civil & structural
engineering & planning

DRAINAGE REPORT

Rose Hill Apartments

3rd & Park Ave
Mukilteo, WA 98275

01/27/2023

CG Project No.: 22332.20

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Table of Contents

Section I – Project Overview

Section I Summary

Overview
Existing Condition
Developed Condition

Overview

This drainage report has been prepared for the construction of a three story 14-unit mixed use building on a partially developed 0.25 ac lot in the City of Mukilteo, WA. The project will comply with the City of Mukilteo 2017 Development Standards, as amended in 2019 (2019 MDS), the city of Mukilteo Municipal Code, and the Department of Ecology's 2019 Stormwater Management Manual of Western Washington (2019 SWMMWW). The project must meet Minimum Requirements #1-9 per Volume I of the 2019 SWMMWW because the project adds more than 5,000 sf of new plus replaced hard surface. The site is considered a new development project. The total disturbance on the project site totals approximately 20,487 sf (0.470 ac), which includes all area contained within the construction clearing limits (see Erosion Control Plan). A full Department of Ecology (DOE) Stormwater Pollution Prevention Plan (SWPPP) is not required since the area of disturbance is less than an acre.

Site Address: 3rd and Park Ave, Mukilteo, WA 98275
Tax Parcel Number: 00596900300601
Watershed: Puget Sound

Existing Conditions

The site is currently partially developed with a small building, concrete walkway, and previous frontage improvements along 3rd Street. The rest of the site is undeveloped with native grasses. The site borders Park Ave to the east, 3rd Street to the south, Park Lane to the north, and commercial/mixed use lots to the west.

The site generally slopes down from south to north at an average of about 12%. Underlying soils consist of fine to medium sand underlain by native glacial till. Perched groundwater was encountered 6' below the ground surface. Infiltration on site was found to be infeasible due to the high level of groundwater. See the geotechnical report in Section VI for more details. The site is in the Everett West Drainage Basin in the Puget Sound Watershed.

The existing areas on the lot are as follows:

Impervious Area	
Walkway:	243 sf (0.006 ac)
Roof:	469 sf (0.011 ac)
Total:	712 sf (0.017 ac)

Pervious Areas

Native Grass:	10,288 sf (0.236 ac)
Total:	10,288 sf (0.236 ac)

Total Lot: 11,000 sf (0.252 ac)

Developed Conditions

In the proposed condition, a new apartment building with retail below will be constructed, new frontage improvements will be added to Park Ave and 3rd Street, and pavement will be replaced along Park Lane.

The proposed coverage is as follows:

Impervious Areas

Roof:	10,585 sf (0.243 ac)

Pervious Areas

Landscaping:	485 sf (0.111 ac)

Total Lot: 11,000 sf (0.252 ac)

The new detention tank has been sized to manage all new on-site impervious areas on site and the associated frontage improvements. Details for sizing are included in Section V of this report.

The project triggers Minimum Requirements #1-9 of the 2019 SWMMWW since over 5,000 sf of new/replaced impervious area is being added. Since the project parcel is less than five acres, the project must meet either the Low Impact Development Standard and BMP T5.13 or On-site Stormwater Management List #2. In this case, List #2 will be used to manage all disturbed areas and new hard surfaces.

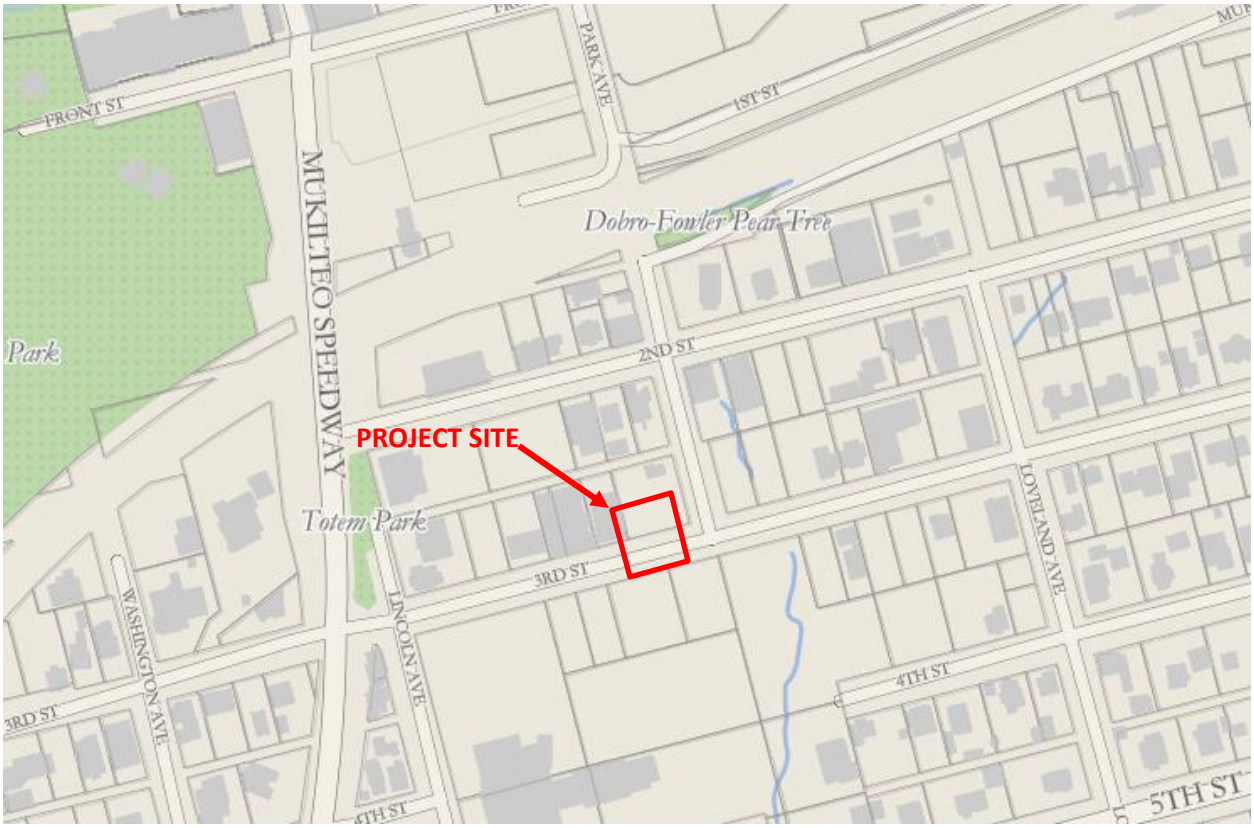

Figure I-1 Vicinity Map

Figure I-2 Aerial Photograph

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Section II – Minimum Requirements

Section II Summary

Narrative

The project will comply with Minimum Requirements #1-9 per the 2019 SWMMWW, as amended by the 2019 MDS, because it is a redevelopment resulting in more than 5,000 sf of new plus replaced impervious surface area (see Figure II-1).

Minimum Requirement #1: Preparation of Stormwater Site Plans

The stormwater site plan consists of this report and the civil drawings and is prepared in accordance with Chapter 3 of Volume 1 of the 2019 SWMMWW.

Minimum Requirement #2: Stormwater Pollution Prevention Plans (SWPPPs)

The SWPPP includes a narrative and drawings. The SWPPP narrative shall include documentation that addresses the 13 elements of Construction Stormwater Pollution Prevention. See Section IV and the civil drawings. A Construction Stormwater General Permit is not required because land disturbance will be under an acre.

Minimum Requirement #3: Source Control of Pollution

Temporary and permanent source control BMPs are required. Section IV lists all required BMPs.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls: Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and down-gradient properties. All projects shall submit an off-site qualitative analysis. A qualitative analysis of the upstream and downstream system entering the site is presented in Section III.

Minimum Requirement #5: On-Site Stormwater Management: The project must evaluate On-Site Stormwater Management BMPs. This is discussed in Section V. The site is inside of the UGA per Snohomish county maps and the site is smaller than 5 acres. Per Table I-3.1 of the 2019 SWMMWW, the Low Impact Development Standard and BMP T5.13 or On-site Stormwater Management List #2 will be used. The project will evaluate BMPs from List #2. See Section V for more.

Minimum Requirement #6: Runoff Treatment

Stormwater treatment facilities shall be provided for each threshold discharge area in which the hard and pervious surfaces subject to this minimum requirement meet the following criteria: the total of pollution-generating hard surface (PGHS) in the threshold discharge area is 5,000 square feet or more; or the total of pollution-generating pervious surfaces (PGPS) in the threshold discharge area, excluding permeable pavement, and from which stormwater will be discharged in a natural or man-made conveyance system

from the site, is three-quarters (3/4) of an acre or more. This project only proposes 2,110 square feet of new/replaced pollution generating hard surface (all in the right of ways) and is exempted from this requirement.

Minimum Requirement #7: Flow Control

Flow control shall be provided for the following thresholds: the total of effective impervious surfaces is 10,000 sf of more in a threshold discharge area, three-quarters of an acre or more of native vegetation is converted to lawn or landscape and surface water is discharged from the site into a conveyance system or receiving waters; 2.5 acres or more of native vegetation are converted to pasture in a threshold discharge area and surface water is discharged from the site into a conveyance system or receiving waters; or a combination of hard surfaces and converted pervious surfaces cause a 0.15 cubic feet per second (cfs) or greater increase in the 100-year flow frequency from a threshold discharge area using 15-minute timesteps. The total effective impervious surface on site is proposed to be over 10,000 sf, thus flow control BMPs are required. See Section V for more.

Minimum Requirement #8: Wetlands Protection: There are no existing wetlands on-site or within the downstream vicinity of the site, and Wetlands Protection is not required.

Minimum Requirement #9: Operation and Maintenance: An operation and maintenance manual that is consistent with the provisions in Volume I and Volume V of the SWMMWW is required for proposed Stormwater Treatment and Flow Control BMPs/facilities. The party (or parties) responsible for maintenance and operation shall be identified in the operation and maintenance manual. For private facilities approved by the City, a copy of the operation and maintenance manual shall be retained on-site or within reasonable access to the site and shall be transferred with the property to future owners. For public facilities, a copy of the operation and maintenance manual shall be retained in the appropriate department. A log of maintenance activity that indicates what actions were taken shall be kept and be available for inspection. See Section VII.

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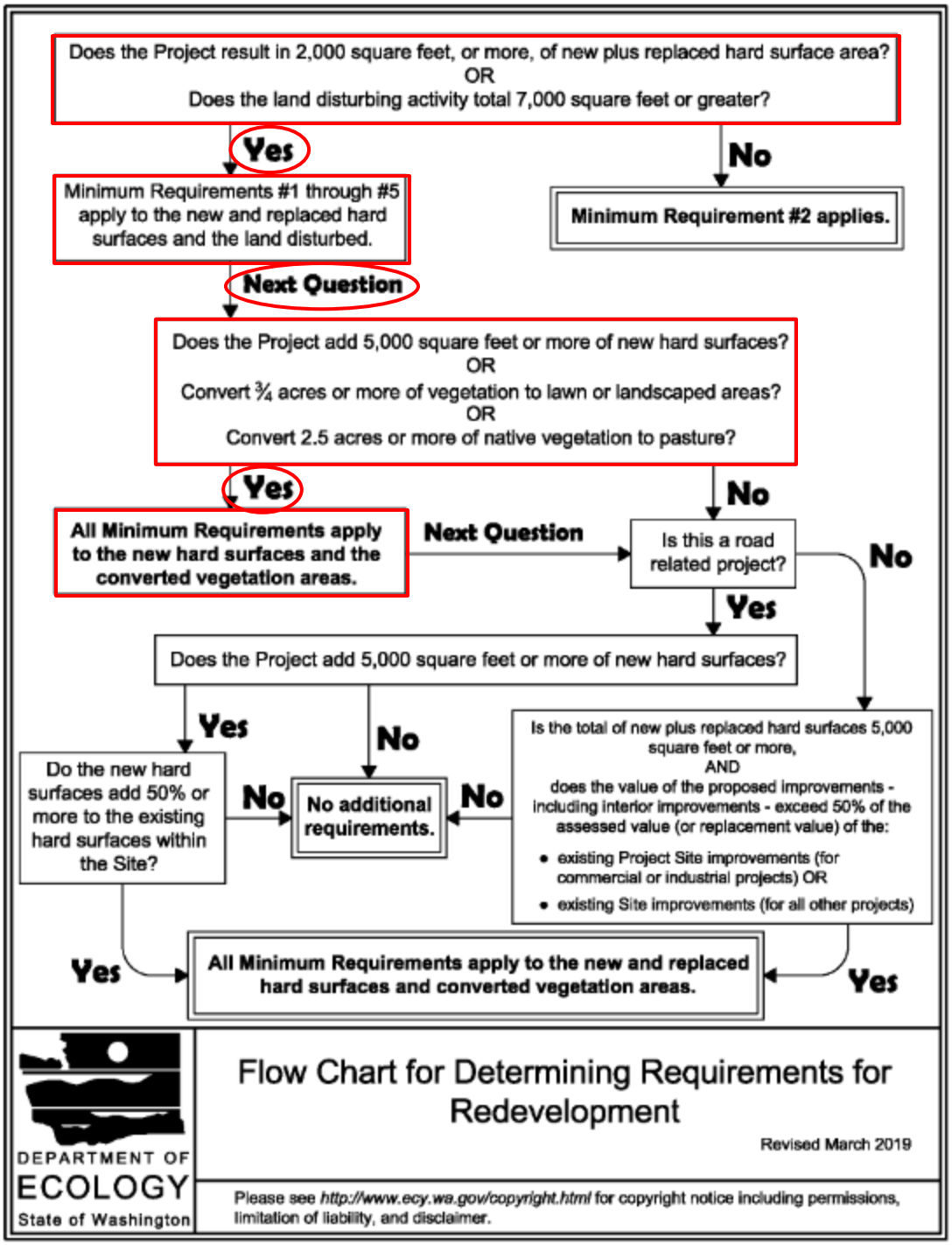

Figure II-1 Flow Chart Determining Minimum Requirements for Redevelopment (Figure I-3.2 in the 2019 SWMMWW)

Section III – Off-Site Analysis

Section III Summary

Task 1 – Define and map the study area
Task 2 – Review all available information of the study area
Task 3 – Field inspect the area
Task 4 - Describe the drainage system, and its existing and predicted problems

An off-site analysis has been prepared according to Chapter 3 of Volume III of the Drainage Manual. It shall assess the potential off-site water quality, erosion, slope stability, and drainage impacts associated with the project and propose appropriate mitigation of those impacts. An initial qualitative analysis shall extend downstream for the entire flow path from the project site to the receiving water or up to one mile, whichever is less. If a receiving waterbody is within one-quarter mile, the analysis shall extend within the receiving water to one-quarter mile from the project site.

