Drainage Report

Shoultes Duplex

City of Marysville, Washington

Tax Parcel: 30051600100800

Group Four Job No. 22-4522

Nov 7, 2022
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Section I

Project Overview and Executive Summary

This drainage report was prepared as part of a Grading and Drainage permit for the City of Marysville per the standards found in the Stormwater Management Manual for Western Washington 2019 (SWMMWW, 2019)

The applicant proposes to build a duplex with a roof area of approximately 5,944 square feet and two new driveways that are approximately 1,219 sf in total on a 0.96 ac property zoned residential located on Shoultes Road in Marysville, WA. Frontage improvements for Shoultes Road include new sidewalk (1,046 sf) and pavement widening (1,768 sf). The total new impervious surface proposed is approximately 9,977 sf.

Runoff mitigation will be provided by infiltration trenches.

Existing Conditions Summary

The existing site is 0.96 acres in an area zoned residential. Most of the parcel is currently forested except the east edge which fronts Shoultes Road and has an existing house approximately 1,145 sf with a 350 sf concrete patio. The eastern three quarters of the project site moderately slopes to the west, with an average approximate slope of 3%. The west quarter of the property has a slope of approximately 50%. Quil Ceda Creek is adjacent to the west edge of the property and receives all stormwater runoff from the project area. See Figure 1 for the Vicinity Map and the Temporary Erosion and Control Plan (TESC).

A geotechnical report for the project site has been prepared by Cobalt Geosciences, LLC. This report found that infiltration is feasible for stormwater runoff as long as infiltration facilities are setback at least 30 feet from the top of the steep slope. No groundwater was observed in testing. See Appendix A.

Mitigation Summary

Presented below is a summary of proposed impervious areas treated solely by on-site storm water management. See Proposed Site Plan.

TDA	Area, SF	BMP	Note
Roof	5,944	Infiltration Trenches (BMP T5.10)	
Driveway	1219	Sheet flow (BMP T5.12)	
Removed Impervious (Existing gravel driveway)	-451	Return to Lawn/Landscape (BMP T5.13)	Includes portion of gravel to be replaced with grass
Frontage Pavement	1,768	Infiltration Trenches (BMP T5.10)	
Frontage Sidewalk	1,046	Infiltration Trenches (BMP T5.10)	

Upstream Analysis

There are no significant upstream tributary areas on site.

Downstream Analysis

The downstream was walked by Curt Iffrig on 11/8/2022 the site visit confirmed conditions observed during Snohomish County resource review. No surface water flow or potential drainage problems were observed.

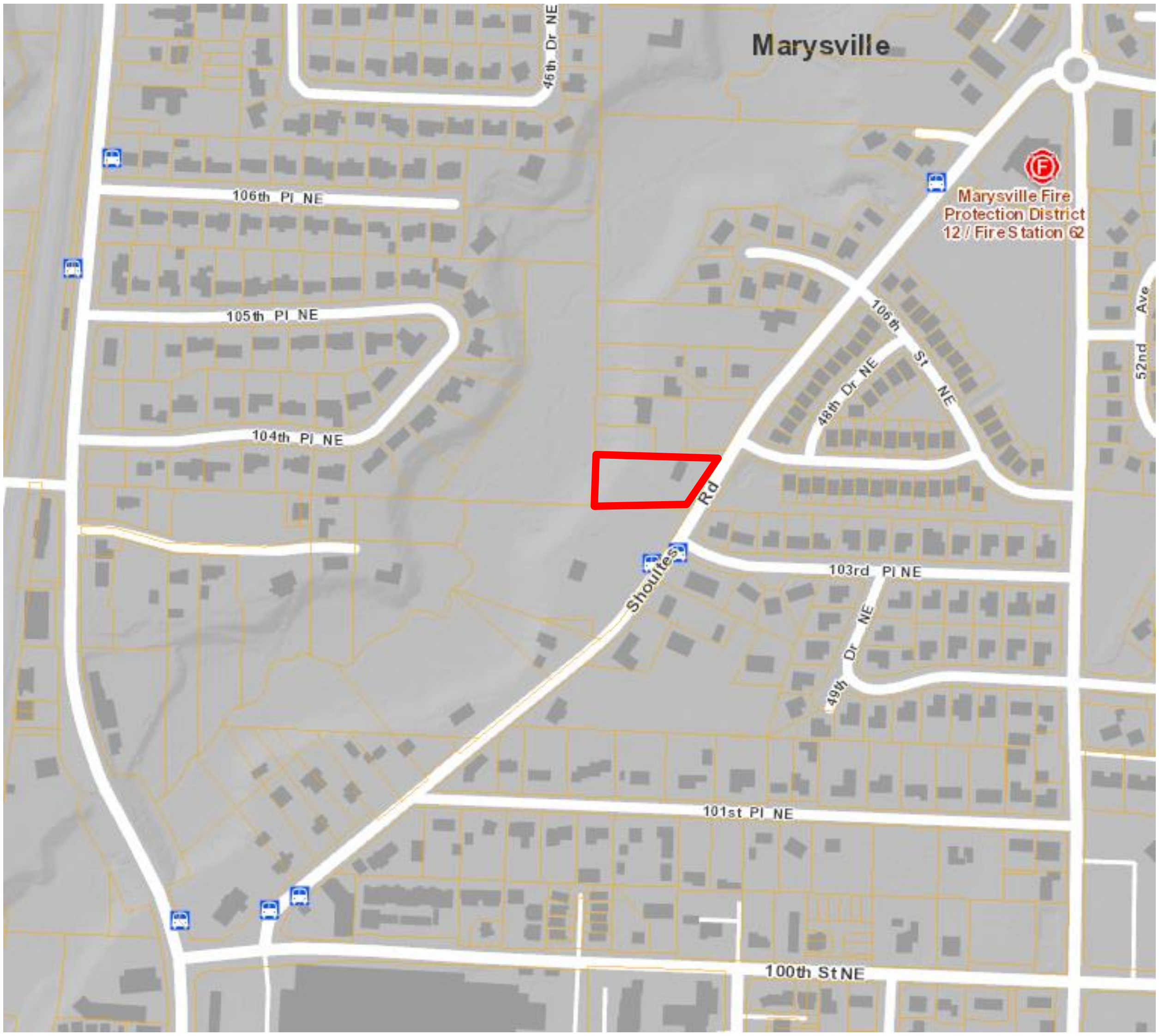


Figure 1: Vicinity Map

Section II: Minimum Requirements

Per the 2019 SWMMWW this project must comply with Minimum Requirements 1 through 9.

MR-1 Targeted Stormwater Site Plan

A Stormwater Site Plan has been prepared per the City of Marysville standards.

MR 2-SWPPP Narrative

A Temporary Erosion and Sediment Control (TESC) plan has been prepared and the SWPPP elements have been addressed in Section III. A full narrative is not required because this project proposes less than one acre of land disturbance.

MR 3-Water Pollution Source Control for New Development

Pollution source control is not required for this residential project.

MR 4-Preservation of Natural Drainage Systems and Outfalls, and Provisions of Off-site Mitigation

The proposed infiltration system maintains the site's natural drainage system. Runoff from offsite driveways will sheet flow along natural flow path.

MR 5-On-site Stormwater Management

A compost-amended soil management plan has been developed utilizing BMP T5.13. The compost amended soil management plan will apply to all landscape surfaces with an area of approximately 808 SF (0.02 Ac). This included the area where existing gravel will be removed

Storm water BMP's have been selected from List #2 in the SWMMWW 2019. Full infiltration per BMP T5.10A is feasible per the geotechnical assessment. It will be used to mitigate all the proposed impervious surface. WWHM 2012 was used to size infiltration trenches to infiltrate nearly 100% of runoff from proposed impervious surfaces. See MR 7 for flow control discussion.

Runoff from driveway surfaces will sheet flow.

MR 6-Runoff Treatment

Runoff treatment is not required for this project because less than 5,000 sf of pollution generating impervious surface is proposed.

