



INSIGHT ENGINEERING CO.



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**STORMWATER SITE PLAN  
For  
C&C COTTAGES**

**Prepared for**  
City of Mukilteo  
11930 Cyrus Way  
Mukilteo, WA 98275  
425.290.1013

**Applicant:**  
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**Project Site**  
**Location:**  
7816 & 7820 44<sup>th</sup> Ave W  
Mukilteo, WA 98275

**IECO Project:** 21-1138

**Certified Erosion and Sedimentation Control Lead:**  
Brian R. Kalab, P.E.

**Stormwater Site Plan Prepared by:**  
Shilpa Xavier, E. I. T.

**Stormwater Site Plan Preparation Date:**  
November 23, 2021

**Approximate Construction Date:**  
May 1, 2022



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### Acronyms and Abbreviations

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|               |  |
|---------------|--|
| <b>BMP</b>    | <b>Best Management Practices</b>                           |
| <b>DOE</b>    | <b>Department of Ecology</b>                               |
| <b>EDDS</b>   | <b>Engineering Design and Development Standards</b>        |
| <b>ESC</b>    | <b>Erosion and Sediment Control</b>                        |
| <b>IECO</b>   | <b>Insight Engineering Company</b>                         |
| <b>MR</b>     | <b>Minimum Requirement</b>                                 |
| <b>SCDM</b>   | <b>Snohomish County Drainage Manual</b>                    |
| <b>SWPPP</b>  | <b>Stormwater Pollution Prevention Plan</b>                |
| <b>SWMMWW</b> | <b>Stormwater Management Manual for Western Washington</b> |
| <b>TESC</b>   | <b>Temporary Erosion and Sediment Control</b>              |
| <b>WWHM</b>   | <b>Western Washington Hydrology Model</b>                  |

## SECTION I: PROJECT DESCRIPTION

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The proposed project ***C&C Cottages*** is located at 7816 & 7820 44<sup>th</sup> Ave W, Mukilteo, WA 98275. More generally the site is in Section 9, Township 28 North, and Range 4 East of the Willamette Meridian in the City of Mukilteo, Washington. Please refer to the Vicinity Map attached later in the section.

The site contains 0.76 Acres. The site is currently developed with two existing houses and access from 44<sup>th</sup> Ave W. The remainder of the site exists as residential landscaping with few trees. The site contains one drainage basin that slopes to the northeast. Please refer to the downstream analysis under Section VIII for more details. Per NRCS survey of Snohomish County, the project site contains Alderwood soils that have a hydrologic classification of Type “C”. Please refer to the soils map and descriptions attached later in this report for more details.

The proposal is to construct seven cottages with associated utilities. The access to the site will from the 44<sup>th</sup> Ave W. Flow control will be met by an underground Stormtank (4,219 SF-ft X 3-ft) which will be located underneath the drive aisle. This stormtank will comprise of ST-36 chambers that provide a total storage capacity of 11,390 CF. The Stormtank was sized using Western Washington Hydrology Model V 4.2.17 (WWHM). The roof and the yard drains will be connected to the onsite detention system. Water quality will be met by a filter upstream of detention. The outflow from the stormtank will be discharged to the proposed drainage system along 44th Ave W.

Per Minimum Requirement #5 (Section 2.5.5 of the SWMMWW), the following NPGIS BMP’s shall be applied to provide onsite stormwater management and must be considered in the following order per List #2: Full Dispersion, Infiltration, Bioretention, Basic Dispersion, and then Perforated Stub-Out Connections. The roof will be connected to the onsite detention system. The following BMP’s shall be applied to the other hard surfaces: Full dispersion, Permeable Pavement, Bioretention, and then Dispersion. The

road and driveways will be directed to the onsite detention system through catch basins. Post-Construction Soil Quality and Depth BMP T.5.13 is proposed to provide onsite stormwater management for the pervious areas of the site. Please refer to Section VI Appendix B for LID Feasibility Analysis Table.

## **2014 SWMMWW MINIMUM REQUIREMENTS SUMMARY**

**MR : MINIMUM REQUIREMENT**  
**SSP : STORMWATER SITE PLAN**

### **MR #1 PREPARATION OF STORMWATER SITE PLAN:**

Stormwater site plan follows 2014 Stormwater Management Manual for Western Washington.

### **MR #2 CONSTRUCTION OF STORMWATER POLLUTION PREVENTION PLAN (SWPPP):**

A SWPPP is provided under Section IV.

**MR #3 SOURCE CONTROL OF POLLUTION:** Onsite BMP's will be used to minimize the source pollutant sources that include parts/vehicle cleaning, spills/leaks of fuel and other liquids, replacement of liquids, outdoor storage of batteries/liquids/parts, and vehicle parking.

### **MR #4 PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND**

**OUTFALLS:** The outflow from the stormtank will be discharged to the proposed drainage system along 44th Ave W.

**MR #5 ONSITE STORMWATER MANAGEMENT:** Per Minimum Requirement #5 (Section 2.5.5 of the SWMMWW), the following NPGIS BMP's shall be applied to provide onsite stormwater management and must be considered in the following order per List #2: Full Dispersion, Infiltration, Bioretention, Basic Dispersion, and then Perforated Stub-Out Connections. The roof will be connected to the onsite detention system. The following BMP's shall be applied to the other hard surfaces: Full dispersion, Permeable Pavement, Bioretention, and then Dispersion. The road and driveways will be directed to the onsite detention system through catch basins. Post-Construction Soil Quality and Depth BMP T.5.13 is proposed to provide onsite stormwater management for the pervious areas of the site. Please refer to Section VI Appendix B for LID Feasibility Analysis Table.

**MR #6 RUNOFF TREATMENT:** Water quality will be met by a filter upstream of detention.

**MR #7 FLOW CONTROL:** Flow control and water quality requirements will be met by an underground Stormtank (4,219 SF-ft X 3-ft) which will be located underneath the drive aisle. The stormtank will provide a total storage capacity of 11,390 CF. The Stormtank was sized using Western Washington Hydrology Model V 4.2.17 (WVHM). The roof and the yard drains will be connected to the onsite detention system. Water quality will be met by a filter upstream of detention. The outflow from the stormtank will be discharged to the proposed drainage system along 44th Ave W.

**MR #8 WETLANDS PROTECTION:** There are no wetlands present onsite.

**MR #9 OPERATIONS AND MAINTENANCE:** An Operation and Maintenance Manual will be provided for the construction submittal.

## SECTION II: SITE ASSESSMENT

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Based on the site reconnaissance and the available topography we have the following info:

- Topography: The clearing area slopes moderately to the northeast. Refer to the grading plan for more details.
- Drainage: The site contains one existing drainage that drains to the northeast of the site.
- Soils: Per NRCS survey of Snohomish County, the project site contains Alderwood gravelly sandy loam, 2 to 8 percent slopes. Refer to the attached soil map later in this report.
- Ground Cover: The site is currently developed with two existing homes and access from 44<sup>th</sup> Ave W. The remainder of the site exists as residential landscaping.
- Critical areas: NA
- The property access has from 44<sup>th</sup> Ave W.

## VICINITY MAP



PHOTO TAKEN FROM PDS PORTAL



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Info@insightengineering.net

## VICINITY MAP C&C Cottages Mukilteo, Washington

**SCALE:**  
NONE

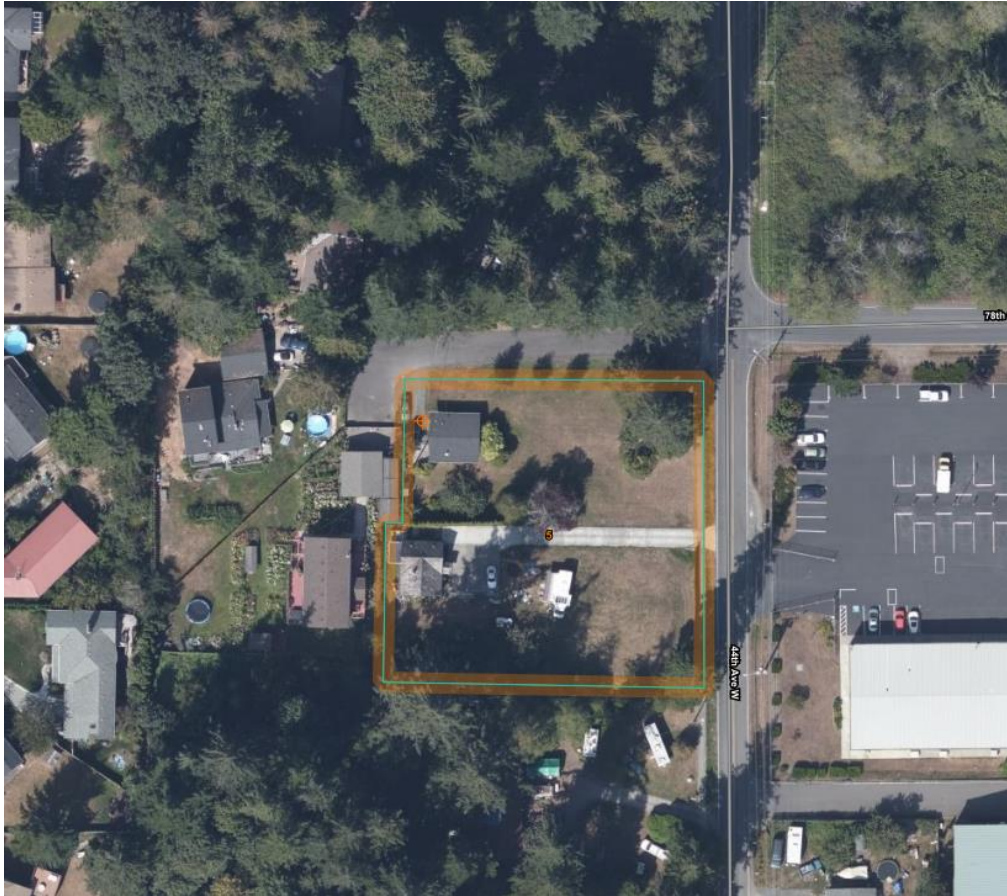
**DATE:** 1/7/22

**JOB #:** 21-1108

**BY:** SX

**FILE NAME:**  
21-1108/doc/StormwaterSitePlan

## ***SOIL MAP***



### **SOILS LEGEND**

**5– Alderwood-Urban land complex, 2 to 8 percent slopes**



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### **SOIL MAP C&C Cottages Mukilteo, Washington**

**SCALE:**  
NONE

**DATE:** 1/7/22

**JOB #:** 21-1138

**BY:** SX

**FILE NAME:**  
21-1138\docs\StormwaterSitePlan

## Snohomish County Area, Washington

5—Alderwood-Urban land complex, 2 to 8 percent slopes

### Map Unit Setting

- *National map unit symbol:* 2hz9
- *Elevation:* 50 to 800 feet
- *Mean annual precipitation:* 25 to 60 inches
- *Mean annual air temperature:* 48 to 52 degrees F
- *Frost-free period:* 180 to 220 days
- *Farmland classification:* Not prime farmland

### Map Unit Composition

- *Alderwood and similar soils:* 60 percent
- *Urban land:* 25 percent
- *Minor components:* 15 percent
- *Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Alderwood

#### Setting

- *Landform:* Till plains
- *Parent material:* Basal till

#### Typical profile

- *H1 - 0 to 7 inches:* gravelly ashy sandy loam
- *H2 - 7 to 35 inches:* very gravelly ashy sandy loam
- *H3 - 35 to 60 inches:* gravelly sandy loam

#### Properties and qualities

- *Slope:* 2 to 8 percent
- *Depth to restrictive feature:* 20 to 40 inches to densic material
- *Natural drainage class:* Moderately well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
- *Depth to water table:* About 18 to 36 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Available water storage in profile:* Low (about 3.0 inches)

#### Interpretive groups

- *Land capability classification (irrigated):* None specified
- *Land capability classification (nonirrigated):* 4s
- *Hydrologic Soil Group:* B
- *Forage suitability group:* Limited Depth Soils (G002XN302WA)
- *Hydric soil rating:* No

### Minor Components

#### Mckenna

- *Percent of map unit:* 5 percent

- *Landform: Depressions*
- *Hydric soil rating: Yes*

**Norma, undrained**

- *Percent of map unit: 5 percent*
- *Landform: Depressions*
- *Hydric soil rating: Yes*

**Terric medisaprists, undrained**

- *Percent of map unit: 5 percent*
- *Landform: Depressions*
- *Hydric soil rating: Yes*

### SECTION III: SITE DEVELOPMENT PLAN W/ON-SITE STORMWATER MANAGEMENT

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The proposal is to construct fourteen cottages with associated utilities. The access to the site will from the 44th Ave W. Flow control and water quality requirements will be met by an underground Stormtank (4,219 SF-ft X 3-ft) which will be located underneath the drive aisle. The stormtank will provide a total storage capacity of 12,277 CF. The Stormtank was sized using Western Washington Hydrology Model V 4.2.13 (WWHM). The roof and the yard drains will be connected to the onsite detention system. Water quality will be met by a filter upstream of detention. The outflow from the stormtank will be discharged to the proposed drainage system along 44th Ave W.

Per Minimum Requirement #5 (Section 2.5.5 of the SWMMWW), the following NPGIS BMP's shall be applied to provide onsite stormwater management and must be considered in the following order per List #2: Full Dispersion, Infiltration, Bioretention, Basic Dispersion, and then Perforated Stub-Out Connections. The roof will be connected to the onsite detention system. The following BMP's shall be applied to the other hard surfaces: Full dispersion, Permeable Pavement, Bioretention, and then Dispersion. The road and driveways will be directed to the onsite detention system through catch basins. Post-Construction Soil Quality and Depth BMP T.5.13 is proposed to provide onsite stormwater management for the pervious areas of the site. Please refer to Section VI Appendix B for LID Feasibility Analysis Table.

#### SECTION IV: CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

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Please refer to the following pages for SWPPP.

Construction Stormwater General Permit

# Wet Weather Stormwater Pollution Prevention Plan (SWPPP)

for  
C&C COTTAGES

Prepared for:  
The Washington State Department of Ecology  
Northwest Regional Office  
3190 – 160<sup>th</sup> Avenue SE  
Bellevue, WA 98008

| Permittee / Owner             | Developer                     | Operator / Contractor |
|-------------------------------|-------------------------------|-----------------------|
| Meitzner Mukilteo, LLC        | Meitzner Mukilteo, LLC        | To be determined      |
| 11611 Airport Road, Suite B-1 | 11611 Airport Road, Suite B-1 |                       |
| Everett, WA 98204             | Everett, WA 98204             |                       |

## Project Site Location

7816 & 7820 44<sup>th</sup> Ave W  
Mukilteo, WA 98275

## Certified Erosion and Sediment Control Lead (CESCL)

| Name                  | Organization        | Contact Phone Number |
|-----------------------|---------------------|----------------------|
| Brian R. Kalab, P. E. | Insight Engineering | 425-303-9363         |

## SWPPP Prepared By

| Name        | Organization        | Contact Phone Number |
|-------------|---------------------|----------------------|
| Nicole Maas | Insight Engineering | 425-303-9363         |

## SWPPP Preparation Date

November 23, 2021

## Project Construction Dates

| Activity / Phase      | Start Date  | End Date      |
|-----------------------|-------------|---------------|
| Construction Duration | May 1, 2022 | March 1, 2023 |

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- E. Construction Stormwater General Permit (CSWGP)
- F. 303(d) List Waterbodies / TMDL Waterbodies Information
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## List of Acronyms and Abbreviations

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| <b>Acronym / Abbreviation</b> | <b>Explanation</b>  |
|-------------------------------|---|
| <b>303(d)</b>                 | Section of the Clean Water Act pertaining to Impaired Waterbodies |
| <b>BFO</b>                    | Bellingham Field Office of the Department of Ecology              |
| <b>BMP(s)</b>                 | Best Management Practice(s)                                       |
| <b>CESCL</b>                  | Certified Erosion and Sediment Control Lead                       |
| <b>CO<sub>2</sub></b>         | Carbon Dioxide  |
| <b>CRO</b>                    | Central Regional Office of the Department of Ecology              |
| <b>CSWGP</b>                  | Construction Stormwater General Permit                            |
| <b>CWA</b>                    | Clean Water Act   |
| <b>DMR</b>                    | Discharge Monitoring Report                                       |
| <b>DO</b>                     | Dissolved Oxygen  |
| <b>Ecology</b>                | Washington State Department of Ecology                            |
| <b>EPA</b>                    | United States Environmental Protection Agency                     |
| <b>ERO</b>                    | Eastern Regional Office of the Department of Ecology              |
| <b>ERTS</b>                   | Environmental Report Tracking System                              |
| <b>ESC</b>                    | Erosion and Sediment Control                                      |
| <b>GULD</b>                   | General Use Level Designation                                     |
| <b>NPDES</b>                  | National Pollutant Discharge Elimination System                   |
| <b>NTU</b>                    | Nephelometric Turbidity Units                                     |
| <b>NWRO</b>                   | Northwest Regional Office of the Department of Ecology            |
| <b>pH</b>                     | Power of Hydrogen   |
| <b>RCW</b>                    | Revised Code of Washington  |
| <b>SPCC</b>                   | Spill Prevention, Control, and Countermeasure                     |
| <b>su</b>                     | Standard Units  |
| <b>SWMMEW</b>                 | Stormwater Management Manual for Eastern Washington               |
| <b>SWMMWW</b>                 | Stormwater Management Manual for Western Washington               |
| <b>SWPPP</b>                  | Stormwater Pollution Prevention Plan                              |
| <b>TESC</b>                   | Temporary Erosion and Sediment Control                            |
| <b>SWRO</b>                   | Southwest Regional Office of the Department of Ecology            |
| <b>TMDL</b>                   | Total Maximum Daily Load  |
| <b>VFO</b>                    | Vancouver Field Office of the Department of Ecology               |
| <b>WAC</b>                    | Washington Administrative Code                                    |
| <b>WSDOT</b>                  | Washington Department of Transportation                           |
| <b>WWHM</b>                   | Western Washington Hydrology Model                                |

## 1 Project Information

Project/Site Name: C&C Cottages  
Street/Location: 7816 & 7820 44<sup>th</sup> Ave W  
City: Mukilteo State: WA Zip code: 98275  
Subdivision:  
Receiving waterbody: Brewery Creek

### 1.1 Existing Conditions

Total acreage (including support activities such as off-site equipment staging yards, material storage areas, borrow areas).

Total acreage: 0.83 acres

Disturbed acreage: 0.83 acres

Existing structures: 0.13 acres

Landscape 0.70 acres

topography:

Drainage patterns: Sheet Flow

Existing Vegetation: Scattered vegetation.

Critical Areas (wetlands, streams, high erosion No wetland  
risk, steep or difficult to stabilize slopes):

List of known impairments for 303(d) listed or Total Maximum Daily Load (TMDL) for the receiving waterbody:

**Table 1 – Summary of Site Pollutant Constituents**

| Constituent<br>(Pollutant) | Location | Depth | Concentration |
|----------------------------|----------|-------|---------------|
| NA                         | NA       | NA    | NA            |

### 1.2 Proposed Construction Activities

Description of site development (example: subdivision):

The proposal is to construct seven cottages with associated utilities. The access to the site will from the 44<sup>th</sup> Ave W.

Description of construction activities (example: site preparation, demolition, excavation):

Prepare the site for construction by the installation of the indicated BMPs. Grade the site for the cottages.

Description of site drainage including flow from and onto adjacent properties. Must be consistent with Site Map in Appendix A:

Flow control and water quality requirements will be met by an underground Stormtank (4,219 SF-ft X 3-ft) which will be located underneath the drive aisle. The stormtank will provide a total

storage capacity of 11,390 CF. The Stormtank was sized using Western Washington Hydrology Model V 4.2.13 (WWHM). The roof and the yard drains will be connected to the onsite detention system. Water quality will be met by a filter upstream of detention. The outflow from the stormtank will be discharged to the proposed drainage system along 44th Ave W.

Description of final stabilization (example: extent of revegetation, paving, landscaping):

The access to the site will from the 44<sup>th</sup> Ave W. Typical residential landscaping will be around the buildings to provide final stabilization.

*Contaminated Site Information:*

Proposed activities regarding contaminated soils or groundwater (example: on-site treatment system, authorized sanitary sewer discharge):

Water quality will be met by a filter upstream of detention.

## 2 Construction Stormwater Best Management Practices (BMPs)

The SWPPP is a living document reflecting current conditions and changes throughout the life of the project. These changes may be informal (i.e., hand-written notes and deletions). Update the SWPPP when the CESCL or local agency has noted a deficiency in BMPs or deviation from original design.

### 2.1 The 13 Elements

#### 2.1.1 Element 1: Preserve Vegetation / Mark Clearing Limits

To protect adjacent properties and to reduce the area of soil exposed to construction, the limits of construction will be clearly marked before land-disturbing activities begin. Trees that are to be preserved, as well as all sensitive areas and their buffers, shall be clearly delineated, both in the field and on the plans. In general, natural vegetation and native topsoil shall be retained in an undisturbed state to the maximum extent possible.

A protective barrier shall be placed around the protected trees prior to land preparation or construction activities, and shall remain in place until all construction activity is terminated. No equipment, chemicals, soil deposits or construction materials shall be placed within the protective barriers. Any landscaping activities subsequent to the removal of the barriers shall be accomplished with light machinery or hand labor. (LMC 17.15.160 B1)

List and describe BMPs:

- Silt Fence (BMP C233)

Install orange barrier fencing along the clearing limits, according to the approved construction plans, prior to any construction activities. Maintain until all construction activities are completed.

Installation Schedules: The limits of construction will be clearly marked before land-disturbing activities begin.

Inspection and Maintenance plan: Site inspections will be conducted at least once a week and within 24 hours following any rainfall event which causes a discharge of stormwater from the site. For sites with temporary stabilization measures, the site inspection frequency can be reduced to once every month. **During the wet season, inspections must be made daily.**

Responsible Staff: Permittee shall take immediate action(s) to: stop, contain, and clean up the unauthorized discharges, or otherwise stop the noncompliance; correct the problem(s); implement appropriate Best Management Practices (BMPs), and/or conduct maintenance of existing BMPs; and achieve compliance with all applicable standards and permit conditions. In addition, if the noncompliance causes a threat to human health or the environment, the Permittee

shall comply with the Noncompliance Notification requirements in Special Condition S5.F of the permit.

### **2.1.2 Element 2: Establish Construction Access**

Construction access or activities occurring on unpaved areas shall be minimized, yet where necessary, access points shall be stabilized to minimize the tracking of sediment onto public roads, street sweeping, and street cleaning shall be employed to prevent sediment from entering state waters.

