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GEOTECHNICAL REPORT

Garibaldi Property
13424 and 13624 Chain Lake Road
Monroe, Washington

Project No. T-8079

Terra Associates, Inc.

Prepared for:

Garibaldi Lake, LLC
Kirkland, Washington

December 14, 2018

TERRA ASSOCIATES, Inc.
Consultants in Geotechnical Engineering, Geology
and
Environmental Earth Sciences

December 14, 2018
Project No. T-8079

Ms. Melanie Davies
Garibaldi Lake, LLC
1010 Market Street
Kirkland, Washington 98033

Subject: Geotechnical Report
Garibaldi Property
13424 and 13624 Chain Lake Road
Monroe, Washington

Dear Ms. Davies:

As requested, we conducted a geotechnical engineering study for the subject project. The attached report presents our findings and recommendations for the geotechnical aspects of project design and construction.

Our study indicates the site soils predominantly consist of glacial till deposits comprised of weathered and unweathered horizons of silty sand with gravel. Perched groundwater seepage was observed at depths of two to four feet in nine of the ten of the test pits excavated at the site.

In our opinion, there are no geotechnical conditions that would preclude the planned residential development. Buildings can be supported on conventional spread footings bearing on competent native soils or on structural fill placed on competent native soils. Floor slabs and pavements can be similarly supported.

Detailed recommendations addressing these issues and other geotechnical design considerations are presented in the attached report. We trust the information presented is sufficient for your current needs. If you have any questions or require additional information, please call.

Sincerely yours,
TERRA ASSOCIATES, INC.

Kevin P. Roberts, P.E.
Geotechnical Engineer

THEODORE J. SCHEPPER STATE OF WASHINGTON 26742 REGISTERED PROFESSIONAL ENGINEER

12-14-18

Theodore J. Schepper, P.E.
President

12220 113th Avenue NE, Ste. 130, Kirkland, Washington 98034
Phone (425) 821-7777 • Fax (425) 821-4334

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1.0 PROJECT DESCRIPTION

We were provided Conceptual Site Plan prepared by CP|H Consultants, dated November 27, 2018. The site plan indicates the project consists of the construction of 61 residential building lots along with associated infrastructure improvements. A new roadway leading westward from Chain Lake Road will access the development. Based on an email from CP|H Consultants dated November 28, 2018, project stormwater will be directed to a single on-site detention vault facility located at the sites' southeast boundary. The moderately rolling site topography indicates that moderate grading will be required to achieve building and roadway elevations. We anticipate a combination of permanent cut and fill slopes and retaining walls will be used to achieve finished site grades.

We expect that the residential structures will be one- to two-story, wood-frame buildings, with their main floors framed over a crawl space or constructed at grade. Foundation loads should be relatively light, in the range of 2 to 3 kips per foot for bearing walls and 20 to 40 kips for isolated columns.

The recommendations contained in the following sections of this report are based on our understanding of the above design features. We should review design drawings as they become available to verify that our recommendations have been properly interpreted and incorporated into project design and to amend or supplement our recommendations, if required.

2.0 SCOPE OF WORK

We explored subsurface conditions at the site by observing conditions in ten test pits excavated to a maximum depth of 10 feet below existing surface grades using a track-mounted mini-excavator. Based on the results of our field study, laboratory testing, and analyses, we developed geotechnical recommendations for project design and construction. Specifically, this report addresses the following:

- Soil and groundwater conditions
- Geologic Hazards per Monroe Municipal Code
- Seismic design parameters per the current International Building Code (IBC)
- Site preparation and grading
- Excavations
- Foundations
- Slab-on-grade floors
- Infiltration feasibility
- Stormwater facilities
- Utilities
- Pavements

It should be noted that recommendations outlined in this report regarding drainage are associated with soil strength, design earth pressures, erosion, and stability. Design and performance issues with respect to moisture as it relates to the structure environment is beyond Terra Associates' purview. A building envelope specialist or contractor should be consulted to address these issues, as needed.

3.0 SITE CONDITIONS

3.1 Surface

The project site consists of 3 tax parcels totaling approximately 14 acres of land located at 13424 and 13624 Chain Lake Road in Monroe, Washington. The approximate location of the site is shown on Figure 1.

A single-family residence with several outbuildings currently occupies the largest northern parcel. This parcel is mainly open and vegetated with short grass. The southern and middle parcels, respectively, contain a single-family residence and greenhouse. These two parcels are primarily wooded with young to mature trees, with brush and lawn near the residence. Each of the parcels is accessed by graveled driveways leading westward from Chain Lake Road.

We observed at ground surface elevation the top surface of a large boulder (glacial erratic) in the vicinity of Test Pit TP-8. Based on its surface appearance, we estimate the buried boulder to be several feet in diameter.

At the northern parcel, existing surface gradients slope gently from northwest to southeast. Topography at the southern parcel is mostly level. A total topographic relief of approximately 90 feet exists from this sites' northwest to southeast corners. No standing or flowing water, springs, zones of emergent groundwater, or indications of soil erosion or instability were seen during our field exploration.

3.2 Soils

The soils observed in the test pits generally consist of about four to ten inches of sod and topsoil overlying weathered and unweathered horizons of glacial till deposits.

Each test pit showed a weathered horizon of till soils extending to depths ranging from 1.5 feet in Test Pit TP-9 to 3.5 feet in Test Pit TP-6. The weathered soils generally consist of silty fine sand and sand/silt with gravel and cobbles. This upper soil horizon has weathered to a medium dense condition.

Unweathered till soils were observed beneath the weathered layer in each test pit. These soils primarily consist of silty sand with variable gravel, cobble, and boulder contents. We observed the lower unweathered soils to be in a dense to very dense condition having varying degrees of cementation. The unweathered till soils were encountered to the total depths of each of our test pits.

The *Surficial Geologic Map of the Skykomish and Snoqualmie Rivers Area, Snohomish and King Counties, Washington,* by D.B. Booth (1990) shows the site underlain by Vashon till (Qvt). The soils we observed in our test pits are consistent with the published description of this soil unit.

