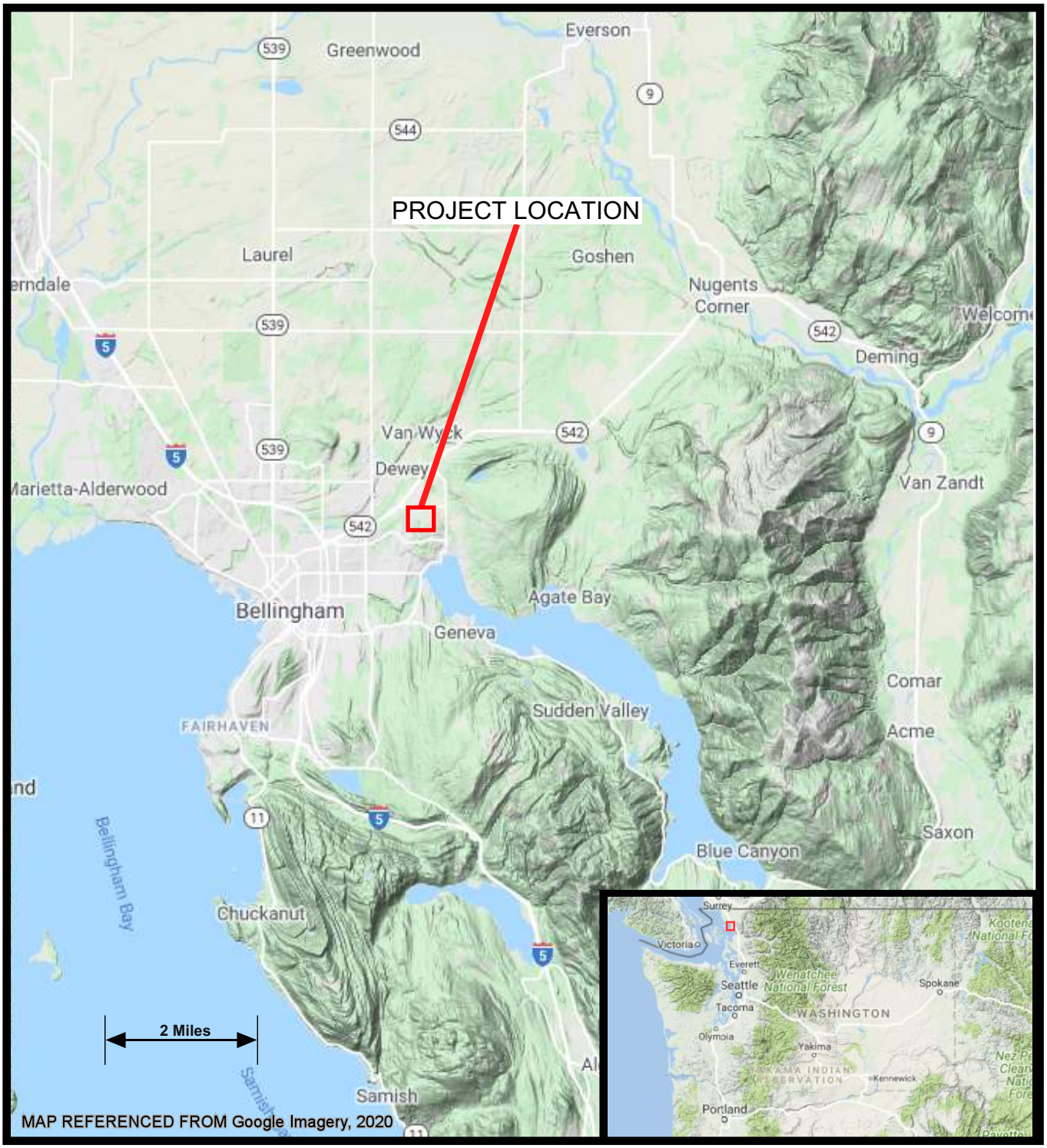
City of Bellingham *City IQ Viewer.* Retrieved May 2020 from https://maps.cob.org/geviewer/Html5Viewer/Index.html?viewer=cityiq

Easterbrook, D. J. (1976). *Geologic Map of Western Whatcom County, Washington* [map]. 1:62,500. Miscellaneous investigations series, map 1-854-B. Reston, VA: U.S. Geological Survey.