List and describe BMPs:

- Stabilized Construction Entrance (BMP C105)

Installation Schedules: Install the temporary construction entrance, according to the approved construction plans, prior to any clearing or grading activities

Inspection and Maintenance plan: Maintain until the access road is paved.

Responsible Staff: Contractor.

### 2.1.3 Element 3: Control Flow Rates

In order to protect the properties and waterways downstream of the project site, stormwater discharges from the site will be controlled. In general, discharge rates of stormwater from the site will be controlled where increases in impervious area or soil compaction during construction could lead to downstream erosion, or where necessary to meet local agency stormwater discharge requirements (e.g. discharge to combined sewer systems).

Will you construct stormwater retention and/or detention facilities?

☒ Yes ☐ No

Will you use permanent infiltration ponds or other low impact development (example: rain gardens, bio-retention, porous pavement) to control flow during construction?

☐ Yes ☒ No

List and describe BMPs: • Temporary sediment Pond (BMP C241)

- Check dams

Installation Schedules: Install orange high rise fencing along the clearing limits, according to the approved construction plans, prior to any construction activities.

Inspection and Maintenance plan: Maintain until all construction activities are completed.

Responsible Staff: Contractor

#### **2.1.4 Element 4: Install Sediment Controls**

Whenever possible, sediment laden water shall be discharged into onsite, relatively level, vegetated areas (BMP C240 paragraph 5, page 4-102).

In some cases, sediment discharge in concentrated runoff can be controlled using permanent stormwater BMPs (e.g., infiltration swales, ponds, trenches). Sediment loads can limit the effectiveness of some permanent stormwater BMPs, such as those used for infiltration or bio-filtration; however, those BMPs designed to remove solids by settling (wet ponds or detention ponds) can be used during the construction phase. When permanent stormwater BMPs will be used to control sediment discharge during construction, the structure will be protected from excessive sedimentation with adequate erosion and sediment control BMPs. Any accumulated sediment shall be removed after construction is complete and the permanent stormwater BMP will be re-stabilized with vegetation per applicable design requirements once the remainder of the site has been stabilized.

The following BMP will be implemented as end-of-pipe sediment controls as required to meet permitted turbidity limits in the site discharge(s). Prior to the implementation of these technologies, sediment sources and erosion control and soil stabilization BMP efforts will be maximized to reduce the need for end-of-pipe sedimentation controls. In addition, sediment will be removed from paved areas in and adjacent to construction work areas manually or using mechanical sweepers, as needed, to minimize tracking of sediments on vehicle tires away from the site and to minimize wash-off of sediments from adjacent streets in runoff.

List and describe BMPs:

- Silt Fence (BMP C233)
- Storm Drain Inlet Protection (BMP C220)
- Temporary sediment Pond (BMP C241)

Installation Schedules: Install silt fencing, according to the approved plans, prior to any clearing or grading activities. Install catch basin filters, according to the approved construction plans, as catch basins are installed and become operable.

Inspection and Maintenance plan: Maintain Silt Fence and Storm Drain Inlet Protection until all construction activities are completed.

Responsible Staff: Contractor.

### 2.1.5 Element 5: Stabilize Soils

The project site is located west of the Cascade Mountain Crest. As such, no soils shall remain exposed and unworked for more than 7 days during the dry season (May 1 to September 30) and 2 days during the wet season (October 1 to April 30). Regardless of the time of year, all soils shall be stabilized at the end of the shift before a holiday or weekend if needed based on weather forecasts.

In general, cut and fill slopes will be stabilized as soon as possible and soil stockpiles will be temporarily covered with plastic sheeting. All stockpiled soils shall be stabilized from erosion, protected with sediment trapping measures, and where possible, be located away from storm drain inlets, waterways, and drainage channels.

#### **West of the Cascade Mountains Crest**

| Season                | Dates                | Number of Days Soils Can be Left Exposed |
|-----------------------|----------------------|--|
| During the Dry Season | May 1 – September 30 | 7 days                                   |
| During the Wet Season | October 1 – April 30 | 2 days                                   |

Soils must be stabilized at the end of the shift before a holiday or weekend if needed based on the weather forecast. **All disturbed, unworked areas must be covered at all times.**

Anticipated project dates: Start date: May 1, 2022 End date: March 1, 2023

Will you construct during the wet season?

☒ Yes ☐ No

List and describe BMPs:

Exposed and un-worked soils shall be stabilized with the application of effective BMPs to prevent erosion throughout the life of the project. The specific BMPs for soil stabilization that shall be used on this project include:

- Temporary and Permanent Seeding (BMP C120)

Installation Schedules:

Apply temporary hydro-seed to exposed and un-worked soils, according to the approved construction plans, as needed to prevent erosion during site grading.

Inspection and Maintenance plan:

Apply permanent hydro-seed to areas at final grade as site grading is completed.

- Mulching (BMP C121)

Installation Schedules:

Apply mulching to exposed and un-worked soils, according to the approved construction plans, as needed to prevent erosion during site grading.

Inspection and Maintenance plan:

Maintain until site grading is completed and permanent hydro-seed is applied.

- Plastic Covering (BMP C123)

Installation Schedules:

Cover stockpiles with plastic sheeting, according to the approved construction plans, as needed to prevent erosion during site grading.

Inspection and Maintenance plan:

Maintain until stockpiles are removed from site.

- Dust Control (BMP C140)

Installation Schedules and Inspection and Maintenance plan:

- ☐ Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.
- ☐ Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition. Maintain the original ground cover as long as practical.
- ☐ Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.
- ☐ Sprinkle the site with water until surface is wet. Repeat as needed. To prevent carryout of mud onto street, refer to Stabilized Construction Entrance (BMP C105).
- ☐ Irrigation water can be used for dust control. Irrigation systems should be installed as a first step on sites where dust control is a concern.
- ☐ Spray exposed soil areas with a dust palliative, following the manufacturer's instructions and cautions regarding handling and application. Used oil is prohibited from use as a dust suppressant. Local governments may approve other dust palliatives such as calcium chloride or PAM.
- ☐ PAM (BMP C126) added to water at a rate of 0.5 lbs. per 1,000 gallons of water per acre and applied from a water truck is more effective than water alone. This is due to increased infiltration of water into the soil and reduced evaporation. In addition, small soil particles are bonded together and are not as easily transported by wind. Adding PAM may actually reduce the quantity of water needed for dust control. Use of PAM could be a cost-effective dust control method.

Techniques that can be used for unpaved roads and lots include:

- ☐ Lower speed limits. High vehicle speed increases the amount of dust stirred up from unpaved roads and lots.
- ☐ Upgrade the road surface strength by improving particle size, shape, and mineral types that make up the surface and base materials.
- ☐ Add surface gravel to reduce the source of dust emission. Limit the amount of fine particles (those smaller than .075 mm) to 10 to 20 percent.
- ☐ Use geotextile fabrics to increase the strength of new roads or roads undergoing reconstruction.
- ☐ Encourage the use of alternate, paved routes, if available.
- ☐ Restrict use of paved roadways by tracked vehicles and heavy trucks to prevent damage to road surface and base.
- ☐ Apply chemical dust suppressants using the admix method, blending the product with the top few inches of surface material. Suppressants may also be applied as surface treatments.
- ☐ Pave unpaved permanent roads and other trafficked areas.
- ☐ Use vacuum street sweepers.
- ☐ Remove mud and other dirt promptly so it does not dry and then turn into dust.
- ☐ Limit dust-causing work on windy days.

□ Contact your local Air Pollution Control Authority for guidance and training on other dust control measures. Compliance with the local Air Pollution Control Authority constitutes compliance with this BMP.

- Early application of gravel base on areas to be paved  
Place gravel base on roadways, according to the approved construction plans, after roadways are graded to sub-grade. Maintain until roads are paved.

Responsible Staff: Contractor.

### **2.1.6 Element 6: Protect Slopes**

All cut and fill slopes will be designed, constructed, and protected in a manner than minimizes erosion. The following specific BMPs will be used to protect slopes for this project:

Will steep slopes be present at the site during construction?

☐ Yes ☒ No

List and describe BMPs:

- Temporary and Permanent Seeding (BMP C120)
- Mulching (BMP C121)
- Interceptor Dike and swale
- Check Dams

Installation Schedules: Apply temporary hydro-seed to cut and fill slopes, according to the approved construction plans, as needed to minimize erosion during site grading.

Inspection and Maintenance plan: Apply permanent hydro-seed to cut and fill slopes at final grade as site grading is completed.

Responsible Staff: Contractor

### **2.1.7 Element 7: Protect Drain Inlets**

All storm drain inlets and culverts made operable during construction shall be protected to prevent unfiltered or untreated water from entering the drainage conveyance system. However, the first priority is to keep all access roads clean of sediment and keep street wash water separate from entering storm drains until treatment can be provided. Storm Drain Inlet Protection (BMP C220) will be implemented for all drainage inlets and culverts that could potentially be impacted by sediment-laden runoff on and near the project site.

List and describe BMPs:

- Stormdrain Inlet Protection

Installation Schedules: Install catch basin filters, according to the approved construction plans, as catch basins become operable.

Inspection and Maintenance plan: Maintain until all construction activities are completed.

Responsible Staff: Contractor

### **2.1.8 Element 8: Stabilize Channels and Outlets**

No site runoff is to be conveyed into channels, or discharged to a stream or some other natural drainage point.— The onsite flowrates will be minimal therefore no BMPs are proposed Stabilize Channels and Outlets.

If any BMPs are provided, the project site is located west of the Cascade Mountain Crest. As such, all temporary on-site conveyance channels shall be designed, constructed, and stabilized to prevent erosion from the expected peak 10 minute velocity of flow from a Type 1A, 10-year, 24-hour recurrence interval storm for the developed condition. Alternatively, the 10-year, 1-hour peak flow rate indicated by an approved continuous runoff simulation model, increased by a factor of 1.6, shall be used. Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches shall be provided at the outlets of all conveyance systems.

|  |
|--|
| Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches, will be installed at the outlets of all conveyance systems. |
|--|

### 2.1.9 Element 9: Control Pollutants

The following pollutants are anticipated to be present on-site:

**Table 2 – Pollutants**

| Pollutant (List pollutants and source, if applicable) |
|---|
| petroleum products                                    |
| chemicals stored in the construction areas            |
| Solid waste   |
| Dust released from demolished sidewalks               |
|   |
|   |
|   |

All pollutants, including waste materials and demolition debris, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well organized, and free of debris. If required, BMPs to be implemented to control specific sources of pollutants are discussed below.

Vehicles, construction equipment, and/or petroleum product storage/dispensing:

- ☐ All vehicles, equipment, and petroleum product storage/dispensing areas will be inspected regularly to detect any leaks or spills, and to identify maintenance needs to prevent leaks or spills.
- ☐ On-site permanent fueling tanks and petroleum product storage containers shall include secondary containment.
- ☐ Spill prevention measures, such as drip pans, will be used when conducting maintenance and repair of vehicles or equipment.
- ☐ In order to perform emergency repairs on site, temporary plastic will be placed beneath and, if raining, over the vehicle.
- ☐ Contaminated surfaces shall be cleaned immediately following any discharge or spill incident.

Chemical storage:

- ☐ Any chemicals stored in the construction areas will conform to the appropriate source control BMPs listed in Volume IV of the Ecology stormwater manual. In Western WA, all chemicals shall have cover, containment, and protection provided on site, per BMP C153 for Material Delivery, Storage and Containment in SWMMWW 2005

Excavation and tunneling spoils dewatering waste:

- ☐ Dewatering BMPs and BMPs specific to the excavation and tunneling (including handling of contaminated soils) are discussed under Element 10.

Demolition:

- ☐ Dust released from demolished sidewalks, buildings, or structures will be controlled using Dust Control measures (BMP C140).
- ☒ Storm drain inlets vulnerable to stormwater discharge carrying dust, soil, or debris will be protected using Storm Drain Inlet Protection (BMP C220 as described above for Element 7).

☐ Process water and slurry resulting from saw-cutting and surfacing operations will be prevented from entering the waters of the State by implementing Saw-cutting and Surfacing Pollution Prevention measures (BMP C152).

Concrete and grout:

☐ Process water and slurry resulting from concrete work will be prevented from entering the waters of the State by implementing Concrete Handling measures (BMP C151).

Sanitary wastewater:

☐ Portable sanitation facilities will be firmly secured, regularly maintained, and emptied when necessary.

Solid Waste:

☐ Solid waste will be stored in secure, clearly marked containers.

Other:

☐ Other BMPs will be administered as necessary to address any additional pollutant sources on site.

A SPCC plan is required for this site.

As per the Federal regulations of the Clean Water Act (CWA) and according to Final Rule 40 CFR Part 112, as stated in the National Register, a Spill Prevention, Control, and Countermeasure (SPCC) Plan is required for construction activities. A SPCC Plan has been prepared to address an approach to prevent, respond to, and report spills or releases to the environment that could result from construction activities. This Plan must:

☐ Be well thought out in accordance with good engineering;

List and describe BMPs: Material Delivery, Storage and Containment (BMP C153),  
Concrete Handling (BMP C151),  
Sawcutting and Surfacing Pollution Protection (BMP C152),

Installation Schedules:

Inspection and Maintenance plan: All pollutants, including waste materials and demolition debris, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well organized, and free of debris.

Achieve three objectives - prevent spills, contain a spill that occurs, and clean up the spill;

- ☐ Identify the name, location, owner, and type of facility;
- ☐ Include the date of initial operation and oil spill history;
- ☐ Name the designated person responsible;
- ☐ Show evidence of approval and certification by the person in authority; and
- ☐ Contain a facility analysis.

Responsible Staff: Contractor.

Will maintenance, fueling, and/or repair of heavy equipment and vehicles occur on-site?

☐ Yes ☒ No

Will wheel wash or tire bath system BMPs be used during construction?

☒ Yes ☐ No

Will pH-modifying sources be present on-site?

☒ Yes ☐ No

**Table 3 – pH-Modifying Sources**

|                                     |  |
|-------------------------------------|--|
| <input type="checkbox"/>            | None   |
| <input checked="" type="checkbox"/> | Bulk cement  |
| <input checked="" type="checkbox"/> | Cement kiln dust   |
| <input checked="" type="checkbox"/> | Fly ash  |
| <input checked="" type="checkbox"/> | Other cementitious materials                               |
| <input checked="" type="checkbox"/> | New concrete washing or curing waters                      |
| <input checked="" type="checkbox"/> | Waste streams generated from concrete grinding and sawing  |
| <input checked="" type="checkbox"/> | Exposed aggregate processes                                |
| <input checked="" type="checkbox"/> | Dewatering concrete vaults                                 |
| <input type="checkbox"/>            | Concrete pumping and mixer washout waters                  |
| <input type="checkbox"/>            | Recycled concrete  |
| <input type="checkbox"/>            | Recycled concrete stockpiles                               |
| <input type="checkbox"/>            | Other (i.e., calcium lignosulfate) [please describe:     ] |

Stormwater runoff will be monitored for pH starting on the first day of any activity that includes more than 40 yards of poured or recycled concrete, or after the application of “Engineered Soils” such as, Portland cement treated base, cement kiln dust, or fly ash. This does not include fertilizers. For concrete work, pH monitoring will start the first day concrete is poured and continue until 3 weeks after the last pour. For engineered soils, the pH monitoring period begins when engineered soils are first exposed to precipitation and continue until the area is fully stabilized.

Stormwater samples will be collected daily from all points of discharge from the site and measured for pH using a calibrated pH meter, pH test kit, or wide range pH indicator paper. If the measured pH is 8.5 or greater, the following steps will be conducted:

1. Prevent the high pH water from entering storm drains or surface water.
2. Adjust or neutralize the high pH water if necessary using appropriate technology such as CO<sub>2</sub> sparging (liquid or dry ice).
3. Contact Ecology if chemical treatment other than CO<sub>2</sub> sparging is planned.

Concrete trucks must not be washed out onto the ground, or into storm drains, open ditches, streets, or streams. Excess concrete must not be dumped on-site, except in designated concrete washout areas with appropriate BMPs installed. Excess concrete must be returned to the plant for recycling if there are no concrete washout areas with appropriate BMPs installed.

Will uncontaminated water from water-only based shaft drilling for construction of building, road, and bridge foundations be infiltrated provided the wastewater is managed in a way that prohibits discharge to surface waters?

☒ Yes ☐ No

Spill kits must be made available at all times on-site in the case of an emergency spill.

### 2.1.10 Element 10: Control Dewatering

No dewatering is proposed for the development. If dewatering is needed, Transport. off-site in a vehicle (vacuum truck for legal disposal).

**Table 4 – Dewatering BMPs**

|                                     |   |
|-------------------------------------|---|
| <input type="checkbox"/>            | Infiltration  |
| <input checked="" type="checkbox"/> | Transport off-site in a vehicle (vacuum truck for legal disposal)                                 |
| <input type="checkbox"/>            | Ecology-approved on-site chemical treatment or other suitable treatment technologies              |
| <input type="checkbox"/>            | Sanitary or combined sewer discharge with local sewer district approval (last resort)             |
| <input type="checkbox"/>            | Use of sedimentation bag with discharge to ditch or swale (small volumes of localized dewatering) |

### **2.1.11 Element 11: Maintain BMPs**

All temporary and permanent Erosion and Sediment Control (ESC) BMPs shall be maintained and repaired as needed to ensure continued performance of their intended function.

Maintenance and repair shall be conducted in accordance with each particular BMP specification (see *Volume II of the SWMMWW* or *Chapter 7 of the SWMMWW*).

List and describe BMPs:

- Materials on hand (BMP C150),
- CESL(BMP C160),

Visual monitoring of all BMPs installed at the site will be conducted at least once every calendar week and within 24 hours of any stormwater or non-stormwater discharge from the site. If the site becomes inactive and is temporarily stabilized, the inspection frequency may be reduced to once every calendar month. During the wet season, inspections must be made daily.

All temporary ESC BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed.

Trapped sediment shall be stabilized on-site or removed. Disturbed soil resulting from removal of either BMPs or vegetation shall be permanently stabilized.

**An on-site stockpile of cover materials in quantities sufficient to cover 50 percent of disturbed surfaces and an on-site stockpile of at least 50 linear feet of silt fence and the necessary stakes per acreage of disturbance must be available at all times during the wet season.**

Additionally, protection must be provided for all BMPs installed for the permanent control of stormwater from sediment and compaction. BMPs that are to remain in place following completion of construction shall be examined and restored to full operating condition. If sediment enters these BMPs during construction, the sediment shall be removed and the facility shall be returned to conditions specified in the construction documents.

### 2.1.12 Element 12: Manage the Project

The project will be managed based on the following principles:

- Projects will be phased to the maximum extent practicable and seasonal work limitations will be taken into account.
- Inspection and monitoring:
  - Inspection, maintenance and repair of all BMPs will occur as needed to ensure performance of their intended function.
  - Site inspections and monitoring will be conducted in accordance with Special Condition S4 of the CSWGP. Sampling locations are indicated on the Site Map. Sampling station(s) are located in accordance with applicable requirements of the CSWGP.
  - Inspections and reports of erosion control measures will occur daily during the wet season. Daily reports will include: weather at the time of inspection, performance of the control measures, and adjustments made to many control measures.
- Maintain an updated SWPPP.
  - The SWPPP will be updated, maintained, and implemented in accordance with Special Conditions S3, S4, and S9 of the CSWGP.

As site work progresses, the SWPPP will be modified routinely to reflect changing site conditions. The SWPPP will be reviewed monthly to ensure the content is current.

List and describe BMPs:

- CESL (BMP C160),
- Scheduling (BMP C162),

**Table 5 – Management**

|                                     |   |
|-------------------------------------|---|
| <input checked="" type="checkbox"/> | Design the project to fit the existing topography, soils, and drainage patterns |
| <input checked="" type="checkbox"/> | Emphasize erosion control rather than sediment control                          |
| <input checked="" type="checkbox"/> | Minimize the extent and duration of the area exposed                            |
| <input checked="" type="checkbox"/> | Keep runoff velocities low  |
| <input checked="" type="checkbox"/> | Retain sediment on-site   |
| <input checked="" type="checkbox"/> | Thoroughly monitor site and maintain all ESC measures                           |
| <input checked="" type="checkbox"/> | Schedule major earthwork during the dry season                                  |
| <input type="checkbox"/>            | Other (please describe)   |

**Table 6 – BMP Implementation Schedule**

| <b>Phase of Construction Project</b>                                 | <b>Stormwater BMPs</b>   | <b>Date</b> | <b>Wet/Dry Season</b> |
|--|--|-------------|-----------------------|
| Mark Clearing Limits   | High Visibility Plastic or Metal Fence (BMP C103)  | 05/01/2022  | Dry                   |
| Mobilize equipment on site   | Construction Road/Parking area stabilization (BMP C107)  | 05/01/2022  | Dry                   |
| Mobilize and store all ESC and soil stabilization products           | Silt Fence (BMP C233)<br>Storm Drain Inlet Protection (BMP C220)<br>Plastic Covering (BMP C123)<br>Surface roughening (BMP C130) | 05/01/2022  | Dry                   |
| Install ESC measures   | Silt Fence (BMP C233)<br>Storm Drain Inlet Protection (BMP C220)   | 05/01/2022  | Dry                   |
| Install stabilized construction entrance                             | Stabilized Construction Entrance (BMP C105)  | 05/01/2022  | Dry                   |
| Begin clearing and grubbing  | Dust Control (BMP C140)  | 05/15/2022  | Dry                   |
| Site grading begins  | Dust Control (BMP C140)  | 05/27/2022  | Dry                   |
| Grade road and stabilize with gravel base                            | Dust Control (BMP C140)  | 05/27/2022  | Dry                   |
| Begin excavation for new utilities and services                      |  | 07/01/2022  | Wet                   |
| Soil stabilization on excavated side slopes (in idle, no work areas) | Mulching (BMP C121)<br>Dust Control (BMP C140)<br>Plastic Covering (BMP C123)<br>Nets and Blankets (BMP C122)                    | 07/05/2022  | Wet                   |
| Temporary erosion control measures (hydro-seeding)                   | Temporary Seeding (BMP C120)   | 09/01/2022  | Wet                   |
| Site grading ends  |  | 09/15/2022  | Wet                   |
| Begin pouring concrete curbs & sidewalks and implement               | BMP C151<br>Concrete Handling (BMP C151)<br>Sawcutting and Surfacing<br>Pollution Prevention (BMP C152)                          | 10/01/2022  | Wet                   |

|   |   |            |     |
|---|---|------------|-----|
| Pave asphalt roads  |   | 11/05/2022 | Wet |
| Implement Element #12 BMPs and manage site to minimize soil disturbance during the wet season | Scheduling (BMP C162)<br>CESC Lead (BMP C160) | 12/01/2022 | Wet |
| Final landscaping and planting begins   |   | 02/1/2023  | Dry |
| Permanent erosion control measures (hydro-seeding)  | Permanent Seeding (BMP C120)                  | 03/01/2023 | Dry |

### 2.1.13 Element 13: Protect Low Impact Development (LID) BMPs

On-site stormwater management BMPs used for runoff from roofs and other hard surfaces include: full dispersion, roof downspout full infiltration or dispersion systems, perforated stubout connections, rain gardens, bioretention systems, permeable pavement, sheetflow dispersion, and concentrated flow dispersion. The areas on the site to be used for these BMPs shall be protected from siltation and compaction during construction by sequencing the construction in a fashion to install these BMPs at the latter part of the construction grading operations, by excluding equipment from the BMPs and the associated areas, and by using the erosion and sedimentation control BMPs listed below. Additional requirements for protecting these BMPs during the construction process, testing functionality, and restoring functionality are needed at the final stage of the construction process.