Detailed descriptions of the subsurface conditions we observed in the test pits are presented on the Test Pit Logs in Appendix A. The approximate locations of the test pits are shown on Figure 2.

3.3 Groundwater

We observed groundwater seepage in all test pits except Test Pit TP-10. Light to heavy seepage flows were observed at depths ranging from two to four feet. The seepage primarily occurs as interflow, which is seepage perched within the basal portion of a weathered till layer on top of the underlying, relatively impermeable till soils. Observed differential flow rates from walls of the test pits indicate an overall northwest-to-southeast groundwater flow gradient.

Perched groundwater levels and flow rates will fluctuate seasonally, and typically reach their highest levels during and shortly following the wet winter and early spring months (November through April). Accordingly, we expect that the seepage flow rates and levels observed in the test pits were near their seasonal highs.

3.4 Geologic Hazards

We evaluated site conditions for the presence of "geologically hazardous areas" as defined in Section 20.05.120 of the Monroe Municipal Code (MMC). Discussions related to erosion, landslide, and seismic hazards are given below.

3.4.1 Erosion Hazard Areas

Section 20.05.120B.1. of the MMC defines erosion hazard areas as those areas "identified by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) as having severe or very severe rill, and inter-rill erosion hazard..."

The NRCS has mapped the site soils as *Tokul gravelly medial loam, 0 to 8 percent slopes* and *Tokul gravelly medial loam, 8 to 15 percent slopes* at the sites' southern northern areas, respectively. The erosion hazard of each of these soil types is described as slight, and therefore, do not meet the above criteria defining an erosion hazard area.

The site soils will be susceptible to erosion when exposed during construction. In our opinion, proper implementation and maintenance of Best Management Practices (BMPs) for erosion prevention and sedimentation control will adequately mitigate the erosion potential in the planned development area. Erosion protection measures as required by the City of Monroe will need to be in place prior to and during grading activity on the site.

3.4.2 Landslide Hazard Areas

We reviewed definitions of Landslide Hazard Areas listed in Section 20.05.120B.2. of the MMC. Based on our field observations, site slope gradients as shown on the site plan, and the inherent high strength of the soils underlying the site, no landslide hazard areas as defined by MMC exist at the site.

3.4.3 Seismic Hazard Areas

Section 20.05.120B.3. of the MMC defines seismic hazard areas as "areas that are subject to severe risk of damage as a result of earthquake-induced ground shaking, slope failure, settlement, soil liquefaction, lateral spreading, or surface failure.

Based on the site topography and the presence of glacially consolidated soils, it is our opinion that the risk for damage resulting from earthquake-induced slope failure, settlement, lateral spreading, surface failure, or soil liquefaction is negligible. Therefore, in our opinion, unusual seismic hazard areas do not exist at the site, and design in accordance with local building codes for determining seismic forces would adequately mitigate impacts associated with ground shaking.

3.5 Seismic Design Parameters

Based on the site soil conditions and our knowledge of the area geology, per the 2015 International Building Code (IBC), site class "C" should be used in structural design. Based on this site class, in accordance with the 2015 IBC, the following parameters should be used in computing seismic forces:

Seismic Design Parameters (IBC 2015)

Spectral response acceleration (Short Period), S_{Ms}	1.171 g
Spectral response acceleration (1 – Second Period), S_{M1}	0.602 g
Five percent damped 0.2 second period, S_{Ds}	0.780 g
Five percent damped 1.0 second period, S_{D1}	0.401 g

The above values were determined using the United States Geological Survey (USGS) online ground motion parameter calculator accessed on December 10, 2018.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 General

Based on our study, there are no geotechnical conditions that would preclude the planned development. In general, structures can be supported on conventional spread footings bearing on competent native soils, or on structural fill placed on the competent native soils. Floor slabs and pavements can be similarly supported.

The majority of the soils at the site contain a sufficient amount of fines (silt- and clay-sized particles) such that they will be difficult to compact as structural fill when too wet or too dry. If grading activities will take place during the winter season, the owner should be prepared to import free-draining granular material for use as structural fill and backfill.

Perched moderate to heavy groundwater seepage flows were observed within the basal portion of the weathered till at some of the test pit locations. Depending on planned site grades, some areas may require the construction interceptor drains to reduce potential seepage impacts to lots and roadways. Specific areas requiring additional subsurface drainage can be determined based on a review of the final grading plans.

Detailed recommendations regarding these issues and other geotechnical design considerations are provided in the following sections of this report. These recommendations should be incorporated into the final design drawings and construction specifications.

4.2 Site Preparation and Grading

To prepare the site for construction, all vegetation, organic surface soils, and demolition debris should be stripped and removed from the site. We expect surface stripping depths of about 4 to 10 inches will be required to remove the topsoil. Organic soils will not be suitable for use as structural fill but may be used for limited depths in nonstructural areas or for landscaping purposes.

Demolition of existing structures should include removal of existing foundations and abandonment of underground septic systems and other buried utilities. Abandoned utility pipes that fall outside of new building areas can be left in place provided they are sealed to prevent intrusion of groundwater seepage and soil. Cut and fill operations can be initiated once clearing and grubbing operations are complete.

A representative of Terra Associates, Inc. should examine all bearing surfaces to verify that conditions encountered are as anticipated and are suitable for placement of structural fill or direct support of building and pavement elements. Our representative may request proofrolling exposed surfaces with a heavy rubber-tired vehicle to determine if any isolated soft and yielding areas are present. If unstable yielding areas are observed, they should be cut to firm bearing soil and filled to grade with structural fill. In pavement areas, if the depth of excavation to remove unstable soils is excessive, use of geotextile fabric such as Mirafi 500X or equivalent in conjunction with clean granular structural fill can be considered in order to limit the depth of removal.

The site soils at the site contain a sufficient amount of fines (silt and clay size particles) that will make them difficult to compact as structural fill if they are too wet or too dry. In addition, laboratory testing and the observed wet condition of the upper till soils indicate they are several percentage points above their optimum moisture contents required for compaction. The ability to use these soils from site excavations as structural fill will depend on their moisture content and the prevailing weather conditions when site grading activities take place. Soils that are too wet to properly compact could be dried by aeration during dry weather conditions, or mixed with an additive such as cement or lime to stabilize the soil and facilitate compaction. If an additive is used, additional Best Management Practices (BMPs) for its use will need to be incorporated into the Temporary Erosion and Sedimentation Control (TESC) plan for the project.