MR 7- Flow Control

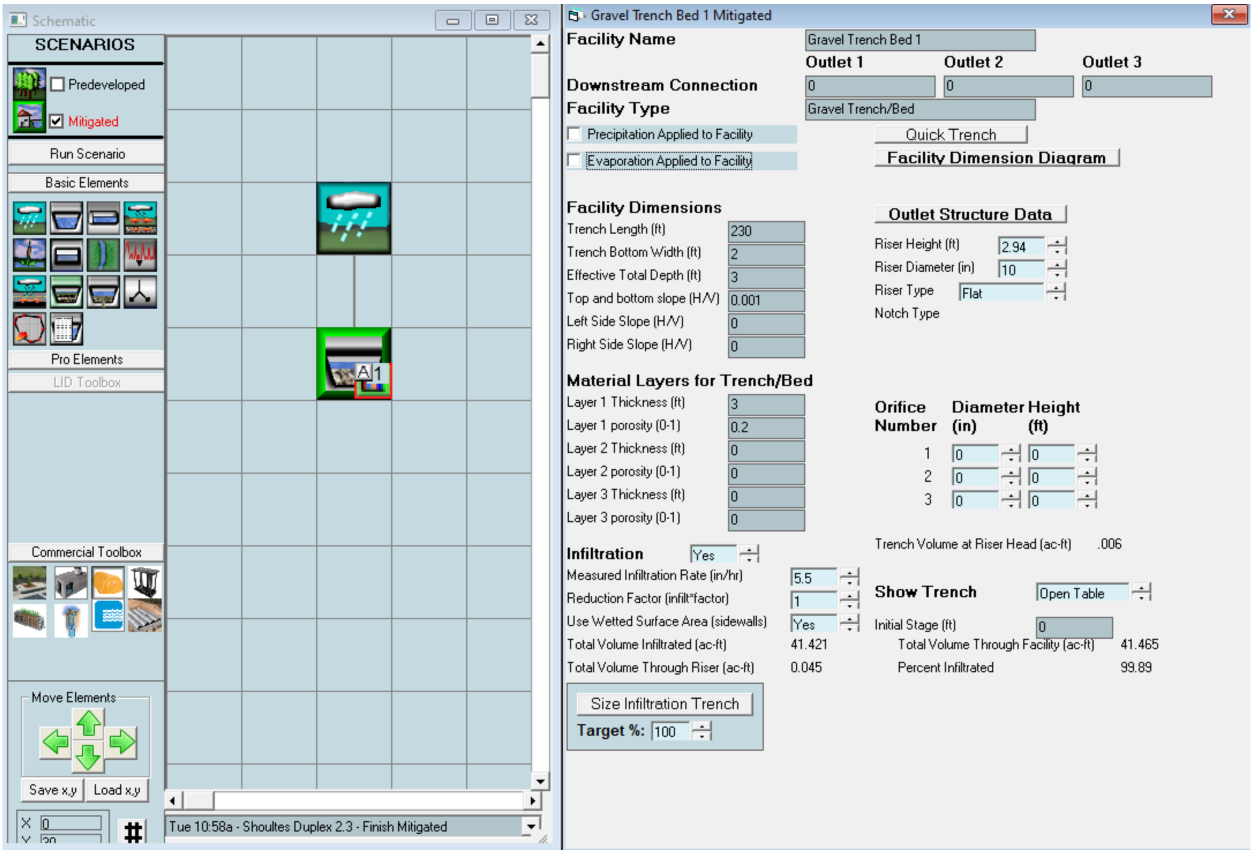
Flow control facilities are not required because this project proposes less than 10,000 sf of impervious area and the 100-year peak runoff increase from the historic condition to the developed condition is less than 0.15 cfs.

The targeted imperious surface is 9,977 sf (0.23 ac). Runoff from the proposed impervious surface will be mitigated by infiltration trenches sized to infiltrate nearly 100% of the runoff. The runoff from the driveways will sheet flow so a 50% credit for sheet flow dispersion was used in the model.

WWHM 2012 was used to model this facility and to demonstrate that the peak runoff increase does not exceed 0.15 cfs. The modeling parameters are described in the table below.

SURFACE	SLOPE	COVER	AREA (ac)
PRE-DEVELOPED (Historic)			
Existing Forest	3-8%	Forest	0.23
DEVELOPED			
Proposed Roof	0%	Roof	0.14
Driveway Impervious (50%)	3-8%	Driveway	0.015
Driveway 50% Credit	3-8%	Lawn	0.015
Pavement Widening	3-8%	Road	0.04
Proposed Sidewalk	3-8%	Sidewalk	0.02

The WWHM parameters for the infiltration trench are shown in the table below. The geotechnical report calculated a design infiltration rate of 5.5 in/hr.



The 100-year peak runoffs for both the historic condition and the developed condition are shown in the table below. Since the proposed infiltration trench infiltrates nearly 100% of the runoff the difference is less than 0.15 cfs so the proposed stormwater mitigation is sufficient. See WWHM 2012 output in the appendix C.

	Impervious 100-year peak runoff (cfs)
Pre-developed (Historic)	0.0056
Developed	0.0000
Difference	0.0056

MR 8- Wetland Protection

Quilceda creek makes up the western boundary of the property. However, no construction is to take place in this area. Wetland protection will not be necessary.

MR 9- Operation and Maintenance

The stormwater BMPs are to be owned, operated and maintained by the owner according to the standards contained in the Snohomish County Drainage Manual 2016, Volume V Chapter 4.

Section III

A SWPP plan has been prepared. All areas of construction shall adhere to Erosion and Sediment Control measures. See sheet 2 for site and SWPPP element locations.

Element #1 – Preserve Vegetation/Mark Clearing Limits

The limits of construction will be clearly marked before land disturbing activities begin. The trees which are to be preserved shall be clearly delineated, both in the field and on the plans.

BMPs: C101, Preserving Natural Vegetation, C102 Buffer Zones, C103 High Visibility Plastic or Metal Fence.

Element #2 – Establish Construction Access

Construction access and activities occurring on unpaved areas shall be minimized. Access points shall be stabilized to minimize the tracking of sediment outside of construction areas. The existing gravel driveway shall be used as a construction entrance.

BMPs: C105 Stabilized Construction Entrance

Element #3 – Control Flow Rate

Stormwater discharges shall be controlled to protect the downstream waterways.

BMPs: C200 Interceptor Dike and Swale, C207 Check Dams

Element #4 – Install Sediment Controls

All storm water runoff from disturbed areas shall pass through an appropriate sediment removal BMP before leaving the construction site.

BMPs: C233 Silt Fence, C235 Straw Wattles

Element #5 – Stabilize Soils

Exposed and unworked soils shall be stabilized with effective erosion control BMPs.

BMPs: C120 Temporary and Permanent Seeding, C121 Mulching, C122 Nets and Blankets, C123 Plastic Covering

Element #6 – Protect Slopes

All cut and fill slopes will be designed, constructed and protected in a manner that minimizes erosion. The project site is relatively flat so slope protection is not anticipated.

BMPs: C120 Temporary and Permanent Seeding, C130 Surface Roughening, C131 Gradient Terraces, C200 Interceptor Dike and Swale

Element #7 – Protect Drain Inlets

All storm drain inlets in project vicinity shall be protected by applying storm drain protection BMP C220. Proposed catch basins shall have protection applied after their installation for the duration of construction.

Element #8 – Stabilize Channels and Outlets

Stabilize channels and outlets. Temporary and permanent conveyance systems and their outlets shall be protected and stabilized to prevent erosion during and after construction.

BMPs: C202 Channel Lining and C290 Outlet Protection

Element #9 – Control Pollutants

All pollutants, including waste materials and demolition debris, which occur onsite shall be handled and disposed of in a manner that does not cause contamination of storm water.

BMPs: C151 Concrete Handling

Element #10 – Control De-watering

De-watering is not anticipated as part of this project. However, if it is necessary, discharge foundation, vault, and trench dewatering water into a controlled conveyance system before discharging to a sediment trap or sediment pond.

Element #11 – Maintain BMPs

All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with each particular BMPs specification. Visual monitoring of the BMPs will be conducted at least once every calendar week and within 24 hours of any storm water discharge from the site. If the site becomes inactive, and is temporarily stabilized, the inspection frequency will be reduced to once every month.

All temporary erosion and sediment control BMPs shall be removed within 30 days after the final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs, or vegetation shall be permanently stabilized.