#### **Relevant BMPs**

- NA

### 3 Pollution Prevention Team

Table 7 – Team Information

| <b>Title</b>   | <b>Name(s)</b>                    | <b>Phone Number</b>  |
|--|-----------------------------------|----------------------|
| <b>Certified Erosion and Sediment Control Lead (CESCL)</b> | Brian Kalab                       | 425-303-9363         |
| <b>Resident Engineer</b>                                   | Brian Kalab / Insight Engineering | 425-303-9363         |
| <b>Emergency Ecology Contact</b>                           | Tracy Walters                     | 425-649-7000         |
| <b>Emergency Permittee/ Owner Contact</b>                  | Mike Metzner                      | (425) 212-2490 X 304 |
| <b>Non-Emergency Owner Contact</b>                         | Mike Metzner                      | (425) 212-2490 X 304 |
| <b>Monitoring Personnel</b>                                | Tony Veslic                       | 253-271-7870         |
| <b>Ecology Regional Office</b>                             | Northwest Regional Office         | 425-649-7000         |

Contractor shall be available 24/7 to call out and direct crews, obtain materials, and authorize immediate expenditures for on-site temporary erosion and sediment control work.

## 4 Monitoring and Sampling Requirements

Monitoring includes visual inspection, sampling for water quality parameters of concern, and documentation of the inspection and sampling findings in a site log book. A site log book will be maintained for all on-site construction activities and will include:

- A record of the implementation of the SWPPP and other permit requirements
- Site inspections
- Stormwater sampling data

The site log book must be maintained on-site within reasonable access to the site and be made available upon request to Ecology or the local jurisdiction.

Numeric effluent limits may be required for certain discharges to 303(d) listed waterbodies. See CSWGP Special Condition S8 and Section 5 of this template.

The receiving waterbody, Brewery Creek, is impaired for: NA

All stormwater and dewatering discharges from the site are subject to an **effluent limit** of 8.5 su for pH and/or 25 NTU for turbidity.

### 4.1 Site Inspection

Site inspections will be conducted at least once every calendar week and within 24 hours following any discharge from the site. For sites that are temporarily stabilized and inactive, the required frequency is reduced to once per calendar month. **Inspections and reports of erosion control measures will occur daily during the wet season.** Daily reports will include: weather at the time of inspection, performance of the control measures, and adjustments made to many control measures.

The discharge point(s) are indicated on the Site Map (see Appendix A) and in accordance with the applicable requirements of the CSWGP.

### 4.2 Stormwater Quality Sampling

#### 4.2.1 Turbidity Sampling

Requirements include calibrated turbidity meter or transparency tube to sample site discharges for compliance with the CSWGP. Sampling will be conducted at all discharge points at least once per calendar week.

Method for sampling turbidity:

**Table 8 – Turbidity Sampling Method**

|                                     |  |
|-------------------------------------|--|
| <input checked="" type="checkbox"/> | Turbidity Meter/Turbidimeter (required for disturbances 5 acres or greater in size)    |
| <input type="checkbox"/>            | Transparency Tube (option for disturbances less than 1 acre and up to 5 acres in size) |

The limit for turbidity value is 25 nephelometric turbidity units (NTU) and a transparency less than 33 centimeters.

If the discharge's turbidity is 26 to 249 NTU **or** the transparency is less than 33 cm but equal to or greater than 6 cm, the following steps will be conducted:

1. Stop effluent discharge to receiving waterbody immediately. If discharge continues, this will be a direct violation of the SWPPP and CSWGP. Implement biker tanks to prevent discharge from entering receiving water body. Replace/repair BMP's if not functioning

properly. Do not discharge runoff until the turbidity value is 25 nephelometric turbidity units (NTU) or less and a transparency less than 33 centimeters.

2. Review the SWPPP for compliance with Special Condition S9. Make appropriate revisions within 7 days of the date the discharge exceeded the limit.
3. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible. Address the problems within 10 days of the date the discharge exceeded the limit. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period.
4. Document BMP implementation and maintenance in the site log book.

If the turbidity exceeds 250 NTU **or** the transparency is 6 cm or less at any time, the following steps will be conducted:

1. Telephone or submit an electronic report to the applicable Ecology Region's Environmental Report Tracking System (ERTS) within 24 hours.
  - **Central Region** (Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima): (509) 575-2490 or [http://www.ecy.wa.gov/programs/spills/forms/nerts\\_online/CRO\\_nerts\\_online.html](http://www.ecy.wa.gov/programs/spills/forms/nerts_online/CRO_nerts_online.html)
  - **Eastern Region** (Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman): (509) 329-3400 or [http://www.ecy.wa.gov/programs/spills/forms/nerts\\_online/ERO\\_nerts\\_online.html](http://www.ecy.wa.gov/programs/spills/forms/nerts_online/ERO_nerts_online.html)
  - **Northwest Region** (King, Kitsap, Island, San Juan, Skagit, Snohomish, Whatcom): (425) 649-7000 or [http://www.ecy.wa.gov/programs/spills/forms/nerts\\_online/NWRO\\_nerts\\_online.html](http://www.ecy.wa.gov/programs/spills/forms/nerts_online/NWRO_nerts_online.html)
  - **Southwest Region** (Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Lewis, Mason, Pacific, Pierce, Skamania, Thurston, Wahkiakum,): (360) 407-6300 or [http://www.ecy.wa.gov/programs/spills/forms/nerts\\_online/SWRO\\_nerts\\_online.html](http://www.ecy.wa.gov/programs/spills/forms/nerts_online/SWRO_nerts_online.html)
2. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible. Address the problems within 10 days of the date the discharge exceeded the limit. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period
3. Document BMP implementation and maintenance in the site log book.
4. Continue to sample discharges daily until one of the following is true:
  - Turbidity is 25 NTU (or lower).
  - Transparency is 33 cm (or greater).
  - Compliance with the water quality limit for turbidity is achieved.
    - 1 - 5 NTU over background turbidity, if background is less than 50 NTU
    - 1% - 10% over background turbidity, if background is 50 NTU or greater
  - The discharge stops or is eliminated.

#### 4.2.2 pH Sampling

pH monitoring is required for “Significant concrete work” (i.e., greater than 1000 cubic yards poured concrete over the life of the project). The use of recycled concrete or engineered soils (soil amendments including but not limited to Portland cement-treated base [CTB], cement kiln dust [CKD] or fly ash) also requires pH monitoring.

For significant concrete work, pH sampling will start the first day concrete is poured and continue until it is cured, typically three (3) weeks after the last pour.

For engineered soils and recycled concrete, pH sampling begins when engineered soils or recycled concrete are first exposed to precipitation and continues until the area is fully stabilized. If the measured pH is 8.5 or greater, the following measures will be taken:

1. Prevent high pH water from entering storm sewer systems or surface water.
2. Adjust or neutralize the high pH water to the range of 6.5 to 8.5 su using appropriate technology such as carbon dioxide (CO<sub>2</sub>) sparging (liquid or dry ice).
3. Written approval will be obtained from Ecology prior to the use of chemical treatment other than CO<sub>2</sub> sparging or dry ice.

Method for sampling pH:

**Table 9 – pH Sampling Method**

|                                     |                               |
|-------------------------------------|-------------------------------|
| <input checked="" type="checkbox"/> | pH meter                      |
| <input type="checkbox"/>            | pH test kit                   |
| <input type="checkbox"/>            | Wide range pH indicator paper |

## 5 Discharges to 303(d) or Total Maximum Daily Load (TMDL) Waterbodies

### 5.1 303(d) Listed Waterbodies

Is the receiving water 303(d) (Category 5) listed for turbidity, fine sediment, phosphorus, or pH?

☐ Yes ☒ No

List the impairment(s):

| Constituent<br>(Pollutant) | Location | Depth | Concentration |
|----------------------------|----------|-------|---------------|
| NA                         | NA       | NA    | NA            |

Describe the method(s) for 303(d) compliance:

List and describe BMPs:

Concrete Handling (BMP C151)

Sawcutting and Surfacing Pollution Prevention (BMP C152)

Outlet Protection (BMP C209)

Mulching (BMP C121)

Temporary and Permanent Seeding (BMP C120)

Dust Control (BMP C140)

Polyacrylamide (PAM) for Soil Erosion Protection (BMP C126)

### 5.2 TMDL Waterbodies

Waste Load Allocation for CWSGP discharges:

List and describe BMPs:

List and describe BMPs:

Concrete Handling (BMP C151)

Sawcutting and Surfacing Pollution Prevention (BMP C152)

Outlet Protection (BMP C209)

Mulching (BMP C121)

Temporary and Permanent Seeding (BMP C120)

Dust Control (BMP C140)

Discharges to TMDL receiving waterbodies will meet in-stream water quality criteria at the point of discharge.

The Construction Stormwater General Permit Proposed New Discharge to an Impaired Water Body form is included in Appendix F.

## **6 Reporting and Record Keeping**

### **6.1 Record Keeping**

#### **6.1.1 Site Log Book**

A site log book will be maintained for all on-site construction activities and will include:

- A record of the implementation of the SWPPP and other permit requirements
- Site inspections
- Sample logs

#### **6.1.2 Records Retention**

Records will be retained during the life of the project and for a minimum of three (3) years following the termination of permit coverage in accordance with Special Condition S5.C of the CSWGP.

Permit documentation to be retained on-site:

- CSWGP
- Permit Coverage Letter
- SWPPP
- Site Log Book

Permit documentation will be provided within 14 days of receipt of a written request from Ecology. A copy of the SWPPP or access to the SWPPP will be provided to the public when requested in writing in accordance with Special Condition S5.G.2.b of the CSWGP.

#### **6.1.3 Updating the SWPPP**

The SWPPP will be modified if:

- Found ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site.
- There is a change in design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the State.

The SWPPP will be modified within seven (7) days if inspection(s) or investigation(s) determine additional or modified BMPs are necessary for compliance. An updated timeline for BMP implementation will be prepared.

### **6.2 Reporting**

#### **6.2.1 Discharge Monitoring Reports**

**Cumulative soil disturbance is one (1) acre or larger; therefore,** Discharge Monitoring Reports (DMRs) will be submitted to Ecology monthly. If there was no discharge during a given

monitoring period the DMR will be submitted as required, reporting “No Discharge”. The DMR due date is fifteen (15) days following the end of each calendar month. DMRs will be reported online through Ecology’s WQWebDMR System.

### 6.2.2 Notification of Noncompliance

If any of the terms and conditions of the permit is not met, and the resulting noncompliance may cause a threat to human health or the environment, the following actions will be taken:

1. Ecology will be notified within 24-hours of the failure to comply by calling the applicable Regional office ERTS phone number (Regional office numbers listed below).
2. Immediate action will be taken to prevent the discharge/pollution or otherwise stop or correct the noncompliance. If applicable, sampling and analysis of any noncompliance will be repeated immediately and the results submitted to Ecology within five (5) days of becoming aware of the violation.
3. A detailed written report describing the noncompliance will be submitted to Ecology within five (5) days, unless requested earlier by Ecology.

Anytime turbidity sampling indicates turbidity is 250 NTUs or greater, or water transparency is 6 cm or less, the Ecology Regional office will be notified by phone within 24 hours of analysis as required by Special Condition S5.A of the CSWGP.

- **Central Region** at (509) 575-2490 for Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, or Yakima County
- **Eastern Region** at (509) 329-3400 for Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, or Whitman County
- **Northwest Region** at (425) 649-7000 for Island, King, Kitsap, San Juan, Skagit, Snohomish, or Whatcom County
- **Southwest Region** at (360) 407-6300 for Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Lewis, Mason, Pacific, Pierce, Skamania, Thurston, or Wahkiakum

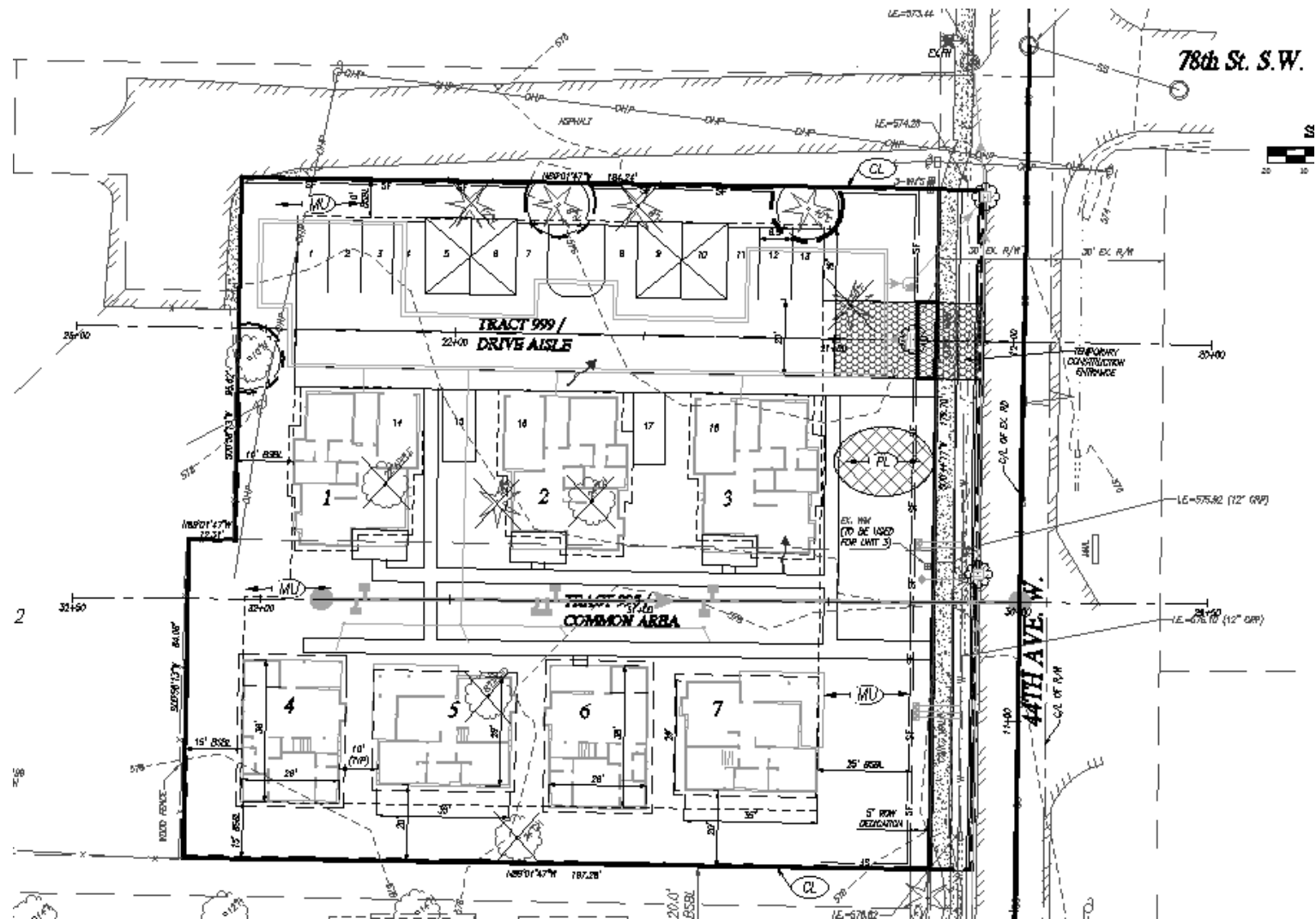
Include the following information:

1. Your name and / Phone number
2. Permit number
3. City / County of project
4. Sample results
5. Date / Time of call
6. Date / Time of sample
7. Project name

In accordance with Special Condition S4.D.5.b of the CSWGP, the Ecology Regional office will be notified if chemical treatment other than CO<sub>2</sub> sparging is planned for adjustment of high pH water.



## A. Site Map



## **B. BMP Detail**

### **Element#1- Preserve Vegetation / Mark Clearing Limits**

- Silt Fence (BMP C233)

### **Element #2 - Establish Construction Access**

- Stabilized Construction Entrance (BMP C105)

### **Element #3 - Control Flow Rates**

- Temporary Sediment Pond (BMP C241)
- Check dam ( C207)

### **Element #4 - Install Sediment Controls**

Silt Fence (BMP C233)

- Storm Drain Inlet Protection (BMP C220)
- Temporary Sediment Pond (BMP C241)

### **Element #5 - Stabilize Soils**

- Mulching (BMP C121)
- Temporary and Permanent Seeding (BMP C120)
- Plastic covering(BMP C123)
- Dust Control (BMP 140)

### **Element #6 - Protect Slopes**

- Mulching (BMP C121)
- Temporary and Permanent Seeding (BMP C120)
- Interceptor Dike and Swale (BMP C200)
- Check dam ( C207)

### **Element #7 – Protect Permenant drain Inlets**

- Stormdrain Inlet Protection

### **Element #9 – Control Pollutants**

- Material Delivery, Storage and Containment (BMP C153)
- Concrete Handling
- Sawcutting and Surfacing Pollution Protection

### **Element #11 – Maintain BMPs**

- CESC Lead (BMP C160)
- Materials on Hand (BMP C150)

### **Element #12 – Manage the Project**

- CESC Lead (BMP C160)
- Scheduling (BMP C162)

**Element #13 – Protect On-site Stormwater Management BMPs for Runoff from Roofs and Other Hard Surfaces**

- NA

## **C. Correspondence**

Ecology

EPA

Local Government

## **D. Site Inspection Form**

# Construction Stormwater Site Inspection Form

Project Name \_\_\_\_\_ Permit # \_\_\_\_\_ Inspection Date \_\_\_\_\_ Time \_\_\_\_\_

Name of Certified Erosion Sediment Control Lead (CESCL) or qualified inspector if *less than one acre*

Print Name: \_\_\_\_\_

Approximate rainfall amount since the last inspection (in inches): \_\_\_\_\_

Approximate rainfall amount in the last 24 hours (in inches): \_\_\_\_\_

Current Weather Clear ☐ Cloudy ☐ Mist ☐ Rain ☐ Wind ☐ Fog ☐

A. Type of inspection: Weekly ☐ Post Storm Event ☐ Other ☐

## B. Phase of Active Construction (check all that apply):

Pre Construction/installation of erosion/sediment controls

Concrete pours

Offsite improvements

☐

Clearing/Demo/Grading

☐

Vertical

Construction/buildings

☐

Site temporary stabilized

☐

Infrastructure/storm/roads

☐

Utilities

☐

Final stabilization

☐☐☐

## C. Questions:

1. Were all areas of construction and discharge points inspected? Yes \_\_\_\_\_ No \_\_\_\_\_
2. Did you observe the presence of suspended sediment, turbidity, discoloration, or oil sheen? Yes \_\_\_\_\_ No \_\_\_\_\_
3. Was a water quality sample taken during inspection? (*refer to permit conditions S4 & S5*) Yes \_\_\_\_\_ No \_\_\_\_\_
4. Was there a turbid discharge 250 NTU or greater, or Transparency 6 cm or less? \* Yes \_\_\_\_\_ No \_\_\_\_\_
5. If yes to #4 was it reported to Ecology? Yes \_\_\_\_\_ No \_\_\_\_\_
6. Is pH sampling required? pH range required is 6.5 to 8.5. Yes \_\_\_\_\_ No \_\_\_\_\_

If answering yes to a discharge, describe the event. Include when, where, and why it happened; what action was taken, and when.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\*If answering yes to # 4 record NTU/Transparency with continual sampling daily until turbidity is 25 NTU or less/ transparency is 33 cm or greater.