Gariepy, D., Graul, C. Heye, A., Howie, D., Labib, F. & Song, K. (n.d.) 2019. *Stormwater Management Manual for Western Washington* (2019 SMMWW) (pp. 1-1108) (United States, Washington Department of Ecology).

Lapen, Thomas J., 2000. *Geologic Map of the Bellingham 1:100,000 Quadrangle, Washington.* Washington State Department of Natural Resources, Division of Geology and Earth Resources, Open File Report 2000-5, scale 1:100,000.

Washington State Department of Natural Resources *Geologic Information Portal.* Retrieved May 2020 from https://geologyportal.dnr.wa.gov/.

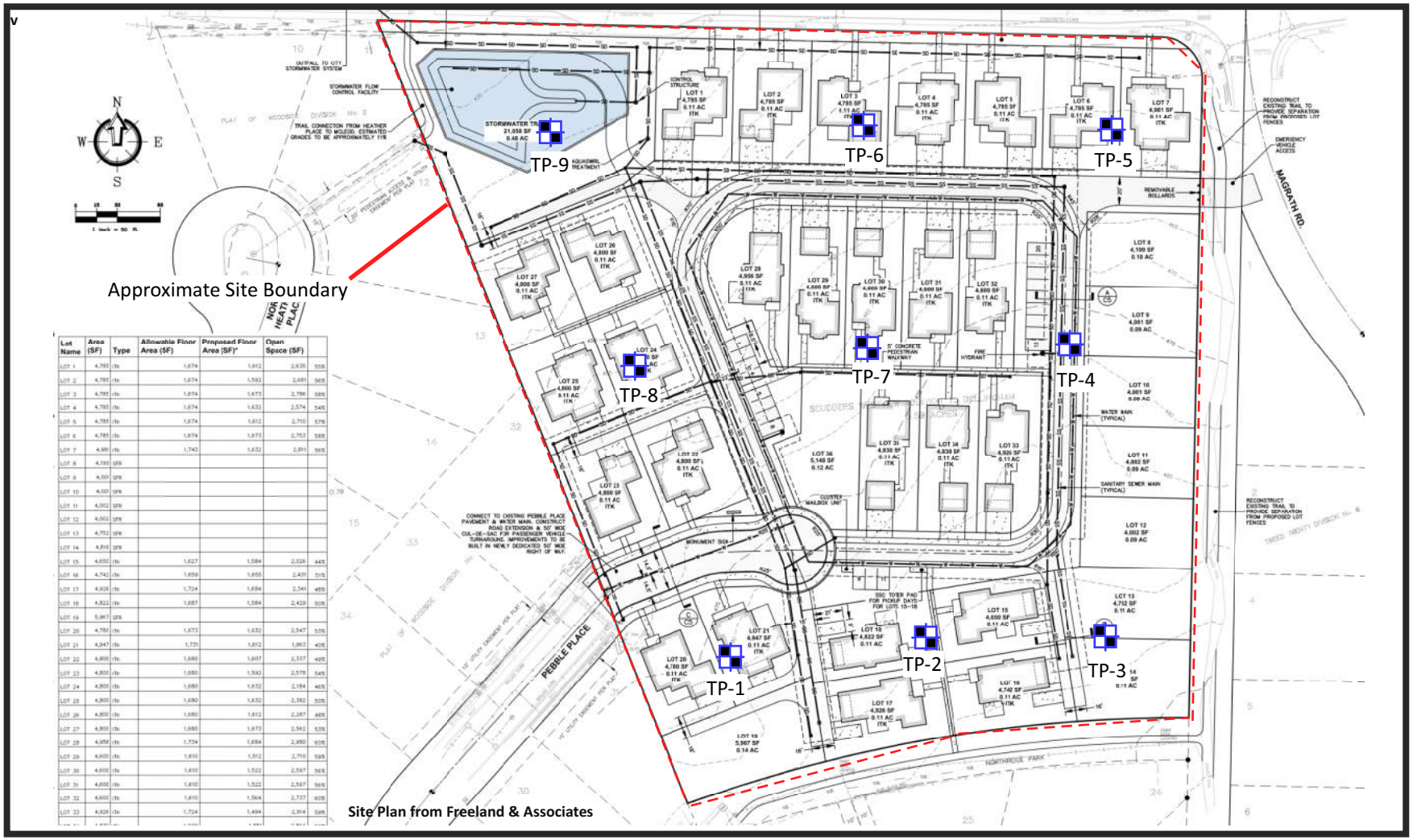


GEOTEST	Date: 5-15-20	By: CD	Scale: As Shown

VICINITY MAP
E MCLEOD RD STORMWATER FEASIBILTY
2500 BLOCK E MCLEOD RD
BELLINGHAM, WA

Project
20-0424

Figure
1



TP-# = Approximate Test Pit Location

N

100 Feet

GEOTEST

Date: 12-6-2022	By: CD	Scale: As Shown	Project 20-0424

SITE AND EXPLORATION PLAN
E McLeod Rd Stormwater Feasibility
2500 Block E McLeod Rd
Bellingham, WA

Figure 2

Soil Classification System

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS LETTER SYMBOL	TYPICAL DESCRIPTIONS[1][2]
COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (Little or no fines)		GW	Well-graded gravel; gravel/sand mixture(s); little or no fines
				GP	Poorly graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)		GM	Silty gravel; gravel/sand/silt mixture(s)
				GC	Clayey gravel; gravel/sand/clay mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve)	CLEAN SAND (Little or no fines)		SW	Well-graded sand; gravelly sand; little or no fines
				SP	Poorly graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sand; sand/silt mixture(s)
				SC	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size)	SILT AND CLAY (Liquid limit less than 50)			ML	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity
				CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