We recommend removing cobbles larger than six inches and boulders from the fill prior to placement and compaction.

If grading activities are planned during the wet winter months, or if they are initiated during the summer and extend into fall and winter, the owner should be prepared to import wet weather structural fill.

For this purpose, we recommend importing a granular soil that meets the following grading requirements:

U.S. Sieve Size	Percent Passing
6 inches	100
No. 4	75 maximum
No. 200	5 maximum*

*Based on the 3/4-inch fraction.

Prior to use, Terra Associates, Inc. should examine and test all materials imported to the site for use as structural fill.

Structural fill should be placed in uniform loose layers not exceeding 12 inches and compacted to a minimum of 95 percent of the soil's maximum dry density, as determined by American Society for Testing and Materials (ASTM) Test Designation D-698 (Standard Proctor). The moisture content of the soil at the time of compaction should be within two percent of its optimum, as determined by this ASTM standard. In nonstructural areas, the degree of compaction can be reduced to 90 percent.

4.3 Excavations

All excavations at the site associated with confined spaces, such as utilities and lower building level retaining walls, must be completed in accordance with local, state, and federal requirements. Based on the Washington State Safety and Health Administration (WSHA) regulations, the sites' upper medium dense soils would be classified as Type C soils. The dense to very dense, cemented till soils would be classified as Type A soils.

Accordingly, for temporary excavations of more than 4 feet and less than 20 feet in depth, the side slopes in Type C soils should be laid back at a slope inclination of 1.5:1 (Horizontal:Vertical) or flatter. If there is insufficient lateral space to complete the excavations in the manners discussed above, or if excavations greater than 20 feet deep are planned, you may need to use temporary shoring to support the excavations.

For Type A soils, side slopes can be laid back at a slope inclination of 0.75:1 or flatter. For temporary excavation slopes less than 8 feet in height in Type A soils, the lower 3.5 feet can be cut to a vertical condition, with a 0.75:1 slope graded above. For temporary excavation slopes greater than 8 feet in height up to a maximum height of 12 feet, the slope above the 3.5-foot vertical portion will need to be laid back at a minimum slope inclination of 1:1.

Deep excavations that expose perched seepage in till can likely be dewatered by conventional sump-pumping procedures along with a system of collection trenches. Temporary dewatering trenches upgradient of excavations may also be considered in areas of heavy interflow seepage.

The above information is provided solely for the benefit of the owner and other design consultants and should not be construed to imply that Terra Associates, Inc. assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

4.4 Foundations

Residential structures may be supported on conventional spread footing foundations bearing on competent native soils or on structural fill placed above the native soils. Foundation subgrades should be prepared as recommended in Section 4.2 of this report.

Perimeter foundations exposed to the weather should bear at a minimum depth of 1.5 feet below final exterior grades for frost protection. Interior foundations can be constructed at any convenient depth below the floor slab. We recommend designing foundations for a net allowable bearing capacity of 2,500 pounds per square foot (psf). For short-term loads, such as wind and seismic, a one-third increase in this allowable capacity can be used in design. With the anticipated loads and this bearing stress applied, building settlements should be less than one-half inch total and one-fourth inch differential.

For designing foundations to resist lateral loads, a base friction coefficient of 0.35 can be used. Passive earth pressure acting on the sides of the footings may also be considered. We recommend calculating this lateral resistance using an equivalent fluid weight of 300 pounds per cubic foot (pcf). We recommend not including the upper 12 inches of soil in this computation because they can be affected by weather or disturbed by future grading activity. This value assumes the foundations will be constructed neat against competent native soil or the excavations are backfilled with structural fill, as described in Section 4.2 of this report. The recommended passive and friction values include a safety factor of 1.5.

4.5 Slab-on-Grade Floors

Slab-on-grade floors may be supported on a subgrade prepared as recommended in Section 4.2 of this report. Immediately below the floor slab, we recommend placing a four-inch thick capillary break layer composed of clean, coarse sand or fine gravel that has less than three percent passing the No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab.

The capillary break layer will not prevent moisture intrusion through the slab caused by water vapor transmission. Where moisture by vapor transmission is undesirable, such as covered floor areas, a common practice is to place a durable plastic membrane on the capillary break layer and then cover the membrane with a layer of clean sand or fine gravel to protect it from damage during construction, and aid in uniform curing of the concrete slab. It should be noted that if the sand or gravel layer overlying the membrane is saturated prior to pouring the slab, it will be ineffective in assisting uniform curing of the slab, and can actually serve as a water supply for moisture transmission through the slab that can subsequently affect floor coverings. Therefore, in our opinion, covering the membrane with a layer of sand or gravel should be avoided if floor slab construction occurs during the wet winter months and the layer cannot be effectively drained. We recommend floor designers and contractors refer to the current American Concrete Institute (ACI) Manual of Concrete Practice for further information regarding vapor barrier installation below slab-on-grade floors.

4.6 Infiltration Feasibility

Based on our study, it is our opinion that subsurface conditions observed in the test pits are not favorable for stormwater infiltration. This is due primarily to the relatively high fines content and dense and/or cemented nature of the till-like soils.

4.7 Stormwater Facilities

Current information indicates a stormwater detention vault is planned for the project. As an option, we are also providing geotechnical recommendations for stormwater pond design and construction.

Detention Vault

Vault foundations supported by the very dense till soils may be designed for an allowable bearing capacity of 5,000 pounds per square foot (psf). For short-term loads, such as seismic, a one-third increase in this allowable capacity can be used. Friction at the base of the vault foundations and passive earth pressures will provide resistance to the lateral loads. These values are provided in Section 4.4.