Element #12 – Manage the Project

Erosion and sediment control BMPs for this project have been designed based on the following principles:

- Design the project to fit the existing topography, soils and drainage patterns.
- Emphasize erosion control rather than sediment control.
- Minimize the extent and duration of the area exposed.

- Keep runoff velocities low.
- Retain sediment on site.
- Thoroughly monitor site and maintain all ESC measures.
- Schedule major earthwork during the dry season.

Element #13 – Protect on-site storm water management BMPs from runoff from roofs and other hard surfaces.

Runoff from impervious surfaces will not be allowed to sheet-flow over lawn or cleared areas. The roof drainage BMPs should be in-place and on-line prior to roof construction completion.

Appendices

A – Geotech Report

B – WWHM 2012 Output

May 3, 2023

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RE: Geotechnical Evaluation
Proposed Duplex
10408 Shoultes Road
Marysville, Washington

In accordance with your authorization, Cobalt Geosciences, LLC has prepared this letter to discuss the results of our geotechnical evaluation at the referenced site.

The purpose of our evaluation was to provide recommendations for foundation design, stormwater management, grading, and earthwork.

Site Description

The site is located at 10408 Shoultes Road in Marysville, Washington. The site consists of one irregularly shaped parcel (No. 30051600100800) with a total area of about 1.02 acres.

Until recently, the site was developed with a residential structure and driveway. The site is currently undeveloped and vegetated with grasses, blackberry vines, ivy, ferns, understory, and variable diameter trees.

The eastern majority of the site is nearly level to slightly sloping. There is a relatively steep slope in the western portion of the site extending downward to the west. This slope is heavily vegetated and has magnitudes of 30 to 60 percent and relief of about 35 feet.

The property is bordered to the north and south by residential properties, to the west by undeveloped land, and to the east by Shoultes Road.

The proposed development includes a new duplex in the central portion of the property. Foundation loads will be light to moderate and site grading may include cuts or fills of 3 feet or less. Stormwater will be infiltrated if determined to be feasible.

Area Geology

The Geologic Map of the Marysville Quadrangle indicates that the site is underlain by Vashon Recessional Outwash – Marysville Sand Member.

The Marysville Sand deposits include normally consolidated sands with areas of gravel and local silt/clay interbeds. These deposits are permeable and have not been glacially consolidated.

Soil & Groundwater Conditions

We excavated a test pit and two hand borings where accessible. The soils included about 12 inches of vegetation and topsoil underlain by approximately 2 to 3 feet of loose to medium dense, silty-fine to medium grained sand (Weathered Marysville Sand).

These deposits were underlain by medium dense, fine to medium grained sand (Marysville Sand), which continued to the termination depths of the explorations.

Groundwater was not encountered during the exploration work. Based on our review of topographic maps and aerial photographs, groundwater is likely 40 feet below site elevations.

Water table elevations often fluctuate over time. The groundwater level will depend on a variety of factors that may include seasonal precipitation, irrigation, land use, climatic conditions and soil permeability. Water levels at the time of the field investigation may be different from those encountered during the construction phase of the project.

Erosion Hazard

The Natural Resources Conservation Services (NRCS) maps for Snohomish County indicate that the site is underlain by Ragnar fine sandy loam (0 to 8 percent slopes). These soils would have a slight to moderate erosion potential in a disturbed state depending on the slope magnitude.

It is our opinion that soil erosion potential at this project site can be reduced through landscaping and surface water runoff control. Typically, erosion of exposed soils will be most noticeable during periods of rainfall and may be controlled by the use of normal temporary erosion control measures, such as silt fences, hay bales, mulching, control ditches and diversion trenches. The typical wet weather season, with regard to site grading, is from October 31st to April 1st. Erosion control measures should be in place before the onset of wet weather.

Seismic Hazard

The overall subsurface profile corresponds to a Site Class *D* as defined by Table 1613.5.2 of the International Building Code (IBC). A Site Class *D* applies to an overall profile consisting of medium dense to very dense soils within the upper 100 feet.

We referenced the U.S. Geological Survey (USGS) Earthquake Hazards Program Website to obtain values for S_S, S_1, F_a, and F_v. The USGS website includes the most updated published data on seismic conditions. The following tables provide seismic parameters from the USGS web site with referenced parameters from ASCE 7-16.

Seismic Design Parameters (ASCE 7-16)

Site Class	Spectral Acceleration at 0.2 sec. (g)	Spectral Acceleration at 1.0 sec. (g)	Site Coefficients		Design Spectral Response Parameters		Design PGA
			F_a	F_v	S_{DS}	S_{D1}	
D	1.093	0.389	1.063	Null	0.774	Null	0.464

Additional seismic considerations include liquefaction potential and amplification of ground motions by soft/loose soil deposits. The liquefaction potential is highest for loose sand with a high groundwater table. The site has a relatively low likelihood of liquefaction. For items listed as "Null" see Section 11.4.8 of the ASCE.

Conclusions and Recommendations

General

The site is underlain by Marysville Sand which consists of poorly graded sand with local silty sands. The proposed residential structure may be supported on a shallow foundation system bearing on medium dense or firmer native soils or on structural fill placed on the native soils.

Overexcavation or recompaction of loose weathered native soils may be necessary depending on the proposed elevations and locations of the new footings. The geotechnical engineer should verify soil conditions during foundation excavations.

Infiltration is feasible in the Marysville Sand below the weathered zone. We recommend trenches or drywells set at least 3 feet below site elevations. We recommend a minimum building setback of 20 feet from the top of the steep slope. We anticipate that the new building will be at least 50 feet from the slope. Infiltration systems should be setback at least 30 feet from the top of the steep slope.

Site Preparation

Trees, shrubs and other vegetation should be removed prior to stripping of surficial organic-rich soil and fill. Based on observations from the site investigation program, it is anticipated that the stripping depth will be 12 to 24 inches. Deeper excavations will be necessary where loose soils persist to greater depths or are underlain by fill.

The native soils consist of poorly graded sands and silty-sands. Most of the soils are suitable for use as structural fill if they meet compaction requirements and are within 3 percent of the optimum moisture.

Some of these soils may only be suitable for use as fill during the summer months, as they will be above the optimum moisture levels in their current state. These soils are variably moisture sensitive and may degrade during periods of wet weather and under equipment traffic.

Imported structural fill should consist of a sand and gravel mixture with a maximum grain size of 3 inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve). Structural fill should be placed in maximum lift thicknesses of 12 inches and should be compacted to a minimum of 95 percent of the modified proctor maximum dry density, as determined by the ASTM D 1557 test method.

Temporary Excavations

Based on our understanding of the project, we anticipate that the grading could include local cuts on the order of approximately 3 feet or less for foundation and utility placement. Any deeper temporary excavations should be sloped no steeper than 1.5H:1V (Horizontal:Vertical) in loose native soils and 1H:1V in medium dense native soils. If an excavation is subject to heavy vibration or surcharge loads (or groundwater), we recommend that the excavations be sloped no steeper than 2H:1V, where room permits.

Temporary cuts should be in accordance with the Washington Administrative Code (WAC) Part N, Excavation, Trenching, and Shoring. Temporary slopes should be visually inspected daily by a qualified person during construction activities and the inspections should be documented in daily reports. The contractor is responsible for maintaining the stability of the temporary cut slopes and reducing slope erosion during construction.

Temporary cut slopes should be covered with visqueen to help reduce erosion during wet weather, and the slopes should be closely monitored until the permanent retaining systems or slope configurations are complete. Materials should not be stored or equipment operated within 10 feet of the top of any temporary cut slope.

Soil conditions may not be completely known from the geotechnical investigation. In the case of temporary cuts, the existing soil conditions may not be completely revealed until the excavation work exposes the soil. Typically, as excavation work progresses the maximum inclination of temporary slopes will need to be re-evaluated by the geotechnical engineer so that supplemental recommendations can be made. Soil and groundwater conditions can be highly variable. Scheduling for soil work will need to be adjustable, to deal with unanticipated conditions, so that the project can proceed and required deadlines can be met.