				OL	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid limit greater than 50)			MH	Inorganic silt; micaceous or diatomaceous fine sand
				CH	Inorganic clay of high plasticity; fat clay
				OH	Organic clay of medium to high plasticity; organic silt
	HIGHLY ORGANIC SOIL			PT	Peat; humus; swamp soil with high organic content

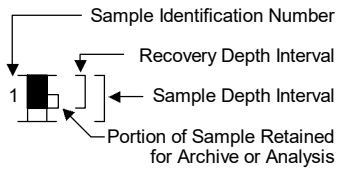
OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT		AC or PC	Asphalt concrete pavement or Portland cement pavement
ROCK		RK	Rock (See Rock Classification)
WOOD		WD	Wood, lumber, wood chips
DEBRIS		DB	Construction debris, garbage

Notes:
1. Soil descriptions are based on the general approach presented in the *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*, as outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the *Standard Test Method for Classification of Soils for Engineering Purposes*, as outlined in ASTM D 2487.
2. Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:

Primary Constituent: > 50% - "GRAVEL," "SAND," "SILT," "CLAY," etc.
Secondary Constituents: > 30% and ≤ 50% - "very gravelly," "very sandy," "very silty," etc.
> 12% and ≤ 30% - "gravelly," "sandy," "silty," etc.
Additional Constituents: > 5% and ≤ 12% - "slightly gravelly," "slightly sandy," "slightly silty," etc.
≤ 5% - "trace gravel," "trace sand," "trace silt," etc., or not noted.

Drilling and Sampling Key

SAMPLE NUMBER & INTERVAL



SAMPLER TYPE

Code	Description
a	3.25-inch O.D., 2.42-inch I.D. Split Spoon
b	2.00-inch O.D., 1.50-inch I.D. Split Spoon
c	Shelby Tube
d	Grab Sample
e	Other - See text if applicable
1	300-lb Hammer, 30-inch Drop
2	140-lb Hammer, 30-inch Drop
3	Pushed
4	Other - See text if applicable

Groundwater

▽ ATD — Approximate water elevation at time of drilling (ATD) or on date noted. Groundwater levels can fluctuate due to precipitation, seasonal conditions, and other factors.