Sampling Results: \_\_\_\_\_ Date: \_\_\_\_\_

| Parameter | Method (circle one)     | Result |    |    | Other/Note |
|-----------|-------------------------|--------|----|----|------------|
|           |                         | NTU    | cm | pH |            |
| Turbidity | tube, meter, laboratory |        |    |    |            |
| pH        | Paper, kit, meter       |        |    |    |            |

# Construction Stormwater Site Inspection Form

D. Check the observed status of all items. Provide "Action Required" details and dates.

| Element #                | Inspection   | BMPs Inspected |    |     | BMP needs maintenance | BMP failed | Action required (describe in section F) |
|--------------------------|--|----------------|----|-----|-----------------------|------------|---|
|                          |  | yes            | no | n/a |                       |            |   |
| 1<br>Clearing Limits     | Before beginning land disturbing activities are all clearing limits, natural resource areas (streams, wetlands, buffers, trees) protected with barriers or similar BMPs? (high visibility recommended) |                |    |     |                       |            |   |
| 2<br>Construction Access | Construction access is stabilized with quarry spalls or equivalent BMP to prevent sediment from being tracked onto roads?  |                |    |     |                       |            |   |
|                          | Sediment tracked onto the road way was cleaned thoroughly at the end of the day or more frequent as necessary.   |                |    |     |                       |            |   |
| 3<br>Control Flow Rates  | Are flow control measures installed to control stormwater volumes and velocity during construction and do they protect downstream properties and waterways from erosion?                               |                |    |     |                       |            |   |
|                          | If permanent infiltration ponds are used for flow control during construction, are they protected from siltation?  |                |    |     |                       |            |   |
| 4<br>Sediment Controls   | All perimeter sediment controls (e.g. silt fence, wattles, compost socks, berms, etc.) installed, and maintained in accordance with the Stormwater Pollution Prevention Plan (SWPPP).                  |                |    |     |                       |            |   |
|                          | Sediment control BMPs (sediment ponds, traps, filters etc.) have been constructed and functional as the first step of grading.   |                |    |     |                       |            |   |
|                          | Stormwater runoff from disturbed areas is directed to sediment removal BMP.  |                |    |     |                       |            |   |
| 5<br>Stabilize Soils     | Have exposed un-worked soils been stabilized with effective BMP to prevent erosion and sediment deposition?  |                |    |     |                       |            |   |

# Construction Stormwater Site Inspection Form

| Element #                          | Inspection  | BMPs Inspected |    |     | BMP needs maintenance | BMP failed | Action required (describe in section F) |
|------------------------------------|---|----------------|----|-----|-----------------------|------------|---|
|                                    |   | yes            | no | n/a |                       |            |   |
| 5<br>Stabilize Soils<br>Cont.      | Are stockpiles stabilized from erosion, protected with sediment trapping measures and located away from drain inlet, waterways, and drainage channels?  |                |    |     |                       |            |   |
|                                    | Have soils been stabilized at the end of the shift, before a holiday or weekend if needed based on the weather forecast?                                |                |    |     |                       |            |   |
| 6<br>Protect Slopes                | Has stormwater and ground water been diverted away from slopes and disturbed areas with interceptor dikes, pipes and or swales?                         |                |    |     |                       |            |   |
|                                    | Is off-site storm water managed separately from stormwater generated on the site?   |                |    |     |                       |            |   |
|                                    | Is excavated material placed on uphill side of trenches consistent with safety and space considerations?  |                |    |     |                       |            |   |
|                                    | Have check dams been placed at regular intervals within constructed channels that are cut down a slope?   |                |    |     |                       |            |   |
| 7<br>Drain Inlets                  | Storm drain inlets made operable during construction are protected.   |                |    |     |                       |            |   |
|                                    | Are existing storm drains within the influence of the project protected?  |                |    |     |                       |            |   |
| 8<br>Stabilize Channel and Outlets | Have all on-site conveyance channels been designed, constructed and stabilized to prevent erosion from expected peak flows?                             |                |    |     |                       |            |   |
|                                    | Is stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes and downstream conveyance systems? |                |    |     |                       |            |   |
| 9<br>Control Pollutants            | Are waste materials and demolition debris handled and disposed of to prevent contamination of stormwater?   |                |    |     |                       |            |   |
|                                    | Has cover been provided for all chemicals, liquid products, petroleum products, and other material?   |                |    |     |                       |            |   |
|                                    | Has secondary containment been provided capable of containing 110% of the volume?   |                |    |     |                       |            |   |
|                                    | Were contaminated surfaces cleaned immediately after a spill incident?  |                |    |     |                       |            |   |
|                                    | Were BMPs used to prevent contamination of stormwater by a pH modifying sources?  |                |    |     |                       |            |   |

# Construction Stormwater Site Inspection Form

| Element #                | Inspection  | BMPs Inspected |    |     | BMP needs maintenance | BMP failed | Action required (describe in section F) |
|--------------------------|---|----------------|----|-----|-----------------------|------------|---|
|                          |   | yes            | no | n/a |                       |            |   |
| 9<br>Cont.               | Wheel wash wastewater is handled and disposed of properly.  |                |    |     |                       |            |   |
| 10<br>Control Dewatering | Concrete washout in designated areas. No washout or excess concrete on the ground.  |                |    |     |                       |            |   |
|                          | Dewatering has been done to an approved source and in compliance with the SWPPP.  |                |    |     |                       |            |   |
|                          | Were there any clean non turbid dewatering discharges?  |                |    |     |                       |            |   |
| 11<br>Maintain BMP       | Are all temporary and permanent erosion and sediment control BMPs maintained to perform as intended?  |                |    |     |                       |            |   |
| 12<br>Manage the Project | Has the project been phased to the maximum degree practicable?  |                |    |     |                       |            |   |
|                          | Has regular inspection, monitoring and maintenance been performed as required by the permit?  |                |    |     |                       |            |   |
|                          | Has the SWPPP been updated, implemented and records maintained?   |                |    |     |                       |            |   |
| 13<br>Protect LID        | Is all Bioretention and Rain Garden Facilities protected from sedimentation with appropriate BMPs?  |                |    |     |                       |            |   |
|                          | Is the Bioretention and Rain Garden protected against over compaction of construction equipment and foot traffic to retain its infiltration capabilities?       |                |    |     |                       |            |   |
|                          | Permeable pavements are clean and free of sediment and sediment laden-water runoff. Muddy construction equipment has not been on the base material or pavement. |                |    |     |                       |            |   |
|                          | Have soiled permeable pavements been cleaned of sediments and pass infiltration test as required by stormwater manual methodology?                              |                |    |     |                       |            |   |
|                          | Heavy equipment has been kept off existing soils under LID facilities to retain infiltration rate.  |                |    |     |                       |            |   |

**E. Check all areas that have been inspected. ✓**

All in place BMPs ☐ All disturbed soils ☐ All concrete wash out area ☐ All material storage areas ☐  
 All discharge locations ☐ All equipment storage areas ☐ All construction entrances/exits ☐

## Construction Stormwater Site Inspection Form

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F. Elements checked "Action Required" (section D) describe corrective action to be taken. List the element number; be specific on location and work needed. Document, initial, and date when the corrective action has been completed and inspected.

| Element # | Description and Location | Action Required | Completion Date | Initials |
|-----------|--------------------------|-----------------|-----------------|----------|
|           |                          |                 |                 |          |
|           |                          |                 |                 |          |
|           |                          |                 |                 |          |
|           |                          |                 |                 |          |
|           |                          |                 |                 |          |
|           |                          |                 |                 |          |
|           |                          |                 |                 |          |

*Attach additional page if needed*

**Sign the following certification:**

"I certify that this report is true, accurate, and complete, to the best of my knowledge and belief"

Inspected by: (print) \_\_\_\_\_ (Signature) \_\_\_\_\_ Date: \_\_\_\_\_

Title/Qualification of Inspector: \_\_\_\_\_

## **E. Construction Stormwater General Permit (CSWGP)**

Download the CSWGP:

<http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html>

#### **F. 303(d) List Waterbodies / TMDL Waterbodies Information**

None

#### **G. Contaminated Site Information**

The Soil profile is provided as Appendix under the Drianage Report.

## SECTION V: SOURCE CONTROL PLAN

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Onsite BMP's will be used to minimize the source pollutant sources that include parts/vehicle cleaning, spills/leaks of fuel and other liquids, replacement of liquids, outdoor storage of batteries/liquids/parts, and vehicle parking.

## SECTION VI: SPECIAL REPORTS AND STUDIES

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- A. Geotech Report
- B. LID Feasibility Analysis
- C. Soil Management Plan

## **A. GEOTECH REPORT**



Cobalt Geosciences, LLC  
P.O. Box 82243  
Kenmore, Washington 98028

August 27, 2021

Mike Mietzner  
[mikem@mietznergroupp.com](mailto:mikem@mietznergroupp.com)

**RE: Geotechnical Evaluation**  
Proposed Residential Development  
7816 and 7820 44<sup>th</sup> Avenue West  
Mukilteo, 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, grading, and earthwork.

### **Site Description**

The site is located at 7816 and 7820 44<sup>th</sup> Avenue West in Mukilteo, Washington. The site consists of two nearly rectangular shaped parcels (No.'s 00611600009003 and 00611600009004) with a total area of 0.81 acres.

The property is developed with residential structures, accessory buildings, and driveways. The remainder of the property is vegetated with grasses, bushes, ferns, ivy, understory, and variable diameter trees.

The site is nearly level to slightly sloping downward to the west at magnitudes of less than 10 percent and relief of about 10 feet. The site is bordered to the north, south and west by residential properties, and to the east by 44<sup>th</sup> Avenue West.

The proposed development includes seven new residential cottages, detached garages, and driveway areas. Stormwater will include infiltration or other systems depending on feasibility. Site grading may include cuts and fills of 3 feet or less and foundation loads are expected to be light. We should be provided with the final plans to verify that our recommendations remain valid and do not require updating.

### **Area Geology**

The Geologic Map of the Mukilteo Quadrangle, indicates that the site is underlain by Vashon Glacial Till.

Vashon Glacial Till includes mixtures of silt, sand, clay, and gravel. These materials are usually impermeable and are typically dense to very dense below a weathered zone.

### **Soil & Groundwater Conditions**

As part of our evaluation, we excavated four hand borings within the property, where accessible.

The explorations encountered approximately 6 inches of grass and topsoil underlain by approximately 3 to 4.5 feet of loose to medium dense, silty-fine to medium grained sand trace gravel (Weathered Glacial Till). These materials were underlain by dense to very dense, silty-fine

to fine grained sand trace gravel (Vashon Glacial Till), which continued to the termination depths of the explorations. The till was partially to well cemented.

Groundwater was not encountered in the explorations; however, the shallow soils were locally mottled. Perched groundwater could be present at shallow depths below the site during the winter months. A likely seasonal high level would be 3.5 to 5 feet below grade.

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 Alderwood-Urban land complex (2 to 15 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 31<sup>st</sup> to April 1<sup>st</sup>. 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 stiff/medium dense soils within the upper 100 feet.

We referenced the U.S. Geological Survey (USGS) Earthquake Hazards Program Website to obtain values for  $S_s$ ,  $S_i$ ,  $F_a$ , 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 7-10 and 7-16.

Seismic Design Parameters (ASCE 7-10)

| 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          | 1.453                                 | 0.565                                 | 1.0               | 1.5   | 0.969                               | 0.565    | 0.619      |

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 <sub>a</sub>    | F <sub>v</sub> | S <sub>DS</sub>                     | S <sub>D1</sub> |            |
| D          | 1.399                                 | 0.499                                 | 1.0               | Null           | 0.933                               | Null            | 0.605      |

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 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 weathered and unweathered glacial till which becomes denser with depth. The proposed residential structures may be supported on shallow foundation systems bearing on medium dense or firmer native soils or on structural fill placed on the native soils. Local overexcavation or recompaction of loose weathered native soils may be necessary depending on the proposed elevations and locations of the new footings.

Widespread infiltration of runoff is not feasible based on the soil conditions and anticipated groundwater conditions during the winter months. Local permeable pavements and dispersion systems may be feasible depending on their location and elevation. We recommend detention with overflow to City infrastructure. We can provide additional recommendations once a civil plan has been prepared.

### 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 6 to 18 inches. Deeper excavations will be necessary in areas of existing foundation systems (where present), below large trees, and in any areas underlain by undocumented fill.

The native soils consist of silty-sand with gravel. Most of the native soils may be used as structural fill provided they achieve 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 most of the utility placement. Any deeper temporary excavations should be sloped no steeper than 1.5H:1V (Horizontal:Vertical) in loose native soils and fill, 1H:1V in medium dense native soils and 3/4H:1V in dense to very dense native soils. If an excavation is subject to heavy vibration or surcharge loads, 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 structures may be supported on shallow spread footing foundation systems bearing on undisturbed 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.

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 2,500 pounds per square foot (psf) may be used for design. A bearing pressure of 5,000 psf may be used for detention vaults set at least 5 feet below grade.

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  $1/2$  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 225 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.

| <b>Wall Design Criteria</b>  |   |
|--|---|
| "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) | 21H* (Uniform Distribution) 1 in 2,500 year event |
| Seismic Increase for "At-rest" Conditions (Lateral Earth Pressure) | 14H* (Uniform Distribution) 1 in 500 year event   |

|  |   |
|--|---|
| Seismic Increase for "Active" Conditions<br>(Lateral Earth Pressure)             | 7H* (Uniform Distribution)              |
| Passive Earth Pressure on Low Side of Wall<br>(Allowable, includes F.S. = 1.5)   | Neglect upper 2 feet, then 275 pcf EFD* |
| Soil-Footing Coefficient of Sliding Friction (Allowable;<br>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 relatively dense glacial till. The unweathered till was cemented and acts as a restrictive layer. We performed a small scale pilot infiltration test (PIT) in an area near HB-1. The test was performed in general accordance with the Washington State Department of Ecology stormwater manual.

The area was excavated to a testing depth of approximately 3 feet below the ground surface. The test pit was pre-soaked for a period of 6 hours. During this period, we reduced the flow rate into the hole to the minimum available with the equipment and water source being used and continued to observe a rising water level. Since a steady state rate was not achieved, we performed a falling head test until the testing water was fully infiltrated.

The design infiltration rate was determined by applying correction factors to the measured infiltration rate as prescribed in Volume III, Section 3.3.6 of the DOE. The measured rate must be reduced through appropriate correction factors for site variability ( $CF_V$ ), uncertainty of test method ( $CF_T$ ), and degree of influent control ( $CF_M$ ) to prevent siltation and bio-buildup.

It should be noted that construction traffic or other disturbance to the target infiltration area could compact the soil, which may decrease the effective infiltration rates. The correction factors and resulting design infiltration rate are also shown in the table below.

| Test Number | Test Depth (ft) | Measured Infiltration Rate (in/hr) | Correction Factors |        |        | Design Infiltration Rate (in/hr) |
|-------------|-----------------|------------------------------------|--------------------|--------|--------|----------------------------------|
|             |                 |                                    | $CF_V$             | $CF_T$ | $CF_M$ |                                  |
| HB-1        | 3.0             | 0.48                               | 0.7                | 0.5    | 0.9    | 0.15                             |

Widespread infiltration is not feasible due to the dense soil conditions at depth. We recommend collection of runoff from new impervious surfaces with direct connection to City infrastructure. Local permeable pavements and dispersion systems could be feasible depending on their location and elevation. We can provide additional recommendations upon request and once civil plans have been prepared.

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 12 inches of the native soils within slab areas be re-compacted to at least 95 percent of the modified proctor (ASTM D1557 Test Method).

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 210 pounds per cubic inch (pci) assuming the slab-on-grade base course is underlain by structural fill placed and compacted as outlined in Section 8.1. 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, silty and 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
- 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 Mike Mietzner and his 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 Mike Mietzner 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**



8/27/2021  
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.

SP 199 (5-79)  
(A.F. #7908040290)

HB-4

HB-3

T.L. #00611600009003  
7816 44TH AVE. W.  
71,681 S.F.

**Subject Property**

T.L. #00611600009004  
7820 44TH AVE. W.  
71,681 S.F.

HB-2

HB-1

T.L. #00611600009001  
7902 44TH AVE. W.  
71,681 S.F.

**HB-1** Approximate  
Hand Boring  
Location



Not to Scale



Proposed Development  
7816 & 7820 44th Avenue West  
Mukilteo, Washington

**SITE PLAN**  
**FIGURE 1**

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[cobaltgeo@gmail.com](mailto:cobaltgeo@gmail.com)

## Unified Soil Classification System (USCS)

| MAJOR DIVISIONS   |   |   | SYMBOL | TYPICAL DESCRIPTION  |
|---|---|---|--------|--|
| COARSE GRAINED SOILS<br>(more than 50% retained on No. 200 sieve) | Gravels<br>(more than 50% of coarse fraction retained on No. 4 sieve) | Clean Gravels<br>(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<br>(more than 12% fines) | GM     | Silty gravels, gravel-sand-silt mixtures   |
|   |   |   | GC     | Clayey gravels, gravel-sand-clay mixtures  |
|   | Sands<br>(50% or more of coarse fraction passes the No. 4 sieve)      | Clean Sands<br>(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<br>(more than 12% fines)   | SM     | Silty sands, sand-silt mixtures  |
|   |   |   | SC     | Clayey sands, sand-clay mixtures   |
|   |   |   |        |  |
| FINE GRAINED SOILS<br>(50% or more passes the No. 200 sieve)      | Silts and Clays<br>(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<br>(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).

#### 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                 |

### 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)           |

### 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   |

Soil Classification Chart





Figure C1



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# Hand Boring HB-1

|                   |            |                                   |
|-------------------|------------|-----------------------------------|
| Date: August 2021 | Depth: 6'  | Groundwater: None                 |
| Contractor:       | Elevation: | Logged By: PH      Checked By: SC |

| Depth (Feet) | Interval  | Graphic Log   | USCS Symbol | Material Description  | Groundwater | Moisture Content (%)   |                      |    |    |    |              |
|--------------|---|---|-------------|---|-------------|------------------------|----------------------|----|----|----|--------------|
|              |   |   |             |   |             | Plastic Limit          | Moisture Content (%) |    |    |    | Liquid Limit |
|              |   |   |             |   |             | DCP Equivalent N-Value |                      |    |    |    |              |
|              |   |   |             |   |             | 0                      | 10                   | 20 | 30 | 40 | 50           |
|              |   |  |             | Topsoil/Grass   |             |                        |                      |    |    |    |              |
| 1            |   |  | SM          | Loose to medium dense, silty-fine to medium grained sand with gravel, dark yellowish brown, moist. (Weathered Glacial Till)         |             |                        |                      |    |    |    |              |
| 2            |   |   |             |   |             |                        |                      |    |    |    |              |
| 3            |  |   |             |   |             |                        |                      |    |    |    |              |
| 4            |   |   |             |   |             |                        |                      |    |    |    |              |
| 5            |   |   |             |   |             |                        |                      |    |    |    |              |
| 6            |  |   | SM          | Dense to very dense, silty-fine to medium grained sand with gravel, mottled yellowish brown to grayish brown, moist. (Glacial Till) |             |                        |                      |    |    |    |              |
| 7            |   |   |             |   |             |                        |                      |    |    |    |              |
| 8            |   |   |             |   |             |                        |                      |    |    |    |              |
| 9            |   |   |             | End of Hand Boring 6'   |             |                        |                      |    |    |    |              |
| 10           |   |   |             |   |             |                        |                      |    |    |    |              |

# Hand Boring HB-2

|                   |            |                                   |
|-------------------|------------|-----------------------------------|
| Date: August 2021 | Depth: 6'  | Groundwater: None                 |
| Contractor:       | Elevation: | Logged By: PH      Checked By: SC |

| Depth (Feet) | Interval | Graphic Log | USCS Symbol | Material Description  | Groundwater | Moisture Content (%)   |                      |    |    |    |              |
|--------------|----------|-------------|-------------|---|-------------|------------------------|----------------------|----|----|----|--------------|
|              |          |             |             |   |             | Plastic Limit          | Moisture Content (%) |    |    |    | Liquid Limit |
|              |          |             |             |   |             | DCP Equivalent N-Value |                      |    |    |    |              |
|              |          |             |             |   |             | 0                      | 10                   | 20 | 30 | 40 | 50           |
|              |          |             |             | Topsoil/Grass   |             |                        |                      |    |    |    |              |
| 1            |          |             | SM          | Loose to medium dense, silty-fine to medium grained sand with gravel, dark yellowish brown, moist. (Weathered Glacial Till)         |             |                        |                      |    |    |    |              |
| 2            |          |             |             |   |             |                        |                      |    |    |    |              |
| 3            |          |             |             |   |             |                        |                      |    |    |    |              |
| 4            |          |             | SM          | Dense to very dense, silty-fine to medium grained sand with gravel, mottled yellowish brown to grayish brown, moist. (Glacial Till) |             |                        |                      |    |    |    |              |
| 5            |          |             |             |   |             |                        |                      |    |    |    |              |
| 6            |          |             |             |   |             |                        |                      |    |    |    |              |
| 7            |          |             |             | End of Hand Boring 6'   |             |                        |                      |    |    |    |              |
| 8            |          |             |             |   |             |                        |                      |    |    |    |              |
| 9            |          |             |             |   |             |                        |                      |    |    |    |              |
| 10           |          |             |             |   |             |                        |                      |    |    |    |              |








Proposed Development  
7816 & 7820 44th Avenue W.  
Mukilteo, Washington

**Hand Boring  
Logs**

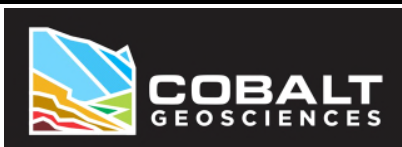
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## Hand Boring HB-3

| Date: August 2021 |   |   |             | Depth: 6'   |             | Groundwater: None                 |                      |    |    |              |    |
|-------------------|---|---|-------------|---|-------------|-----------------------------------|----------------------|----|----|--------------|----|
| Contractor:       |   |   |             | Elevation:  |             | Logged By: PH      Checked By: SC |                      |    |    |              |    |
| Depth (Feet)      | Interval  | Graphic Log   | USCS Symbol | Material Description  | Groundwater | Moisture Content (%)              |                      |    |    |              |    |
|                   |   |   |             |   |             | Plastic Limit                     | Moisture Content (%) |    |    | Liquid Limit |    |
|                   |   |   |             |   |             | DCP Equivalent N-Value            |                      |    |    |              |    |
|                   |   |   |             |   |             | 0                                 | 10                   | 20 | 30 | 40           | 50 |
|                   |   |  |             | Topsoil/Grass   |             |                                   |                      |    |    |              |    |
| 1                 |   |  | SM          | Loose to medium dense, silty-fine to medium grained sand with gravel, dark yellowish brown, moist. (Weathered Glacial Till)         |             |                                   |                      |    |    |              |    |
| 2                 |   |   |             |   |             |                                   |                      |    |    |              |    |
| 3                 |  |   |             |   |             |                                   |                      |    |    |              |    |
| 4                 |   |  | SM          | Dense to very dense, silty-fine to medium grained sand with gravel, mottled yellowish brown to grayish brown, moist. (Glacial Till) |             |                                   |                      |    |    |              |    |
| 5                 |   |   |             |   |             |                                   |                      |    |    |              |    |
| 6                 |  |   |             |   |             |                                   |                      |    |    |              |    |
| 7                 |   |   |             |   |             |                                   |                      |    |    |              |    |
| 8                 |   |   |             | End of Hand Boring 6'   |             |                                   |                      |    |    |              |    |
| 9                 |   |   |             |   |             |                                   |                      |    |    |              |    |
| 10                |   |   |             |   |             |                                   |                      |    |    |              |    |