The magnitude of earth pressures developing on the vault walls will depend in part on the quality and compaction of the wall backfill. To prevent development of hydrostatic pressure and uplift on the vault, wall drainage must be installed. Vault wall drainage should consist of a minimum 4-inch diameter perforated PVC pipe placed around the perimeter of the vault at an elevation no higher than its dead storage elevation. The drain pipe should be enveloped in drainage aggregate that extends as a 12-inch thick layer to the top of the vault. Alternatively, prefabricated drainage panels such as Miradrain G100N can be substituted for the 12-inch gravel drainage layer. The panels should extend at least six inches into the drainage aggregate surrounding the perforated drain pipe.

With the recommended wall backfill and drainage, we recommend designing the vault walls for an earth pressure imposed by an equivalent fluid weighing 50 pcf. Any portion of the wall for which drainage cannot be provided should be designed for an earth pressure equivalent to a fluid weighing 85 pcf. For evaluating walls under seismic loading, an additional uniform earth pressure equivalent to 8H psf, where H is the height of the below-grade wall in feet, can be used. These values assume a horizontal backfill condition. Where applicable, a uniform horizontal traffic surcharge value of 75 psf should be included in design of vault walls.

Detention Pond

Based on the results of our test pit explorations, we expect that very dense till soils would be exposed at stormwater detention pond bottom elevations. If fill berms will be constructed, the berm locations should be stripped of topsoil, duff, and soils containing organic material prior to the placement of fill. The fill berms should be constructed by placing structural fill in layers no more than 12 inches thick and compacting the lifts to a minimum of 95 percent of the soil's maximum dry density, as determined by American Society for Testing and Materials (ASTM) Test Designation D-1557 (Modified Proctor). Material used to construct pond berms should consist of predominately granular soils with a maximum size of 3 inches and a minimum of 20 percent fines. The results of laboratory testing indicate that till soils would meet this gradational requirement. Terra Associates, Inc. should examine and test on-site soils, or imported materials proposed for use as berm fill prior to their use.

Because of exposure to fluctuating stored water levels, soils exposed on the interior side slopes of the ponds may be subject to some risk of periodic shallow instability or sloughing. Establishing interior slopes at a 3:1 gradient will significantly reduce or eliminate this potential. Exterior berm slopes and interior slopes above the maximum water surface should be graded to a finished inclination no steeper than 2:1. Finished slope faces should be thoroughly compacted and vegetated to guard against erosion.

4.8 Utilities

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) or City of Monroe requirements. At minimum, trench backfill should be placed and compacted as structural fill as described in Section 4.2 of this report. Soils excavated on-site should generally be suitable for use as backfill material. However, the vast majority of the upper site soils are fine grained and moisture sensitive; therefore, moisture conditioning may be necessary to facilitate proper compaction. If utility construction takes place during the winter, it may be necessary to import suitable wet weather fill for utility trench backfilling.

4.9 Pavements

Pavement subgrade should be prepared as described in the Section 4.2 of this report. Regardless of the degree of relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. The subgrade should be proofrolled with heavy rubber-tire construction equipment such as a loaded 10-yard dump truck to verify this condition.

The pavement design section is dependent upon the supporting capability of the subgrade soils and the traffic conditions to which it will be subjected. For residential access, with traffic consisting mainly of light passenger vehicles with only occasional heavy traffic, and with a stable subgrade prepared as recommended, we recommend the following options for pavement sections:

- Two inches of hot mix asphalt (HMA) over four inches of crushed rock base (CRB)
- Full depth HMA – 3 ½ inches

The paving materials used should conform to the Washington State Department of Transportation (WSDOT) specifications for ½-inch class HMA and CRB.

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability. For optimum pavement performance, we recommend surface drainage gradients of at least two percent. Some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