Task 1 – Define and map the study area

The study area is defined as the entire flow path from the project site to the receiving waterbody or up to one mile, whichever is less. Per the survey and site visit, runoff from the site flows north to the property line. Per the Snohomish County GIS Drainage Inventory Map and the survey, existing drainage infrastructure consists of catch basins and conveyance pipes.

Task 2 – Review all available information on the study area

Online information was reviewed of the study area from City of Mukilteo maps and the survey. No critical areas are located near or on-site and no issues are expected with the additional proposed construction. Figure III-1 depicts the study area.

Task 3 – Field inspect the study area

A site visit was done in the afternoon on 01/06/2023. It was a clear day and had rained within recent days. Per Figure III-1, there are catch basins and conveyance pipes along the north and east frontage of the site. During the site visit, it was observed that stormwater from the site flows down gradient to the north where it reaches a catch basins within the ROWs of Park lane and Park Avenue. From there, stormwater flows to the north via the public drainage system. It continues to flow north through private properties and beneath the train tracks to the north of 801 Mukilteo Lane. The stormwater continues to flow northerly via the public drainage system beneath Mukilteo Speedway and private properties. It then outlets into Possession Sound. The site appears to be well drained. Overall, during the downstream walk there did not appear to be any evidence of flooding or erosion. It does not appear that upstream runoff onto the property will be a concern.

Task 4 – Describe the drainage system, and its existing and predicted problems

During the downstream walk, there did not appear to be any evidence of downstream flooding or erosion. The proposed detention pipes should reduce the impact of existing and added impervious areas on-site. All impervious areas are to be routed to a detention pipe with a flow control structure, which will connect to a catch basin in the ROW. There are no predicted problems with this system.

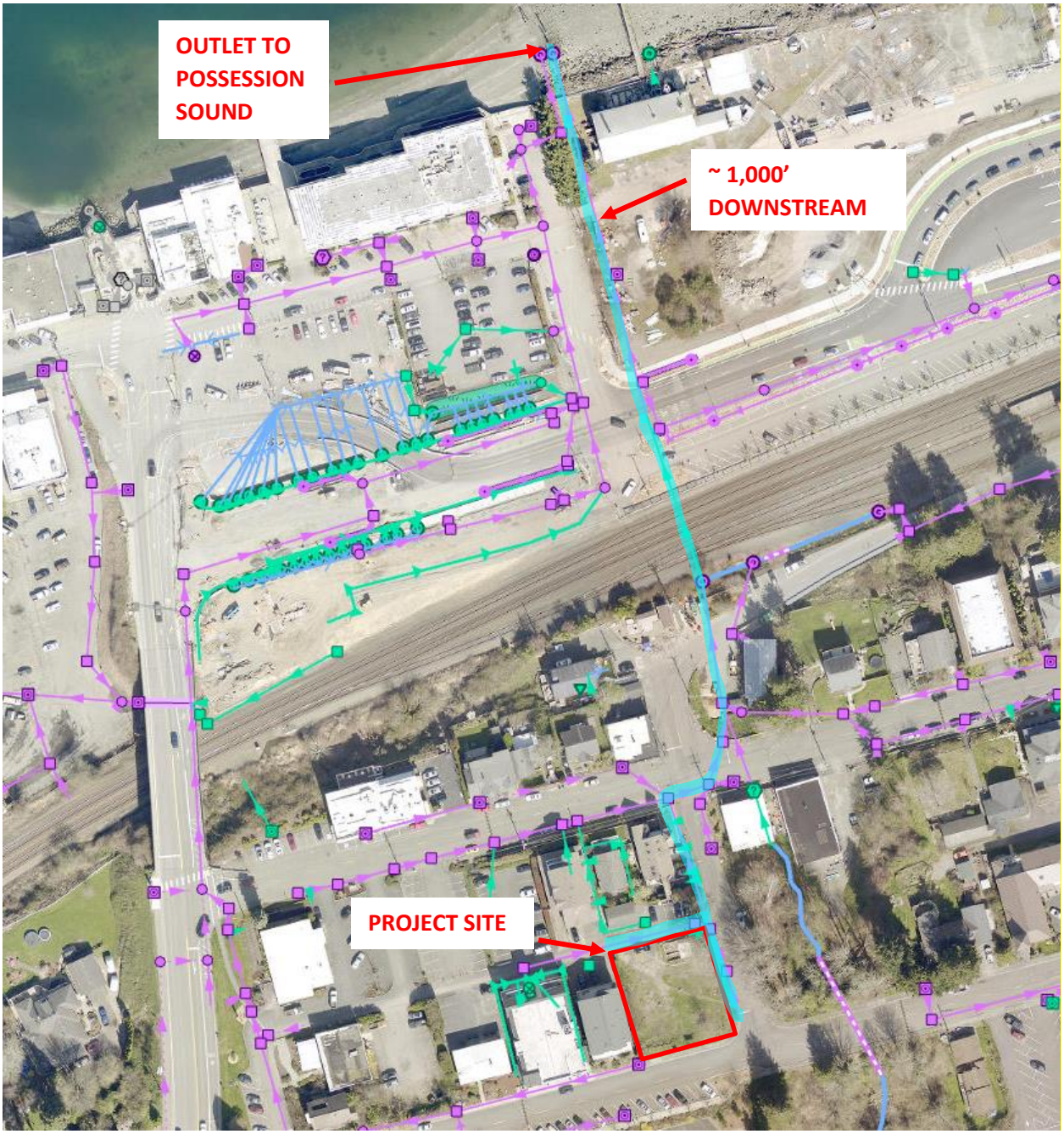

Figure III-1 Study Area.

Figure III-2 Looking westerly from the east side of Park Ave

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Figure III-3 Looking northwest from the same location as the previous photo

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Figure III-4 Looking southwesterly from the intersection of Park Lane and Park Ave

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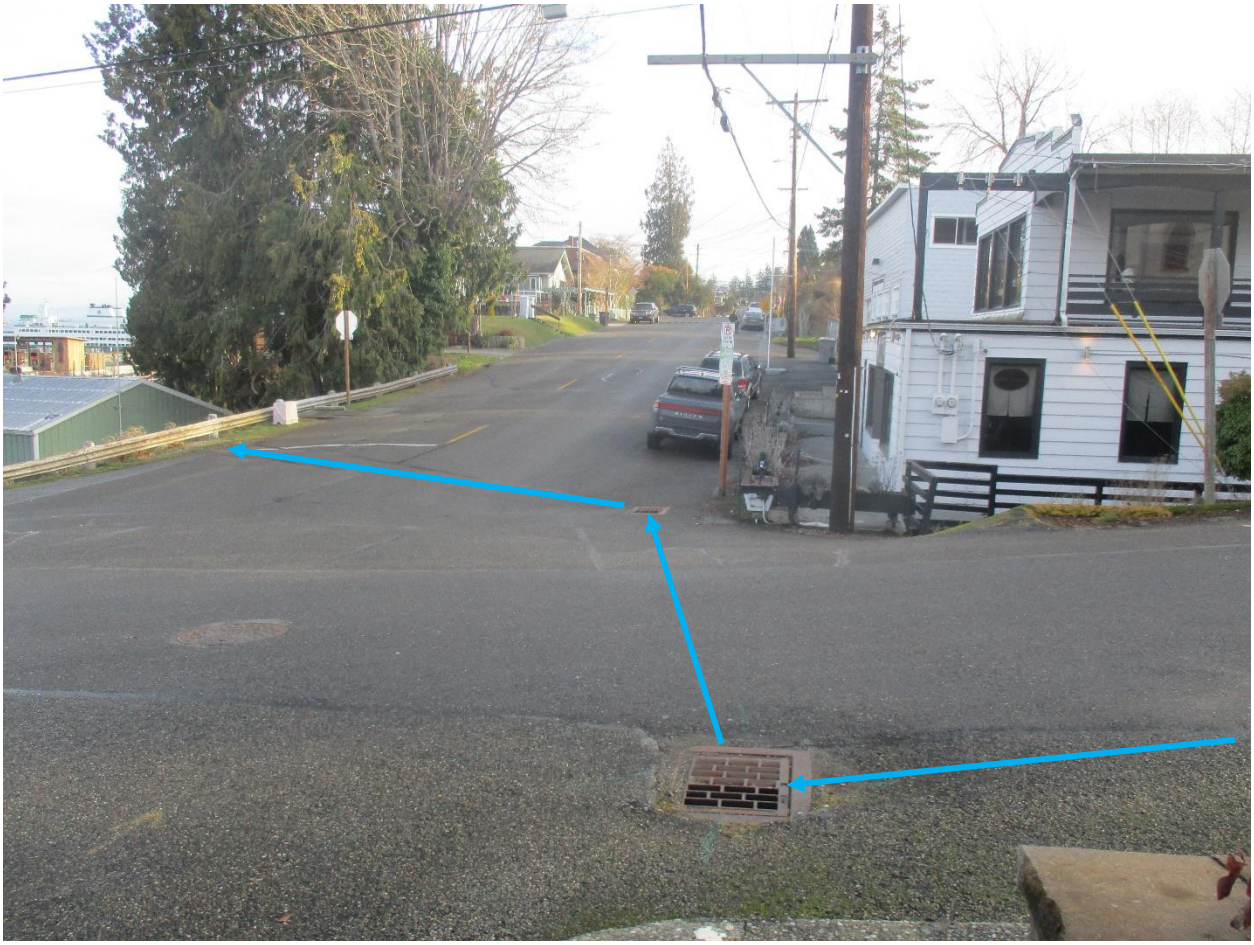

Figure III-5 Looking easterly from the intersection of 2nd Street and Park Ave

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Figure III-6 Looking southerly from 801 Mukilteo Ln

Figure III-7 Looking northerly from the same location as the previous photo

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Figure III-8 Looking northerly from the outlet location

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Section IV – Stormwater Pollution Prevention Plan (SWPPP) Narrative

Section IV Summary

Narrative
Source Control BMPs
DOE SWPPP

Land disturbance will occur in the area of the proposed development, as well as in the areas of proposed grading and drainage BMPs. The total area of land disturbance is 0.377 ac and contains all area within the construction clearing limits. A Construction Stormwater General Permit is not required because land disturbing activities total under one acre. However, a full DOE SWPPP has been prepared per Mukilteo Development Standards MR#2.

Source Control BMPs

The project proposes to use source control BMPs applicable to all site per Volume 4 Section 1 of the 2019 SWMMWW. Additional source control BMPs are included in the following table.

BMP ID	BMP Descriptor	Temporary or Permanent?
S417	Maintenance of Stormwater Drainage and Treatment Systems	Temporary
S421	Parking and Storage of Vehicles and Equipment	Permanent
S411	Landscaping and Lawn/Vegetation Management	Temporary
S425	Soil Erosion and Sediment Control at Industrial Sites	Temporary
S429	Storage or Transfer (Outside) of Solid Raw Materials, Byproducts, or Finished Products	Permanent
S412	Loading and Unloading Areas for Liquid or Solid Material	Permanent
S424	Roof/Building Drains at Manufacturing and Commercial Buildings	Permanent
S438	Construction Demolition	Temporary
S422	Labeling Storm Drain Inlets on Your Property	Temporary
S451	Building, Repair, Remodeling, Painting, and Construction	Temporary

Other source control BMPs may be added as necessary. All temporary BMPs are to be implemented during construction.

DOE SWPPP

See the following pages for full DOE SWPPP.

Construction Stormwater General Permit

Stormwater Pollution Prevention Plan (SWPPP)

for

Rose Hill Apartments

Prepared for:

The Washington State Department of Ecology

Northwest Regional Office

Permittee / Owner	Developer	Operator / Contractor
Williams Investments	TBD	TBD

3rd and Park Ave, Mukilteo, WA 98275. Tax Parcel Number: 00596900300601

Certified Erosion and Sediment Control Lead (CESCL)

Name	Organization	Contact Phone Number
TBD	TBD	TBD

SWPPP Prepared By

Name	Organization	Contact Phone Number
CG Engineering	CG Engineering	425.778.8500

SWPPP Preparation Date

January 24, 2023

Project Construction Dates

Activity / Phase	Start Date	End Date
Construction	TBD	TBD

Table of Contents

List of Tables

List of Appendices

Appendix/Glossary

List of Acronyms and Abbreviations

Acronym / Abbreviation	Explanation
303(d)	Section of the Clean Water Act pertaining to Impaired Waterbodies
BFO	Bellingham Field Office of the Department of Ecology
BMP(s)	Best Management Practice(s)
CESCL	Certified Erosion and Sediment Control Lead
CO_2	Carbon Dioxide
CRO	Central Regional Office of the Department of Ecology
CSWGP	Construction Stormwater General Permit
CWA	Clean Water Act
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ERO	Eastern Regional Office of the Department of Ecology
ERTS	Environmental Report Tracking System
ESC	Erosion and Sediment Control
GULD	General Use Level Designation
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
NWRO	Northwest Regional Office of the Department of Ecology
pH	Power of Hydrogen
RCW	Revised Code of Washington
SPCC	Spill Prevention, Control, and Countermeasure
su	Standard Units
SWMMEW	Stormwater Management Manual for Eastern Washington
SWMMWW	Stormwater Management Manual for Western Washington
SWPPP	Stormwater Pollution Prevention Plan
TESC	Temporary Erosion and Sediment Control
SWRO	Southwest Regional Office of the Department of Ecology
TMDL	Total Maximum Daily Load
VFO	Vancouver Field Office of the Department of Ecology
WAC	Washington Administrative Code
WSDOT	Washington Department of Transportation
WWHM	Western Washington Hydrology Model

1 Project Information

Project/Site Name: Rose Hill Apartments
Street/Location: 3rd Street & Park Ave
City: Mukilteo State: WA Zip code: 98275
Subdivision: N/A
Receiving waterbody: Possession Sound (North)

1.1 Existing Conditions

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

Total acreage: 0.25 ac
Disturbed acreage: 0.47 ac
Existing structures: 0.006 ac
Landscape topography: 0.236 ac landscaping
Drainage patterns: The site generally slopes down from south to north at an average grade of 12%.
Existing Vegetation: Grass, shrubs, blackberry bushes
Critical Areas (wetlands, streams, high erosion risk, steep or difficult to stabilize slopes): N/A

List of known impairments for 303(d) listed or Total Maximum Daily Load (TMDL) for the receiving waterbody: Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, and Polychlorinated Biphenyls (PCBs).