Field and Lab Test Data

Code	Description
PP = 1.0	Pocket Penetrometer, tsf
TV = 0.5	Torvane, tsf
PID = 100	Photoionization Detector VOC screening, ppm
W = 10	Moisture Content, %
D = 120	Dry Density, pcf
-200 = 60	Material smaller than No. 200 sieve, %
GS	Grain Size - See separate figure for data
AL	Atterberg Limits - See separate figure for data
GT	Other Geotechnical Testing
CA	Chemical Analysis

GEOTEST

E McLeod Rd Stormwater Feasibility
2500 Block E McLeod Rd
Bellingham, WA

Soil Classification System and Key

Figure 3

TP-1

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type / Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Undetermined	
0				ML	Soft, dark brown, moist, sandy SILT, trace gravel, abundant organics (Topsoil)	Groundwater not encountered.
				ML	Medium stiff, reddish brown, moist, sandy SILT, trace gravel, scattered organics (Subsoil)	
2	1			SM	Medium dense, light brown to gray, mottled, moist, gravelly, very silty SAND, trace boulders (Weathered Glaciomarine Drift)	
				ML	Very stiff to hard, light gray, moist, very sandy SILT, trace fine gravel, blocky (Glaciomarine Drift)	
4	2	W = 25 GS				
6						
8						

Test Pit Completed 05/05/20
Total Depth of Test Pit = 6.5 ft.

TP-2

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type / Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Undetermined	
0				ML	Soft, dark brown, moist, sandy SILT, trace gravel, abundant organics (Topsoil)	Groundwater not encountered.
				ML	Very stiff to hard, light gray, slight mottling, moist, very sandy SILT, trace fine gravel, blocky (Glaciomarine Drift)	
2	3			SLS	Moderately hard, medium to light brown, dry, SILTSTONE, small blocky fracture (Chuckanut Bedrock)	
4						
6						
8						

Test Pit Completed 05/05/20
Total Depth of Test Pit = 3.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST

E McLeod Rd Stormwater Feasibility
2500 Block E McLeod Rd
Bellingham, WA

Log of Test Pits

Figure 4

TP-3

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Undetermined	
0					ML	Soft, dark brown, moist, sandy SILT, trace gravel, abundant organics (Topsoil)	Groundwater not encountered.
2	4 5		W = 13 GS		SM	Medium dense, light gray to brown, slight mottling, moist, gravelly, very silty SAND, scattered thin roots (Glaciomarine Drift)	
4					SNS	Moderately hard, medium to light brown, dry, SANDSTONE, large blocky fracture (Chuckanut Bedrock)	
6	Test Pit Completed 05/05/20 Total Depth of Test Pit = 5.0 ft.						
8							

TP-4

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Undetermined	
0					ML	Soft, dark brown, moist, sandy SILT, trace gravel, abundant organics (Topsoil)	Groundwater not encountered.
					ML	Medium stiff, reddish brown, moist, sandy SILT, trace gravel, scattered organics (Subsoil)	
2	6 7				ML	Very stiff to hard, light gray, slight mottling, moist, very sandy SILT, trace fine gravel, blocky (Glaciomarine Drift)	
					SNS	Non-plastic per Atterberg analysis	
4	Test Pit Completed 05/05/20 Total Depth of Test Pit = 3.5 ft.					Moderately hard, medium to light brown, dry, SANDSTONE, massive, minimal fracture (Chuckanut Bedrock)	
6							
8							

Notes:
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3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST

E McLeod Rd Stormwater Feasibility
2500 Block E McLeod Rd
Bellingham, WA

Log of Test Pits

Figure 5

TP-5

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Undetermined	
0					ML	Soft, dark brown, moist, sandy SILT, trace gravel, abundant organics - forest duff (Topsoil)	Groundwater not encountered.
					ML		
					ML	Medium stiff, reddish brown, moist, sandy SILT, trace gravel, scattered organics (Subsoil)	
2	8				SNS	Very stiff to hard, light gray, slight mottling, moist, very sandy SILT, trace fine gravel, blocky (Glaciomarine Drift)	
						Moderately hard, medium to light brown, dry, SANDSTONE, massive, minimal fracture (Chuckanut Bedrock)	
4							
6							
8							

Test Pit Completed 05/05/20
Total Depth of Test Pit = 3.0 ft.