If any variations or undesirable conditions are encountered during construction, we should be notified so that supplemental recommendations can be made. If room constraints or groundwater conditions do not permit temporary slopes to be cut to the maximum angles allowed by the WAC, temporary shoring systems may be required. The contractor should be responsible for developing temporary shoring systems, if needed. We recommend that Cobalt Geosciences and the project structural engineer review temporary shoring designs prior to installation, to verify the suitability of the proposed systems.

Foundation Design

The proposed residence may be supported on a shallow spread footing foundation system bearing on undisturbed medium dense or firmer native soils or on properly compacted structural fill placed on the suitable native soils. Any undocumented fill and/or loose native soils should be removed and replaced with structural fill below foundation elements. Structural fill below footings should consist of clean angular rock 5/8 to 4 inches in size. We should verify soil conditions during foundation excavation work. Bearing soils will vary from 2.5 to 4 feet below grade.

For shallow foundation support, we recommend widths of at least 16 and 24 inches, respectively, for continuous wall and isolated column footings supporting the proposed structure. Provided that the footings are supported as recommended above, a net allowable bearing pressure of 2,000 pounds per square foot (psf) may be used for design.

A 1/3 increase in the above value may be used for short duration loads, such as those imposed by wind and seismic events. Structural fill placed on bearing, native subgrade should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. Footing excavations should be inspected to verify that the foundations will bear on suitable material.

Exterior footings should have a minimum depth of 18 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower. Interior footings should have a minimum depth of 12 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower.

If constructed as recommended, the total foundation settlement is not expected to exceed 1 inch. Differential settlement, along a 25-foot exterior wall footing, or between adjoining column footings, should be less than ½ inch. This translates to an angular distortion of 0.002. Most settlement is expected to occur during construction, as the loads are applied. However, additional post-construction settlement may occur if the foundation soils are flooded or saturated. All footing excavations should be observed by a qualified geotechnical consultant.

Resistance to lateral footing displacement can be determined using an allowable friction factor of 0.40 acting between the base of foundations and the supporting subgrades. Lateral resistance for footings can also be developed using an allowable equivalent fluid passive pressure of 250 pounds per cubic foot (pcf) acting against the appropriate vertical footing faces (neglect the upper 12 inches below grade in exterior areas). The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance.

Care should be taken to prevent wetting or drying of the bearing materials during construction. Any extremely wet or dry materials, or any loose or disturbed materials at the bottom of the footing excavations, should be removed prior to placing concrete. The potential for wetting or drying of the bearing materials can be reduced by pouring concrete as soon as possible after completing the footing excavation and evaluating the bearing surface by the geotechnical engineer or his representative.

Concrete Retaining Walls

The following table, titled **Wall Design Criteria**, presents the recommended soil related design parameters for retaining walls with a level backslope. Contact Cobalt if an alternate retaining wall system is used. This has been included for new cast in place walls, if proposed.

Wall Design Criteria	
"At-rest" Conditions (Lateral Earth Pressure – EFD+)	55 pcf (Equivalent Fluid Density)
"Active" Conditions (Lateral Earth Pressure – EFD+)	35 pcf (Equivalent Fluid Density)
Seismic Increase for "At-rest" Conditions (Lateral Earth Pressure)	12H* (Uniform Distribution) 1 in 500 year event
Seismic Increase for "Active" Conditions (Lateral Earth Pressure)	6H* (Uniform Distribution)
Passive Earth Pressure on Low Side of Wall (Allowable, includes F.S. = 1.5)	Neglect upper 2 feet, then 250 pcf EFD+
Soil-Footing Coefficient of Sliding Friction (Allowable; includes F.S. = 1.5)	0.40

*H is the height of the wall; Increase based on one in 500 year seismic event (10 percent probability of being exceeded in 50 years),
+EFD – Equivalent Fluid Density

The stated lateral earth pressures do not include the effects of hydrostatic pressure generated by water accumulation behind the retaining walls. Uniform horizontal lateral active and at-rest pressures on the retaining walls from vertical surcharges behind the wall may be calculated using active and at-rest lateral earth pressure coefficients of 0.3 and 0.5, respectively. A soil unit weight of 125 pcf may be used to calculate vertical earth surcharges.

To reduce the potential for the buildup of water pressure against the walls, continuous footing drains (with cleanouts) should be provided at the bases of the walls. The footing drains should consist of a minimum 4-inch diameter perforated pipe, sloped to drain, with perforations placed down and enveloped by a minimum 6 inches of pea gravel in all directions.

The backfill adjacent to and extending a lateral distance behind the walls at least 2 feet should consist of free-draining granular material. All free draining backfill should contain less than 3 percent fines (passing the U.S. Standard No. 200 Sieve) based upon the fraction passing the U.S. Standard No. 4 Sieve with at least 30 percent of the material being retained on the U.S. Standard No. 4 Sieve. The primary purpose of the free-draining material is the reduction of hydrostatic pressure. Some potential for the moisture to contact the back face of the wall may exist, even with treatment, which may require that more extensive waterproofing be specified for walls, which require interior moisture sensitive finishes.

We recommend that the backfill be compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557. In place density tests should be performed to verify adequate compaction. Soil compactors place transient surcharges on the backfill. Consequently, only light hand operated equipment is recommended within 3 feet of walls so that excessive stress is not imposed on the walls.

Stormwater Management Feasibility

The site is underlain by Marysville Sand member of Vashon Recessional Outwash. Infiltration is suitable in these soil deposits. Groundwater was not encountered in the explorations. Groundwater appears to be ponded at the base of the adjacent ravine. The approximate depth to groundwater is approximately 40 feet.

Because the recessional deposits have not been overridden by glacial ice, this soil unit is considered normally-consolidated. The Washington State Department of Ecology 2019 Stormwater Management Manual for Western Washington allows determination of infiltration rates of this soil unit by Soil Particle Size Distribution testing. This method involves using a logarithmic equation and grain size values along with correction factors for testing type, soil homogeneity, and influent control.

The equation in conjunction with sieve analysis results yields design infiltration rates of between 5 and 8 inches per hour at depths of 3 to 6 feet below grade. These rates reflect application of correction factors for variability (0.6 used), influent control (0.9), and testing analysis type (0.4). We should be provided with the final civil plans so that we may provide specific infiltration rates at specific system locations and depths.

We performed a small scale pilot infiltration test in TP-1 at 4 feet below grade. Following saturation, testing, and application of the correction factors noted above, the design rate was determined to be 5.5 inches per hour. We recommend using this rate for system design.

Infiltration systems should have a depth of at least 3 feet below existing grades and located at least 10 feet apart. Any fine grained soils or interbeds of fine grained soils must be removed prior to rock placement. Systems should be setback at least 30 feet from the top of the steep slope areas.

We should be provided with final plans for review to determine if the intent of our recommendations has been incorporated or if additional modifications are needed.

Slab-on-Grade

We recommend that the upper 18 inches of the existing native soils within slab areas be re-compacted to at least 95 percent of the modified proctor (ASTM D1557 Test Method). If this is not possible, overexcavation and replacement with suitable structural fill will be necessary.

Often, a vapor barrier is considered below concrete slab areas. However, the usage of a vapor barrier could result in curling of the concrete slab at joints. Floor covers sensitive to moisture typically requires the usage of a vapor barrier. A materials or structural engineer should be consulted regarding the detailing of the vapor barrier below concrete slabs. Exterior slabs typically do not utilize vapor barriers.

The American Concrete Institutes ACI 360R-06 Design of Slabs on Grade and ACI 302.1R-04 Guide for Concrete Floor and Slab Construction are recommended references for vapor barrier selection and floor slab detailing.

Slabs on grade may be designed using a coefficient of subgrade reaction of 150 pounds per cubic inch (pci) assuming the slab-on-grade base course is underlain by structural fill placed and compacted as outlined above. A 4- to 6-inch-thick capillary break layer should be placed over the prepared subgrade. This material should consist of pea gravel or 5/8 inch clean angular rock.

A perimeter drainage system is recommended unless interior slab areas are elevated a minimum of 12 inches above adjacent exterior grades. If installed, a perimeter drainage system should consist of a 4-inch diameter perforated drain pipe surrounded by a minimum 6 inches of drain rock wrapped in a non-woven geosynthetic filter fabric to reduce migration of soil particles into the drainage system. The perimeter drainage system should discharge by gravity flow to a suitable stormwater system.