Table 1 includes a list of suspected and/or known contaminants associated with the construction activity.

No known or suspected contaminants are associated with the site.

Table 1 – Summary of Site Pollutant Constituents

Constituent (Pollutant)	Location	Depth	Concentration

1.2 Proposed Construction Activities

Description of site development (example: subdivision):
New apartment construction. The project proposes a new 14 unit mixed use building on the 0.25 acre lot with frontage improvements on 3rd Street, Park Ave, and Park Lane, and a new onsite detention pipe.

Description of construction activities (example: site preparation, demolition, excavation):
Clearing and excavation of the site area, filling and grading, utility installation, building and driveway construction, and landscaping.

Description of site drainage including flow from and onto adjacent properties. Must be consistent with Site Map in Appendix A:
The site generally slopes downward from the S to the N and drainage in the developed condition is expected to flow in the same direction.

Description of final stabilization (example: extent of revegetation, paving, landscaping):
The proposed building will cover the majority of the site. The remaining areas will be residential landscaping.

Contaminated Site Information:
Proposed activities regarding contaminated soils or groundwater (example: on-site treatment system, authorized sanitary sewer discharge):
N/A

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 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 in the field. 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.

High Visibility Fence will be placed around the areas of disturbance on the property.

List and describe BMPs:

- Preserving Natural Vegetation (BMP C101)
- High Visibility Fence (BMP C103)

Installation Schedules: Install BMPs prior to clearing and grading.

Inspection and Maintenance plan: As needed.

Responsible Staff: CESCL.

2.1.2 Element 2: Establish Construction Access

Limit vehicle access to one route, if possible.

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, street cleaning, or wheel wash/tire baths may be necessary if the stabilized construction access is not effective. If sediment is tracked off site, clean the affected roadway thoroughly at the end of each day, or more necessary as needed. All wheel wash wastewater shall be controlled on-site and CANNOT be discharged into waters of the State.

A new construction entrance will be installed on the north side of the site accessing Park Lane.

List and describe BMPs: N/A

Installation Schedules: N/A

Inspection and Maintenance plan: N/A

Responsible Staff: N/A

2.1.3 Element 3: Control Flow Rates

Stormwater will flow along the existing grade during construction. A detention vault will be constructed for permanent stormwater control. Stormwater can be directed to the detention facility for sediment control. Otherwise, silt fences will be used to mitigate sediment flow.

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:

- Silt Fence (BMP C233)

Installation Schedules: Install BMPs prior to grading.

Inspection and Maintenance plan: As needed.

Responsible Staff: CESCL.

2.1.4 Element 4: Install Sediment Controls

Stormwater must be filtered prior to being discharged to an infiltration system or leaving the construction site. Sediment control BMPs will be installed as one of the first steps of grading. These BMPs must be functional before other land-disturbing activities, especially grading and filling, take place.

A silt fence will be installed at the downstream portions of the clearing limits.

If sediment controls are ineffective and turbid water is observed discharging from the site, additional energy dissipation BMPs and sediment control BMPs should be installed such as wattles. It may also be necessary to stabilize soils per Element 5 that are not being worked on.

List and describe BMPs:

- Silt Fence (BMP C233)

Installation Schedules: Install BMPs prior to clearing and grading.

Inspection and Maintenance plan: Repair sediment controls as needed.

Responsible Staff: CESCL.

2.1.5 Element 5: Stabilize Soils

Stabilize exposed and unworked soils by the BMPs listed below to prevent erosion. Protect stockpiles with plastic covering or other approved sediment trapping measures. Stabilize exposed soils with Temporary and Permanent Seeding, Mulching, Sodding, Topsoiling/Compost, or Surface Roughening. Minimize soil compaction by applying gravel base early on areas to be paved.

The ESC Supervisor shall be familiar with BMPs for soil stabilization and dust control and implement these BMPs where needed on the proposed site.

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.

Anticipated project dates: Start date: TBD End date: TBD

Will you construct during the wet season?
☒ Yes ☐ No

List and describe BMPs:

- Temporary and Permanent Seeding (BMP C120)
- Mulching (BMP C121)
- Nets and Blankets (BMP C122)
- Plastic Covering (BMP C123)
- Sodding (BMP C124)
- Topsoiling/Composting (BMP C125)
- Surface Roughening (BMP C130)
- Dust Control (BMP C140)

Installation Schedules: As needed as soil is exposed.

Inspection and Maintenance plan: End of the shift before a holiday or weekend and prior to forecasted rain events.

Responsible Staff: CESCL.

2.1.6 Element 6: Protect Slopes

All cut and fill slopes will be designed, constructed, and protected in a manner that minimizes erosion.

Will steep slopes be present at the site during construction?
☒ Yes ☐ No

List and describe BMPs:

- Temporary and Permanent Seeding (BMP C120)
- Nets and Blankets (BMP C122)
- Plastic Covering (BMP C123)

Installation Schedules: Install BMPs prior to grading and as needed to minimize erosion.

Inspection and Maintenance plan: As needed.

Responsible Staff: CESCL.

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 will be implemented for all drainage inlets and culverts that could potentially be impacted by sediment-laden runoff on and near the project site.

Inlet protection should be provided as shown on the C2.1 Plan. Inlet protection devices will be cleaned, or removed and replaced, when sediment has filled the device by one third (1/3) or as specified by the manufacturer.

List and describe BMPs:

- Storm Drain Inlet Protection (BMP C220)

Installation Schedules: Before land disturbance for existing catch basins and as new catch basins are made operable.

Inspection and Maintenance plan: Inlets will be inspected weekly at a minimum and daily during storm events.

Responsible Staff: CESCL.

2.1.8 Element 8: Stabilize Channels and Outlets

Where site runoff is to be conveyed in channels, or discharged to a stream or some other natural drainage point, efforts will be taken to prevent downstream erosion.

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.

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.

List and describe BMPs:

- Channel Lining (BMP C202)

Installation Schedules: Install BMPs prior to grading.

Inspection and Maintenance plan: As needed.

Responsible Staff: CESCL.

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)
Concrete
Concrete process water
Concrete slurry
Asphalt materials
Utility materials

List and describe BMPs:

- Concrete Handling (BMP C151)
- Sawcutting and Surfacing Pollution Prevention (BMP C152)
- Material Delivery, Storage and Containment (BMP C153)

Installation Schedules: As needed as pollutant source materials are used on-site.

Inspection and Maintenance plan: As needed.

Responsible Staff: CESCL.

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

☐	None
☒	Bulk cement
☒	Cement kiln dust
☒	Fly ash
☒	Other cementitious materials
☐	New concrete washing or curing waters
☐	Waste streams generated from concrete grinding and sawing
☒	Exposed aggregate processes
☐	Dewatering concrete vaults
☐	Concrete pumping and mixer washout waters

☐	Recycled concrete
☐	Recycled concrete stockpiles
☐	Other (i.e., calcium lignosulfate) [please describe:]

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.

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

2.1.10 Element 10: Control Dewatering

Dewatering is not anticipated to be associated with this construction project.

If necessary, only clean, non-turbid dewatering water (such as well-point groundwater) may be discharged to systems tributary to, or directly into, surface waters of the State, provided the dewatering flow does not cause erosion or flooding of receiving waters.

Table 4 – Dewatering BMPs

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

List and describe BMPs: N/A.

Installation Schedules: N/A.

Inspection and Maintenance plan: N/A.

Responsible Staff: CESCL.

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 SWMMEW*).

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.

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.

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.
- 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.

Table 5 – Management

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

Table 6 – BMP Implementation Schedule

Phase of Construction Project	Stormwater BMPs	Date	Wet/Dry Season
Pre-construction	Preserving Natural Vegetation (BMP C101)	TBD	Dry
Pre-construction	High Visibility Fence (BMP C103)	TBD	Dry
Pre-construction	Silt Fence (BMP C233)	TBD	Dry
Land disturbance	Temporary and Permanent Seeding (BMP C120)	TBD	Dry
Land disturbance	Mulching (BMP C121)	TBD	Dry
Land disturbance	Nets and Blankets (BMP C122)	TBD	Dry
Land disturbance	Plastic Covering (BMP C123)	TBD	Dry
Land disturbance	Sodding (BMP C124)	TBD	Dry
Land disturbance	Topsoiling/Composting (BMP C125)	TBD	Dry
Land disturbance	Surface Roughening (BMP C130)	TBD	Dry
Land disturbance	Dust Control (BMP C140)	TBD	Dry
Land disturbance	Channel Lining (BMP C202)	TBD	Dry
Land disturbance	Storm Drain Inlet Protection (BMP C220)	TBD	Dry
Construction	Sawcutting and Surfacing Pollution Prevention (BMP C152)	TBD	Dry
Construction	Material Delivery, Storage and Containment (BMP C153)	TBD	Dry

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

Detention will be the primary means of stormwater management for the roofs and other hard surfaces on this project. The detention pipe will need to be protected from compaction during construction. This can be done by placing orange protective fencing around the pipe as it is constructed in order to avoid compaction from vehicle traffic.

3 Pollution Prevention Team

Table 7 – Team Information

Title	Name(s)	Phone Number
Certified Erosion and Sediment Control Lead (CESCL)	TBD	TBD
Resident Engineer	CG Engineering	425.778.8500
Emergency Ecology Contact	TBD	TBD
Emergency Permittee/ Owner Contact	Ryan Kilby	425.750.7926
Non-Emergency Owner Contact	Ryan Kilby	425.750.7926
Monitoring Personnel	TBD	TBD
Ecology Regional Office	Northwest Regional Office	425.649.7000

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

File a blank form under Appendix D.

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.

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.

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

☐	Turbidity Meter/Turbidimeter (required for disturbances 5 acres or greater in size)
☒	Transparency Tube (option for disturbances less than 1 acre and up to 5 acres in size)

The benchmark 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. Review the SWPPP for compliance with Special Condition S9. Make appropriate revisions within 7 days of the date the discharge exceeded the benchmark.

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 benchmark. 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.

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
    - **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
    - **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
    - **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
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 benchmark. 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_2) sparging (liquid or dry ice).
3. Written approval will be obtained from Ecology prior to the use of chemical treatment other than CO_2 sparging or dry ice.

Method for sampling pH:

Table 9 – pH Sampling Method

☐	pH meter
☒	pH test kit
☐	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): N/A

5.2 TMDL Waterbodies

Waste Load Allocation for CSWGP discharges: N/A

List and describe BMPs: N/A

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_2 sparging is planned for adjustment of high pH water.

A. Site Map

Figure A-1. Site map.

B. BMP Detail

BMP details are shown on the approved TESC plan. Additional/alternative BMPs are listed below and available for download from the Ecology Construction Stormwater website:

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

Element #1 - Mark Clearing Limits

- BMP C101: Preserving Natural Vegetation
- BMP C102: Buffer Zones
- BMP C103: High Visibility Plastic or Metal Fence
- BMP C233: Silt Fence

Element #2 - Establish Construction Access

- BMP C105: Stabilized Construction Entrance/Exit
- BMP C106: Wheel Wash
- BMP C107: Construction Road/Parking Area Stabilization

Element #3 - Control Flow Rates

- BMP C203: Water Bars
- BMP C207: Check Dams
- BMP C209: Outlet Protection
- BMP C235: Wattles
- BMP C240: Sediment Trap
- BMP C241: Temporary Sediment Pond

Element #4 - Install Sediment Controls

- BMP C231: Brush Barrier
- BMP C232: Gravel Filter Berm
- BMP C233: Silt Fence
- BMP C234: Vegetated Strip
- BMP C235: Wattles
- BMP C240: Sediment Trap
- BMP C241: Temporary Sediment Pond
- BMP C250: Construction Stormwater Chemical Treatment
- BMP C251: Construction Stormwater Filtration

Element #5 - Stabilize Soils

- BMP C120: Temporary and Permanent Seeding
- BMP C121: Mulching
- BMP C122: Nets and Blankets
- BMP C123: Plastic Covering
- BMP C124: Sodding
- BMP C125: Topsoiling/Composting
- BMP C126: Polyacrylamide for Soil Erosion Protection
- BMP C130: Surface Roughening
- BMP C131: Gradient Terraces
- BMP C140: Dust Control

Element #6 - Protect Slopes

- BMP C120: Temporary and Permanent Seeding

- BMP C121: Mulching
- BMP C122: Nets and Blankets
- BMP C123: Plastic Covering
- BMP C124: Sodding
- BMP C130: Surface Roughening
- BMP C131: Gradient Terraces
- BMP C200: Interceptor Dike and Swale
- BMP C201: Grass-Lined Channels
- BMP C203: Water Bars
- BMP C204: Pipe Slope Drains
- BMP C205: Subsurface Drains
- BMP C206: Level Spreader
- BMP C207: Check Dams
- BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam)

Element #7 - Protect Drain Inlets

- BMP C220: Storm Drain Inlet Protection

Element #8 - Stabilize Channels and Outlets

- BMP C202: Channel Lining
- BMP C122: Nets and Blankets
- BMP C207: Check Dams
- BMP C209: Outlet Protection

Element #9 – Control Pollutants

- BMP C151: Concrete Handling
- BMP C152: Sawcutting and Surfacing Pollution Prevention
- BMP C153: Material Delivery, Storage and Containment
- BMP C154: Concrete Washout Area
- BMP C250: Construction Stormwater Chemical Treatment
- BMP C251: Construction Stormwater Filtration
- BMP C252: High pH Neutralization Using CO2
- BMP C253: pH Control for High pH Water
- See Volume IV – Source Control BMPs

Element #10 - Control Dewatering

- BMP C203: Water Bars
- BMP C236: Vegetative Filtration

Element #11: Maintain BMPs

- BMP C150: Materials On Hand
- BMP C160: Certified Erosion and Sediment Control Lead

Element #12: Manage the Project

- BMP C150: Materials On Hand
- BMP C160: Certified Erosion and Sediment Control Lead
- BMP C162: Scheduling

Element #13: Protect LID BMPs

- BMP C103: High Visibility Fence

C. Correspondence

D. Site Inspection Form

	Permit #	Inspection Date	Time
Project Name			

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	☐	Clearing/Demo/Grading	☐	Infrastructure/storm/roads	☐
Concrete pours	☐	Vertical Construction/buildings	☐	Utilities	☐
Offsite improvements	☐	Site temporary stabilized	☐	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				

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 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 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 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 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 Stabilize Soils	Have exposed un-worked soils been stabilized with effective BMP to prevent erosion and sediment deposition?						
	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 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 Drain Inlets	Storm drain inlets made operable during construction are protected.						
	Are existing storm drains within the influence of the project protected?						