## Hand Boring HB-4

| Date: August 2021 |          |             |             | Depth: 6'   |             | Groundwater: None      |                      |                |    |              |    |
|-------------------|----------|-------------|-------------|---|-------------|------------------------|----------------------|----------------|----|--------------|----|
| Contractor:       |          |             |             | Elevation:  |             | Logged By: PH          |                      | Checked By: SC |    |              |    |
| Depth (Feet)      | Interval | Graphic Log | USCS Symbol | Material Description  | Groundwater | Moisture Content (%)   |                      |                |    |              |    |
|                   |          |             |             |   |             | Plastic Limit          | Moisture Content (%) |                |    | Liquid Limit |    |
|                   |          |             |             |   |             | DCP Equivalent N-Value |                      |                |    |              |    |
|                   |          |             |             |   |             | 0                      | 10                   | 20             | 30 | 40           | 50 |
|                   |          |             |             | Topsoil/Grass   |             |                        |                      |                |    |              |    |
| 1                 |          |             | SM          | Loose to medium dense, silty-fine to medium grained sand with gravel, dark yellowish brown, moist. (Weathered Glacial Till)         |             |                        |                      |                |    |              |    |
| 2                 |          |             |             |   |             |                        |                      |                |    |              |    |
| 3                 |          |             |             |   |             |                        |                      |                |    |              |    |
| 4                 |          |             |             |   |             |                        |                      |                |    |              |    |
| 5                 |          |             | SM          | Dense to very dense, silty-fine to medium grained sand with gravel, mottled yellowish brown to grayish brown, moist. (Glacial Till) |             |                        |                      |                |    |              |    |
| 6                 |          |             |             |   |             |                        |                      |                |    |              |    |
| 7                 |          |             |             | End of Hand Boring 6'   |             |                        |                      |                |    |              |    |
| 8                 |          |             |             |   |             |                        |                      |                |    |              |    |
| 9                 |          |             |             |   |             |                        |                      |                |    |              |    |
| 10                |          |             |             |   |             |                        |                      |                |    |              |    |



Proposed Development  
7816 & 7820 44th Avenue W.  
Mukilteo, Washington

**Hand Boring  
Logs**

Cobalt Geosciences, LLC  
P.O. Box 82243  
Kenmore, WA 98028  
(206) 331-1097  
[www.cobaltgeo.com](http://www.cobaltgeo.com)  
[cobaltgeo@gmail.com](mailto:cobaltgeo@gmail.com)

## B. LID FEASIBILITY ANALYSIS

| Minimum Requirement<br>#5 BMP  | INFEASIBILITY/EVALUATION CRITERIA<br>FOR MR #5 BMPS.   | Location of supporting documentation   |
|--|--|--|
| <b>Lawn and landscaped areas:</b><br>1. Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Volume V, Chapter 5 of this manual. | Feasible   | BMP T5.13 is proposed for all lawn and landscape areas.  |
| <b>Roofs:</b><br>1. Full Dispersion in accordance with BMP T5.30 in Volume V, Chapter 5 of this manual, or,  | Infeasible   | Full Dispersion is infeasible because the required native vegetation preservation could not be achieved.   |
| 2. Downspout Full Infiltration Systems in accordance with BMP T5.10A in Volume III, Chapter 3 of this manual.  | <b>Infeasible.</b><br><ul style="list-style-type: none"> <li>The depth from final grade to seasonal high-water table, hardpan, or other low permeability layer is 3 feet or more;</li> </ul>   | As per the Geotech report attached under Section VI Appendix A, glacial till was found at less than 3-ft below ground in most of the hand borings.   |
| 3. Bioretention/Rain-Garden in accordance with Volume V, Chapter 7 of this manual.   | <b>Infeasible</b><br><ul style="list-style-type: none"> <li>Where there is a lack of usable space for rain garden/bioretention facilities at re-development sites, or where there is insufficient space within the existing public right-of-way on public road projects.</li> <li>Where the a minimum vertical separation of 3 feet to the seasonal high water table, bedrock or other impervious layer would</li> </ul> | As per the Geotech report attached under Section VI Appendix A, glacial till was found at less than 3-ft below ground in most of the hand borings. There is also a lack of usable space for rain garden/bioretention facilities at re-development sites, or where there is insufficient space within the existing public right-of-way on public road projects. |

|   |   |  |
|---|---|--|
|   | <p>not be achieved below bioretention that: 1) would serve a drainage area that meets or exceeds: a) 5,000 square feet of pollution-generating impervious surface, or b) 10,000 square feet of impervious surface, or c) three-quarter (3/4) acres of pervious surfaces; and 2) cannot reasonably be broken down into amounts smaller than indicated in (1).</p> <p>●If the measured native soil infiltration rate is less than 0.30 in/hour.</p> |  |
| 4. For single-family residential roofs, Downspout Dispersion Systems in accordance with BMP T5.10B in Volume III, Chapter 3 of this manual. | <p><b>Infeasible</b></p> <ul style="list-style-type: none"> <li>Downspout dispersion systems are not allowed if a vegetated flowpath of 25 feet or more cannot be provided or if the use of a dispersion system might cause erosion or flooding problems onsite or on adjacent properties.</li> </ul>   | Downspout dispersion systems are not feasible because the required 25-foot vegetated flowpath cannot be achieved.                                  |
| 5. Perforated Stub-out Connections in accordance with BMP T5.10C in Volume III, Chapter 3 of this manual.                                   | <p><b>Infeasible</b></p> <ul style="list-style-type: none"> <li>Perforated stub-outs are not appropriate when seasonal water table or soil restrictive layer is less than one (1) foot below trench bottom.</li> </ul>  | As per the Geotech report attached under Section VI Appendix A, glacial till was found at less than 3-ft below ground in most of the hand borings. |
| <b>Other Hard Surfaces:</b>   |   |  |
| 1. Full Dispersion in accordance with BMP T5.30 in Volume V, Chapter 5 of this manual.  | <b>Infeasible</b>   | Full Dispersion is infeasible because the required native vegetation preservation could not be achieved.   |

|  |   |   |
|--|---|---|
|  |   |   |
| <p>2. Permeable pavement in accordance with BMP T5.15 in Volume V, Chapter 5 of this manual. NOTE: This is not a requirement to pave these surfaces. Where pavement is proposed, it must be permeable to the extent feasible unless full dispersion is employed.</p> | <p><b>Infeasible</b></p> <ul style="list-style-type: none"> <li>• Where seasonal high ground water or an underlying impermeable/low permeable layer would create saturated conditions within one foot of the bottom of the lowest gravel base course.</li> </ul>  | <p>As per the Geotech report attached under Section VI Appendix A, glacial till was found at less than 3-ft below ground in most of the hand borings.</p>   |
| <p>3. Bioretention in accordance with Volume V, Chapter 7 of this manual.</p>  | <p><b>Infeasible</b></p> <ul style="list-style-type: none"> <li>• Where there is a lack of usable space for rain garden/bioretention facilities at re-development sites, or where there is insufficient space within the existing public right-of-way on public road projects.</li> <li>• Where the a minimum vertical separation of 3 feet to the seasonal high water table, bedrock or other impervious layer would not be achieved below bioretention that: 1) would serve a drainage area that meets or exceeds: a) 5,000 square feet of pollution-generating impervious surface, or b) 10,000 square feet of impervious surface, or c) three-quarter (3/4) acres of pervious surfaces; and 2) cannot reasonably be broken down into amounts smaller than indicated in (1).</li> <li>• If the measured native soil infiltration rate is less</li> </ul> | <p>As per the Geotech report attached under Section VI Appendix A, glacial till was found at less than 3-ft below ground in most of the hand borings. There is also a lack of usable space for rain garden/bioretention facilities at re-development sites, or where there is insufficient space within the existing public right-of-way on public road projects. .</p> |

|   |  |   |
|---|--|---|
|   | than 0.30 in/hour.   |   |
| 4. Sheet Flow Dispersion in accordance with BMP T5.12, or   | <b>Infeasible</b> <ul style="list-style-type: none"> <li>If a minimum 10-foot flow path per every 20 feet of contributing surface flow path cannot be provided;</li> </ul> | Sheet flow Dispersion is infeasible because the site cannot provide the required vegetated flow paths for each unit.        |
| 5. Concentrated Flow Dispersion in accordance with BMP T5.11 in Volume V, Chapter 5 of this manual. | <b>Infeasible</b> <ul style="list-style-type: none"> <li>If a vegetated flowpath of 25 feet or more cannot be provided;</li> </ul>   | Concentrated flow Dispersion is infeasible because the site cannot provide the required vegetated flow paths for each unit. |

## **C. SOIL MANAGEMENT PLAN**

## SOIL MANAGEMENT PLAN WORKSHEET

Site Address: 7816 44<sup>th</sup> Ave W, Mukilteo, WA \_\_\_\_\_

Permit Number: \_\_\_\_\_

### REQUIRED ATTACHMENTS

- \_\_\_\_\_ 3 original scaled site plans, as a separate sheet in Civil set, showing soil management option(s) for:  
 Lawn / Turf Areas (with square footage shown)  
 Planting Bed Areas (with square footage shown)  
 Show on SWPPP where soil will be left undisturbed and protected during construction and/or where stockpile locations will be  
 \_\_\_\_\_ Soil test results (if proposing custom amendment rates).

### LAWN / TURF AREAS

|   |   |  |   |
|---|---|--|---|
| <b>TOTAL LAWN / TURF AREAS Sq. Ft. 16,552</b> _____ |   |  |   |
| SELECT TREATMENT*                                   | <input checked="" type="checkbox"/> Pre-approved compost amendment<br>1.75" minimum required  | _____ Custom compost amendment**<br>_____ inches (attach soils tests and calculations) | _____ Topsoil import<br>8" minimum required |
| DETERMINE COMPOST/ TOPSOIL QUANTITY                 | _____ 1.75 inches compost / topsoil to be applied (as selected above)<br><input checked="" type="checkbox"/> 3.1<br>_____ = cubic yards / 1,000 sq. ft. X _____,000s sq. ft. (Total Lawn / Turf Areas above)<br>_____ 90 = <b>TOTAL CUBIC YARDS</b> |  |   |

### PLANTING BED AREAS

|   |   |  |   |
|---|---|--|---|
| <b>TOTAL PLANTING BED AREAS Sq. Ft.</b> _____ |   |  |   |
| SELECT TREATMENT*                             | _____ Pre-approved compost amendment<br>1.75" minimum required  | _____ Custom compost amendment**<br>_____ inches (attach soils tests and calculations) | _____ Topsoil import<br>_____ 8" minimum required |
| DETERMINE COMPOST/ TOPSOIL QUANTITY           | _____ inches compost / topsoil to be applied (as selected above)<br><input checked="" type="checkbox"/> 3.1<br>_____ = cubic yards / 1,000 sq. ft. X _____,000s sq. ft. (Total Lawn/Turf Areas above)<br>_____ = <b>TOTAL CUBIC YARDS</b> |  |   |
| MULCH QUANTITY                                | _____ inches mulch to be applied (minimum 2")<br><input checked="" type="checkbox"/> 3.1<br>_____ = cubic yards / 1,000 sq. ft. X _____,000s sq. ft.<br>_____ = <b>TOTAL CUBIC YARDS</b>  |  |   |

## SOIL MANAGEMENT PLAN WORKSHEET

Site Address: 7816 44<sup>th</sup> Ave W, Mukilteo,  
WA \_\_\_\_\_

Permit Number: \_\_\_\_\_

\*For previously graded sites, soils shall require custom amendment or topsoil import.

### TOTAL SOIL CALCULATIONS FOR ENTIRE SITE

|   |  |
|---|--|
| <b>Pre-Approved Compost Amendment</b>   | <b>Quantity:</b> _____ <b>192 cu. yds.</b> |
| <b>Specific product and supplier</b> Thomas Farm Agricultural Composting ((425) 232-9618) _____ |  |
| <b>Custom Compost Amendment**</b>   | <b>Quantity:</b> _____ <b>cu. yds.</b>     |
| <b>Test Results Required to be Attached</b>   |  |
| <b>Specific product and supplier</b> _____  |  |
| <b>Mulch</b>  | <b>Quantity:</b> _____ <b>cu. yds.</b>     |
| <b>Specific product and supplier</b> _____  |  |

1. Pre-Approved Compost Amendment must:
  - a. Meet the definition for “composted materials” in WAC 173-350, section 220;
  - b. Have organic matter content of 35%-65%, and a carbon to nitrogen ratio below 25:1;
  - c. The carbon to nitrogen ratio may be as high as 35:1, if plantings are entirely native to Puget Sound lowland regions.
2. Custom compost amendment calculations must be provided by a qualified professional to meet organic content requirements. Qualified professionals include licensed Landscape Architects, Civil Engineers or Geologists; certified Agronomists, Soil Scientists, or Crop Advisors.

### RETAIN YOUR RECEIPTS

Keep your receipts for all imported soils and mulch. You will be required to verify material type and quantity prior to Permit Final.

## HOW TO DEVELOP A SOIL MANAGEMENT PLAN

### HOW TO DETERMINE SOIL AMENDMENT, TOPSOIL AND MULCH NEEDS

*These specifications are designed to achieve the required 8 inch depth of soil with 10% “Soil Organic Matter” (SOM) content in planting beds, and 5% organic content in lawn/turf areas.*

#### **STEP 1. Review site conditions, landscape and grading plans.**

Determine if subsoil can be easily amended or if compaction will require subsoil plowing or topsoil import. Identify areas that can be left undisturbed, and where soil can be stockpiled, amended and reapplied after grading. Compacted subsoils must be scarified before applying amendments or topsoil.

#### **STEP 2. Select a soil management option for each planting area.**

Choose soil management options from the chart below for each landscape area within your proposed area of disturbance. You can use more than one option on a site!

#### **STEP 3. Calculate compost and/or topsoil volumes for each area.**

Use the formulas on the Soil Management Plan Worksheet to calculate the cubic yards of compost, topsoil and mulch needed.

#### **STEP 4. Identify compost and/or topsoil to be applied and retain records.**

Compost used as amendment or in topsoil mixes must be **weed-free** and supplied by a permitted composting facility (see list of [compost facilities at https://ecology.wa.gov/Waste-Toxics/Reducing-recycling-waste/Organic-materials/Managing-organics-compost](https://ecology.wa.gov/Waste-Toxics/Reducing-recycling-waste/Organic-materials/Managing-organics-compost)). Include name of product and supplier in “**Total Soil Calculations For Entire Site**” on the Soil Management Plan Worksheet.

#### **STEP 5. Turn in completed Soil Management Plan Worksheet with Site Plan for review and approval.**

## HOW TO DEVELOP A SOIL MANAGEMENT PLAN

| Soil Management Options   | Soil Management Specifications  |  |   |
|---|---|--|---|
|   | Using pre-approved amendment rates  |  | Using Custom Amendment Rates*   |
|   | Lawn/Turf   | Planting Beds  | Lawn/Turf or Planting Beds  |
| <b><u>Option 1</u></b><br>Leave native soil undisturbed, protect from compaction.   | Not applicable – Undisturbed native soils do not require soil amendment   | Not applicable – Undisturbed native soils do not require soil amendment  | Not applicable – Undisturbed native soils do not require soil amendment   |
| Soils that have been cleared and graded, and not covered by hard surfaces or developed as storm water structures, must be restored to 8 inches settled depth, using one of the following 3 options: |   |  |   |
| <b><u>Option 2</u></b><br>Scarify to depth yielding 12” uncompacted soils. Amend soil in place.   | Rototill 1.75 inches of compost into 6.25 inches soil (9.5” unsettled; 8” settled depth)  | Rototill 3 inches of compost into 5 inches of soil (9.5” unsettled; 8” settled depth)  | Test soils for organic content. Applicant shall provide soil calculations Rototill calculated amount of compost to achieve 8 inches of settled soil depth, at 5% organic for lawn/turf and 10% organic for planting beds. |
| <b><u>Option 3</u></b><br>Stockpile site soil and cover with weed barrier. Scarify to depth yielding 12” uncompacted soils. Reapply, and amend in place.  | Reapply stockpiled soil. Rototill 1.75 inches of compost into 6.25 inches soil (9.5” unsettled; 8” settled depth)   | Reapply stockpiled soil. Rototill 3 inches of compost into 6.25 inches soil (9.5” unsettled; 8” settled depth)   | Reapply stockpiled soil. Rototill calculated amount of compost to achieve 8 inches of settled soil depth, at 5% organic for lawn/turf and 10% organic for planting beds. Applicant shall provide soil calculations        |
| <b><u>Option 4</u></b><br>Scarify to 6” depth. Import topsoil containing adequate organic amendment.  | Topsoil must be 5% organic matter (~25% compost). Soil portion is sand or sandy loam as defined by USDA. Place 3” topsoil on surface and till into 2” soil. Place second lift of 3” topsoil and mix on surface. | Topsoil must be 10% organic matter (~40% compost). Soil portion is sand or sandy loam as defined by USDA. Place 3” topsoil on surface and till into 2” soil. Place 3” topsoil on surface and till into 2” soil. Place second lift of 3” topsoil, mix on surface. | Not applicable  |

## SECTION VII: OTHER PERMITS

---

A right of way permit will be required from City of Mukilteo.

A Construction Stormwater General Permit is required from the Department of Ecology.

## SECTION VIII: PERMANENT STORMWATER CONTROL PLAN

---

### A. OFF-SITE ANALYSIS

A site reconnaissance was performed by Brian Kalab of Insight Engineering on September 29, 2021 to verify the downstream flow paths and observe any drainage problems downstream of the site. The sky was cloudy and overcast with a temperature of 55 degrees.

The site contains 0.76 Acres. The site is currently developed with two existing houses and access from 44<sup>th</sup> Ave W. The remainder of the site exists as residential landscaping with few trees. The site contains one drainage basin that slopes to the northeast. Please refer to the downstream analysis under Section VIII for more details. Per NRCS survey of Snohomish County, the project site contains Alderwood soils that have a hydrologic classification of Type “C”. Please refer to the soils map and descriptions attached later in this report for more details.

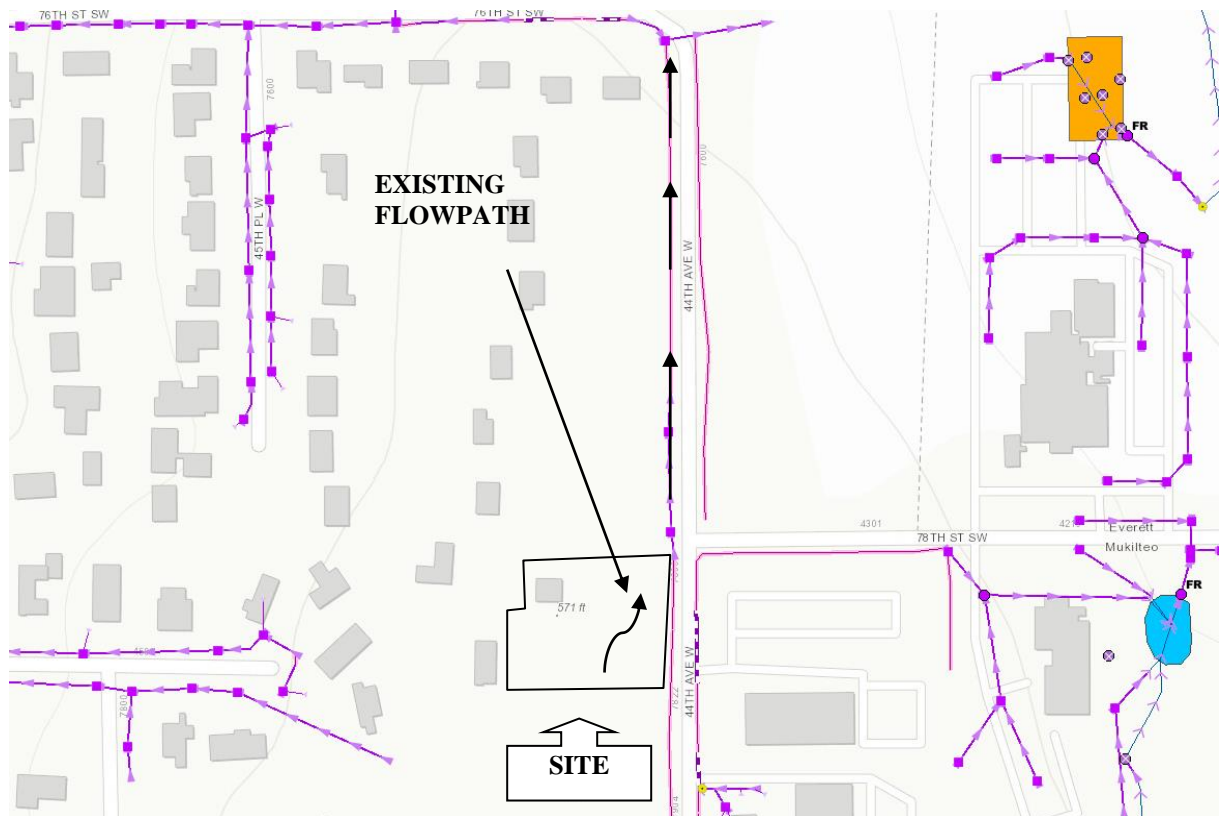
#### **Upstream Analysis**

Based on the site reconnaissance and the topographic survey of the site, the off-site area entering the site is very minimal. Refer to the Downstream Analysis Map attached in the next page for more details.

#### **Downstream Analysis**

Refer to the Downstream Analysis Maps 1 and 2 attached to the next pages for a visual description of the downstream flow. The runoff from the existing site flows to the northeast and enters the existing drainage system along 44<sup>th</sup> Ave W. The flow continues north for 630-ft along 44<sup>th</sup> Ave W through 12” CMP and discharges into Brewery Creek located in the Japanese Gulch Conservation Area. This creek meanders northwest in an unrestricted manner to finally drain into Puget Sound. This is where the downstream analysis was concluded.

## DOWNSTREAM ANALYSIS MAP-1



**INSIGHT ENGINEERING CO.**

P.O. Box 1478 Everett, WA 98206  
425-303-9363  
Info@insightengineering.net

### **Figure 4 - Downstream Analysis Map-1**

C&C Cottages  
Mukilteo, Washington

**SCALE:**  
NONE

**DATE:** 1/7/22

**JOB #:** 19-1018

**BY:** SX

**FILE NAME:**

19-1018\docs\drainage report

**P.O. Box 1478 Everett, WA 98206**  
**425-303-9363**  
**Info@insightengineering.net**

**Figure 5 - Downstream Analysis Map-2**  
C&C Cottages  
Mukilteo, Washington

|                       |   |                       |
|-----------------------|---|-----------------------|
| <b>SCALE:</b><br>NONE | <b>DATE:</b> 1/7/22                               | <b>JOB #:</b> 21-1138 |
| <b>BY:</b> SX         | <b>FILE NAME:</b><br>21-1138\docs\drainage report |                       |

## B. PRE-DEVELOPED HYDROLOGY

---

The site contains 0.76 Acres. The site is currently developed with two existing houses and access from 44th Ave W. The remainder of the site exists as residential landscaping with few trees. The site contains one drainage basin that that slopes to the northeast. Please refer to the downstream analysis under Section VIII for more details. Per NRCS survey of Snohomish County, the project site contains Alderwood soils that have a hydrologic classification of Type “C”. Please refer to the soils map and descriptions attached later in this report for more details.