TP-6

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Undetermined	
0					ML	Soft, dark brown, moist, sandy SILT, trace gravel, abundant organics (Topsoil)	Groundwater not encountered.
	9				ML	Medium stiff, reddish brown, moist, sandy SILT, trace gravel, scattered organics (Subsoil)	
					ML		
2	10				SNS	Very stiff to hard, light gray, slight mottling, moist, very sandy SILT, trace fine gravel, blocky (Glaciomarine Drift)	
						Moderately hard, medium to light brown, dry, SANDSTONE, massive, minimal fracture (Chuckanut Bedrock)	
4							
6							
8							

Test Pit Completed 05/05/20
Total Depth of Test Pit = 2.8 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST

E McLeod Rd Stormwater Feasibility
2500 Block E McLeod Rd
Bellingham, WA

Log of Test Pits

Figure 6

TP-7

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type / Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Undetermined	
0				ML	Soft, dark brown, moist, sandy SILT, trace gravel, abundant organics (Topsoil)	Groundwater not encountered.
				ML	Medium stiff, reddish brown, moist, sandy SILT, trace gravel, scattered organics (Subsoil)	
2	11	W = 17 GS		ML		
				SLS	Very stiff to hard, light gray, slight mottling, moist, very sandy SILT, trace fine gravel, minor thin roots (Glaciomarine Drift)	
					Moderately hard, medium to light brown, dry, SILTSTONE, flakey fracture (Chuckanut Bedrock)	
4					Test Pit Completed 05/05/20 Total Depth of Test Pit = 3.0 ft.	
6						
8						

TP-8

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type / Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Undetermined	
0				ML	Soft, dark brown, moist, sandy SILT, trace gravel, abundant organics (Topsoil)	Groundwater not encountered.
				ML	Medium stiff, reddish brown, moist, sandy SILT, trace gravel, scattered organics (Subsoil)	
2	12			ML		
	13				Very stiff to hard, light gray, slight mottling, moist, gravelly, very sandy SILT, trace boulders (Glaciomarine Drift)	
4				SNS	Moderately hard, medium to light brown, dry, SANDSTONE, massive, minimal fracture (Chuckanut Bedrock)	
					Test Pit Completed 05/05/20 Total Depth of Test Pit = 4.5 ft.	
6						
8						

Notes:
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2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST

E McLeod Rd Stormwater Feasibility
2500 Block E McLeod Rd
Bellingham, WA

Log of Test Pits

Figure 7

TP-9

SAMPLE DATA			SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): Undetermined	
0					ML	Soft, dark brown, moist, sandy SILT, trace gravel, abundant organics (Topsoil)	Groundwater not encountered.
					ML	Medium stiff, reddish brown, moist, sandy SILT, trace gravel, scattered organics (Subsoil)	
2	14				ML	Very stiff to hard, light gray, slight mottling, moist, gravelly, very sandy SILT, trace cobbles (Glaciomarine Drift)	
					SNS	Non-plastic per Atterberg analysis	
4						Moderately hard, medium to light brown, dry, SANDSTONE, massive, minimal fracture (Chuckanut Bedrock)	
6							
8							

Test Pit Completed 05/05/20
Total Depth of Test Pit = 3.8 ft.