8 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 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?						
	Wheel wash wastewater is handled and disposed of properly.						
10 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 Maintain BMP	Are all temporary and permanent erosion and sediment control BMPs maintained to perform as intended?						
12 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 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 ☐

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)

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

G. Contaminated Site Information

H. Engineering Calculations

Section V – Permanent Stormwater Control Plan Narrative

Section V Summary

Narrative
Feasibility Review
Runoff Treatment
Flow Control
WWHM2012 Report

Narrative

The project must address the use of On-Site Stormwater Management BMP's from list No. 2 for all new plus replaced hard surfaces and land disturbed. All BMPs were found to be infeasible, so the stormwater will discharge into a stormwater main Park Ave. Post-construction soil quality and depth in accordance with BMP T5.13 in the 2019 SWMMWW will be used for all disturbed pervious areas. The site requires flow control.

Feasibility Review

The project must implement on-site stormwater management BMPs to the maximum extent feasible per Minimum Requirement #5.

Lawn and landscaped areas:

1. Post-construction soil quality and depth in accordance with BMP T5.13 in Chapter 5 of Volume V of the SCDM will be used for all disturbed pervious areas.

Roofs:

1. Full Dispersion in accordance with BMP T5.30 is **infeasible** because less than 65% of the site threshold discharge area is in a forest or native condition.
2. Downspout Infiltration in accordance with BMP T5.10A is **infeasible** per the geotechnical report located in Appendix B. The presence of high groundwater is not conducive for infiltration.
3. Bioretention in accordance with Volume V, Chapter 7 of the SCDM is **infeasible** because the geotechnical engineer does not recommend that infiltration be used for the project.
4. Downspout Dispersion in accordance with BMP T5.10B is **infeasible** due to lack of remaining developed pervious areas required for dispersion flowpaths.
5. Perforated Stub-out Connections in accordance with BMP T5.10C are **infeasible** because the geotechnical engineer does not recommend that infiltration be used for the project and due to lack of area to implement the required trench prior to connection to ROW drainage.

Other Hard Surfaces:

1. Full Dispersion in accordance with BMP T5.30 is **infeasible** because less than 65% of the site threshold discharge area is in a forest or native condition.

2. Permeable Pavement in accordance with BMP T5.15 is **infeasible** because the geotechnical engineer does not recommend that infiltration be used for the project.
3. Bioretention in accordance with Volume V, Chapter 7 of the SCDM is **infeasible** because the geotechnical engineer does not recommend that infiltration be used for the project.
4. Sheet Flow Dispersion and Concentrated Flow Dispersion in accordance with BMP T5.12 and BMP T5.11 are **infeasible** due to lack of remaining developed pervious areas required for dispersion flowpaths.

Flow Control

As there is less than 5,000 sf of pollution generating surfaces proposed runoff treatment per Minimum Requirement 6 is not required.

Flow Control

The project requires flow control per Minimum Requirement 7 as there is more than 10,000 sf of impervious surface created on site. The following sections detail the BMPs to be used for these requirements.

No Low Impact BMPs are feasible for the site and flow control is required per Minimum Requirement #7. A 48"Ø x 630 LF detention pipe will be utilized to meet flow control thresholds for this project. The outlet of the vault is connected to a flow control structure that discharges to a catch basin in Park Ave. See the attached WWHM printout for the model used to size the detention vault.

All stormwater management BMPs were found to be infeasible. Because of this, the project proposes to tie into the existing storm main in the Park Ave right-of-way (ROW) after being flow controlled onsite with the use of detention pipes and a flow control facility.

The proposed basin considered in detention calculations is as follows:

Impervious Areas	
Roof:	10,585 sf (0.243 ac)
Sidewalk:	1,173 sf (0.027 ac)
Asphalt:	7,316 sf (0.168 ac)
Total:	19,074 sf (0.438 ac)
Pervious Areas	
Landscaping:	667 sf (0.015 ac)
Total:	667 sf (0.015 ac)

Flow Control Design requires that the stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. Typically the pre-developed condition is regarded as a forested cover. With such a small area of a site, modeled as a forest, the pre-developed durations are much smaller

than can be achieved using the minimum orifice size (0.5" Ø) allowed by the Department of Ecology and the City of Mukilteo.

Department of Ecology prescribes a recommended methodology for sizing a flow control system under these circumstances. This document is included in this section of the Drainage Report, and was used to generate the 630 LF detention pipe depicted in the engineering plans. CG Engineering confirmed with Amanda Heye at Department of Ecology that this is still the active recommendation, as the document is dated 2015.

-First, infiltration needs to be ruled out. This was done in the geotechnical report, included in Section VI of this Drainage Report. This was due to high groundwater, fill soils, and glacial till soils present on the site.

-Department of Ecology then requires that the live storage be reduced to 3 feet. This led us to consider using detention pipe rather than a vault, which requires 7' of inside clearance (much of the inside volume would be of no use to this project, as there is no runoff treatment needed wherein we may have doubled this system as a combination wetvault). The pipe is 4 foot diameter to allow for 6" of freeboard and 6" of sediment storage below the outlet.

-Next, the site is run in WWHM assuming no orifice restriction, using the WWHM autosizing feature. By running this, a system meeting duration curves was created using a 0.25 inch diameter orifice and 495 lineal feet of 4' diameter tank (Figure 1 & Figure 2).

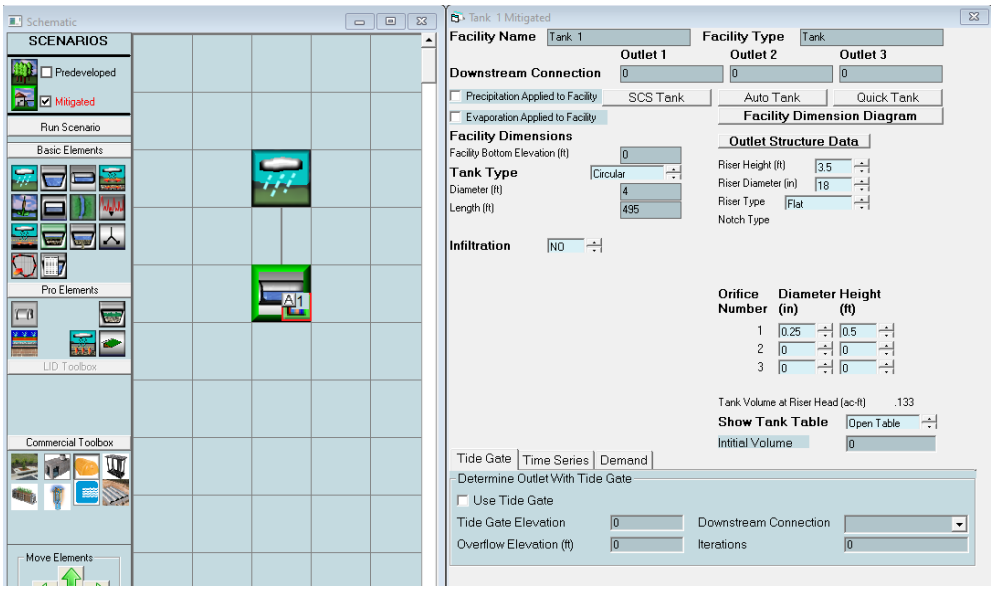


Figure 1: Detention Pipe with smaller orifice

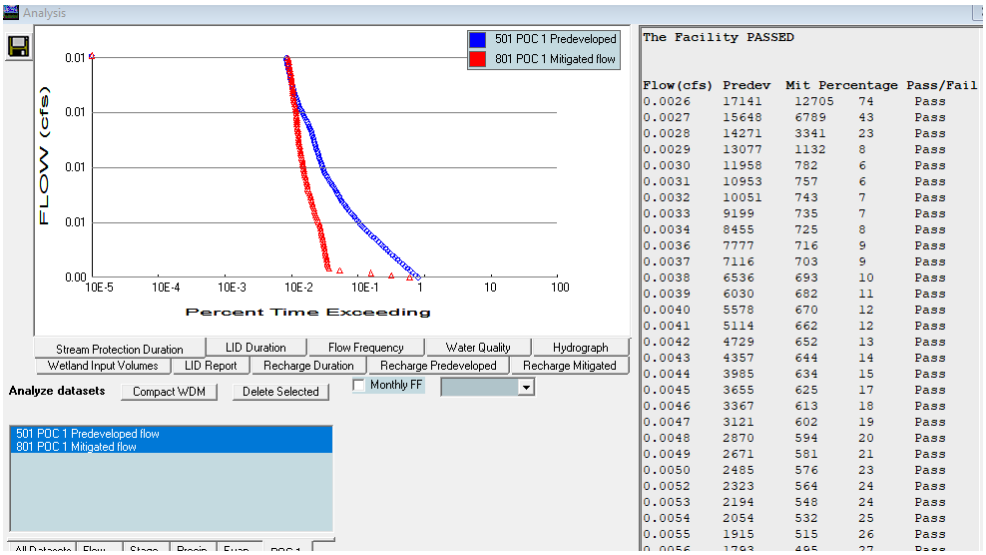


Figure 2: Detention Pipe with compliant duration curve.

-Next, the DOE then outlines an iterative process to create a system using a half inch orifice with "acceptable failures". This is done by increasing the orifice size to 0.5 inch diameter then altering the rest of the flow control structure. While typically, the red line should be entirely left of the blue line, as shown in Figure 2, DOE allows in this case that the red line push right of the blue nearing the bottom. It must be entirely left of the blue line following the "turn" in the red line nearest to the bottom, where the orifice occurs. The model shows as failing because a 0.5 inch orifice cannot restrict the flows to the standard required.

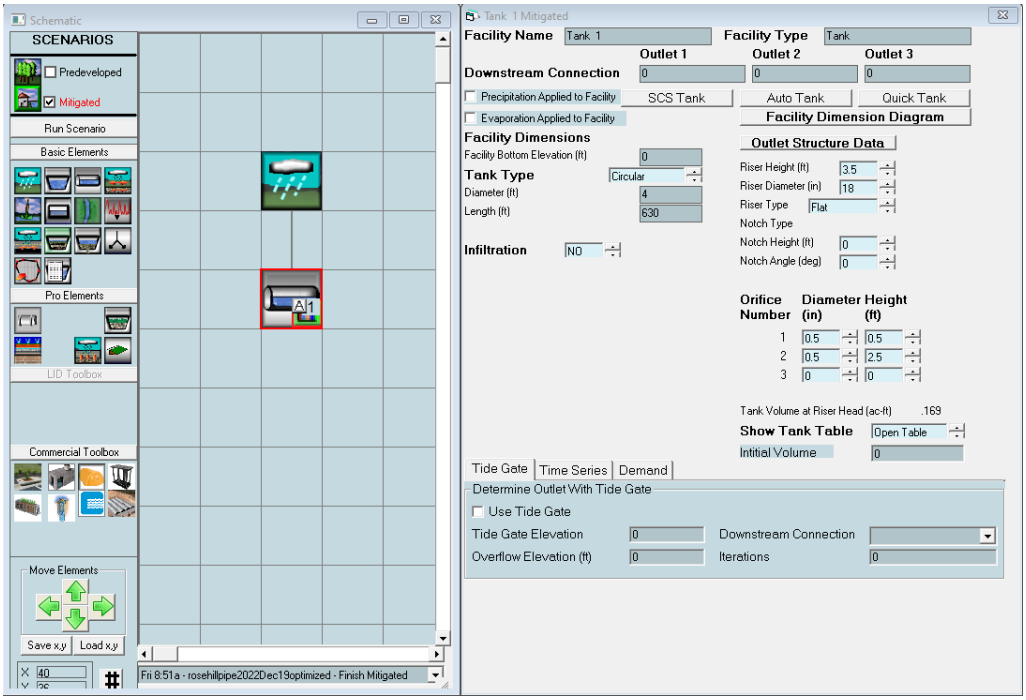


Figure 3: Upsized Detention pipe with 0.5 inch orifice

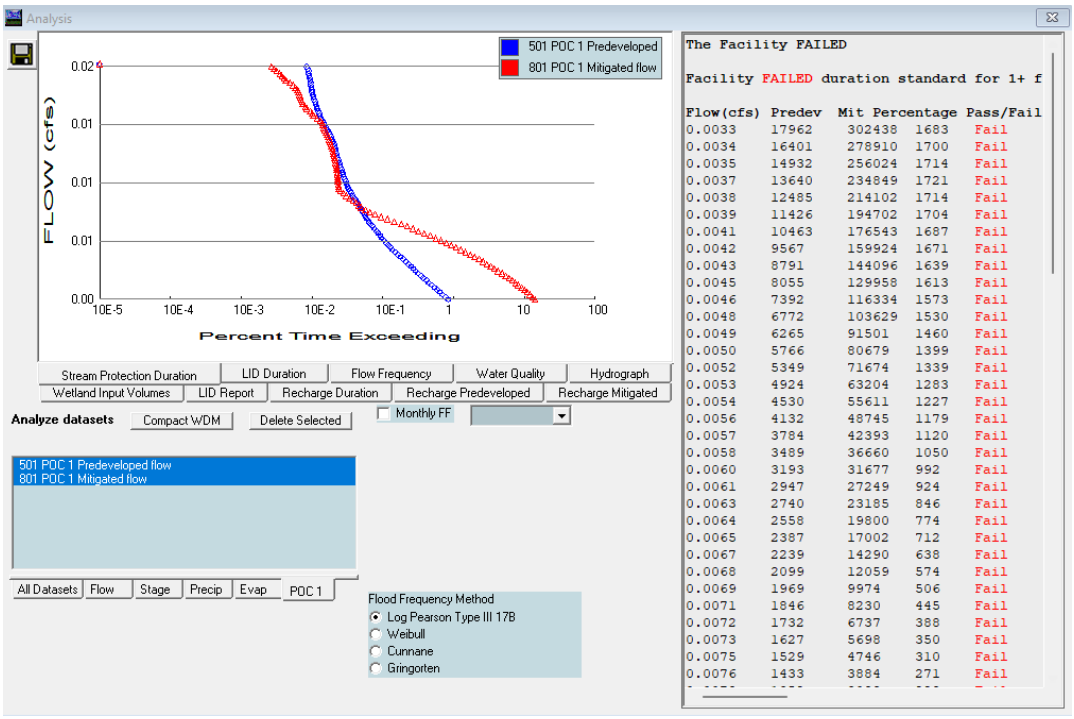


Figure 4: Failure at bottom of curve

WWHM2012
PROJECT REPORT

Project Name: rosehillpipe2022Dec19optimized
Site Name:
Site Address:
City :
Report Date: 1/26/2023
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
(adjusted) **Precip Scale:** 0.00
Version Date: 2021/08/18
Version : 4.2.18

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Flat	.1
C, Forest, Mod	.24
C, Forest, Steep	.12
Pervious Total	0.46

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.46

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Pasture, Flat	.02
Pervious Total	**0.02**

Impervious Land Use	acre
ROOF TOPS FLAT	0.24
DRIVEWAYS FLAT	0.08
DRIVEWAYS MOD	0.12
Impervious Total	**0.44**
Basin Total	**0.46**

Element Flows To:

Surface	Interflow	Groundwater
Tank 1	Tank 1	

Name : Tank 1
Tank Name: Tank 1

Dimensions
Depth: 4 ft.
Tank Type : Circular
Diameter : 4 ft.
Length : 630 ft.
Discharge Structure
Riser Height: 3.5 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 0.5 in. **Elevation:** 0.5 ft.
Orifice 2 Diameter: 0.5 in. **Elevation:** 2.5 ft.