## C. DEVELOPED HYDROLOGY

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The proposal is to construct fourteen cottages with associated utilities. The access to the site will from the 44<sup>th</sup> Ave W. Flow control and water quality requirements will be met by an underground Stormtank (4,219 SF-ft X 3-ft) which will be located underneath the drive aisle. The stormtank will provide a total storage capacity of 12,277 CF. The Stormtank was sized using Western Washington Hydrology Model V 4.2.13 (WWHM). The roof and the yard drains will be connected to the onsite detention system. Water quality will be met by a filter upstream of detention. The outflow from the stormtank will be discharged to the proposed drainage system along 44th Ave W.

## D. STORMWATER FLOW CONTROL

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The proposal is to construct fourteen cottages with associated utilities. The access to the site will from the 44th Ave W. Flow control and water quality requirements will be met by an underground Stormtank (4,219 SF-ft X 3-ft) which will be located underneath the drive aisle. The stormtank will provide a total storage capacity of 12,277 CF. The Stormtank was sized using Western Washington Hydrology Model V 4.2.13 (WVHM). The roof and the yard drains will be connected to the onsite detention system. Water quality will be met by a filter upstream of detention. The outflow from the stormtank will be discharged to the proposed drainage system along 44th Ave W.

Per Minimum Requirement #5 (Section 2.5.5 of the SWMMWW), the following NPGIS BMP's shall be applied to provide onsite stormwater management and must be considered in the following order per List #2: Full Dispersion, Infiltration, Bioretention, Basic Dispersion, and then Perforated Stub-Out Connections. The roof will be connected to the onsite detention system. The following BMP's shall be applied to the other hard surfaces: Full dispersion, Permeable Pavement, Bioretention, and then Dispersion. The road and driveways will be directed to the onsite detention system through catch basins. Post-Construction Soil Quality and Depth BMP T.5.13 is proposed to provide onsite stormwater management for the pervious areas of the site. Please refer to Section VI Appendix B for LID Feasibility Analysis Table.

## **DETENTION ANALYSIS**

Per NRCS survey of Snohomish County, the project site contains Alderwood soils that have a hydrologic classification of Type "C".

Site Area = 0.76 Acres (33,326 SF)

Frontage Improvement = 0.07 Acres ( 2,822 SF)

Total Area Included in the Analysis = 0.83 Acres (36,148 SF)

### **Existing Basin Summary**

Total Area Included in the Analysis = 0.83 Acres

Total Existing Basin Area = 0.83 Acres

*The entire pervious area was modeled as forested areas.*

*Refer to the Existing Basin Map and WWHM Report for basin representation.*

### **Developed Basin Summary**

Total Area Included in the Analysis = 0.83 Acres

Total Developed Basin Area = 0.83 Acres

### **Impervious Areas:**

Frontage Sidewalk = 1,306 SF (0.03 Acres)

Drive aisle = 6,402 SF (0.15 Acres)

Sidewalk = 2,527 SF (0.06 Acres)

Roof = 8,997 SF (0.21 Acres)

Total Impervious = 19,232 SF (0.45 Acres)

Total Pervious Areas = 0.83 Acres-0.45 Acres= 0.38 Acres

**Detention Volume Required: 11,384 CF**

**Detention Volume Provided: 11,390 CF**

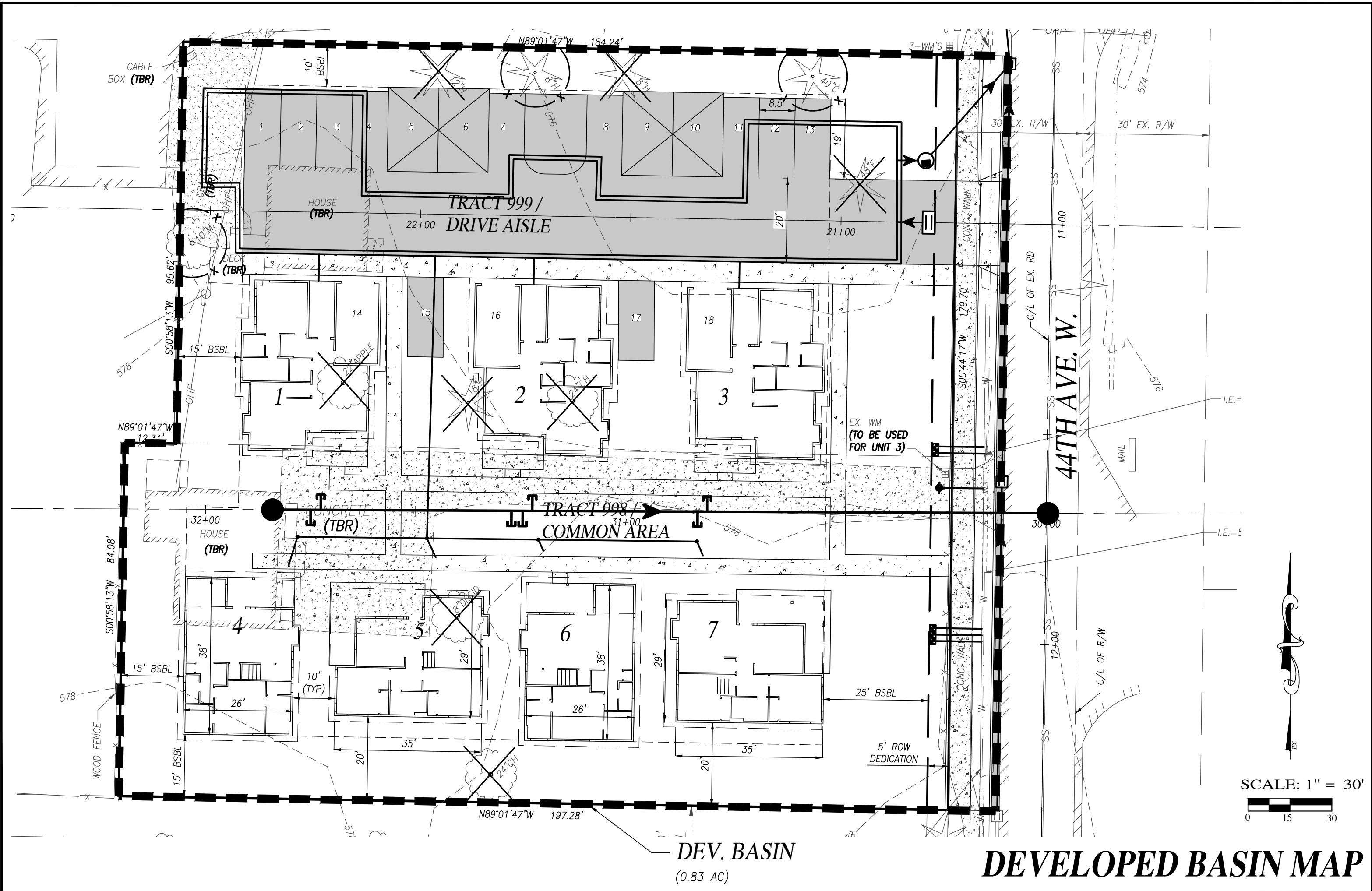
*Refer to the Developed basin map for basin representation. Refer to following pages for the WWHM report for the detention sizing calculations.*

**The Total New Impervious Area for the Project= 19,232 SF (0.45 Acres)**

*WWHM-1 shows that when the auto vault was run for this project, the lower orifice sized came out to be less than 0.5-in. Per City of Mukilteo, the orifice diameters*

*should be greater than 0.5-in. Infiltration is not feasible in this site per Geotech Report, due the presence of hardpan at less than 3-ft in most of the hand borings. Therefore, as per the DOE document “Detention with half-inch orifice-July2015”, the detention was resized. The optimized system sized does not cause failure in the Flow Control Standard at any point along the curve, other than those failure resulting from the initial 0.5” orifice with 3’ maximum live storage. Please refer to WWHM-2 for more details.*





## **WWHM-1-Autovault sized with less than 0.5-in orifice**

### **WWHM2012 PROJECT REPORT**

---

**Project Name:** C&C Cottages  
**Site Name:** C&C Cottages  
**Site Address:** 7816 & 7820 44th Ave W Mukilteo, WA 98275  
**City** : Mukilteo  
**Report Date:** 11/23/2021  
**Gage** : Everett  
**Data Start** : 1948/10/01  
**Data End** : 2009/09/30  
**Precip Scale:** 0.80  
**Version Date:** 2019/09/13  
**Version** : 4.2.17

---

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

---

**High Flow Threshold for POC 1:** 50 year

---

#### **PREDEVELOPED LAND USE**

**Name** : Existing Basin  
**Bypass:** No

**GroundWater:** No

|                                   |                    |
|-----------------------------------|--------------------|
| <b><u>Pervious Land Use</u></b>   | <b><u>acre</u></b> |
| C, Forest, Flat                   | .83                |
| <b>Pervious Total</b>             | <b>0.83</b>        |
| <b><u>Impervious Land Use</u></b> | <b><u>acre</u></b> |
| <b>Impervious Total</b>           | <b>0</b>           |
| <b>Basin Total</b>                | <b>0.83</b>        |

---

|                          |           |             |
|--------------------------|-----------|-------------|
| <b>Element Flows To:</b> |           |             |
| Surface                  | Interflow | Groundwater |

---

#### **MITIGATED LAND USE**

**Name** : Developed Basin  
**Bypass:** No

GroundWater: No

| <u>Pervious Land Use</u>   | <u>acre</u> |
|----------------------------|-------------|
| C, Lawn, Flat              | .38         |
| <b>Pervious Total</b>      | <b>0.38</b> |
| <u>Impervious Land Use</u> | <u>acre</u> |
| ROADS FLAT                 | 0.15        |
| ROOF TOPS FLAT             | 0.21        |
| SIDEWALKS FLAT             | 0.09        |
| <b>Impervious Total</b>    | <b>0.45</b> |
| <b>Basin Total</b>         | <b>0.83</b> |

---

| Element Flows To: |           |             |
|-------------------|-----------|-------------|
| Surface           | Interflow | Groundwater |
| Vault 1           | Vault 1   |             |

---

Name : Vault 1  
Width : 61.603315712727 ft.  
Length : 61.603315712727 ft.  
Depth: 4 ft.  
Discharge Structure  
Riser Height: 3 ft.  
Riser Diameter: 18 in.  
Orifice 1 Diameter: 0.35 in. Elevation: 0 ft.  
Orifice 2 Diameter: 0.53 in. Elevation: 2.651 ft.  
Orifice 3 Diameter: 0.94 in. Elevation: 2.87166666666667 ft.

Element Flows To:  
Outlet 1                      Outlet 2

---

| Vault Hydraulic Table |                  |                       |                       |                    |
|-----------------------|------------------|-----------------------|-----------------------|--------------------|
| <u>Stage(feet)</u>    | <u>Area(ac.)</u> | <u>Volume(ac-ft.)</u> | <u>Discharge(cfs)</u> | <u>Infilt(cfs)</u> |
| 0.0000                | 0.087            | 0.000                 | 0.000                 | 0.000              |
| 0.0444                | 0.087            | 0.003                 | 0.000                 | 0.000              |
| 0.0889                | 0.087            | 0.007                 | 0.001                 | 0.000              |
| 0.1333                | 0.087            | 0.011                 | 0.001                 | 0.000              |
| 0.1778                | 0.087            | 0.015                 | 0.001                 | 0.000              |
| 0.2222                | 0.087            | 0.019                 | 0.001                 | 0.000              |
| 0.2667                | 0.087            | 0.023                 | 0.001                 | 0.000              |
| 0.3111                | 0.087            | 0.027                 | 0.001                 | 0.000              |
| 0.3556                | 0.087            | 0.031                 | 0.002                 | 0.000              |
| 0.4000                | 0.087            | 0.034                 | 0.002                 | 0.000              |

|        |       |       |       |       |
|--------|-------|-------|-------|-------|
| 0.4444 | 0.087 | 0.038 | 0.002 | 0.000 |
| 0.4889 | 0.087 | 0.042 | 0.002 | 0.000 |
| 0.5333 | 0.087 | 0.046 | 0.002 | 0.000 |
| 0.5778 | 0.087 | 0.050 | 0.002 | 0.000 |
| 0.6222 | 0.087 | 0.054 | 0.002 | 0.000 |
| 0.6667 | 0.087 | 0.058 | 0.002 | 0.000 |
| 0.7111 | 0.087 | 0.062 | 0.002 | 0.000 |
| 0.7556 | 0.087 | 0.065 | 0.002 | 0.000 |
| 0.8000 | 0.087 | 0.069 | 0.003 | 0.000 |
| 0.8444 | 0.087 | 0.073 | 0.003 | 0.000 |
| 0.8889 | 0.087 | 0.077 | 0.003 | 0.000 |
| 0.9333 | 0.087 | 0.081 | 0.003 | 0.000 |
| 0.9778 | 0.087 | 0.085 | 0.003 | 0.000 |
| 1.0222 | 0.087 | 0.089 | 0.003 | 0.000 |
| 1.0667 | 0.087 | 0.092 | 0.003 | 0.000 |
| 1.1111 | 0.087 | 0.096 | 0.003 | 0.000 |
| 1.1556 | 0.087 | 0.100 | 0.003 | 0.000 |
| 1.2000 | 0.087 | 0.104 | 0.003 | 0.000 |
| 1.2444 | 0.087 | 0.108 | 0.003 | 0.000 |
| 1.2889 | 0.087 | 0.112 | 0.003 | 0.000 |
| 1.3333 | 0.087 | 0.116 | 0.003 | 0.000 |
| 1.3778 | 0.087 | 0.120 | 0.003 | 0.000 |
| 1.4222 | 0.087 | 0.123 | 0.004 | 0.000 |
| 1.4667 | 0.087 | 0.127 | 0.004 | 0.000 |
| 1.5111 | 0.087 | 0.131 | 0.004 | 0.000 |
| 1.5556 | 0.087 | 0.135 | 0.004 | 0.000 |
| 1.6000 | 0.087 | 0.139 | 0.004 | 0.000 |
| 1.6444 | 0.087 | 0.143 | 0.004 | 0.000 |
| 1.6889 | 0.087 | 0.147 | 0.004 | 0.000 |
| 1.7333 | 0.087 | 0.151 | 0.004 | 0.000 |
| 1.7778 | 0.087 | 0.154 | 0.004 | 0.000 |
| 1.8222 | 0.087 | 0.158 | 0.004 | 0.000 |
| 1.8667 | 0.087 | 0.162 | 0.004 | 0.000 |
| 1.9111 | 0.087 | 0.166 | 0.004 | 0.000 |
| 1.9556 | 0.087 | 0.170 | 0.004 | 0.000 |
| 2.0000 | 0.087 | 0.174 | 0.004 | 0.000 |
| 2.0444 | 0.087 | 0.178 | 0.004 | 0.000 |
| 2.0889 | 0.087 | 0.182 | 0.004 | 0.000 |
| 2.1333 | 0.087 | 0.185 | 0.004 | 0.000 |
| 2.1778 | 0.087 | 0.189 | 0.004 | 0.000 |
| 2.2222 | 0.087 | 0.193 | 0.005 | 0.000 |
| 2.2667 | 0.087 | 0.197 | 0.005 | 0.000 |
| 2.3111 | 0.087 | 0.201 | 0.005 | 0.000 |
| 2.3556 | 0.087 | 0.205 | 0.005 | 0.000 |
| 2.4000 | 0.087 | 0.209 | 0.005 | 0.000 |
| 2.4444 | 0.087 | 0.213 | 0.005 | 0.000 |
| 2.4889 | 0.087 | 0.216 | 0.005 | 0.000 |
| 2.5333 | 0.087 | 0.220 | 0.005 | 0.000 |
| 2.5778 | 0.087 | 0.224 | 0.005 | 0.000 |
| 2.6222 | 0.087 | 0.228 | 0.005 | 0.000 |
| 2.6667 | 0.087 | 0.232 | 0.006 | 0.000 |
| 2.7111 | 0.087 | 0.236 | 0.007 | 0.000 |
| 2.7556 | 0.087 | 0.240 | 0.008 | 0.000 |
| 2.8000 | 0.087 | 0.243 | 0.008 | 0.000 |
| 2.8444 | 0.087 | 0.247 | 0.009 | 0.000 |
| 2.8889 | 0.087 | 0.251 | 0.012 | 0.000 |

|        |       |       |       |       |
|--------|-------|-------|-------|-------|
| 2.9333 | 0.087 | 0.255 | 0.015 | 0.000 |
| 2.9778 | 0.087 | 0.259 | 0.017 | 0.000 |
| 3.0222 | 0.087 | 0.263 | 0.072 | 0.000 |
| 3.0667 | 0.087 | 0.267 | 0.295 | 0.000 |
| 3.1111 | 0.087 | 0.271 | 0.610 | 0.000 |
| 3.1556 | 0.087 | 0.274 | 0.994 | 0.000 |
| 3.2000 | 0.087 | 0.278 | 1.429 | 0.000 |
| 3.2444 | 0.087 | 0.282 | 1.903 | 0.000 |
| 3.2889 | 0.087 | 0.286 | 2.402 | 0.000 |
| 3.3333 | 0.087 | 0.290 | 2.911 | 0.000 |
| 3.3778 | 0.087 | 0.294 | 3.415 | 0.000 |
| 3.4222 | 0.087 | 0.298 | 3.902 | 0.000 |
| 3.4667 | 0.087 | 0.302 | 4.357 | 0.000 |
| 3.5111 | 0.087 | 0.305 | 4.769 | 0.000 |
| 3.5556 | 0.087 | 0.309 | 5.130 | 0.000 |
| 3.6000 | 0.087 | 0.313 | 5.435 | 0.000 |
| 3.6444 | 0.087 | 0.317 | 5.684 | 0.000 |
| 3.6889 | 0.087 | 0.321 | 5.884 | 0.000 |
| 3.7333 | 0.087 | 0.325 | 6.050 | 0.000 |
| 3.7778 | 0.087 | 0.329 | 6.287 | 0.000 |
| 3.8222 | 0.087 | 0.333 | 6.464 | 0.000 |
| 3.8667 | 0.087 | 0.336 | 6.636 | 0.000 |
| 3.9111 | 0.087 | 0.340 | 6.804 | 0.000 |
| 3.9556 | 0.087 | 0.344 | 6.967 | 0.000 |
| 4.0000 | 0.087 | 0.348 | 7.127 | 0.000 |
| 4.0444 | 0.087 | 0.352 | 7.284 | 0.000 |
| 4.0889 | 0.000 | 0.000 | 7.437 | 0.000 |

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## ANALYSIS RESULTS

### Stream Protection Duration

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#### Predeveloped Landuse Totals for POC #1

Total Pervious Area:0.83

Total Impervious Area:0

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#### Mitigated Landuse Totals for POC #1

Total Pervious Area:0.38

Total Impervious Area:0.45

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#### Flow Frequency Return Periods for Predeveloped. POC #1

| <u>Return Period</u> | <u>Flow(cfs)</u> |
|----------------------|------------------|
| 2 year               | 0.01004          |
| 5 year               | 0.015582         |
| 10 year              | 0.019014         |
| 25 year              | 0.023            |
| 50 year              | 0.02571          |
| 100 year             | 0.02821          |

**Flow Frequency Return Periods for Mitigated. POC #1**

| <u>Return Period</u> | <u>Flow(cfs)</u> |
|----------------------|------------------|
| 2 year               | 0.005118         |
| 5 year               | 0.010016         |
| 10 year              | 0.01509          |
| 25 year              | 0.024473         |
| 50 year              | 0.034337         |
| 100 year             | 0.047407         |

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

| <u>Year</u> | <u>Predeveloped</u> | <u>Mitigated</u> |
|-------------|---------------------|------------------|
| 1949        | 0.001               | 0.004            |
| 1950        | 0.013               | 0.005            |
| 1951        | 0.009               | 0.004            |
| 1952        | 0.007               | 0.004            |
| 1953        | 0.006               | 0.004            |
| 1954        | 0.014               | 0.005            |
| 1955        | 0.017               | 0.050            |
| 1956        | 0.014               | 0.052            |
| 1957        | 0.016               | 0.004            |
| 1958        | 0.011               | 0.005            |
| 1959        | 0.011               | 0.004            |
| 1960        | 0.010               | 0.004            |
| 1961        | 0.011               | 0.005            |
| 1962        | 0.007               | 0.003            |
| 1963        | 0.009               | 0.004            |
| 1964        | 0.010               | 0.004            |
| 1965        | 0.010               | 0.005            |
| 1966        | 0.005               | 0.004            |
| 1967        | 0.014               | 0.004            |
| 1968        | 0.014               | 0.005            |
| 1969        | 0.007               | 0.004            |
| 1970        | 0.008               | 0.004            |
| 1971        | 0.012               | 0.028            |
| 1972        | 0.011               | 0.004            |
| 1973        | 0.006               | 0.005            |
| 1974        | 0.010               | 0.005            |
| 1975        | 0.008               | 0.004            |
| 1976        | 0.008               | 0.005            |
| 1977        | 0.004               | 0.003            |
| 1978        | 0.008               | 0.004            |
| 1979        | 0.013               | 0.003            |
| 1980        | 0.009               | 0.004            |
| 1981        | 0.007               | 0.003            |
| 1982        | 0.011               | 0.005            |
| 1983        | 0.009               | 0.005            |
| 1984        | 0.010               | 0.008            |
| 1985        | 0.015               | 0.033            |
| 1986        | 0.038               | 0.008            |
| 1987        | 0.013               | 0.007            |
| 1988        | 0.009               | 0.004            |
| 1989        | 0.006               | 0.004            |
| 1990        | 0.011               | 0.004            |
| 1991        | 0.012               | 0.005            |

|      |       |       |
|------|-------|-------|
| 1992 | 0.009 | 0.004 |
| 1993 | 0.006 | 0.004 |
| 1994 | 0.004 | 0.005 |
| 1995 | 0.010 | 0.005 |
| 1996 | 0.022 | 0.005 |
| 1997 | 0.042 | 0.105 |
| 1998 | 0.006 | 0.004 |
| 1999 | 0.011 | 0.005 |
| 2000 | 0.006 | 0.005 |
| 2001 | 0.001 | 0.002 |
| 2002 | 0.010 | 0.012 |
| 2003 | 0.007 | 0.004 |
| 2004 | 0.010 | 0.004 |
| 2005 | 0.008 | 0.004 |
| 2006 | 0.023 | 0.017 |
| 2007 | 0.016 | 0.015 |
| 2008 | 0.023 | 0.006 |
| 2009 | 0.009 | 0.004 |