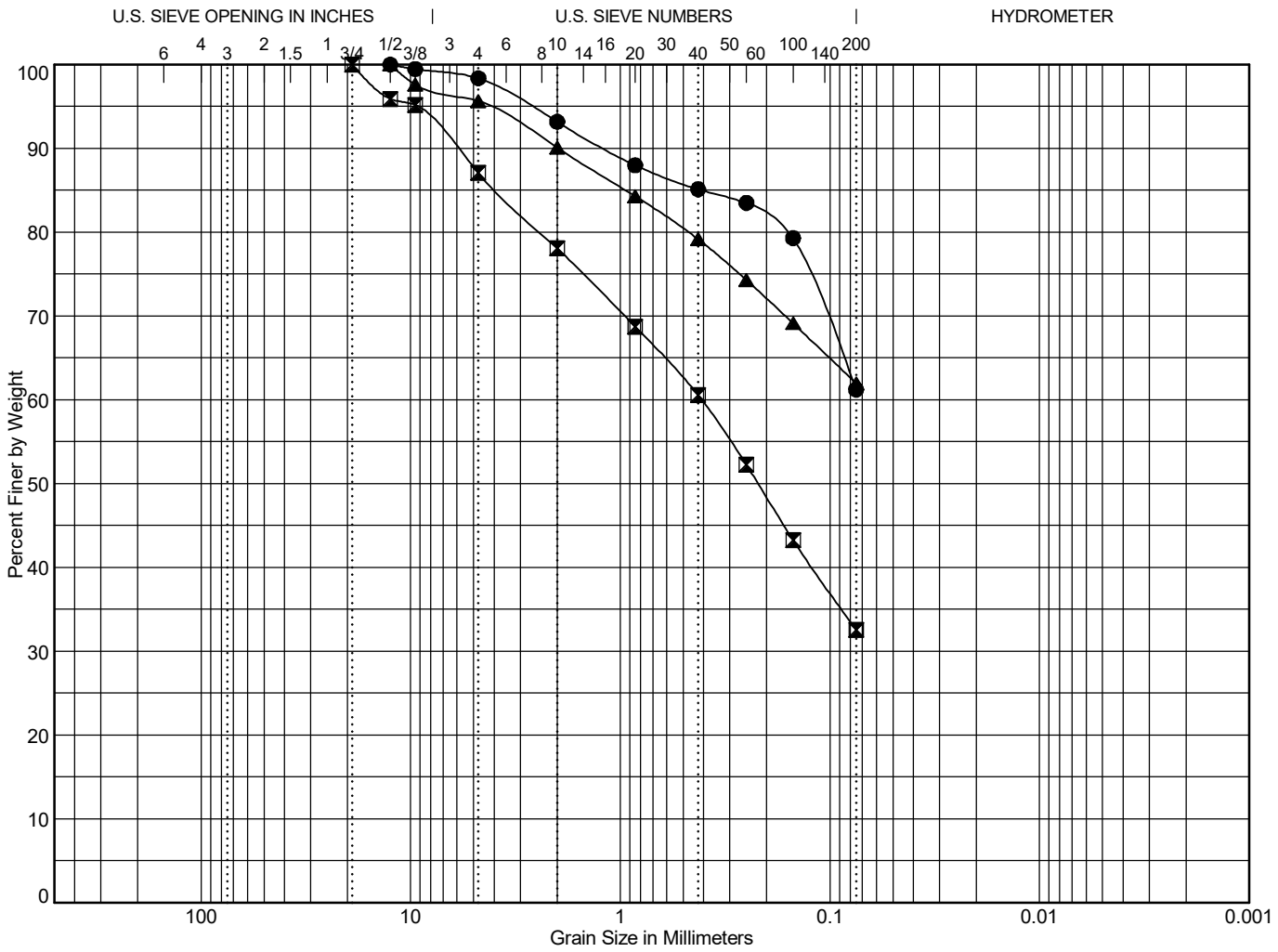
Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

GEOTEST

E McLeod Rd Stormwater Feasibility
2500 Block E McLeod Rd
Bellingham, WA

Log of Test Pits

Figure 8



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Point		Depth	Classification	LL	PL	PI	C_c	C_u
●	TP-1	4.5	Very sandy SILT, trace fine gravel (ML)					
⊠	TP-3	2.0	Gravelly, very silty SAND (SM)					
▲	TP-7	1.8	Very sandy SILT, trace fine gravel (ML)					

Point		Depth	D_{90}	D_{60}	D_{50}	D_{30}	D_{10}	%Coarse Gravel	% Fine Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
●	TP-1	4.5	1.184	0.072*	0.049*	0.023*	0.011*	0.0	1.6	5.2	8.1	23.9	61.2
⊠	TP-3	2.0	6.1	0.41	0.22	0.063*	0.017*	0.0	12.9	9.0	17.5	28.0	32.6
▲	TP-7	1.8	1.972	0.062*	0.024*	0.003*	0*	0.0	4.3	5.6	10.9	17.2	62.0