Element Flows To:

Outlet 1	Outlet 2

Tank Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.000	0.000	0.000	0.000
0.0444	0.012	0.000	0.000	0.000
0.0889	0.017	0.001	0.000	0.000
0.1333	0.020	0.001	0.000	0.000
0.1778	0.023	0.002	0.000	0.000

0.2222	0.026	0.004	0.000	0.000
0.2667	0.028	0.005	0.000	0.000
0.3111	0.031	0.006	0.000	0.000
0.3556	0.032	0.008	0.000	0.000
0.4000	0.034	0.009	0.000	0.000
0.4444	0.036	0.011	0.000	0.000
0.4889	0.037	0.012	0.000	0.000
0.5333	0.039	0.014	0.001	0.000
0.5778	0.040	0.016	0.001	0.000
0.6222	0.041	0.018	0.002	0.000
0.6667	0.043	0.019	0.002	0.000
0.7111	0.044	0.021	0.003	0.000
0.7556	0.045	0.023	0.003	0.000
0.8000	0.046	0.025	0.003	0.000
0.8444	0.047	0.028	0.004	0.000
0.8889	0.048	0.030	0.004	0.000
0.9333	0.048	0.032	0.004	0.000
0.9778	0.049	0.034	0.004	0.000
1.0222	0.050	0.036	0.004	0.000
1.0667	0.051	0.038	0.005	0.000
1.1111	0.051	0.041	0.005	0.000
1.1556	0.052	0.043	0.005	0.000
1.2000	0.053	0.045	0.005	0.000
1.2444	0.053	0.048	0.005	0.000
1.2889	0.054	0.050	0.006	0.000
1.3333	0.054	0.053	0.006	0.000
1.3778	0.055	0.055	0.006	0.000
1.4222	0.055	0.057	0.006	0.000
1.4667	0.055	0.060	0.006	0.000
1.5111	0.056	0.062	0.006	0.000
1.5556	0.056	0.065	0.007	0.000
1.6000	0.056	0.067	0.007	0.000
1.6444	0.056	0.070	0.007	0.000
1.6889	0.057	0.072	0.007	0.000
1.7333	0.057	0.075	0.007	0.000
1.7778	0.057	0.078	0.007	0.000
1.8222	0.057	0.080	0.007	0.000
1.8667	0.057	0.083	0.007	0.000
1.9111	0.057	0.085	0.008	0.000
1.9556	0.057	0.088	0.008	0.000
2.0000	0.057	0.090	0.008	0.000
2.0444	0.057	0.093	0.008	0.000
2.0889	0.057	0.096	0.008	0.000
2.1333	0.057	0.098	0.008	0.000
2.1778	0.057	0.101	0.008	0.000
2.2222	0.057	0.103	0.008	0.000
2.2667	0.057	0.106	0.009	0.000
2.3111	0.057	0.108	0.009	0.000
2.3556	0.056	0.111	0.009	0.000
2.4000	0.056	0.113	0.009	0.000
2.4444	0.056	0.116	0.009	0.000
2.4889	0.056	0.118	0.009	0.000
2.5333	0.055	0.121	0.010	0.000
2.5778	0.055	0.123	0.011	0.000
2.6222	0.055	0.126	0.012	0.000
2.6667	0.054	0.128	0.012	0.000

250 4th Avenue South, Suite 200
Edmonds, WA 98020
ph. 425.778.8500 | f. 425.778.5536
www.cgengineering.com

2.7111	0.054	0.131	0.013	0.000
2.7556	0.053	0.133	0.013	0.000
2.8000	0.053	0.135	0.014	0.000
2.8444	0.052	0.138	0.014	0.000
2.8889	0.051	0.140	0.014	0.000
2.9333	0.051	0.142	0.015	0.000
2.9778	0.050	0.145	0.015	0.000
3.0222	0.049	0.147	0.015	0.000
3.0667	0.048	0.149	0.016	0.000
3.1111	0.048	0.151	0.016	0.000
3.1556	0.047	0.153	0.016	0.000
3.2000	0.046	0.155	0.016	0.000
3.2444	0.045	0.157	0.017	0.000
3.2889	0.044	0.159	0.017	0.000
3.3333	0.043	0.161	0.017	0.000
3.3778	0.041	0.163	0.017	0.000
3.4222	0.040	0.165	0.018	0.000
3.4667	0.039	0.167	0.018	0.000
3.5111	0.037	0.169	0.037	0.000
3.5556	0.036	0.170	0.227	0.000
3.6000	0.034	0.172	0.521	0.000
3.6444	0.032	0.173	0.888	0.000
3.6889	0.031	0.175	1.311	0.000
3.7333	0.028	0.176	1.776	0.000
3.7778	0.026	0.177	2.268	0.000
3.8222	0.023	0.178	2.775	0.000
3.8667	0.020	0.179	3.281	0.000
3.9111	0.017	0.180	3.773	0.000
3.9556	0.012	0.181	4.236	0.000
4.0000	0.000	0.181	4.660	0.000
4.0444	0.000	0.000	5.033	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.46
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.02
Total Impervious Area:0.44

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.00652
5 year	0.010026
10 year	0.012246

25 year	0.014888
50 year	0.01673
100 year	0.018467

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.007048
5 year	0.008481
10 year	0.009496
25 year	0.01085
50 year	0.011912
100 year	0.01302

Stream Protection Duration
POC #1
The Facility FAILED

Facility FAILED duration standard for 1+ flows. (ACCEPTABLE WITH UPSIZED ORIFICE)

Flow(cfs)	**Predev**	**Mit**	**Percentage**	**Pass/Fail**
0.0033	17962	302438	1683	Fail
0.0034	16401	278910	1700	Fail
0.0035	14932	256024	1714	Fail
0.0037	13640	234849	1721	Fail
0.0038	12485	214102	1714	Fail
0.0039	11426	194702	1704	Fail
0.0041	10463	176543	1687	Fail
0.0042	9567	159924	1671	Fail
0.0043	8791	144096	1639	Fail
0.0045	8055	129958	1613	Fail
0.0046	7392	116334	1573	Fail
0.0048	6772	103629	1530	Fail
0.0049	6265	91501	1460	Fail
0.0050	5766	80679	1399	Fail
0.0052	5349	71674	1339	Fail
0.0053	4924	63204	1283	Fail
0.0054	4530	55611	1227	Fail
0.0056	4132	48745	1179	Fail
0.0057	3784	42393	1120	Fail
0.0058	3489	36660	1050	Fail
0.0060	3193	31677	992	Fail
0.0061	2947	27249	924	Fail
0.0063	2740	23185	846	Fail
0.0064	2558	19800	774	Fail
0.0065	2387	17002	712	Fail
0.0067	2239	14290	638	Fail
0.0068	2099	12059	574	Fail
0.0069	1969	9974	506	Fail
0.0071	1846	8230	445	Fail
0.0072	1732	6737	388	Fail
0.0073	1627	5698	350	Fail
0.0075	1529	4746	310	Fail
0.0076	1433	3884	271	Fail

0.0078	1352	3099	229	Fail
0.0079	1280	2490	194	Fail
0.0080	1222	2030	166	Fail
0.0082	1169	1659	141	Fail
0.0083	1126	1415	125	Fail
0.0084	1080	1210	112	Fail
0.0086	1039	1060	102	Pass
0.0087	994	978	98	Pass
0.0088	944	898	95	Pass
0.0090	894	814	91	Pass
0.0091	850	716	84	Pass
0.0092	803	655	81	Pass
0.0094	770	595	77	Pass
0.0095	732	535	73	Pass
0.0097	701	513	73	Pass
0.0098	678	508	74	Pass
0.0099	656	503	76	Pass
0.0101	635	497	78	Pass
0.0102	622	494	79	Pass
0.0103	604	490	81	Pass
0.0105	589	485	82	Pass
0.0106	574	482	83	Pass
0.0107	559	477	85	Pass
0.0109	545	472	86	Pass
0.0110	532	466	87	Pass
0.0112	519	460	88	Pass
0.0113	507	454	89	Pass
0.0114	491	445	90	Pass
0.0116	477	437	91	Pass
0.0117	469	429	91	Pass
0.0118	460	422	91	Pass
0.0120	452	412	91	Pass
0.0121	445	404	90	Pass
0.0122	435	394	90	Pass
0.0124	424	385	90	Pass
0.0125	412	374	90	Pass
0.0126	394	364	92	Pass
0.0128	381	349	91	Pass
0.0129	368	336	91	Pass
0.0131	353	329	93	Pass
0.0132	340	314	92	Pass
0.0133	324	305	94	Pass
0.0135	314	297	94	Pass
0.0136	297	280	94	Pass
0.0137	284	250	88	Pass
0.0139	275	225	81	Pass
0.0140	269	215	79	Pass
0.0141	260	202	77	Pass
0.0143	254	180	70	Pass
0.0144	248	171	68	Pass
0.0146	239	159	66	Pass
0.0147	234	155	66	Pass
0.0148	228	150	65	Pass
0.0150	225	146	64	Pass
0.0151	221	143	64	Pass
0.0152	215	138	64	Pass

0.0154	212	134	63	Pass
0.0155	208	125	60	Pass
0.0156	206	115	55	Pass
0.0158	204	103	50	Pass
0.0159	201	91	45	Pass
0.0160	197	86	43	Pass
0.0162	195	80	41	Pass
0.0163	191	75	39	Pass
0.0165	190	68	35	Pass
0.0166	184	62	33	Pass
0.0167	181	57	31	Pass

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.

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 Water Quality?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft.)	Cumulative Infiltration Credit	Percent Volume	Water Quality Percent Treated	Comment
Tank 1 POC	N	47.99			N	0.00		
Total Volume Infiltrated		47.99	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.

DEPARTMENT OF ECOLOGY
State of Washington

Ecology often receives technical questions related to stormwater. Ecology's internal Stormwater Technical Team (SWTT) reviews and responds to the questions. This document is a record of one such response.

This document is Ecology's clarification of existing (at the time of the question) Ecology guidance and/or requirements. The clarification is brief, and intended for use by the SWTT for consistency in future responses. Local jurisdictions may have requirements that vary from this clarification. Consult with your municipality or other regulating authority to find out the exact requirements that apply to your project.

Question:

Ecology's 2014 SWMMWW states:

> "*Minimum orifice diameter is 0.5 inches. Note: In some instances, a 0.5-inch bottom orifice will be too large to meet target release rates, even with minimal head. In these cases, the live storage depth need not be reduced to less than 3 feet in an attempt to meet the performance standards. Also, under such circumstances, flow-throttling devices may be a feasible option. These devices will throttle flows while maintaining a plug-resistant opening.*" (Section 3.2.4, pIII-3-46).
>
> Also,
>
> "*The minimum orifice diameter should be 0.5 inches to minimize clogging and maintenance requirements.*" (BMP T7.30, pV-7-24).

What is the recommended method to size a detention pond (or retention pond, bioretention, etc.) if the model meeting the Flow Control standard for MR7 yields an orifice smaller than 0.5 inches?

Answer:

Is infiltration feasible? If infiltration is feasible, you must first use infiltration to the maximum extent feasible for the site. After you have applied infiltration design to the site, you may use the following design guidance.

Ecology recommends the following steps when WWHM's auto-sizing feature yields an orifice smaller than 0.5 inches.

> **Goal:** To size the detention BMP to not cause failure in the **Flow Control Standard** at any point along the curve, other than those failures resulting from the initial 0.5" orifice with 3' maximum live storage depth.
>
> On WWHM's **Stream Protection Duration** graph for the **Point of Compliance**, the red line must **NOT** cross above the blue line at or after the inflection point where water begins discharging through the second method of discharge (orifice, notch, or riser overflow).

Procedure:

- Size the detention BMP using WWHM's auto-sizing feature. The live storage depth must not be greater than 3 feet.
- Make manual, iterative adjustments to the discharge structure. The first iteration should be to upsize the initial orifice to 0.5". Adjustments you may make to the discharge structure include the orifice diameter, orifice height, the number of orifices, and notch type and width/height. Run WWHM after each iterative adjustment.
- Observe the how the adjustments effect the **Stream Protection Duration** curves. With the exception of the red points associated with the initial 0.5" orifice, you must keep the red line to the left of the blue line. The "FAIL"s in the table to the right of the graph indicate where the red line crosses the blue line.
- Iteratively reduce the facility area (footprint) while keeping the live storage depth at 3 feet maximum. Run WWHM after each iteration to see if the reduced facility size still meets the "Goal" above. Continue iteration to optimize the facility.