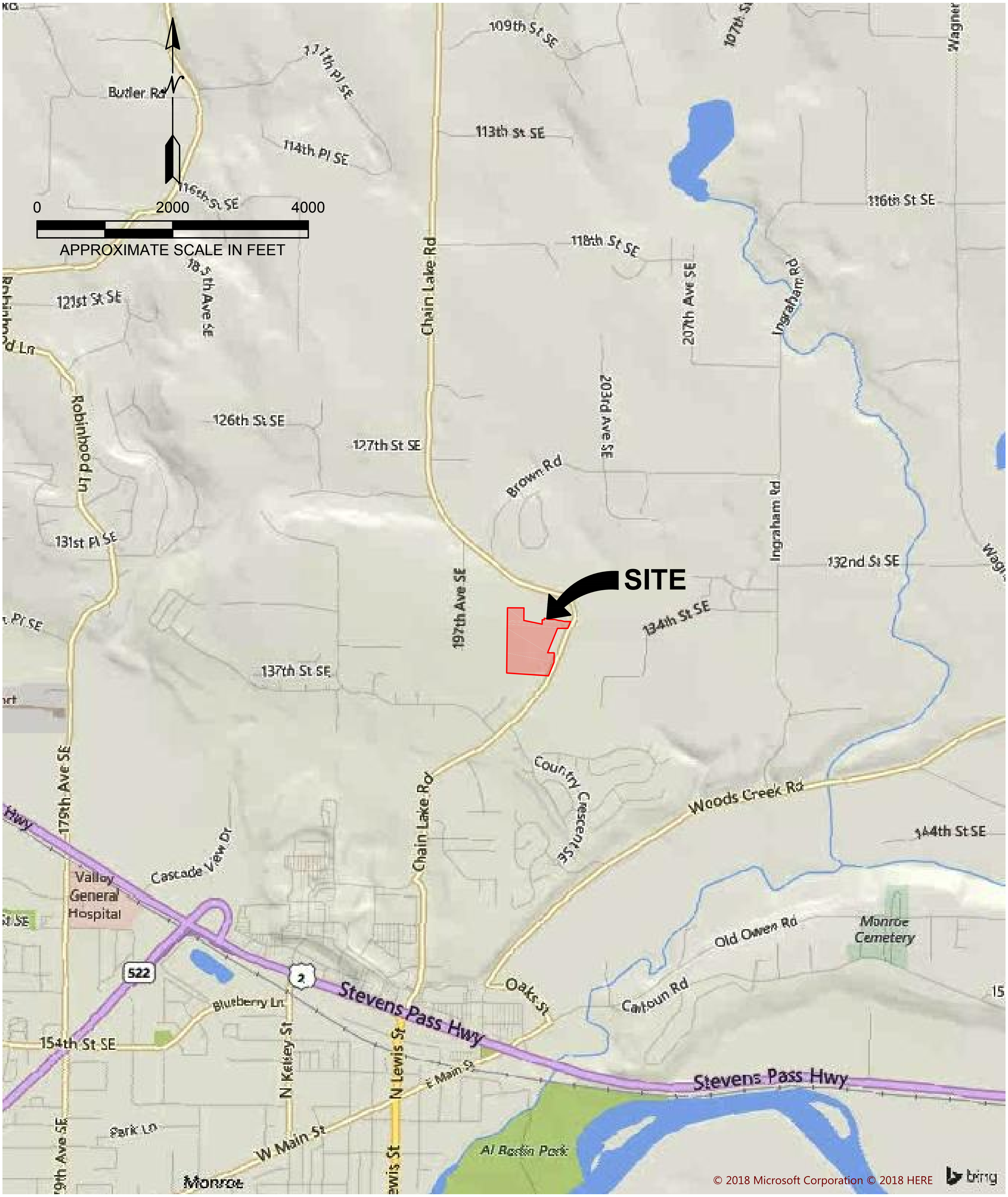
5.0 ADDITIONAL SERVICES

Terra Associates, Inc. should review the final designs and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and implemented in project design. We should also provide geotechnical services during construction in order to observe compliance with our design concepts, specifications, and recommendations. This will allow for design changes if subsurface conditions differ from those anticipated prior to the start of construction.

6.0 LIMITATIONS

We prepared this report in accordance with generally accepted geotechnical engineering practices. This report is the copyrighted property of Terra Associates, Inc. and is intended for specific application to the Garibaldi Property project in Monroe, Washington. This report is for the exclusive use of Garibaldi Lake, LLC and their authorized representatives. No other warranty, expressed or implied, is made.

The analyses and recommendations presented in this report are based on data obtained from our on-site test pits. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, Terra Associates, Inc. should be requested to reevaluate the recommendations in this report prior to proceeding with construction.



REFERENCE: https://www.bing.com/maps

ACCESSED 12/13/18

Terra Associates, Inc.
Consultants in Geotechnical Engineering
Geology and
Environmental Earth Sciences

VICINITY MAP
GARIBALDI PROPERTY
MONROE, WASHINGTON

Proj.No. T-8079	Date: DEC 2018	Figure 1

NOTE:

THIS SITE PLAN IS SCHEMATIC. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE. IT IS INTENDED FOR REFERENCE ONLY AND SHOULD NOT BE USED FOR DESIGN OR CONSTRUCTION PURPOSES.

REFERENCE: SITE PLAN PROVIDED BY CPH CONSULTANTS.

LEGEND:

APPROXIMATE TEST PIT LOCATION

0 120 240
APPROXIMATE SCALE IN FEET

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EXPLORATION LOCATION PLAN
GARIBALDI PROPERTY
MONROE, WASHINGTON

Proj.No. T-8079	Date: DEC 2018	Figure 2

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

Garibaldi Property
Monroe, Washington

On November 29, 2018, we investigated subsurface conditions at the site by excavating 10 test pits to a maximum depth of 10 feet below existing surface grades using a Takeuchi TB145 mini-excavator. The test pit locations are shown on Figure 2. The test pit locations were approximately determined in the field by sighting and pacing from existing surface features. The Test Pit Logs are presented on Figures A-2 through A-11.

A geologist from our office maintained a log of each test pit as it was excavated, classified the soil conditions encountered, and obtained representative soil samples. All soil samples were visually classified in the field in accordance with the Unified Soil Classification System. A copy of this classification is presented as Figure A-1.

Representative soil samples obtained from the test pits were placed in sealed plastic bags and taken to our laboratory for further examination and testing. The moisture content of each sample was measured and is reported on the Test Pit Logs. Grain size analyses were performed on six of the soil samples. The results are shown on Figures A-12 and A-13.

MAJOR DIVISIONS				LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	More than 50% material larger than No. 200 sieve size	**GRAVELS** More than 50% of coarse fraction is larger than No. 4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
			Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
				GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
		SANDS More than 50% of coarse fraction is smaller than No. 4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, sands with gravel, little or no fines.
				SP	Poorly-graded sands, sands with gravel, little or no fines.
			Sands with fines	SM	Silty sands, sand-silt mixtures, non-plastic fines.
				SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS	More than 50% material smaller than No. 200 sieve size	**SILTS AND CLAYS** Liquid Limit is less than 50%		ML	Inorganic silts, rock flour, clayey silts with slight plasticity.
				CL	Inorganic clays of low to medium plasticity. (Lean clay)
				OL	Organic silts and organic clays of low plasticity.
		SILTS AND CLAYS Liquid Limit is greater than 50%		MH	Inorganic silts, elastic.
				CH	Inorganic clays of high plasticity. (Fat clay)
				OH	Organic clays of high plasticity.
HIGHLY ORGANIC SOILS				PT	Peat.

DEFINITION OF TERMS AND SYMBOLS

COHESIONLESS

Density	Standard Penetration Resistance in Blows/Foot
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	>50

COHESIVE

Consistancy	Standard Penetration Resistance in Blows/Foot
Very Soft	0-2
Soft	2-4
Medium Stiff	4-8
Stiff	8-16
Very Stiff	16-32
Hard	>32

Symbol	Definition
I	2" OUTSIDE DIAMETER SPILT SPOON SAMPLER
‖	2.4" INSIDE DIAMETER RING SAMPLER OR SHELBY TUBE SAMPLER
▼	WATER LEVEL (Date)
Tr	TORVANE READINGS, tsf
Pp	PENETROMETER READING, tsf
DD	DRY DENSITY, pounds per cubic foot
LL	LIQUID LIMIT, percent
PI	PLASTIC INDEX
N	STANDARD PENETRATION, blows per foot

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UNIFIED SOIL CLASSIFICATION SYSTEM
GARIBALDI PROPERTY
MONROE, WASHINGTON

Proj.No. T-8079 | Date: DEC 2018 | Figure A-1

LOG OF TEST PIT NO. TP-1

FIGURE A-2

PROJECT NAME: Garibaldi Property **PROJ. NO:** T-8079 **LOGGED BY:** KR

LOCATION: Monroe, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** 365 Feet

DATE LOGGED: November 29, 2018 **DEPTH TO GROUNDWATER:** 2.5 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0–3		(5 inches SOD) Brown silty fine SAND/SILT, few gravels, moist to wet. (SM/ML) (Weathered till)	Medium Dense	45.9
3–9		Gray-brown silty SAND, some gravel, few cobbles, fine to medium sand, moderately cemented, moist. (SM) (Till)	Very Dense	12.7
9–10		Test pit terminated at approximately 9 feet. Moderate perched groundwater seepage at 2.5 feet. No caving.		