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**Stream Protection Duration**

**Ranked Annual Peaks for Predeveloped and Mitigated. POC #1**

| <b>Rank</b> | <b>Predeveloped</b> | <b>Mitigated</b> |
|-------------|---------------------|------------------|
| 1           | 0.0421              | 0.1045           |
| 2           | 0.0380              | 0.0519           |
| 3           | 0.0232              | 0.0502           |
| 4           | 0.0227              | 0.0334           |
| 5           | 0.0221              | 0.0279           |
| 6           | 0.0175              | 0.0168           |
| 7           | 0.0162              | 0.0151           |
| 8           | 0.0155              | 0.0117           |
| 9           | 0.0147              | 0.0083           |
| 10          | 0.0145              | 0.0080           |
| 11          | 0.0142              | 0.0073           |
| 12          | 0.0141              | 0.0058           |
| 13          | 0.0138              | 0.0055           |
| 14          | 0.0130              | 0.0052           |
| 15          | 0.0129              | 0.0052           |
| 16          | 0.0128              | 0.0051           |
| 17          | 0.0119              | 0.0051           |
| 18          | 0.0116              | 0.0049           |
| 19          | 0.0113              | 0.0049           |
| 20          | 0.0112              | 0.0049           |
| 21          | 0.0111              | 0.0048           |
| 22          | 0.0111              | 0.0048           |
| 23          | 0.0108              | 0.0048           |
| 24          | 0.0108              | 0.0047           |
| 25          | 0.0107              | 0.0047           |
| 26          | 0.0104              | 0.0047           |
| 27          | 0.0102              | 0.0047           |
| 28          | 0.0102              | 0.0046           |
| 29          | 0.0100              | 0.0046           |
| 30          | 0.0098              | 0.0045           |
| 31          | 0.0098              | 0.0045           |
| 32          | 0.0098              | 0.0045           |
| 33          | 0.0096              | 0.0045           |

|    |        |        |
|----|--------|--------|
| 34 | 0.0092 | 0.0044 |
| 35 | 0.0090 | 0.0044 |
| 36 | 0.0087 | 0.0044 |
| 37 | 0.0087 | 0.0043 |
| 38 | 0.0086 | 0.0043 |
| 39 | 0.0086 | 0.0043 |
| 40 | 0.0086 | 0.0042 |
| 41 | 0.0084 | 0.0042 |
| 42 | 0.0082 | 0.0041 |
| 43 | 0.0081 | 0.0041 |
| 44 | 0.0079 | 0.0040 |
| 45 | 0.0076 | 0.0040 |
| 46 | 0.0075 | 0.0039 |
| 47 | 0.0074 | 0.0039 |
| 48 | 0.0071 | 0.0038 |
| 49 | 0.0066 | 0.0038 |
| 50 | 0.0065 | 0.0037 |
| 51 | 0.0062 | 0.0037 |
| 52 | 0.0061 | 0.0036 |
| 53 | 0.0060 | 0.0036 |
| 54 | 0.0059 | 0.0036 |
| 55 | 0.0058 | 0.0036 |
| 56 | 0.0055 | 0.0035 |
| 57 | 0.0054 | 0.0034 |
| 58 | 0.0037 | 0.0034 |
| 59 | 0.0037 | 0.0033 |
| 60 | 0.0015 | 0.0033 |
| 61 | 0.0013 | 0.0023 |

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**Stream Protection Duration**

**POC #1**

**The Facility PASSED**

**The Facility PASSED.**

| <b>Flow(cfs)</b> | <b>Predev</b> | <b>Mit</b> | <b>Percentage</b> | <b>Pass/Fail</b> |
|------------------|---------------|------------|-------------------|------------------|
| 0.0050           | 21881         | 21859      | 99                | Pass             |
| 0.0052           | 20046         | 12887      | 64                | Pass             |
| 0.0054           | 18311         | 6141       | 33                | Pass             |
| 0.0056           | 16760         | 5724       | 34                | Pass             |
| 0.0059           | 15293         | 5371       | 35                | Pass             |
| 0.0061           | 13988         | 5048       | 36                | Pass             |
| 0.0063           | 12831         | 4729       | 36                | Pass             |
| 0.0065           | 11815         | 4502       | 38                | Pass             |
| 0.0067           | 10836         | 4273       | 39                | Pass             |
| 0.0069           | 9952          | 4055       | 40                | Pass             |
| 0.0071           | 9167          | 3852       | 42                | Pass             |
| 0.0073           | 8481          | 3647       | 43                | Pass             |
| 0.0075           | 7837          | 3433       | 43                | Pass             |
| 0.0077           | 7247          | 3251       | 44                | Pass             |
| 0.0079           | 6697          | 3054       | 45                | Pass             |
| 0.0082           | 6188          | 2873       | 46                | Pass             |
| 0.0084           | 5711          | 2648       | 46                | Pass             |
| 0.0086           | 5247          | 2423       | 46                | Pass             |
| 0.0088           | 4827          | 2145       | 44                | Pass             |

|        |      |      |    |      |
|--------|------|------|----|------|
| 0.0090 | 4447 | 1911 | 42 | Pass |
| 0.0092 | 4113 | 1869 | 45 | Pass |
| 0.0094 | 3801 | 1830 | 48 | Pass |
| 0.0096 | 3540 | 1788 | 50 | Pass |
| 0.0098 | 3275 | 1759 | 53 | Pass |
| 0.0100 | 3029 | 1726 | 56 | Pass |
| 0.0102 | 2798 | 1690 | 60 | Pass |
| 0.0105 | 2609 | 1649 | 63 | Pass |
| 0.0107 | 2443 | 1608 | 65 | Pass |
| 0.0109 | 2301 | 1567 | 68 | Pass |
| 0.0111 | 2180 | 1484 | 68 | Pass |
| 0.0113 | 2060 | 1389 | 67 | Pass |
| 0.0115 | 1955 | 1334 | 68 | Pass |
| 0.0117 | 1860 | 1296 | 69 | Pass |
| 0.0119 | 1745 | 1251 | 71 | Pass |
| 0.0121 | 1657 | 1213 | 73 | Pass |
| 0.0123 | 1560 | 1186 | 76 | Pass |
| 0.0125 | 1456 | 1158 | 79 | Pass |
| 0.0128 | 1372 | 1133 | 82 | Pass |
| 0.0130 | 1308 | 1096 | 83 | Pass |
| 0.0132 | 1241 | 1061 | 85 | Pass |
| 0.0134 | 1197 | 1038 | 86 | Pass |
| 0.0136 | 1156 | 1007 | 87 | Pass |
| 0.0138 | 1117 | 975  | 87 | Pass |
| 0.0140 | 1076 | 948  | 88 | Pass |
| 0.0142 | 1033 | 916  | 88 | Pass |
| 0.0144 | 997  | 886  | 88 | Pass |
| 0.0146 | 967  | 859  | 88 | Pass |
| 0.0148 | 936  | 823  | 87 | Pass |
| 0.0151 | 903  | 790  | 87 | Pass |
| 0.0153 | 868  | 764  | 88 | Pass |
| 0.0155 | 834  | 739  | 88 | Pass |
| 0.0157 | 797  | 709  | 88 | Pass |
| 0.0159 | 770  | 673  | 87 | Pass |
| 0.0161 | 738  | 620  | 84 | Pass |
| 0.0163 | 721  | 573  | 79 | Pass |
| 0.0165 | 690  | 535  | 77 | Pass |
| 0.0167 | 669  | 492  | 73 | Pass |
| 0.0169 | 649  | 432  | 66 | Pass |
| 0.0171 | 637  | 389  | 61 | Pass |
| 0.0174 | 615  | 349  | 56 | Pass |
| 0.0176 | 592  | 314  | 53 | Pass |
| 0.0178 | 577  | 285  | 49 | Pass |
| 0.0180 | 565  | 254  | 44 | Pass |
| 0.0182 | 550  | 249  | 45 | Pass |
| 0.0184 | 538  | 242  | 44 | Pass |
| 0.0186 | 524  | 237  | 45 | Pass |
| 0.0188 | 513  | 234  | 45 | Pass |
| 0.0190 | 504  | 234  | 46 | Pass |
| 0.0192 | 494  | 232  | 46 | Pass |
| 0.0194 | 482  | 231  | 47 | Pass |
| 0.0196 | 471  | 227  | 48 | Pass |
| 0.0199 | 456  | 225  | 49 | Pass |
| 0.0201 | 440  | 216  | 49 | Pass |
| 0.0203 | 427  | 215  | 50 | Pass |
| 0.0205 | 417  | 211  | 50 | Pass |

|        |     |     |    |      |
|--------|-----|-----|----|------|
| 0.0207 | 406 | 208 | 51 | Pass |
| 0.0209 | 390 | 203 | 52 | Pass |
| 0.0211 | 376 | 201 | 53 | Pass |
| 0.0213 | 360 | 199 | 55 | Pass |
| 0.0215 | 345 | 196 | 56 | Pass |
| 0.0217 | 328 | 196 | 59 | Pass |
| 0.0219 | 319 | 193 | 60 | Pass |
| 0.0222 | 312 | 193 | 61 | Pass |
| 0.0224 | 303 | 192 | 63 | Pass |
| 0.0226 | 294 | 192 | 65 | Pass |
| 0.0228 | 289 | 192 | 66 | Pass |
| 0.0230 | 283 | 187 | 66 | Pass |
| 0.0232 | 277 | 184 | 66 | Pass |
| 0.0234 | 272 | 184 | 67 | Pass |
| 0.0236 | 268 | 183 | 68 | Pass |
| 0.0238 | 265 | 182 | 68 | Pass |
| 0.0240 | 261 | 180 | 68 | Pass |
| 0.0242 | 257 | 176 | 68 | Pass |
| 0.0245 | 251 | 174 | 69 | Pass |
| 0.0247 | 245 | 168 | 68 | Pass |
| 0.0249 | 241 | 164 | 68 | Pass |
| 0.0251 | 237 | 158 | 66 | Pass |
| 0.0253 | 232 | 150 | 64 | Pass |
| 0.0255 | 227 | 145 | 63 | Pass |
| 0.0257 | 224 | 142 | 63 | Pass |

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**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          | Through      | Volume     |
| Volume                            |               | Treatment?   | Needs            | Volume       | Volume     |
|                                   | Water Quality |              |                  | Facility     | (ac-ft.)   |
| Infiltration Infiltrated          |               | Treatment    |                  | (ac-ft)      | Credit     |
|                                   |               | (ac-ft)      |                  |              |            |
| Vault 1 POC                       | N             | 64.24        |                  |              | N          |
| 0.00                              |               |              |                  |              |            |
| Total Volume Infiltrated          |               | 64.24        | 0.00             | 0.00         |            |
| 0.00                              | 0.00          | 0%           | No Treat. Credit |              |            |
| Compliance with LID Standard 8    |               |              |                  |              |            |
| Duration Analysis Result = Failed |               |              |                  |              |            |

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**Perln and Implnd Changes**

No changes have been made.

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## WWHM-2-Stormtank sized with greater than 0.5-in

### WWHM2012 PROJECT REPORT

---

**Project Name:** C&C Cottages  
**Site Name:** C&C Cottages  
**Site Address:** 7816 & 7820 44th Ave W Mukilteo, WA  
**City** : Mukilteo  
**Report Date:** 11/23/2021  
**Gage** : Everett  
**Data Start** : 1948/10/01  
**Data End** : 2009/09/30  
**Precip Scale:** 0.80  
**Version Date:** 2019/09/13  
**Version** : 4.2.17

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

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**High Flow Threshold for POC 1:** 50 year

---

#### PREDEVELOPED LAND USE

**Name** : Existing Basin  
**Bypass:** No

**GroundWater:** No

|                            |             |
|----------------------------|-------------|
| <u>Pervious Land Use</u>   | <u>acre</u> |
| C, Forest, Flat            | .83         |
| <b>Pervious Total</b>      | <b>0.83</b> |
| <u>Impervious Land Use</u> | <u>acre</u> |
| <b>Impervious Total</b>    | <b>0</b>    |
| <b>Basin Total</b>         | <b>0.83</b> |

---

**Element Flows To:**

|                |                  |                    |
|----------------|------------------|--------------------|
| <b>Surface</b> | <b>Interflow</b> | <b>Groundwater</b> |
|----------------|------------------|--------------------|

---

#### MITIGATED LAND USE

Name : Developed Basin

Bypass: No

GroundWater: No

| <u>Pervious Land Use</u>   | <u>acre</u> |
|----------------------------|-------------|
| C, Lawn, Flat              | .38         |
| Pervious Total             | 0.38        |
| <u>Impervious Land Use</u> | <u>acre</u> |
| ROADS FLAT                 | 0.15        |
| ROOF TOPS FLAT             | 0.21        |
| SIDEWALKS FLAT             | 0.09        |
| Impervious Total           | 0.45        |
| Basin Total                | 0.83        |

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Element Flows To:

| Surface             | Interflow           | Groundwater |
|---------------------|---------------------|-------------|
| Gravel Trench Bed 1 | Gravel Trench Bed 1 |             |

---

Name : Gravel Trench Bed 1

Bottom Length: 64.95 ft.

Bottom Width: 64.95 ft.

Trench bottom slope 1: 0 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: 0.9

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

Discharge Structure

Riser Height: 3 ft.

Riser Diameter: 12 in.

Orifice 1 Diameter: 0.5 in. Elevation: 0 ft.

Orifice 2 Diameter: 0.5 in. Elevation: 1.75 ft.

Orifice 3 Diameter: 0.75 in. Elevation: 2.2 ft.

Element Flows To:

|          |          |
|----------|----------|
| Outlet 1 | Outlet 2 |
|----------|----------|

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**Gravel Trench Bed Hydraulic Table**

| <u>Stage(feet)</u> | <u>Area(ac.)</u> | <u>Volume(ac-ft.)</u> | <u>Discharge(cfs)</u> | <u>Infilt(cfs)</u> |
|--------------------|------------------|-----------------------|-----------------------|--------------------|
|--------------------|------------------|-----------------------|-----------------------|--------------------|

---

|        |       |       |       |       |
|--------|-------|-------|-------|-------|
| 0.0000 | 0.096 | 0.000 | 0.000 | 0.000 |
| 0.0444 | 0.096 | 0.003 | 0.001 | 0.000 |
| 0.0889 | 0.096 | 0.007 | 0.002 | 0.000 |
| 0.1333 | 0.096 | 0.011 | 0.002 | 0.000 |
| 0.1778 | 0.096 | 0.015 | 0.002 | 0.000 |
| 0.2222 | 0.096 | 0.019 | 0.003 | 0.000 |
| 0.2667 | 0.096 | 0.023 | 0.003 | 0.000 |
| 0.3111 | 0.096 | 0.027 | 0.003 | 0.000 |
| 0.3556 | 0.096 | 0.031 | 0.004 | 0.000 |
| 0.4000 | 0.096 | 0.034 | 0.004 | 0.000 |
| 0.4444 | 0.096 | 0.038 | 0.004 | 0.000 |
| 0.4889 | 0.096 | 0.042 | 0.004 | 0.000 |
| 0.5333 | 0.096 | 0.046 | 0.005 | 0.000 |
| 0.5778 | 0.096 | 0.050 | 0.005 | 0.000 |
| 0.6222 | 0.096 | 0.054 | 0.005 | 0.000 |
| 0.6667 | 0.096 | 0.058 | 0.005 | 0.000 |
| 0.7111 | 0.096 | 0.062 | 0.005 | 0.000 |
| 0.7556 | 0.096 | 0.065 | 0.005 | 0.000 |
| 0.8000 | 0.096 | 0.069 | 0.006 | 0.000 |
| 0.8444 | 0.096 | 0.073 | 0.006 | 0.000 |
| 0.8889 | 0.096 | 0.077 | 0.006 | 0.000 |
| 0.9333 | 0.096 | 0.081 | 0.006 | 0.000 |
| 0.9778 | 0.096 | 0.085 | 0.006 | 0.000 |
| 1.0222 | 0.096 | 0.089 | 0.006 | 0.000 |
| 1.0667 | 0.096 | 0.093 | 0.007 | 0.000 |
| 1.1111 | 0.096 | 0.096 | 0.007 | 0.000 |
| 1.1556 | 0.096 | 0.100 | 0.007 | 0.000 |
| 1.2000 | 0.096 | 0.104 | 0.007 | 0.000 |
| 1.2444 | 0.096 | 0.108 | 0.007 | 0.000 |
| 1.2889 | 0.096 | 0.112 | 0.007 | 0.000 |
| 1.3333 | 0.096 | 0.116 | 0.007 | 0.000 |
| 1.3778 | 0.096 | 0.120 | 0.008 | 0.000 |
| 1.4222 | 0.096 | 0.124 | 0.008 | 0.000 |
| 1.4667 | 0.096 | 0.127 | 0.008 | 0.000 |
| 1.5111 | 0.096 | 0.131 | 0.008 | 0.000 |
| 1.5556 | 0.096 | 0.135 | 0.008 | 0.000 |
| 1.6000 | 0.096 | 0.139 | 0.008 | 0.000 |
| 1.6444 | 0.096 | 0.143 | 0.008 | 0.000 |
| 1.6889 | 0.096 | 0.147 | 0.008 | 0.000 |
| 1.7333 | 0.096 | 0.151 | 0.008 | 0.000 |
| 1.7778 | 0.096 | 0.154 | 0.010 | 0.000 |
| 1.8222 | 0.096 | 0.158 | 0.011 | 0.000 |
| 1.8667 | 0.096 | 0.162 | 0.011 | 0.000 |
| 1.9111 | 0.096 | 0.166 | 0.012 | 0.000 |
| 1.9556 | 0.096 | 0.170 | 0.012 | 0.000 |
| 2.0000 | 0.096 | 0.174 | 0.013 | 0.000 |
| 2.0444 | 0.096 | 0.178 | 0.013 | 0.000 |
| 2.0889 | 0.096 | 0.182 | 0.013 | 0.000 |
| 2.1333 | 0.096 | 0.185 | 0.014 | 0.000 |
| 2.1778 | 0.096 | 0.189 | 0.014 | 0.000 |
| 2.2222 | 0.096 | 0.193 | 0.017 | 0.000 |
| 2.2667 | 0.096 | 0.197 | 0.019 | 0.000 |
| 2.3111 | 0.096 | 0.201 | 0.020 | 0.000 |
| 2.3556 | 0.096 | 0.205 | 0.021 | 0.000 |
| 2.4000 | 0.096 | 0.209 | 0.022 | 0.000 |
| 2.4444 | 0.096 | 0.213 | 0.023 | 0.000 |

|        |       |       |       |       |
|--------|-------|-------|-------|-------|
| 2.4889 | 0.096 | 0.216 | 0.024 | 0.000 |
| 2.5333 | 0.096 | 0.220 | 0.025 | 0.000 |
| 2.5778 | 0.096 | 0.224 | 0.026 | 0.000 |
| 2.6222 | 0.096 | 0.228 | 0.027 | 0.000 |
| 2.6667 | 0.096 | 0.232 | 0.028 | 0.000 |
| 2.7111 | 0.096 | 0.236 | 0.028 | 0.000 |
| 2.7556 | 0.096 | 0.240 | 0.029 | 0.000 |
| 2.8000 | 0.096 | 0.244 | 0.030 | 0.000 |
| 2.8444 | 0.096 | 0.247 | 0.030 | 0.000 |
| 2.8889 | 0.096 | 0.251 | 0.031 | 0.000 |
| 2.9333 | 0.096 | 0.255 | 0.032 | 0.000 |
| 2.9778 | 0.096 | 0.259 | 0.032 | 0.000 |
| 3.0222 | 0.096 | 0.263 | 0.068 | 0.000 |
| 3.0667 | 0.096 | 0.268 | 0.216 | 0.000 |
| 3.1111 | 0.096 | 0.272 | 0.424 | 0.000 |
| 3.1556 | 0.096 | 0.276 | 0.672 | 0.000 |
| 3.2000 | 0.096 | 0.281 | 0.943 | 0.000 |
| 3.2444 | 0.096 | 0.285 | 1.219 | 0.000 |
| 3.2889 | 0.096 | 0.289 | 1.484 | 0.000 |
| 3.3333 | 0.096 | 0.294 | 1.720 | 0.000 |
| 3.3778 | 0.096 | 0.298 | 1.917 | 0.000 |
| 3.4222 | 0.096 | 0.302 | 2.067 | 0.000 |
| 3.4667 | 0.096 | 0.306 | 2.177 | 0.000 |
| 3.5111 | 0.096 | 0.311 | 2.290 | 0.000 |
| 3.5556 | 0.096 | 0.315 | 2.387 | 0.000 |
| 3.6000 | 0.096 | 0.319 | 2.479 | 0.000 |
| 3.6444 | 0.096 | 0.324 | 2.569 | 0.000 |
| 3.6889 | 0.096 | 0.328 | 2.655 | 0.000 |
| 3.7333 | 0.096 | 0.332 | 2.738 | 0.000 |
| 3.7778 | 0.096 | 0.337 | 2.819 | 0.000 |
| 3.8222 | 0.096 | 0.341 | 2.898 | 0.000 |
| 3.8667 | 0.096 | 0.345 | 2.975 | 0.000 |
| 3.9111 | 0.096 | 0.349 | 3.049 | 0.000 |
| 3.9556 | 0.096 | 0.354 | 3.122 | 0.000 |
| 4.0000 | 0.096 | 0.358 | 3.193 | 0.000 |

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## ANALYSIS RESULTS

### Stream Protection Duration

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Predeveloped Landuse Totals for POC #1  
 Total Pervious Area:0.83  
 Total Impervious Area:0

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Mitigated Landuse Totals for POC #1  
 Total Pervious Area:0.38  
 Total Impervious Area:0.45

---

Flow Frequency Return Periods for Predeveloped. POC #1

| <u>Return Period</u> | <u>Flow(cfs)</u> |
|----------------------|------------------|
| 2 year               | 0.01004          |
| 5 year               | 0.015582         |
| 10 year              | 0.019014         |
| 25 year              | 0.023            |
| 50 year              | 0.02571          |
| 100 year             | 0.02821          |

**Flow Frequency Return Periods for Mitigated. POC #1**

| <u>Return Period</u> | <u>Flow(cfs)</u> |
|----------------------|------------------|
| 2 year               | 0.007117         |
| 5 year               | 0.009183         |
| 10 year              | 0.010728         |
| 25 year              | 0.012889         |
| 50 year              | 0.014656         |
| 100 year             | 0.016565         |

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**Stream Protection Duration**