Example:

Set up your site within WWHM and run the auto-sizing feature. For the example shown in the screenshots below, we have used the following scenario:

Site Location: Ecology Headquarters, Lacey WA
Predeveloped Scenario: 0.25 acres C Forest, Flat
Mitigated Scenario: 0.25 acres Parking/Flat; Vault with 3 feet of live storage depth

Auto-vault suggests the following:

48.5' x 48.5' vault with 3' live storage depth. (0.163 acre-ft of live storage volume)
0.42" orifice @ 0', rectangular notch 0.01' wide and 1.06' high
18" diameter riser

This is not your final vault size, because the suggested orifice is smaller than Ecology's minimum allowed 0.5".

Below is the **Stream Protection Duration** graph for the **Point of Compliance**. This graph shows that the vault configuration meets Ecology's **Flow Control Standard**.

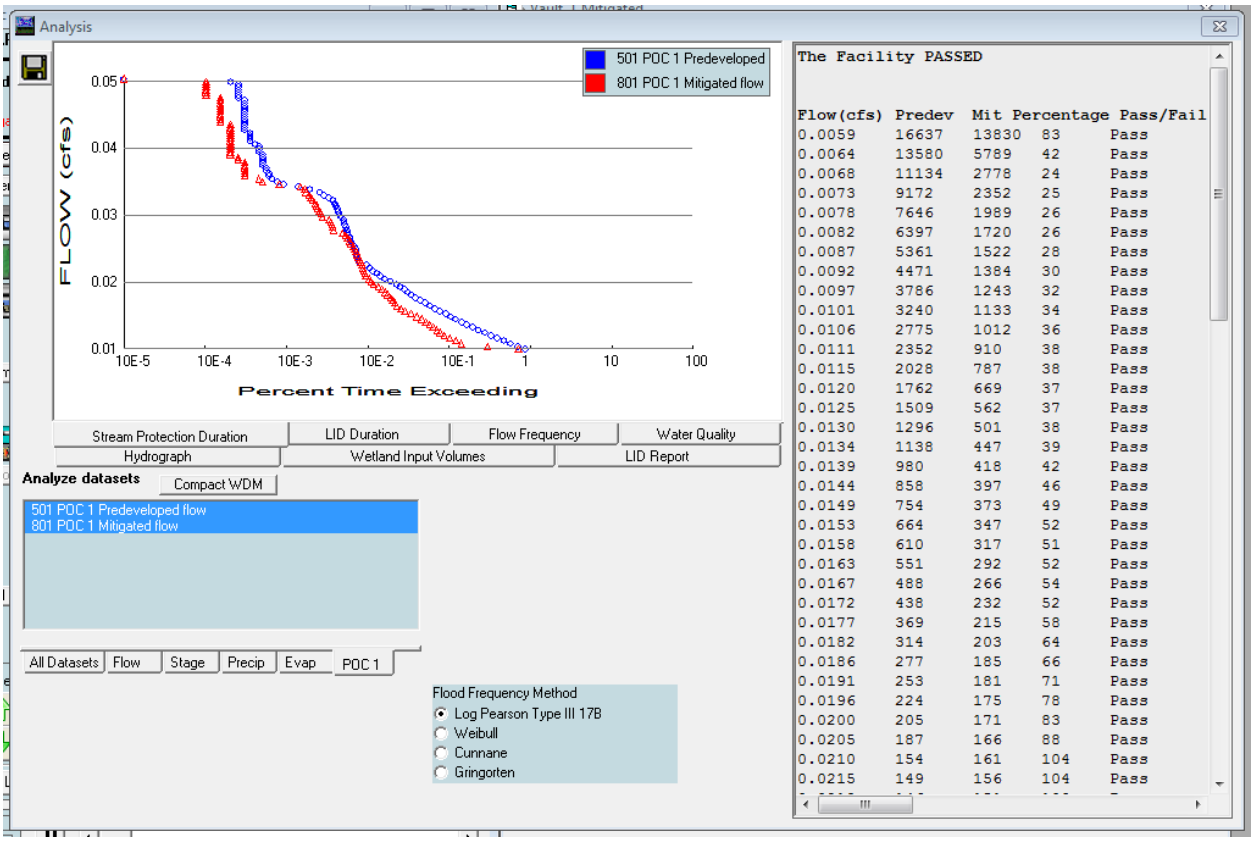


Figure 1: Stream Protection Duration Graph for the Point of Compliance (Auto-Sized)

You can verify that the water level is reaching the riser, and therefore utilizing all of the live storage depth, by checking the **Annual Peaks** listed in the **Flow Frequency** analysis output for the **Vault 1 Stage Mitigated** dataset. Below is the graph showing the stage elevation reaching 3 feet, the elevation of the riser.

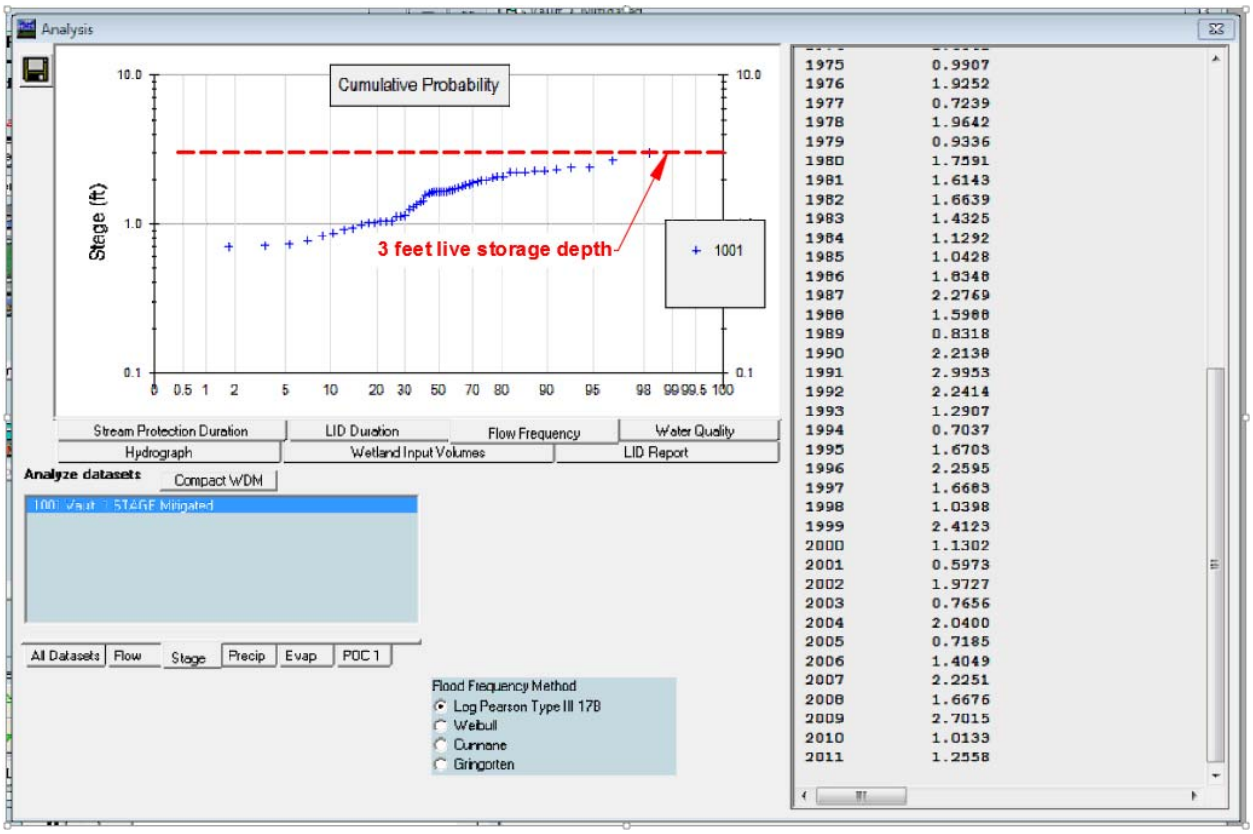


Figure 2: Flow Frequency Graph for the Vault 1 Stage Mitigated Dataset (Auto-Sized)

Iteration 1:

Manually adjust the vault using WWHM. From here on you will no longer use WWHM's auto-sizing feature.

- Remove the notch
- Adjust the orifice from 0.42" to 0.5" diameter

Below is the new **Stream Protection Duration** graph for the **Point of Compliance**.

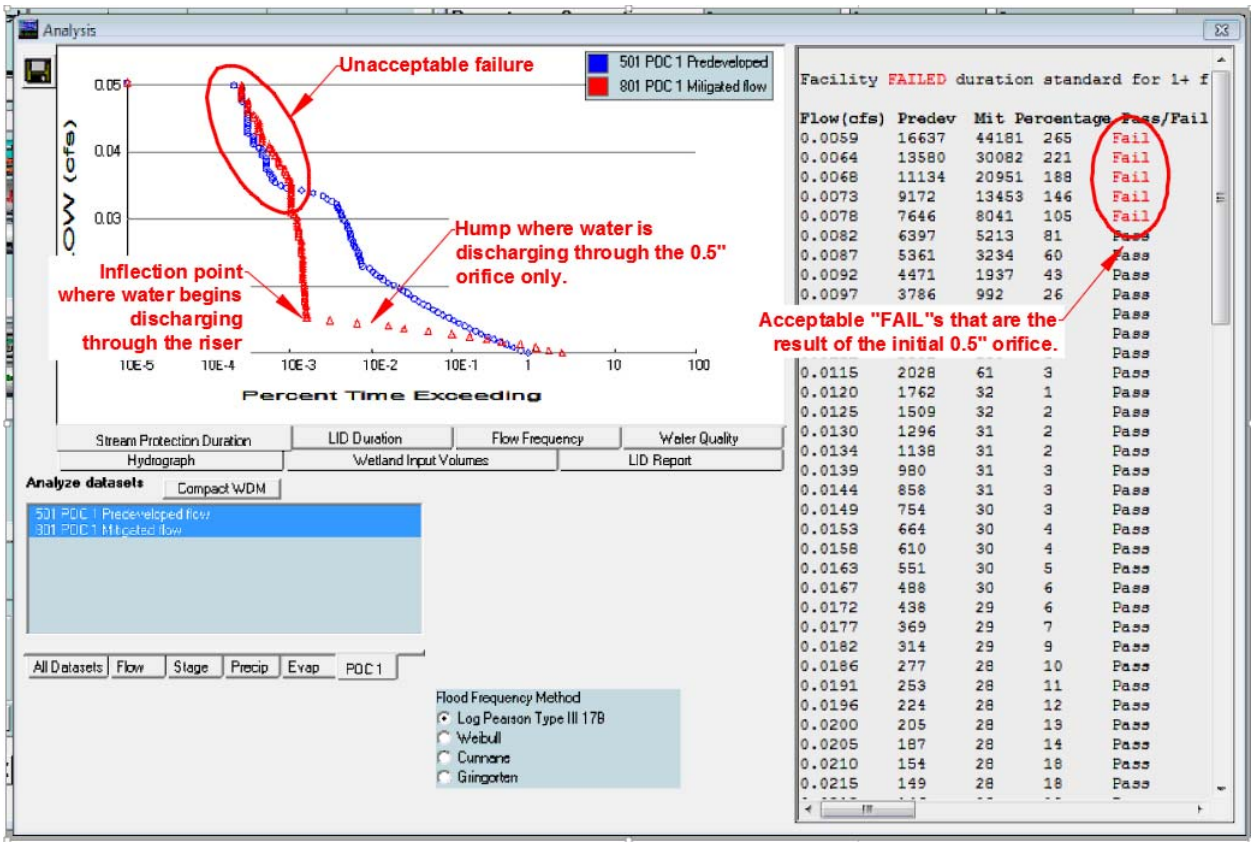


Figure 3: Stream Protection Duration Graph for the Point of Compliance (Iteration 1)

- The red hump in the lower right of the graph shows where the water is discharging only through the 0.5" orifice.
- Notice the 5 "FAIL"s in the table on the right, indicating flows that are higher than Ecology's **Flow Control Standard**. This is the result of the 0.5" orifice, and Ecology **will accept** the "FAIL"s in this case.
- The mitigated flow (the red line) spikes up when it begins discharging through the riser. Notice the red line crosses over the predeveloped flow (the blue line) during this spike, causing failure during higher flows. Ecology **will NOT accept** these "FAIL"s. Note the screenshot above does not show the "FAIL"s from the riser discharge in the table. The user must use the scroll bar to the right of the table to see these "FAIL"s.

Below is the graph showing the stage elevation reaching 3 feet, the elevation of the riser. This confirms that the entire live storage depth is utilized.

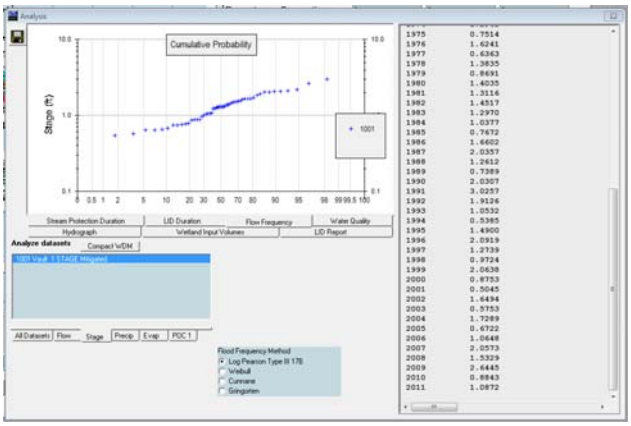


Figure 4: Flow Frequency Graph for the Vault 1 Stage Mitigated Dataset (Iteration 1)

We will add an orifice to bring the red line closer to the blue line on the Stream Protection Duration graph.