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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Environmental Earth Sciences

LOG OF TEST PIT NO. TP-2

FIGURE A-3

PROJECT NAME: Garibaldi Property **PROJ. NO:** T-8079 **LOGGED BY:** KR

LOCATION: Monroe, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** 349 Feet

DATE LOGGED: November 29, 2018 **DEPTH TO GROUNDWATER:** 3 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
0–3		(7 inches TOPSOIL) Brown silty fine SAND/SILT, few gravels, moist to wet. (SM/ML) (Weathered till) *2 feet: 2-foot boulder.	Medium Dense	23.7
3–9 (▼ 3)		Gray-brown silty SAND, some gravel, few cobbles, trace boulders, fine to medium sand, moderately cemented, moist. (SM) (Till)	Very Dense	14.0
9–10		Test pit terminated at approximately 9 feet. Moderate perched groundwater seepage at 3 feet. No caving.		

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-3

FIGURE A-4

PROJECT NAME: Garibaldi Property **PROJ. NO:** T-8079 **LOGGED BY:** KR

LOCATION: Monroe, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** 309 Feet

DATE LOGGED: November 29, 2018 **DEPTH TO GROUNDWATER:** 2 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0–3		(6 inches TOPSOIL) Light brown mottled silty fine SAND, few gravels, moist to wet. (SM) (Weathered till)	Medium Dense	16.6 (at 2 ft)
3–6		Gray-brown silty SAND, some gravel and cobbles, fine to medium sand, wet. (SM) (Till)	Dense	
6–9		*6 feet: Moist, moderately cemented, very dense.	Very Dense	10.3 (at 7 ft)
9–10		Test pit terminated at approximately 9 feet. Moderate perched groundwater seepage at 2 feet. No caving.		

Groundwater symbol at 2 ft.

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-4

FIGURE A-5

PROJECT NAME: Garibaldi Property **PROJ. NO:** T-8079 **LOGGED BY:** KR

LOCATION: Monroe, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** 312 Feet

DATE LOGGED: November 29, 2018 **DEPTH TO GROUNDWATER:** 2 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
0–3		(8 inches TOPSOIL) Light brown mottled silty fine SAND/SILT, few gravels, moist to wet. (SM/ML) (Weathered till)	Medium Dense	32.2 (at 2 ft)
2 (groundwater)				
3–9		Gray-brown silty SAND, some gravel, few cobbles, trace boulders, fine to medium sand, weakly cemented, moist to wet. (SM) (Till)	Dense	10.7 (at 8 ft)
9–10		Test pit terminated at approximately 9 feet. Light perched groundwater seepage at 2 feet. No caving.		
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-5

FIGURE A-6

PROJECT NAME: Garibaldi Property **PROJ. NO:** T-8079 **LOGGED BY:** KR

LOCATION: Monroe, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** 326 Feet

DATE LOGGED: November 29, 2018 **DEPTH TO GROUNDWATER:** 4 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0		(6 inches TOPSOIL) Brown silty SAND, few gravels, fine sand, moist. (SM) (Weathered till)	Medium Dense	
3		Brown-gray silty SAND, some gravel, few cobbles, fine to medium sand, strongly cemented, moist to wet. (SM) (Till)	Very Dense	38.4
4 (groundwater)				
5		*5 feet: Very difficult digging.		
7				9.6
9		Test pit terminated at 9 feet due to excavator refusal. Light perched groundwater seepage at 4 feet. No caving.		
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-6

FIGURE A-7

PROJECT NAME: Garibaldi Property **PROJ. NO:** T-8079 **LOGGED BY:** KR

LOCATION: Monroe, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** 322 Feet

DATE LOGGED: November 29, 2018 **DEPTH TO GROUNDWATER:** 2.5 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
0–3.5		(6 inches TOPSOIL) Brown silty SAND, few gravels, fine sand, moist. (SM) (Weathered till) *2.5 feet: Wet	Medium Dense	35.8
3.5–10		Brown-gray silty SAND, some gravel and cobbles, fine to medium sand, wet. (SM) (Till) *5 feet: Very difficult digging.	Very Dense	11.7
10–15		Test pit terminated at approximately 10 feet. Moderate perched groundwater seepage at 2.5 feet. No caving.		

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-7

FIGURE A-8

PROJECT NAME: Garibaldi Property **PROJ. NO:** T-8079 **LOGGED BY:** KR

LOCATION: Monroe, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** 318 Feet

DATE LOGGED: November 29, 2018 **DEPTH TO GROUNDWATER:** 3 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
0–2.5		(8 inches TOPSOIL/DUFF) Brown silty SAND, some gravel, fine sand, moist. (SM) (Weathered till) *1-foot: Breached an abandoned 4-inch PVC drainline.	Medium Dense	20.8
2.5–8.5 (groundwater at 3)		Gray-brown mottled silty SAND, some gravel and cobbles, trace boulders, fine to medium sand, moist to wet. (SM) (Till)	Very Dense	9.8
8.5–10		Test pit terminated at approximately 8.5 feet. Light perched groundwater seepage at 3 feet. No caving.		
10				

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-8

FIGURE A-9

PROJECT NAME: Garibaldi Property **PROJ. NO:** T-8079 **LOGGED BY:** KR

LOCATION: Monroe, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** 338 Feet

DATE LOGGED: November 29, 2018 **DEPTH TO GROUNDWATER:** 2.5 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0–3 (groundwater ▼ at 2.5)		(5 inches SOD) Brown silty SAND, some gravel, fine sand, moist. (SM) (Weathered till) *1-foot: 18-inch boulder.	Medium Dense	29.9
3–9.5		Gray-brown mottled silty SAND, some gravel and cobbles, trace boulders, fine to medium sand, moist. (SM) (Till)	Very Dense	13.1
9.5–15		Test pit terminated at approximately 9.5 feet. Heavy perched groundwater seepage at 2.5 feet. No caving.		