Exterior grades surrounding buildings should be sloped at a minimum of one percent to facilitate surface water flow away from the building and preferably with a relatively impermeable surface cover immediately adjacent to the building.

Erosion and Sediment Control

Erosion and sediment control (ESC) is used to reduce the transportation of eroded sediment to wetlands, streams, lakes, drainage systems, and adjacent properties. Erosion and sediment control measures should be implemented, and these measures should be in general accordance with local regulations. At a minimum, the following basic recommendations should be incorporated into the design of the erosion and sediment control features for the site:

- Schedule the soil, foundation, utility, and other work requiring excavation or the disturbance of the site soils, to take place during the dry season (generally May through September). However, provided precautions are taken using Best Management Practices (BMP's), grading activities can be completed during the wet season (generally October through April).
- All site work should be completed and stabilized as quickly as possible.
- Additional perimeter erosion and sediment control features may be required to reduce the possibility of sediment entering the surface water. This may include additional silt fences, silt

fences with a higher Apparent Opening Size (AOS), construction of a berm, or other filtration systems.

- Any runoff generated by dewatering discharge should be treated through construction of a sediment trap if there is sufficient space. If space is limited other filtration methods will need to be incorporated.

Utilities

Utility trenches should be excavated according to accepted engineering practices following OSHA (Occupational Safety and Health Administration) standards, by a contractor experienced in such work. The contractor is responsible for the safety of open trenches. Traffic and vibration adjacent to trench walls should be reduced; cyclic wetting and drying of excavation side slopes should be avoided. Depending upon the location and depth of some utility trenches, groundwater flow into open excavations could be experienced, especially during or shortly following periods of precipitation.

In general, sandy soils were encountered at shallow depths in the explorations at this site. These soils have low cohesion and density and will have a tendency to cave or slough in excavations. Shoring or sloping back trench sidewalls is required within these soils in excavations greater than 4 feet deep.

All utility trench backfill should consist of imported structural fill or suitable on site soils. Utility trench backfill placed in or adjacent to buildings and exterior slabs should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. The upper 5 feet of utility trench backfill placed in pavement areas should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. Below 5 feet, utility trench backfill in pavement areas should be compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557. Pipe bedding should be in accordance with the pipe manufacturer's recommendations.

The contractor is responsible for removing all water-sensitive soils from the trenches regardless of the backfill location and compaction requirements. Depending on the depth and location of the proposed utilities, we anticipate the need to re-compact existing fill soils below the utility structures and pipes. The contractor should use appropriate equipment and methods to avoid damage to the utilities and/or structures during fill placement and compaction procedures.

CONSTRUCTION FIELD REVIEWS

Cobalt Geosciences should be retained to provide part time field review during construction in order to verify that the soil conditions encountered are consistent with our design assumptions and that the intent of our recommendations is being met. This will require field and engineering review to:

- Monitor and test structural fill placement and soil compaction
- Observe bearing capacity at foundation locations
- Observe slab-on-grade preparation
- Verify infiltration system soil conditions
- Monitor foundation drainage placement
- Observe excavation stability

Geotechnical design services should also be anticipated during the subsequent final design phase to support the structural design and address specific issues arising during this phase. Field and engineering review services will also be required during the construction phase in order to provide a Final Letter for the project.

CLOSURE

This report was prepared for the exclusive use of Julia Krykun and her appointed consultants. Any use of this report or the material contained herein by third parties, or for other than the intended purpose, should first be approved in writing by Cobalt Geosciences, LLC.

The recommendations contained in this report are based on assumed continuity of soils with those of our test holes and assumed structural loads. Cobalt Geosciences should be provided with final architectural and civil drawings when they become available in order that we may review our design recommendations and advise of any revisions, if necessary.

Use of this report is subject to the Statement of General Conditions provided in Appendix A. It is the responsibility of Julia Krykun who is identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Cobalt Geosciences should any of these not be satisfied.

Sincerely,

Cobalt Geosciences, LLC

5/3/2023
Phil Haberman, PE, LG, LEG
Principal

Statement of General Conditions

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Cobalt Geosciences and the Client. Any use which a third party makes of this report is the responsibility of such third party.

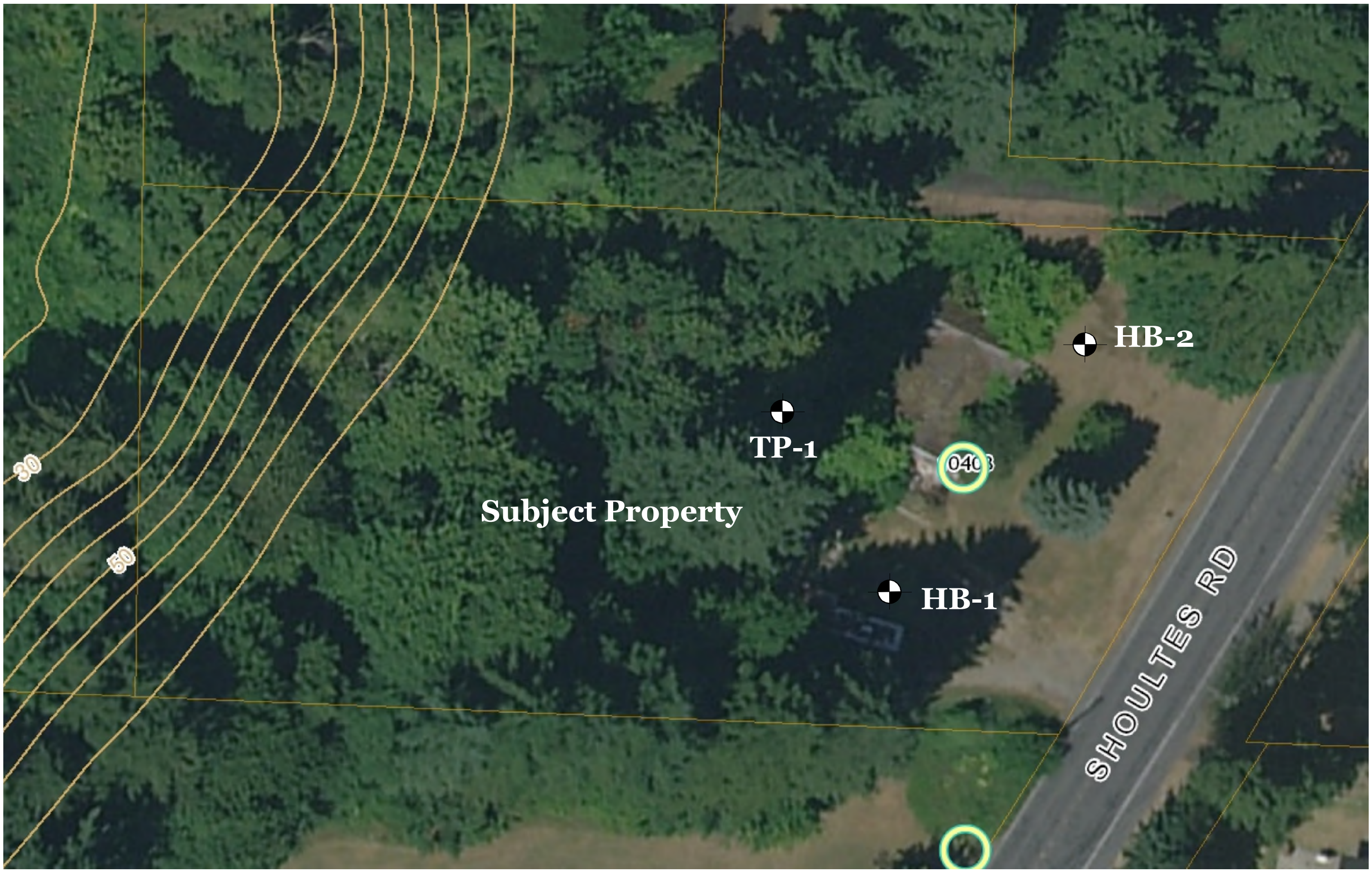
BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Cobalt Geosciences present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Cobalt Geosciences is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Cobalt Geosciences at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Cobalt Geosciences must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Cobalt Geosciences will not be responsible to any party for damages incurred as a result of failing to notify Cobalt Geosciences that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Cobalt Geosciences, sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Cobalt Geosciences cannot be responsible for site work carried out without being present.