Iteration 2:
Vault Size: 48.5' x 48.5' (0.163 acre-ft of live storage volume)
Orifices: 0.5" @ 0', 0.5" @ 2.5'

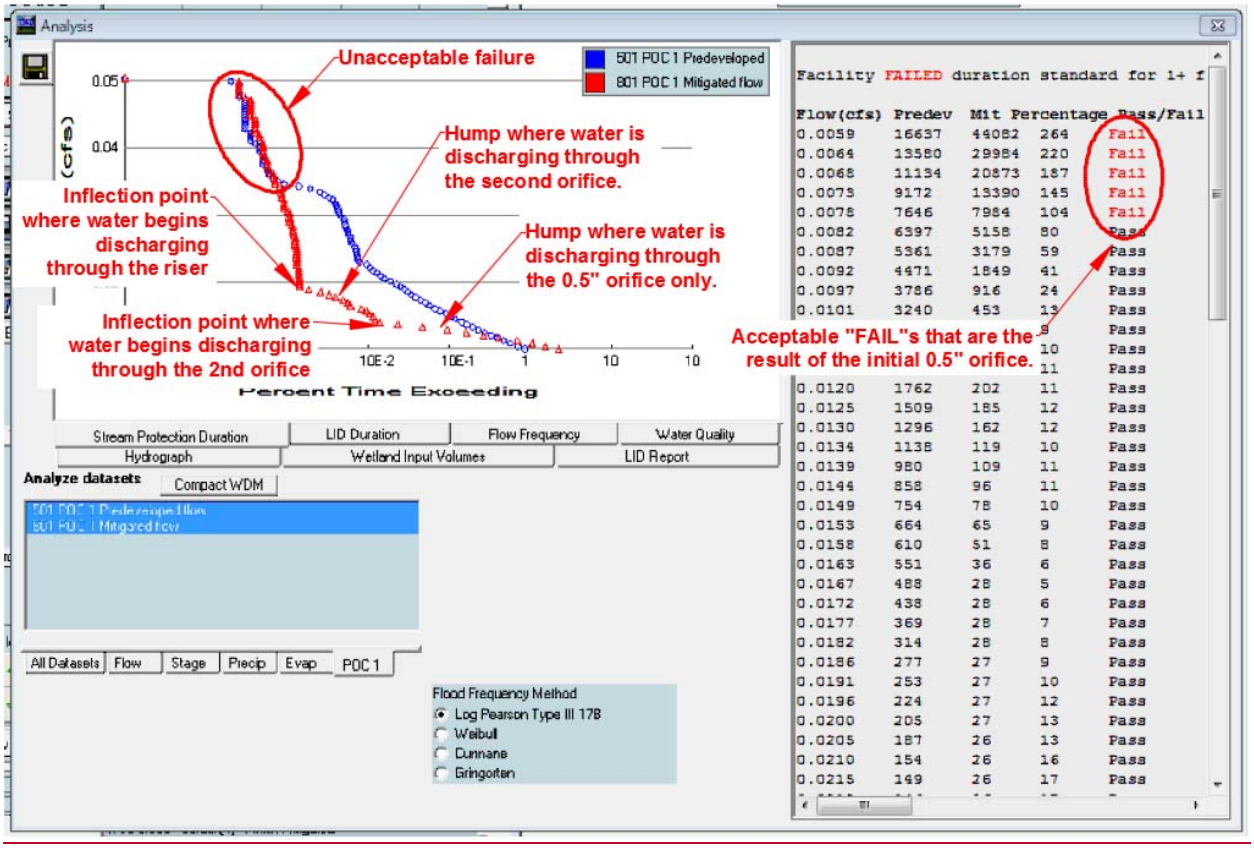


Figure 5: Stream Protection Duration Graph for the Point of Compliance (Iteration 2)

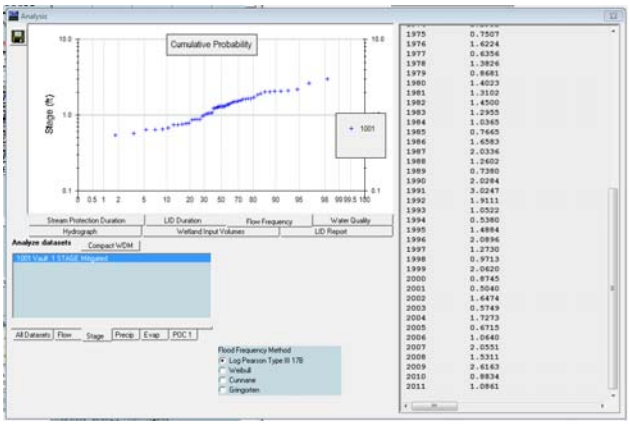


Figure 6: Flow Frequency Graph for the Vault 1 Stage Mitigated Dataset (Iteration 2)

- You can see the second hump in the red line, where flow is discharging through the new 0.5" orifice at 2.5'.
- The spike in the red line to the left shows that water is still discharging through the riser.
- The Flow Frequency graph confirms that the design utilizes all of the live storage depth.
- This vault design is not yet acceptable, because the red line crosses the blue line after the inflection point where water begins discharging through the second orifice.

We will move the second hump in the red line to the right, to more closely match the blue line. We will do this by lowering the second orifice.

Iteration 3:
Vault Size: 48.5' x 48.5' (0.163 acre-ft of live storage volume)
Orifices: 0.5" @ 0', 0.5" @ 2'

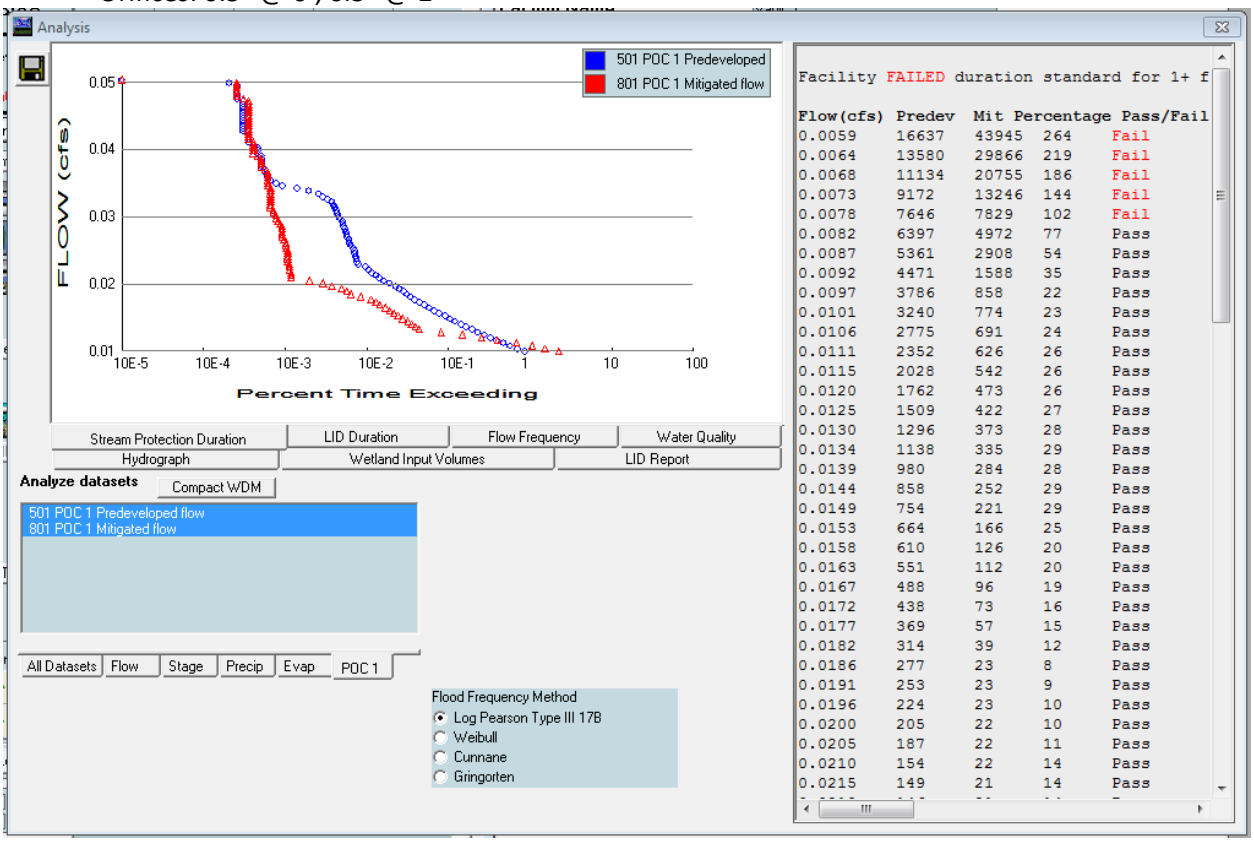


Figure 7: Stream Protection Duration Graph for the Point of Compliance (Iteration 3)

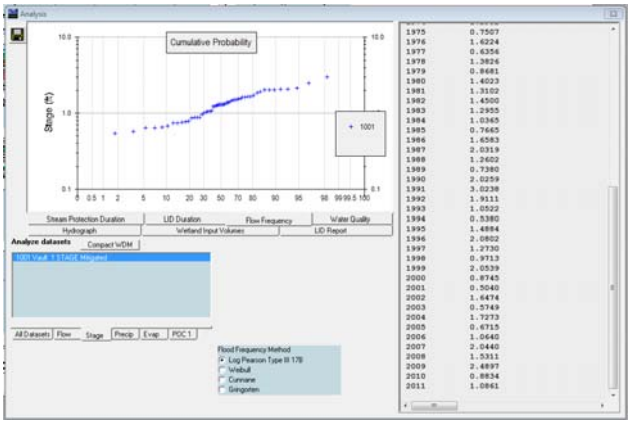


Figure 8: Flow Frequency Graph for the Vault 1 Stage Mitigated Dataset (Iteration 3)

- The second hump in the red line has shifted to the right. This is the result of lowering the second orifice from 2.5' to 2.0'.
- The spike in the red line to the left shows that water is still discharging through the riser.
- The Flow Frequency graph confirms that the design utilizes all of the live storage depth.
- This vault design is not yet acceptable, because the red line crosses the blue line after the inflection point where water begins discharging through the second orifice.

We will move the second hump in the red line further to the right, to more closely match the blue line. We will do this by further lowering the second orifice.

Iteration 4:
Vault Size: 48.5' x 48.5' (0.163 acre-ft of live storage volume)
Orifices: 0.5" @ 0', 0.5" @ 1.25'

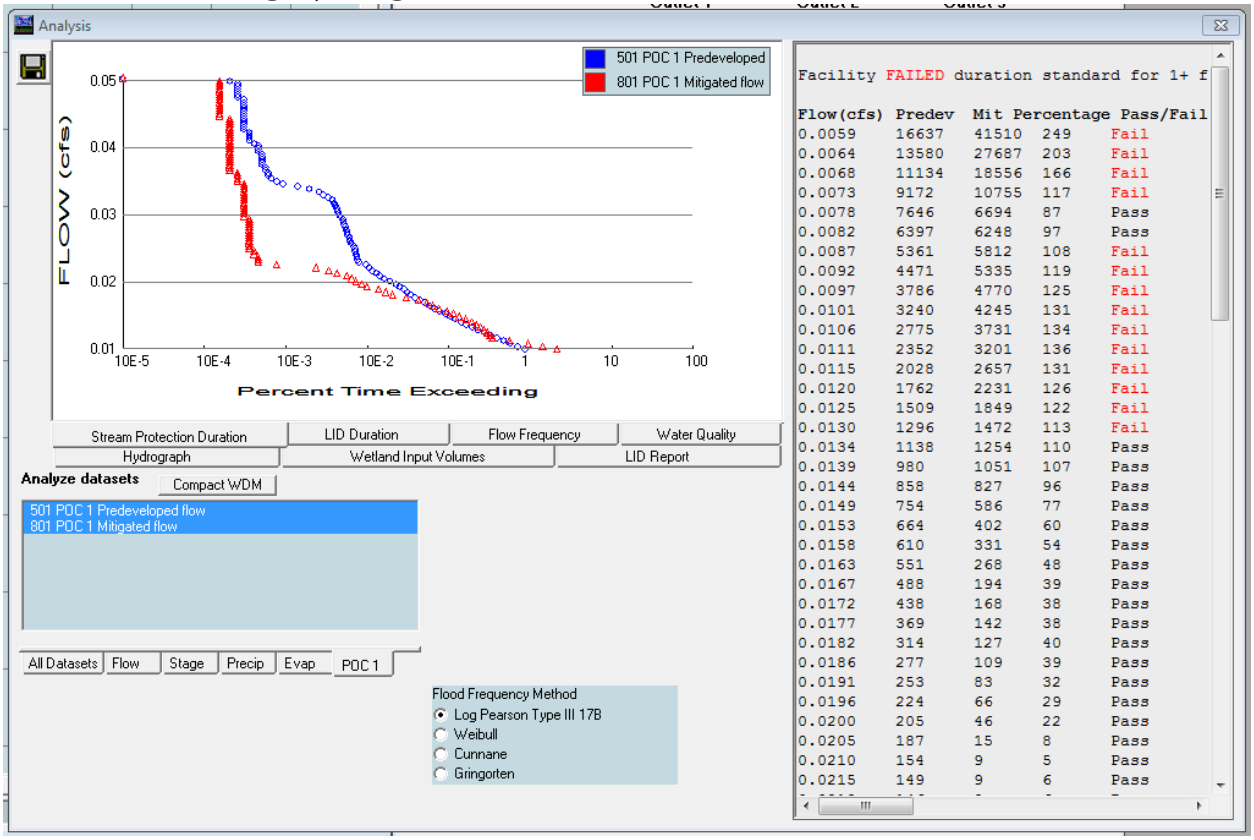


Figure 9: Stream Protection Duration Graph for the Point of Compliance (Iteration 4)

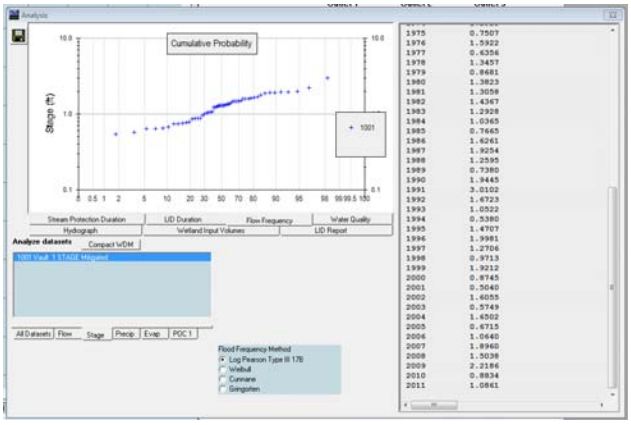


Figure 10: Flow Frequency Graph for the Vault 1 Stage Mitigated Dataset (Iteration 4)

- The second hump in the red line has been pushed too far to the right, causing unacceptable "FAIL"s.
- The spike in the red line to the left shows that water is still discharging through the riser.