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-9

FIGURE A-10

PROJECT NAME: Garibaldi Property **PROJ. NO:** T-8079 **LOGGED BY:** KR

LOCATION: Monroe, Washington **SURFACE CONDITIONS:** Grass **APPROX. ELEV:** 348 Feet

DATE LOGGED: November 29, 2018 **DEPTH TO GROUNDWATER:** 2.5 Feet **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0–1.5		(4 inches TOPSOIL) Brown silty SAND, few gravels, fine sand, moist. (SM) (Weathered till)	Loose	52.2 (at 1)
1.5–9		Gray-brown mottled silty SAND, some gravel, few cobbles, trace boulders, fine to medium sand, moderately cemented, moist. (SM) (Till)	Very Dense	14.0 (at 6)
9		Test pit terminated at approximately 9 feet. Light perched groundwater seepage at 1.5 feet. No caving.		

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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LOG OF TEST PIT NO. TP-10

FIGURE A-11

PROJECT NAME: Garibaldi Property **PROJ. NO:** T-8079 **LOGGED BY:** KR

LOCATION: Monroe, Washington **SURFACE CONDITIONS:** Brush **APPROX. ELEV:** 303 Feet

DATE LOGGED: November 29, 2018 **DEPTH TO GROUNDWATER:** N/A **DEPTH TO CAVING:** N/A

Depth (ft)	Sample No.	Description	Consistency/ Relative Density	W (%)
0				
0–3		(10 inches TOPSOIL) Brown SILT with fine sand, few gravels, moist. (ML) (Weathered till)	Medium Dense	38.7
3–9		Brown-gray mottled silty SAND, some gravel, few cobbles, fine to medium sand, moderately cemented, moist. (SM) (Till)	Very Dense	8.7
9–10		Test pit terminated at approximately 9 feet. No groundwater. No caving.		

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.

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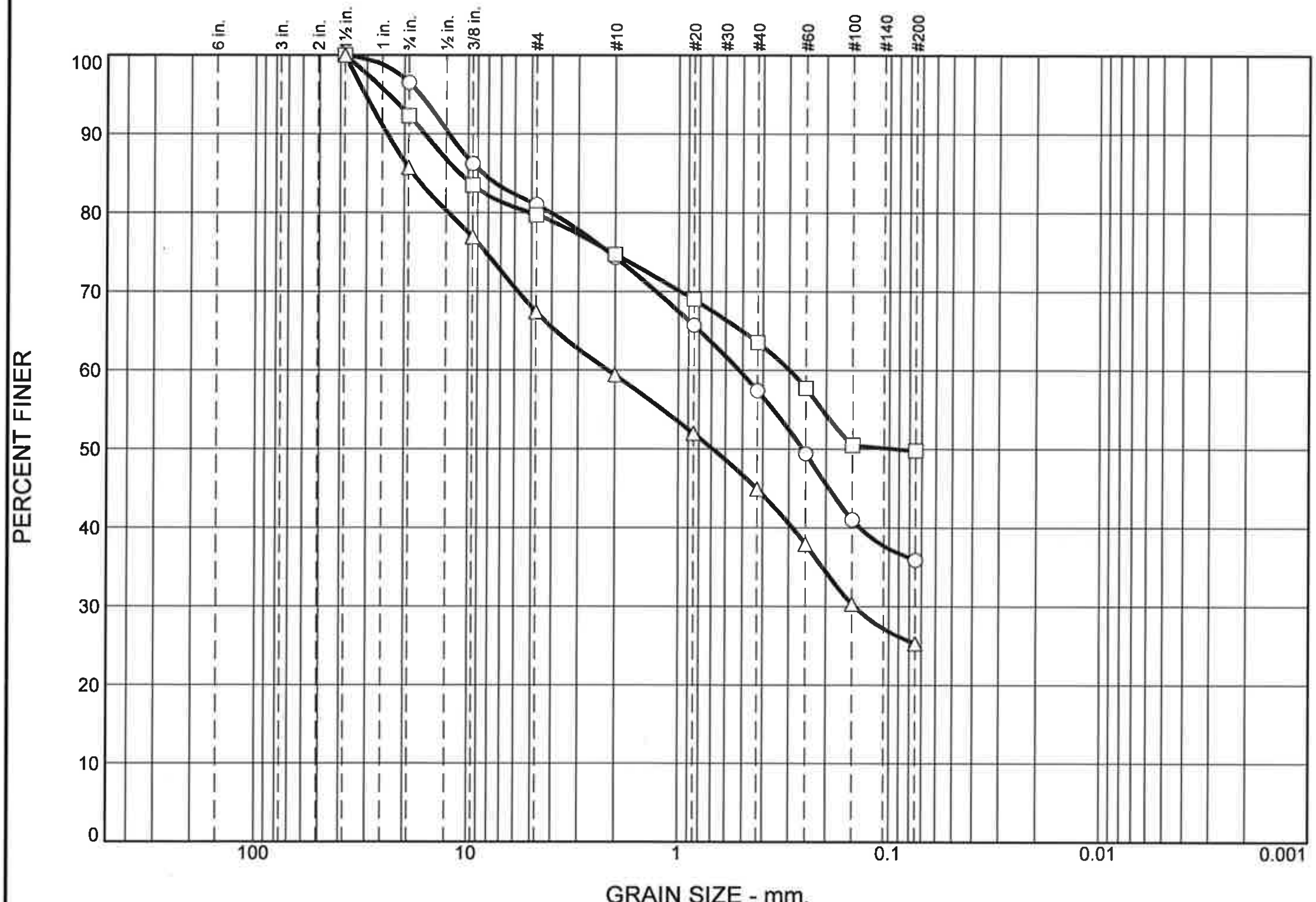
Particle Size Distribution Report