Not to Scale

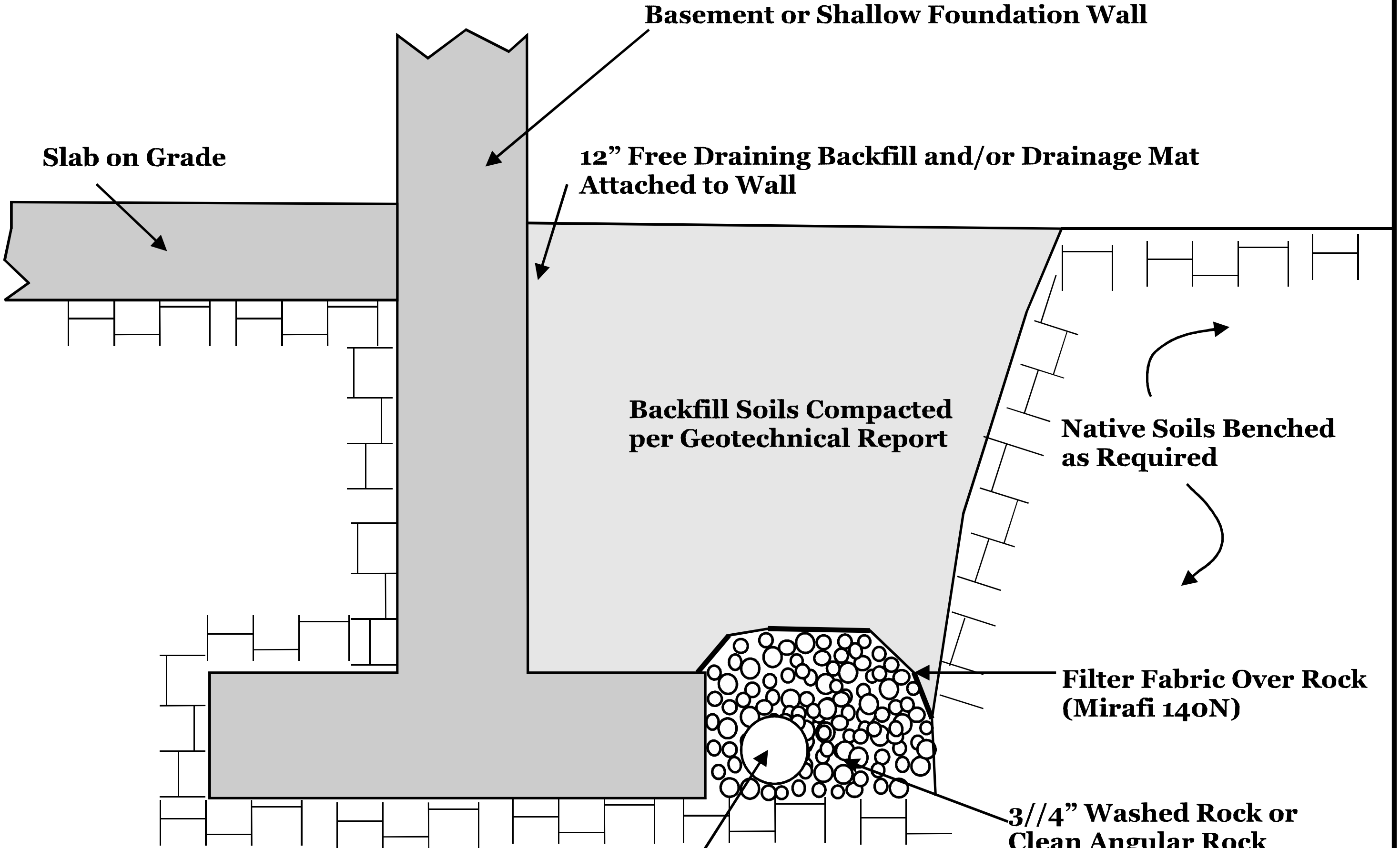
Sno. Co. Gis Aerial Image

N

TP-1
HB-1

Approximate Test Pit
& Hand Boring Location

COBALT GEOSCIENCES	Proposed Residence 10408 Shoultes Road Marysville, Washington	**SITE MAP FIGURE 1**	Cobalt Geosciences, LLC P.O. Box 82243 Kenmore, WA 98028 (206) 331-1097 www.cobaltgeo.com cobaltgeo@gmail.com



Not to Scale

COBALT GEOSCIENCES	**Typical Foundation Drain Detail**	**Attachment**	Cobalt Geosciences, LLC PO Box 1792 North Bend, WA 98045 (206) 331-1097 www.cobaltgeo.com phil@cobaltgeo.com

Unified Soil Classification System (USCS)

MAJOR DIVISIONS			SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS (more than 50% retained on No. 200 sieve)	Gravels (more than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		Gravels with Fines (more than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (50% or more of coarse fraction passes the No. 4 sieve)	Clean Sands (less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly graded sand, gravelly sands, little or no fines
		Sands with Fines (more than 12% fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS (50% or more passes the No. 200 sieve)	Silts and Clays (liquid limit less than 50)	Inorganic	ML	Inorganic silts of low to medium plasticity, sandy silts, gravelly silts, or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays silty clays, lean clays
		Organic	OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays (liquid limit 50 or more)	Inorganic	MH	Inorganic silts, micaceous or diatomaceous fine sands or silty soils, elastic silt
			CH	Inorganic clays of medium to high plasticity, sandy fat clay, or gravelly fat clay
		Organic	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat, humus, swamp soils with high organic content (ASTM D4427)

Classification of Soil Constituents

MAJOR constituents compose more than 50 percent, by weight, of the soil. Major constituents are capitalized (i.e., SAND).

Minor constituents compose 12 to 50 percent of the soil and precede the major constituents (i.e., silty SAND). Minor constituents preceded by "slightly" compose 5 to 12 percent of the soil (i.e., slightly silty SAND).

Trace constituents compose 0 to 5 percent of the soil (i.e., slightly silty SAND, trace gravel).

Grain Size Definitions

Description	Sieve Number and/or Size
Fines	<#200 (0.08 mm)
Sand	
-Fine	#200 to #40 (0.08 to 0.4 mm)
-Medium	#40 to #10 (0.4 to 2 mm)
-Coarse	#10 to #4 (2 to 5 mm)
Gravel	
-Fine	#4 to 3/4 inch (5 to 19 mm)
-Coarse	3/4 to 3 inches (19 to 76 mm)
Cobbles	3 to 12 inches (75 to 305 mm)
Boulders	>12 inches (305 mm)

Relative Density (Coarse Grained Soils)

N, SPT, Blows/FT	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium dense
30 - 50	Dense
Over 50	Very dense

Consistency (Fine Grained Soils)

N, SPT, Blows/FT	Relative Consistency
Under 2	Very soft
2 - 4	Soft
4 - 8	Medium stiff
8 - 15	Stiff
15 - 30	Very stiff
Over 30	Hard

Moisture Content Definitions

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

Test Pit TP-1

Date: May 2023	Depth: 9'	Groundwater: None
Contractor: Jim	Elevation:	Logged By: PH Checked By: SC

Depth (Feet)	Interval	Graphic Log	USCS Symbol	Material Description	Groundwater	Moisture Content (%) Plastic Limit / Liquid Limit; DCP Equivalent N-Value 0 10 20 30 40 50
0–1				Topsoil/Grass		
1–3.5			SP/SM	Loose to medium dense, silty-fine to medium grained sand trace gravel, yellowish brown, moist. (Weathered Outwash)		
3.5–9	■ (~3.5–4), ■ (~5.5–6)		SP	Medium dense, fine to medium grained sand trace gravel, grayish brown, moist. (Recessional Outwash)		
9				End of Test Pit 9'		

Proposed Residence
10408 Shoultes Road
Marysville, Washington

Test Pit Logs

Cobalt Geosciences, LLC
P.O. Box 82243
Kenmore, WA 98028
(206) 331-1097
www.cobaltgeo.com
cobaltgeo@gmail.com