**Annual Peaks for Predeveloped and Mitigated. POC #1**

| <u>Year</u> | <u>Predeveloped</u> | <u>Mitigated</u> |
|-------------|---------------------|------------------|
| 1949        | 0.001               | 0.006            |
| 1950        | 0.013               | 0.008            |
| 1951        | 0.009               | 0.006            |
| 1952        | 0.007               | 0.006            |
| 1953        | 0.006               | 0.006            |
| 1954        | 0.014               | 0.007            |
| 1955        | 0.017               | 0.011            |
| 1956        | 0.014               | 0.011            |
| 1957        | 0.016               | 0.008            |
| 1958        | 0.011               | 0.007            |
| 1959        | 0.011               | 0.007            |
| 1960        | 0.010               | 0.007            |
| 1961        | 0.011               | 0.008            |
| 1962        | 0.007               | 0.006            |
| 1963        | 0.009               | 0.007            |
| 1964        | 0.010               | 0.005            |
| 1965        | 0.010               | 0.007            |
| 1966        | 0.005               | 0.006            |
| 1967        | 0.014               | 0.006            |
| 1968        | 0.014               | 0.007            |
| 1969        | 0.007               | 0.007            |
| 1970        | 0.008               | 0.006            |
| 1971        | 0.012               | 0.011            |
| 1972        | 0.011               | 0.006            |
| 1973        | 0.006               | 0.008            |
| 1974        | 0.010               | 0.007            |
| 1975        | 0.008               | 0.006            |
| 1976        | 0.008               | 0.007            |
| 1977        | 0.004               | 0.006            |
| 1978        | 0.008               | 0.006            |
| 1979        | 0.013               | 0.006            |
| 1980        | 0.009               | 0.006            |
| 1981        | 0.007               | 0.005            |
| 1982        | 0.011               | 0.008            |
| 1983        | 0.009               | 0.007            |

|      |       |       |
|------|-------|-------|
| 1984 | 0.010 | 0.010 |
| 1985 | 0.015 | 0.009 |
| 1986 | 0.038 | 0.013 |
| 1987 | 0.013 | 0.012 |
| 1988 | 0.009 | 0.008 |
| 1989 | 0.006 | 0.006 |
| 1990 | 0.011 | 0.008 |
| 1991 | 0.012 | 0.007 |
| 1992 | 0.009 | 0.008 |
| 1993 | 0.006 | 0.005 |
| 1994 | 0.004 | 0.008 |
| 1995 | 0.010 | 0.008 |
| 1996 | 0.022 | 0.008 |
| 1997 | 0.042 | 0.026 |
| 1998 | 0.006 | 0.006 |
| 1999 | 0.011 | 0.007 |
| 2000 | 0.006 | 0.008 |
| 2001 | 0.001 | 0.004 |
| 2002 | 0.010 | 0.008 |
| 2003 | 0.007 | 0.007 |
| 2004 | 0.010 | 0.008 |
| 2005 | 0.008 | 0.007 |
| 2006 | 0.023 | 0.009 |
| 2007 | 0.016 | 0.008 |
| 2008 | 0.023 | 0.014 |
| 2009 | 0.009 | 0.007 |

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**Stream Protection Duration**

**Ranked Annual Peaks for Predeveloped and Mitigated. POC #1**

| <b>Rank</b> | <b>Predeveloped</b> | <b>Mitigated</b> |
|-------------|---------------------|------------------|
| 1           | 0.0421              | 0.0261           |
| 2           | 0.0380              | 0.0136           |
| 3           | 0.0232              | 0.0131           |
| 4           | 0.0227              | 0.0115           |
| 5           | 0.0221              | 0.0113           |
| 6           | 0.0175              | 0.0111           |
| 7           | 0.0162              | 0.0107           |
| 8           | 0.0155              | 0.0104           |
| 9           | 0.0147              | 0.0087           |
| 10          | 0.0145              | 0.0085           |
| 11          | 0.0142              | 0.0083           |
| 12          | 0.0141              | 0.0082           |
| 13          | 0.0138              | 0.0081           |
| 14          | 0.0130              | 0.0081           |
| 15          | 0.0129              | 0.0081           |
| 16          | 0.0128              | 0.0080           |
| 17          | 0.0119              | 0.0080           |
| 18          | 0.0116              | 0.0078           |
| 19          | 0.0113              | 0.0078           |
| 20          | 0.0112              | 0.0077           |
| 21          | 0.0111              | 0.0077           |
| 22          | 0.0111              | 0.0077           |
| 23          | 0.0108              | 0.0076           |
| 24          | 0.0108              | 0.0075           |
| 25          | 0.0107              | 0.0075           |

|    |        |        |
|----|--------|--------|
| 26 | 0.0104 | 0.0074 |
| 27 | 0.0102 | 0.0073 |
| 28 | 0.0102 | 0.0073 |
| 29 | 0.0100 | 0.0073 |
| 30 | 0.0098 | 0.0073 |
| 31 | 0.0098 | 0.0072 |
| 32 | 0.0098 | 0.0072 |
| 33 | 0.0096 | 0.0071 |
| 34 | 0.0092 | 0.0069 |
| 35 | 0.0090 | 0.0069 |
| 36 | 0.0087 | 0.0069 |
| 37 | 0.0087 | 0.0068 |
| 38 | 0.0086 | 0.0068 |
| 39 | 0.0086 | 0.0067 |
| 40 | 0.0086 | 0.0067 |
| 41 | 0.0084 | 0.0066 |
| 42 | 0.0082 | 0.0065 |
| 43 | 0.0081 | 0.0064 |
| 44 | 0.0079 | 0.0064 |
| 45 | 0.0076 | 0.0064 |
| 46 | 0.0075 | 0.0062 |
| 47 | 0.0074 | 0.0062 |
| 48 | 0.0071 | 0.0061 |
| 49 | 0.0066 | 0.0061 |
| 50 | 0.0065 | 0.0061 |
| 51 | 0.0062 | 0.0060 |
| 52 | 0.0061 | 0.0059 |
| 53 | 0.0060 | 0.0057 |
| 54 | 0.0059 | 0.0057 |
| 55 | 0.0058 | 0.0056 |
| 56 | 0.0055 | 0.0056 |
| 57 | 0.0054 | 0.0055 |
| 58 | 0.0037 | 0.0055 |
| 59 | 0.0037 | 0.0052 |
| 60 | 0.0015 | 0.0049 |
| 61 | 0.0013 | 0.0042 |

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**Stream Protection Duration**

**POC #1**

**The Facility FAILED**

**Facility FAILED duration standard for 1+ flows.**

| <b>Flow(cfs)</b> | <b>Predev</b> | <b>Mit</b> | <b>Percentage</b> | <b>Pass/Fail</b>                      |
|------------------|---------------|------------|-------------------|---------------------------------------|
| 0.0050           | 21881         | 139070     | 635               | <span style="color: red;">Fail</span> |
| 0.0052           | 20046         | 119307     | 595               | <span style="color: red;">Fail</span> |
| 0.0054           | 18311         | 102260     | 558               | <span style="color: red;">Fail</span> |
| 0.0056           | 16760         | 86154      | 514               | <span style="color: red;">Fail</span> |
| 0.0059           | 15293         | 72230      | 472               | <span style="color: red;">Fail</span> |
| 0.0061           | 13988         | 60594      | 433               | <span style="color: red;">Fail</span> |
| 0.0063           | 12831         | 51355      | 400               | <span style="color: red;">Fail</span> |
| 0.0065           | 11815         | 42521      | 359               | <span style="color: red;">Fail</span> |
| 0.0067           | 10836         | 34714      | 320               | <span style="color: red;">Fail</span> |
| 0.0069           | 9952          | 28105      | 282               | <span style="color: red;">Fail</span> |
| 0.0071           | 9167          | 22886      | 249               | <span style="color: red;">Fail</span> |

|        |      |       |     |      |
|--------|------|-------|-----|------|
| 0.0073 | 8481 | 18018 | 212 | Fail |
| 0.0075 | 7837 | 13952 | 178 | Fail |
| 0.0077 | 7247 | 10806 | 149 | Fail |
| 0.0079 | 6697 | 8459  | 126 | Fail |
| 0.0082 | 6188 | 6423  | 103 | Fail |
| 0.0084 | 5711 | 4770  | 83  | Pass |
| 0.0086 | 5247 | 3625  | 69  | Pass |
| 0.0088 | 4827 | 2712  | 56  | Pass |
| 0.0090 | 4447 | 2184  | 49  | Pass |
| 0.0092 | 4113 | 2118  | 51  | Pass |
| 0.0094 | 3801 | 2053  | 54  | Pass |
| 0.0096 | 3540 | 1983  | 56  | Pass |
| 0.0098 | 3275 | 1911  | 58  | Pass |
| 0.0100 | 3029 | 1841  | 60  | Pass |
| 0.0102 | 2798 | 1740  | 62  | Pass |
| 0.0105 | 2609 | 1603  | 61  | Pass |
| 0.0107 | 2443 | 1472  | 60  | Pass |
| 0.0109 | 2301 | 1237  | 53  | Pass |
| 0.0111 | 2180 | 1144  | 52  | Pass |
| 0.0113 | 2060 | 1025  | 49  | Pass |
| 0.0115 | 1955 | 957   | 48  | Pass |
| 0.0117 | 1860 | 908   | 48  | Pass |
| 0.0119 | 1745 | 872   | 49  | Pass |
| 0.0121 | 1657 | 834   | 50  | Pass |
| 0.0123 | 1560 | 791   | 50  | Pass |
| 0.0125 | 1456 | 746   | 51  | Pass |
| 0.0128 | 1372 | 684   | 49  | Pass |
| 0.0130 | 1308 | 602   | 46  | Pass |
| 0.0132 | 1241 | 496   | 39  | Pass |
| 0.0134 | 1197 | 454   | 37  | Pass |
| 0.0136 | 1156 | 399   | 34  | Pass |
| 0.0138 | 1117 | 341   | 30  | Pass |
| 0.0140 | 1076 | 328   | 30  | Pass |
| 0.0142 | 1033 | 315   | 30  | Pass |
| 0.0144 | 997  | 302   | 30  | Pass |
| 0.0146 | 967  | 298   | 30  | Pass |
| 0.0148 | 936  | 296   | 31  | Pass |
| 0.0151 | 903  | 294   | 32  | Pass |
| 0.0153 | 868  | 292   | 33  | Pass |
| 0.0155 | 834  | 290   | 34  | Pass |
| 0.0157 | 797  | 289   | 36  | Pass |
| 0.0159 | 770  | 288   | 37  | Pass |
| 0.0161 | 738  | 286   | 38  | Pass |
| 0.0163 | 721  | 284   | 39  | Pass |
| 0.0165 | 690  | 282   | 40  | Pass |
| 0.0167 | 669  | 281   | 42  | Pass |
| 0.0169 | 649  | 279   | 42  | Pass |
| 0.0171 | 637  | 278   | 43  | Pass |
| 0.0174 | 615  | 276   | 44  | Pass |
| 0.0176 | 592  | 274   | 46  | Pass |
| 0.0178 | 577  | 272   | 47  | Pass |
| 0.0180 | 565  | 270   | 47  | Pass |
| 0.0182 | 550  | 268   | 48  | Pass |
| 0.0184 | 538  | 266   | 49  | Pass |
| 0.0186 | 524  | 264   | 50  | Pass |
| 0.0188 | 513  | 263   | 51  | Pass |

|        |     |     |    |      |
|--------|-----|-----|----|------|
| 0.0190 | 504 | 261 | 51 | Pass |
| 0.0192 | 494 | 258 | 52 | Pass |
| 0.0194 | 482 | 256 | 53 | Pass |
| 0.0196 | 471 | 253 | 53 | Pass |
| 0.0199 | 456 | 251 | 55 | Pass |
| 0.0201 | 440 | 247 | 56 | Pass |
| 0.0203 | 427 | 245 | 57 | Pass |
| 0.0205 | 417 | 242 | 58 | Pass |
| 0.0207 | 406 | 240 | 59 | Pass |
| 0.0209 | 390 | 237 | 60 | Pass |
| 0.0211 | 376 | 234 | 62 | Pass |
| 0.0213 | 360 | 231 | 64 | Pass |
| 0.0215 | 345 | 228 | 66 | Pass |
| 0.0217 | 328 | 226 | 68 | Pass |
| 0.0219 | 319 | 223 | 69 | Pass |
| 0.0222 | 312 | 219 | 70 | Pass |
| 0.0224 | 303 | 216 | 71 | Pass |
| 0.0226 | 294 | 212 | 72 | Pass |
| 0.0228 | 289 | 209 | 72 | Pass |
| 0.0230 | 283 | 205 | 72 | Pass |
| 0.0232 | 277 | 201 | 72 | Pass |
| 0.0234 | 272 | 198 | 72 | Pass |
| 0.0236 | 268 | 186 | 69 | Pass |
| 0.0238 | 265 | 177 | 66 | Pass |
| 0.0240 | 261 | 163 | 62 | Pass |
| 0.0242 | 257 | 146 | 56 | Pass |
| 0.0245 | 251 | 132 | 52 | Pass |
| 0.0247 | 245 | 127 | 51 | Pass |
| 0.0249 | 241 | 122 | 50 | Pass |
| 0.0251 | 237 | 117 | 49 | Pass |
| 0.0253 | 232 | 103 | 44 | Pass |
| 0.0255 | 227 | 82  | 36 | Pass |
| 0.0257 | 224 | 67  | 29 | Pass |

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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.

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Water Quality BMP Flow and Volume for POC #1  
On-line facility volume: 0.0425 acre-feet  
On-line facility target flow: 0.0535 cfs.  
Adjusted for 15 min: 0.0535 cfs.  
Off-line facility target flow: 0.0303 cfs.  
Adjusted for 15 min: 0.0303 cfs.

---

#### LID Report

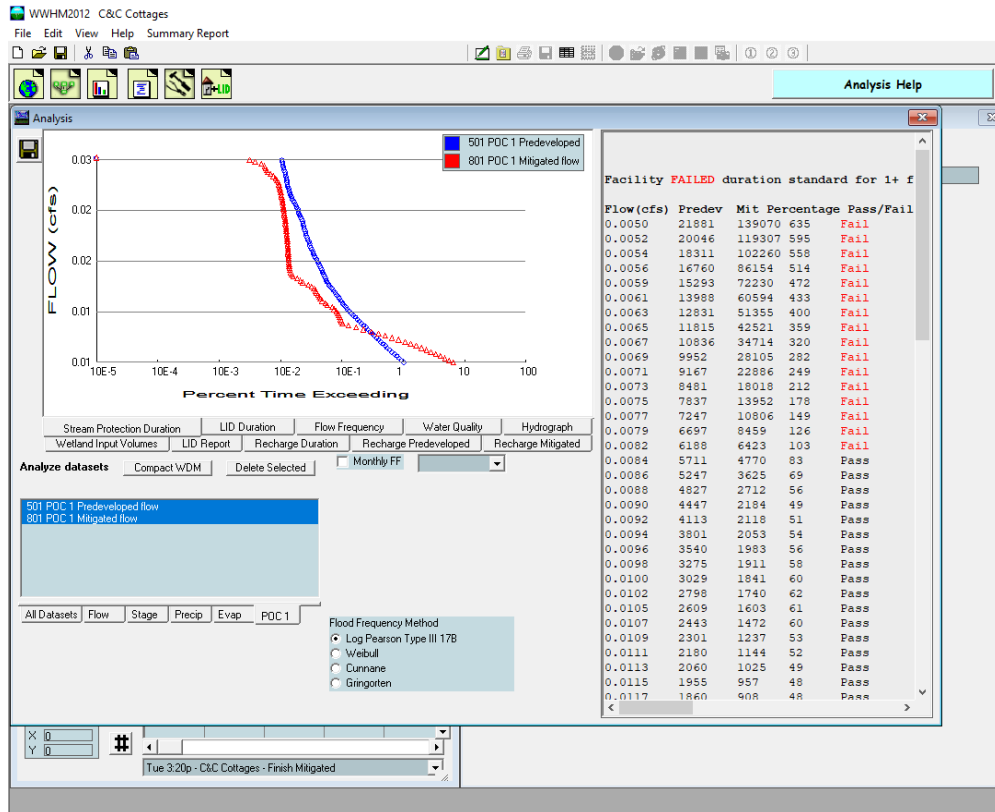
| LID Technique           | Used for      | Total Volume | Volume   | Infiltration | Cumulative |
|-------------------------|---------------|--------------|----------|--------------|------------|
| Percent                 | Water Quality | Percent      | Through  | Volume       | Volume     |
| Volume                  | Treatment?    | Needs        | Facility | (ac-ft.)     |            |
| Infiltration            | Water Quality | Treatment    |          |              |            |
| Infiltrated             |               | Treated      | (ac-ft)  |              | Credit     |
|                         |               | (ac-ft)      |          |              |            |
| Gravel Trench Bed 1 POC | N             | 64.27        |          |              | N          |
| 0.00                    |               |              |          |              |            |

Total Volume Infiltrated 64.27 0.00 0.00  
 0.00 0.00 0% No Treat. Credit  
 Compliance with LID Standard 8  
 Duration Analysis Result = Failed

## PerlnD and Implnd Changes

No changes have been made.

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## E. STORMWATER TREATMENT PLAN

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Water quality will be met by a filter upstream of detention.

### **Water Quality Basin Summary**

Total Area Included in the Analysis = 0.62 Acres

Total Developed Basin Area = 0.62 Acres

#### **Impervious Areas:**

|                   |                                |
|-------------------|--------------------------------|
| Frontage Sidewalk | = 1,306 SF (0.03 Acres)        |
| Drive aisle       | = 6,402 SF (0.15 Acres)        |
| <u>Sidewalk</u>   | <u>= 2,527 SF (0.06 Acres)</u> |
| Total Impervious  | = 10,235 SF (0.24 Acres)       |

Total Pervious Areas = 0.62 Acres - 0.24 Acres = 0.38 Acres

**WWHM2012  
PROJECT REPORT**

---

**Project Name:** C&C Water Quality  
**Site Name:** C&C Cottages  
**Site Address:** 7816 & 7820 44th Ave W Mukilteo, WA  
**City** : Mukilteo  
**Report Date:** 12/1/2021  
**Gage** : Everett  
**Data Start** : 1948/10/01  
**Data End** : 2009/09/30  
**Precip Scale:** 0.80  
**Version Date:** 2019/09/13  
**Version** : 4.2.17

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

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**High Flow Threshold for POC 1:** 50 year

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**PREDEVELOPED LAND USE**

**Name** : Existing Basin  
**Bypass:** No

**GroundWater:** No

|                            |             |
|----------------------------|-------------|
| <u>Pervious Land Use</u>   | <u>acre</u> |
| C, Forest, Flat            | .62         |
| <b>Pervious Total</b>      | <b>0.62</b> |
| <u>Impervious Land Use</u> | <u>acre</u> |
| <b>Impervious Total</b>    | <b>0</b>    |
| <b>Basin Total</b>         | <b>0.62</b> |

---

|                          |           |             |
|--------------------------|-----------|-------------|
| <b>Element Flows To:</b> |           |             |
| Surface                  | Interflow | Groundwater |

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**MITIGATED LAND USE**

**Name** : Developed Basin  
**Bypass:** No

**GroundWater:** No

|                            |             |
|----------------------------|-------------|
| <u>Pervious Land Use</u>   | <u>acre</u> |
| C, Lawn, Flat              | .38         |
| Pervious Total             | 0.38        |
| <u>Impervious Land Use</u> | <u>acre</u> |
| ROADS FLAT                 | 0.15        |
| SIDEWALKS FLAT             | 0.09        |
| Impervious Total           | 0.24        |
| Basin Total                | 0.62        |

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|                   |           |             |
|-------------------|-----------|-------------|
| Element Flows To: |           |             |
| Surface           | Interflow | Groundwater |

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#### ANALYSIS RESULTS

##### Stream Protection Duration

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Predeveloped Landuse Totals for POC #1  
Total Pervious Area:0.62  
Total Impervious Area:0

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Mitigated Landuse Totals for POC #1  
Total Pervious Area:0.38  
Total Impervious Area:0.24

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Flow Frequency Return Periods for Predeveloped. POC #1

|                      |                  |
|----------------------|------------------|
| <u>Return Period</u> | <u>Flow(cfs)</u> |
| 2 year               | 0.0075           |
| 5 year               | 0.01164          |
| 10 year              | 0.014203         |
| 25 year              | 0.017181         |
| 50 year              | 0.019205         |
| 100 year             | 0.021073         |

Flow Frequency Return Periods for Mitigated. POC #1

|                      |                  |
|----------------------|------------------|
| <u>Return Period</u> | <u>Flow(cfs)</u> |
| 2 year               | 0.08644          |
| 5 year               | 0.124554         |
| 10 year              | 0.154423         |
| 25 year              | 0.1979           |

|          |          |
|----------|----------|
| 50 year  | 0.234762 |
| 100 year | 0.275729 |

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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.

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Water Quality BMP Flow and Volume for POC #1  
On-line facility volume: 0.0265 acre-feet  
On-line facility target flow: 0.0285 cfs.  
Adjusted for 15 min: 0.0285 cfs.  
Off-line facility target flow: 0.016 cfs.  
Adjusted for 15 min: 0.016 cfs.

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#### LID Report

| LID Technique                     | Used for      | Total Volume | Volume    | Infiltration | Cumulative |
|-----------------------------------|---------------|--------------|-----------|--------------|------------|
| Percent                           | Water Quality | Percent      | Comment   | Volume       | Volume     |
| Volume                            | Treatment?    | Needs        | Through   | Volume       | Volume     |
|                                   | Water Quality | Treatment    | Facility  | (ac-ft.)     |            |
| Infiltration Infiltrated          |               | Treated      | (ac-ft)   |              | Credit     |
|                                   |               | (ac-ft)      | (ac-ft)   |              |            |
| Total Volume Infiltrated          |               | 0.00         | 0.00      | 0.00         |            |
| 0.00                              | 0.00          | 0%           | No Treat. |              | Credit     |
| Compliance with LID Standard 8    |               |              |           |              |            |
| Duration Analysis Result = Failed |               |              |           |              |            |

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#### Perlnd and Implnd Changes

No changes have been made.

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## F. CONVEYANCE ANALYSIS

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The 100yr peak flow for the project is only 0.44 cfs. A 12-inch pipe can convey 3 cfs at a minimum slope of 0.5-percent. The minimum size of the proposed system is 12-inch for the project that can easily convey 0.44 cfs and therefore a detailed conveyance analysis was not performed.

## G. MAINTENANCE AND OPERATION MANUAL

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An Operation and Maintenance Manual will be provided for the construction submittal.