	% +3"	% Gravel Coarse	% Gravel Fine	% Sand Coarse	% Sand Medium	% Sand Fine	% Fines Silt	% Fines Clay
○	0.0	3.5	15.5	6.7	16.9	21.5	35.9	
□	0.0	7.7	12.6	5.0	11.2	13.7	49.8	
△	0.0	14.3	18.3	8.0	14.5	19.6	25.3	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			8.5605	0.5198	0.2590					
□			10.9888	0.2990	0.0914					
△			18.2182	2.1557	0.6888	0.1462				

Material Description	USCS	AASHTO
○ Silty SAND	SM	
□ Silty SAND	SM	
△ Silty SAND	SM	

Project No. T-8079 **Client:** Garibaldi Lake, LLC
Project: Garibaldi Property

○ **Location:** TP-1 **Depth:** -6 feet
□ **Location:** TP-3 **Depth:** -2 feet
△ **Location:** TP-5 **Depth:** -7 feet

Remarks:

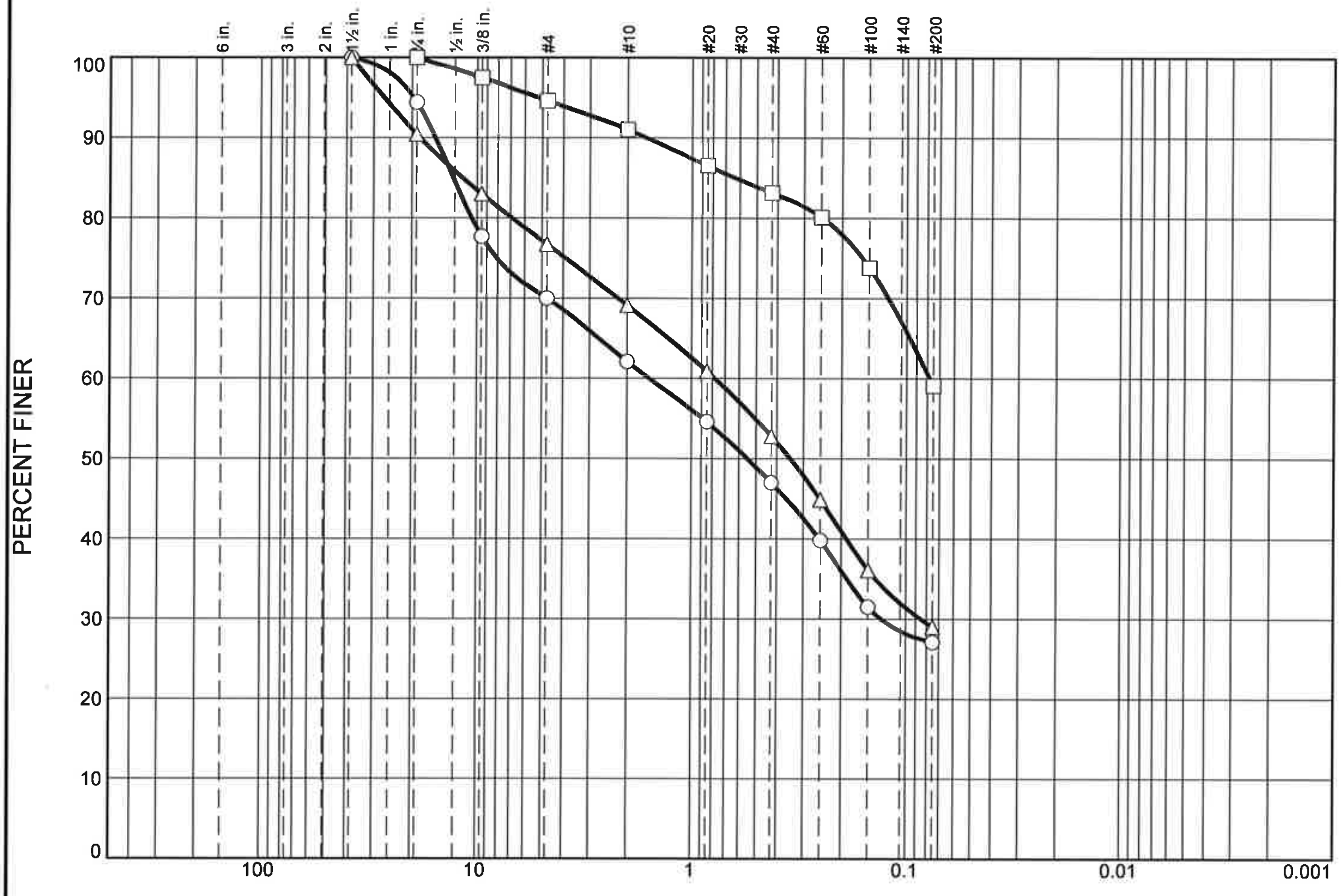
Terra Associates, Inc.

Kirkland, WA

Figure A-12

Tested By: FQ

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	5.6	24.4	7.9	15.1	19.9	27.1	
□	0.0	0.0	5.4	3.6	7.9	24.0	59.1	
△	0.0	9.6	13.7	7.6	16.3	23.8	29.0	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			12.8907	1.5730	0.5495	0.1308				
□			0.6343	0.0779						
△			11.6942	0.7809	0.3464	0.0849				

Material Description	USCS	AASHTO
○ Silty SAND	SM	
□ SILT	ML	
△ Silty SAND	SM	

Project No. T-8079 **Client:** Garibaldi Lake, LLC

Project: Garibaldi Property

○ **Location:** TP-7 **Depth:** -6 feet

□ **Location:** TP-10 **Depth:** -2.5 feet

△ **Location:** TP-10 **Depth:** -8 feet

Remarks:

Terra Associates, Inc.

Kirkland, WA

Figure A-13

Tested By: FQ