Hand Boring HB-1

Date: May 2023	Depth: 7'	Groundwater: None
Contractor: Jim	Elevation:	Logged By: PH Checked By: SC

Depth (Feet)	Interval	Graphic Log	USCS Symbol	Material Description	Groundwater	Moisture Content (%) / DCP Equivalent N-Value (0, 10, 20, 30, 40, 50)
0–1				Topsoil/Grass		
1–3	■ (2)		SP/SM	Loose to medium dense, silty-fine to medium grained sand trace gravel, yellowish brown, moist. (Weathered Outwash)		
3–7	■ (4)		SP	Medium dense, fine to medium grained sand trace gravel, grayish brown, moist. (Recessional Outwash) -Local areas of SP-SM		
7				End of Hand Boring 7'		

Plastic Limit — Liquid Limit

Hand Boring HB-2

Date: May 2023	Depth: 7'	Groundwater: None
Contractor: Jim	Elevation:	Logged By: PH Checked By: SC

Depth (Feet)	Interval	Graphic Log	USCS Symbol	Material Description	Groundwater	Moisture Content (%) / DCP Equivalent N-Value (0, 10, 20, 30, 40, 50)
0–1				Topsoil/Grass		
1–4	■ (3)		SP/SM	Loose to medium dense, silty-fine to medium grained sand trace gravel, yellowish brown, moist. (Weathered Outwash)		
4–7	■ (6)		SP	Medium dense, fine to medium grained sand trace gravel, grayish brown, moist. (Recessional Outwash) -Local areas of SP-SM		
7				End of Hand Boring 7'		

Plastic Limit — Liquid Limit

Cobalt Geosciences, LLC
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Kenmore, WA 98028
(206) 331-1097
www.cobaltgeo.com
cobaltgeo@gmail.com

WWHM2012
PROJECT REPORT

Project Name: Shoultes Duplex 2.3
Site Name:
Site Address:
City :
Report Date: 5/17/2023
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.20
Version Date: 2021/08/18
Version : 4.2.18

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Mod	.23

Pervious Total 0.23

Impervious Land Use	acre

Impervious Total 0

Basin Total 0.23

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
A B, Lawn, Mod	**.015**
Pervious Total	**0.015**

Impervious Land Use	**acre**
ROADS MOD	**0.04**
ROOF TOPS FLAT	**0.14**
DRIVEWAYS MOD	**0.015**
SIDEWALKS MOD	**0.02**
Impervious Total	**0.215**
Basin Total	**0.23**

Element Flows To:

Surface	**Interflow**	**Groundwater**
Gravel Trench Bed 1	Gravel Trench Bed 1	

Name : Gravel Trench Bed 1
Bottom Length: 230.00 ft.
Bottom Width: 2.00 ft.
Trench bottom slope 1: 0.001 To 1
Trench Left side slope 0: 0 To 1
Trench right side slope 2: 0 To 1
Material thickness of first layer: 3
Pour Space of material for first layer: 0.2
Material thickness of second layer: 0
Pour Space of material for second layer: 0
Material thickness of third layer: 0
Pour Space of material for third layer: 0
Infiltration On
Infiltration rate: 5.5
Infiltration safety factor: 1
Wetted surface area On
Total Volume Infiltrated (ac-ft.): 41.421
Total Volume Through Riser (ac-ft.): 0.045
Total Volume Through Facility (ac-ft.): 41.465
Percent Infiltrated: 99.89
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Discharge Structure
Riser Height: 2.94 ft.
Riser Diameter: 10 in.

Element Flows To:

Outlet 1	**Outlet 2**

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.010	0.000	0.000	0.000
0.0333	0.010	0.000	0.000	0.058
0.0667	0.010	0.000	0.000	0.058
0.1000	0.010	0.000	0.000	0.058
0.1333	0.010	0.000	0.000	0.058
0.1667	0.010	0.000	0.000	0.058
0.2000	0.010	0.000	0.000	0.058
0.2333	0.010	0.000	0.000	0.058
0.2667	0.010	0.000	0.000	0.058
0.3000	0.010	0.000	0.000	0.058
0.3333	0.010	0.000	0.000	0.058
0.3667	0.010	0.000	0.000	0.058
0.4000	0.010	0.000	0.000	0.058
0.4333	0.010	0.000	0.000	0.058
0.4667	0.010	0.001	0.000	0.058
0.5000	0.010	0.001	0.000	0.058
0.5333	0.010	0.001	0.000	0.058
0.5667	0.010	0.001	0.000	0.058
0.6000	0.010	0.001	0.000	0.058
0.6333	0.010	0.001	0.000	0.058
0.6667	0.010	0.001	0.000	0.058
0.7000	0.010	0.001	0.000	0.058
0.7333	0.010	0.001	0.000	0.058
0.7667	0.010	0.001	0.000	0.058
0.8000	0.010	0.001	0.000	0.058
0.8333	0.010	0.001	0.000	0.058
0.8667	0.010	0.001	0.000	0.058
0.9000	0.010	0.001	0.000	0.058
0.9333	0.010	0.002	0.000	0.058
0.9667	0.010	0.002	0.000	0.058
1.0000	0.010	0.002	0.000	0.058
1.0333	0.010	0.002	0.000	0.058
1.0667	0.010	0.002	0.000	0.058
1.1000	0.010	0.002	0.000	0.058
1.1333	0.010	0.002	0.000	0.058
1.1667	0.010	0.002	0.000	0.058
1.2000	0.010	0.002	0.000	0.058
1.2333	0.010	0.002	0.000	0.058
1.2667	0.010	0.002	0.000	0.058
1.3000	0.010	0.002	0.000	0.058
1.3333	0.010	0.002	0.000	0.058
1.3667	0.010	0.002	0.000	0.058
1.4000	0.010	0.003	0.000	0.058
1.4333	0.010	0.003	0.000	0.058
1.4667	0.010	0.003	0.000	0.058
1.5000	0.010	0.003	0.000	0.058
1.5333	0.010	0.003	0.000	0.058
1.5667	0.010	0.003	0.000	0.058
1.6000	0.010	0.003	0.000	0.058
1.6333	0.010	0.003	0.000	0.058
1.6667	0.010	0.003	0.000	0.058
1.7000	0.010	0.003	0.000	0.058
1.7333	0.010	0.003	0.000	0.058
1.7667	0.010	0.003	0.000	0.058
1.8000	0.010	0.003	0.000	0.058

1.8333	0.010	0.003	0.000	0.058
1.8667	0.010	0.003	0.000	0.058
1.9000	0.010	0.004	0.000	0.058
1.9333	0.010	0.004	0.000	0.058
1.9667	0.010	0.004	0.000	0.058
2.0000	0.010	0.004	0.000	0.058
2.0333	0.010	0.004	0.000	0.058
2.0667	0.010	0.004	0.000	0.058
2.1000	0.010	0.004	0.000	0.058
2.1333	0.010	0.004	0.000	0.058
2.1667	0.010	0.004	0.000	0.058
2.2000	0.010	0.004	0.000	0.058
2.2333	0.010	0.004	0.000	0.058
2.2667	0.010	0.004	0.000	0.058
2.3000	0.010	0.004	0.000	0.058
2.3333	0.010	0.004	0.000	0.058
2.3667	0.010	0.005	0.000	0.058
2.4000	0.010	0.005	0.000	0.058
2.4333	0.010	0.005	0.000	0.058
2.4667	0.010	0.005	0.000	0.058
2.5000	0.010	0.005	0.000	0.058
2.5333	0.010	0.005	0.000	0.058
2.5667	0.010	0.005	0.000	0.058
2.6000	0.010	0.005	0.000	0.058
2.6333	0.010	0.005	0.000	0.058
2.6667	0.010	0.005	0.000	0.058
2.7000	0.010	0.005	0.000	0.058
2.7333	0.010	0.005	0.000	0.058
2.7667	0.010	0.005	0.000	0.058
2.8000	0.010	0.005	0.000	0.058
2.8333	0.010	0.006	0.000	0.058
2.8667	0.010	0.006	0.000	0.058
2.9000	0.010	0.006	0.000	0.058
2.9333	0.010	0.006	0.000	0.058
2.9667	0.010	0.006	0.038	0.058
3.0000	0.010	0.006	0.129	0.058