*Extrapolated from data

$C_c = D_{30}^2/(D_{60} * D_{10})$

$C_u = D_{60}/D_{10}$

To be well graded: $1 < C_c < 3$ and $C_u > 4$ for GW or $C_u > 6$ for SW

GEOTEST

E McLeod Rd Stormwater Feasibility
2500 Block E McLeod Rd
Bellingham, WA

Grain Size Test Data

Figure 9

REPORT LIMITATIONS AND GUIDELINES FOR ITS USE[1]

Subsurface issues may cause construction delays, cost overruns, claims, and disputes. While you cannot eliminate all such risks, you can manage them. The following information is provided to help:

Geotechnical Services are Performed for Specific Purposes, Persons, and Projects

At GeoTest our geotechnical engineers and geologists structure their services to meet specific needs of our clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of an owner, a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client. No one except you should rely on your geotechnical engineer who prepared it. And no one – not even you – should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report is Based on a Unique Set of Project-Specific Factors

GeoTest's geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the clients goals, objectives, and risk management preferences; the general nature of the structure involved its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless GeoTest, who conducted the study specifically states otherwise, do not rely on a geotechnical engineering report that was:

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

1Information in this document is based upon material developed by ASFE, Professional Firms Practicing in the Geosciences(asfe.org)

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed, for example, from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed construction,
- alterations in drainage designs; or
- composition of the design team; the passage of time; man-made alterations and construction whether on or adjacent to the site; or by natural alterations and events, such as floods, earthquakes or groundwater fluctuations; or project ownership.

Always inform GeoTest's geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. Do not rely on the findings and conclusions of this report, whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact GeoTest before applying the report to determine if it is still relevant. A minor amount of additional testing or analysis will help determine if the report remains applicable.

Most Geotechnical and Geologic Findings are Professional Opinions

Our site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoTest's engineers and geologists review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ – sometimes significantly – from those indicated in your report. Retaining GeoTest who developed this report to provide construction observation is the most effective method of managing the risks associated with anticipated or unanticipated conditions.

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A Report's Recommendations are Not Final

Do not over-rely on the construction recommendations included in this report. Those recommendations are not final, because geotechnical engineers or geologists develop them principally from judgment and opinion. GeoTest's geotechnical engineers or geologists can finalize their recommendations only by observing actual subsurface conditions revealed during construction. GeoTest cannot assume responsibility or liability for the report's recommendations if our firm does not perform the construction observation.

A Geotechnical Engineering or Geologic Report may be Subject to Misinterpretation

Misinterpretation of this report by other design team members can result in costly problems. Lower that risk by having GeoTest confer with appropriate members of the design team after submitting the report. Also, we suggest retaining GeoTest to review pertinent elements of the design teams plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having GeoTest participate in pre-bid and preconstruction conferences, and by providing construction observation.

Do not Redraw the Exploration Logs

Our geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors of omissions, the logs included in this report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable; but recognizes that separating logs from the report can elevate risk.

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In that letter, consider advising the contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with GeoTest and/or to conduct additional study to obtain the specific types of information they need or prefer. A pre-bid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

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In addition, it is recommended that a contingency for unanticipated conditions be included in your project budget and schedule.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering or geology is far less exact than other engineering disciplines. This lack of understanding can create unrealistic expectations that can lead to disappointments, claims, and disputes. To help reduce risk, GeoTest includes an explanatory limitations section in our reports. Read these provisions closely. Ask questions and we encourage our clients or their representative to contact our office if you are unclear as to how these provisions apply to your project.

Environmental Concerns Are Not Covered in this Geotechnical or Geologic Report

The equipment, techniques, and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study. For that reason, a geotechnical engineering or geologic report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated containments, etc. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk management guidance. Do not rely on environmental report prepared for some one else.

Obtain Professional Assistance to Deal with Biological Pollutants

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts biological pollutants from growing on indoor surfaces. Biological pollutants includes but is not limited to molds, fungi, spores, bacteria and viruses. To be effective, all such strategies should be devised for the express purpose of prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional biological pollutant prevention consultant. Because just a small amount of water or moisture can lead to the development of severe biological infestations, a number of prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of this study, the geotechnical engineer or geologist in charge of this project is not a biological pollutant prevention consultant; none of the services preformed in connection with this geotechnical engineering or geological study were designed or conducted for the purpose of preventing biological infestations.

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