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.23
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.015
Total Impervious Area:0.215

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.000296
5 year	0.00072
10 year	0.001238
25 year	0.002348
50 year	0.003675
100 year	0.005632

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

Stream Protection Duration

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.000	0.000
1950	0.001	0.000
1951	0.001	0.000
1952	0.000	0.000
1953	0.000	0.000
1954	0.002	0.000
1955	0.001	0.015
1956	0.000	0.000
1957	0.000	0.000
1958	0.000	0.069
1959	0.001	0.000
1960	0.000	0.000
1961	0.001	0.222
1962	0.000	0.000
1963	0.000	0.000
1964	0.001	0.000
1965	0.000	0.000
1966	0.000	0.000
1967	0.001	0.158
1968	0.000	0.000
1969	0.000	0.051
1970	0.000	0.000
1971	0.001	0.000
1972	0.000	0.079
1973	0.000	0.000
1974	0.001	0.000
1975	0.000	0.000
1976	0.001	0.000
1977	0.000	0.000
1978	0.000	0.000
1979	0.001	0.017
1980	0.000	0.000
1981	0.000	0.000
1982	0.000	0.000
1983	0.000	0.000
1984	0.000	0.000

1985	0.000	0.000
1986	0.002	0.000
1987	0.002	0.000
1988	0.000	0.000
1989	0.000	0.000
1990	0.000	0.000
1991	0.000	0.000
1992	0.000	0.000
1993	0.000	0.000
1994	0.000	0.000
1995	0.000	0.000
1996	0.003	0.000
1997	0.007	0.000
1998	0.000	0.045
1999	0.000	0.000
2000	0.000	0.034
2001	0.000	0.000
2002	0.000	0.000
2003	0.000	0.000
2004	0.000	0.073
2005	0.000	0.000
2006	0.008	0.000
2007	0.000	0.000
2008	0.000	0.000
2009	0.000	0.000

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0084	0.2223
2	0.0074	0.1583
3	0.0032	0.0790
4	0.0023	0.0735
5	0.0018	0.0694
6	0.0015	0.0513
7	0.0013	0.0452
8	0.0012	0.0343
9	0.0012	0.0169
10	0.0008	0.0145
11	0.0008	0.0000
12	0.0007	0.0000
13	0.0006	0.0000
14	0.0006	0.0000
15	0.0006	0.0000
16	0.0005	0.0000
17	0.0005	0.0000
18	0.0005	0.0000
19	0.0005	0.0000
20	0.0004	0.0000
21	0.0004	0.0000
22	0.0004	0.0000
23	0.0003	0.0000
24	0.0002	0.0000
25	0.0002	0.0000
26	0.0002	0.0000
27	0.0002	0.0000

28	0.0002	0.0000
29	0.0002	0.0000
30	0.0002	0.0000
31	0.0002	0.0000
32	0.0002	0.0000
33	0.0002	0.0000
34	0.0002	0.0000
35	0.0002	0.0000
36	0.0002	0.0000
37	0.0002	0.0000
38	0.0002	0.0000
39	0.0002	0.0000
40	0.0002	0.0000
41	0.0002	0.0000
42	0.0002	0.0000
43	0.0002	0.0000
44	0.0002	0.0000
45	0.0002	0.0000
46	0.0002	0.0000
47	0.0002	0.0000
48	0.0002	0.0000
49	0.0002	0.0000
50	0.0002	0.0000
51	0.0002	0.0000
52	0.0002	0.0000
53	0.0002	0.0000
54	0.0002	0.0000
55	0.0002	0.0000
56	0.0002	0.0000
57	0.0002	0.0000
58	0.0002	0.0000
59	0.0002	0.0000
60	0.0002	0.0000
61	0.0001	0.0000

Stream Protection Duration
POC #1
The Facility FAILED

Facility FAILED duration standard for 1+ flows.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0001	1657	44	2	Pass
0.0002	271	44	16	Pass
0.0002	152	44	28	Pass
0.0003	129	44	34	Pass
0.0003	112	44	39	Pass
0.0003	99	44	44	Pass
0.0004	81	44	54	Pass
0.0004	69	44	63	Pass
0.0004	61	44	72	Pass
0.0005	58	44	75	Pass
0.0005	53	44	83	Pass
0.0005	50	44	88	Pass
0.0006	49	44	89	Pass
0.0006	45	44	97	Pass

0.0006	42	44	104	Pass
0.0007	38	44	115	Fail
0.0007	36	44	122	Fail
0.0008	33	44	133	Fail
0.0008	31	44	141	Fail
0.0008	29	44	151	Fail
0.0009	29	44	151	Fail
0.0009	29	44	151	Fail
0.0009	26	44	169	Fail
0.0010	26	44	169	Fail
0.0010	26	44	169	Fail
0.0010	25	44	176	Fail
0.0011	23	43	186	Fail
0.0011	23	43	186	Fail
0.0011	23	43	186	Fail
0.0012	22	43	195	Fail
0.0012	20	43	215	Fail
0.0013	19	43	226	Fail
0.0013	18	43	238	Fail
0.0013	16	43	268	Fail
0.0014	16	43	268	Fail
0.0014	16	43	268	Fail
0.0014	15	43	286	Fail
0.0015	15	43	286	Fail
0.0015	15	43	286	Fail
0.0015	14	43	307	Fail
0.0016	13	43	330	Fail
0.0016	13	43	330	Fail
0.0016	13	43	330	Fail
0.0017	13	43	330	Fail
0.0017	13	43	330	Fail
0.0018	13	43	330	Fail
0.0018	11	43	390	Fail
0.0018	11	43	390	Fail
0.0019	11	43	390	Fail
0.0019	11	43	390	Fail
0.0019	11	43	390	Fail
0.0020	11	43	390	Fail
0.0020	11	43	390	Fail
0.0020	11	43	390	Fail
0.0021	11	43	390	Fail
0.0021	11	43	390	Fail
0.0021	11	43	390	Fail
0.0022	11	43	390	Fail
0.0022	11	43	390	Fail
0.0022	11	43	390	Fail
0.0023	10	43	430	Fail
0.0023	9	43	477	Fail
0.0024	9	43	477	Fail
0.0024	9	43	477	Fail
0.0024	9	43	477	Fail
0.0025	9	43	477	Fail
0.0025	9	43	477	Fail
0.0025	9	43	477	Fail
0.0026	8	43	537	Fail
0.0026	7	43	614	Fail
0.0026	7	43	614	Fail

0.0027	7	43	614	Fail
0.0027	7	43	614	Fail
0.0027	7	43	614	Fail
0.0028	7	43	614	Fail
0.0028	7	43	614	Fail
0.0029	7	43	614	Fail
0.0029	7	43	614	Fail
0.0029	7	43	614	Fail
0.0030	7	43	614	Fail
0.0030	7	43	614	Fail
0.0030	7	43	614	Fail
0.0031	7	43	614	Fail
0.0031	7	43	614	Fail
0.0031	7	43	614	Fail
0.0032	6	43	716	Fail
0.0032	6	43	716	Fail
0.0032	6	43	716	Fail
0.0033	6	43	716	Fail
0.0033	6	43	716	Fail
0.0034	6	43	716	Fail
0.0034	6	43	716	Fail
0.0034	6	43	716	Fail
0.0035	6	43	716	Fail
0.0035	5	43	860	Fail
0.0035	5	43	860	Fail
0.0036	5	43	860	Fail
0.0036	5	43	860	Fail
0.0036	5	43	860	Fail
0.0037	5	43	860	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

LID Technique   Used for   Total Volume   Volume   Infiltration   Cumulative
Percent   Water Quality   Percent   Comment
                                 Treatment?   Needs   Through   Volume   Volume
Volume   Water Quality
                                               Treatment   Facility   (ac-ft.)   Infiltration
Infiltrated   Treated
                                               (ac-ft)   (ac-ft)   Credit

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Gravel Trench Bed 1 POC   N   37.73   N   99.89
Total Volume Infiltrated   37.73   0.00   0.00
99.89   0.00   0%   No Treat. Credit
Compliance with LID Standard 8
Duration Analysis Result = Failed

Perlnd and Implnd Changes

No changes have been made.