- The Flow Frequency graph confirms that the design utilizes all of the live storage depth.
- This vault design is not yet acceptable, because the red line crosses the blue line after the inflection point where water begins discharging through the second orifice.

We will move the second hump in the red line back to the left, so that the red line does not cross the blue line during discharge from the second orifice. We will do this by raising the second orifice.

Iteration 5:
Vault Size: 48.5' x 48.5' (0.163 acre-ft of live storage volume)
Orifices: 0.5" @ 0', 0.5" @ 1.5'

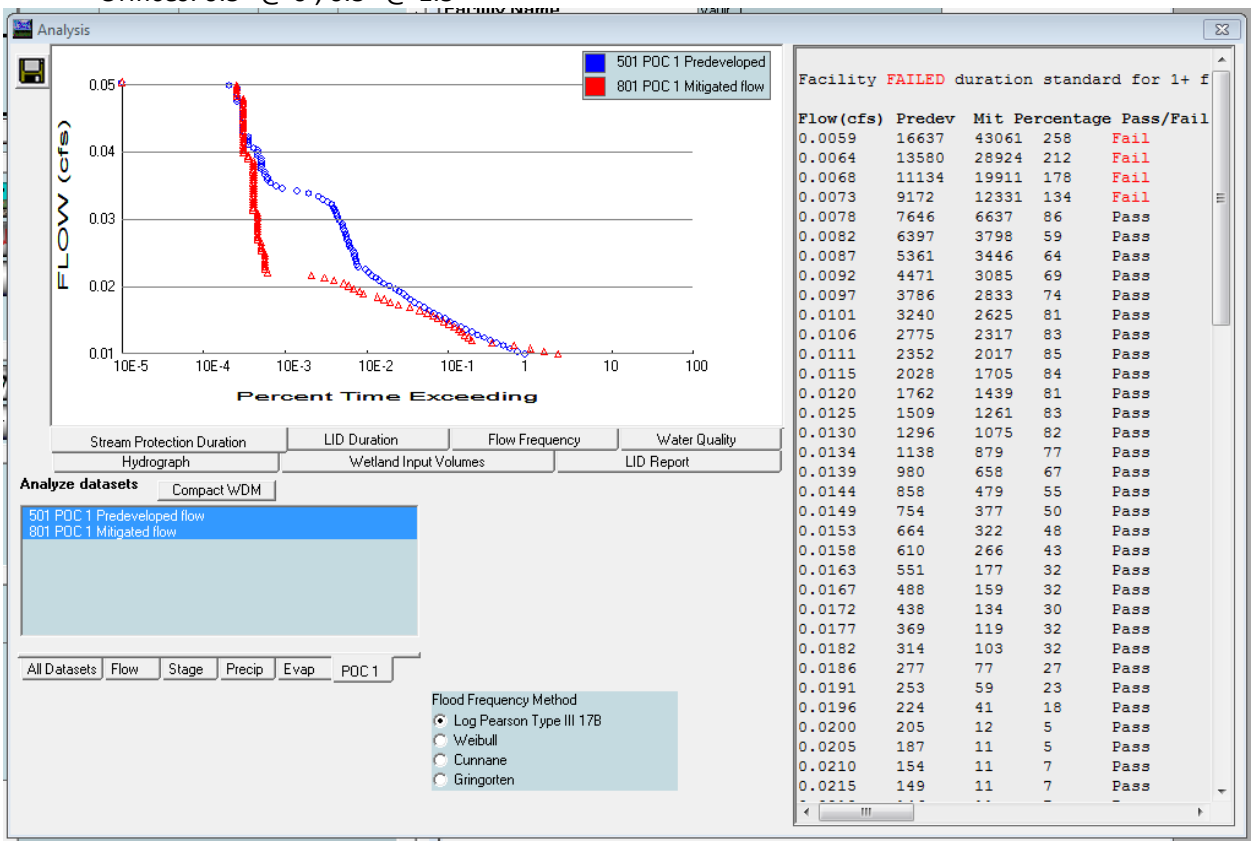


Figure 11: Stream Protection Duration Graph for the Point of Compliance (Iteration 5)

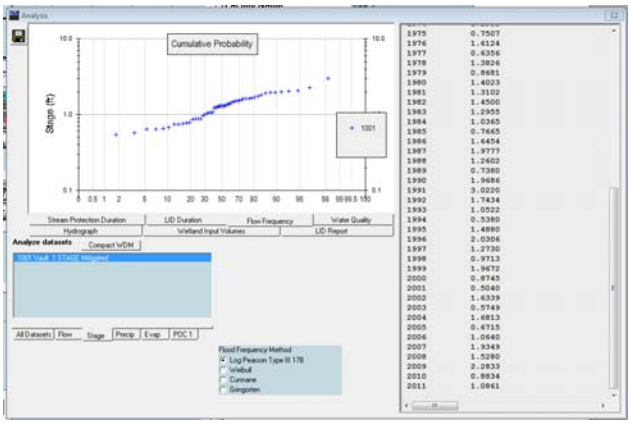


Figure 12: Flow Frequency Graph for the Vault 1 Stage Mitigated Dataset (Iteration 5)

- The second hump in the red line now very closely matches the blue line, without crossing it and causing unacceptable “FAIL”s.
- The spike in the red line to the left shows that water is still discharging through the riser.
- The Flow Frequency graph confirms that the design utilizes all of the live storage depth.
- This vault design is not yet acceptable, because the red line crosses the blue line after the inflection point where water begins discharging through the second orifice.

There is still a large gap between the red and blue lines, above the second hump in the red line. We will close this gap by adding a third orifice.

Iteration 6:

Vault Size: 48.5' x 48.5' (0.163 acre-ft of live storage volume)

Orifices: 0.5" @ 0', 0.5" @ 1.5', 0.5" @ 2.5'

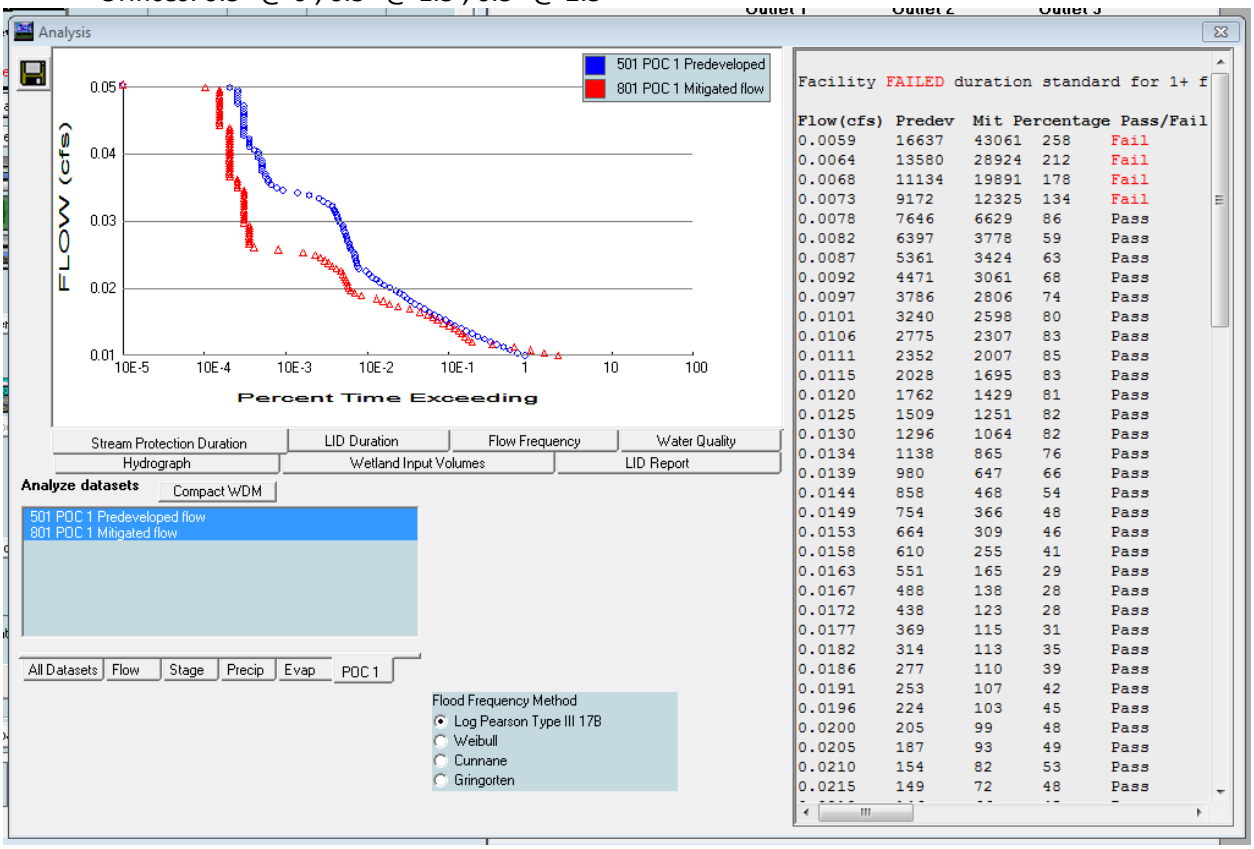


Figure 13: Stream Protection Duration Graph for the Point of Compliance (Iteration 6)

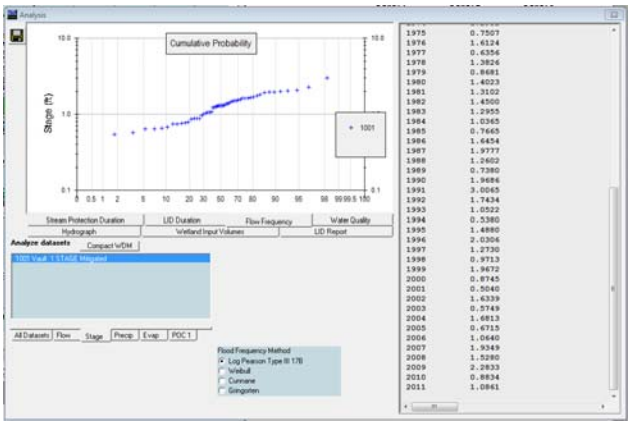


Figure 14: Flow Frequency Graph for the Vault 1 Stage Mitigated Dataset (Iteration 6)

- You can see the third hump in the red line, where flow is discharging through the new 0.5" orifice at 2.5'.
- The spike in the red line to the left shows that water is still discharging through the riser.
- The Flow Frequency graph confirms that the design utilizes all of the live storage depth.
- This vault design is acceptable, since the red line no longer crosses the blue line after the inflection point where water begins discharging through the second orifice.

However, there is still a gap between the red and blue lines, indicating that the vault may be smaller.

We will close the gap further by enlarging the third orifice before we shrink the vault size.

Iteration 7:
Vault Size: 48.5' x 48.5' (0.163 acre-ft of live storage volume)
Orifices: 0.5" @ 0', 0.5" @ 1.5', 0.75" @ 2.5'

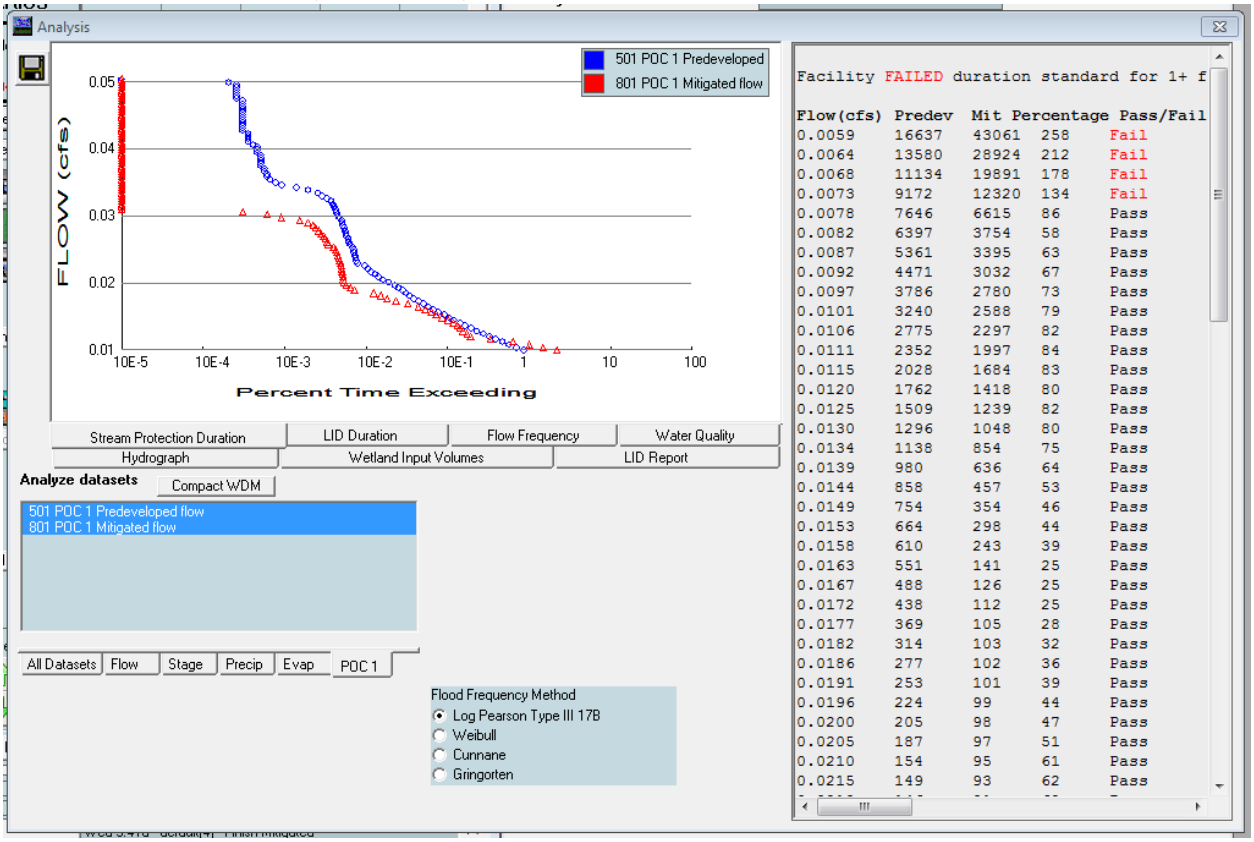


Figure 15: Stream Protection Duration Graph for the Point of Compliance (Iteration 7)

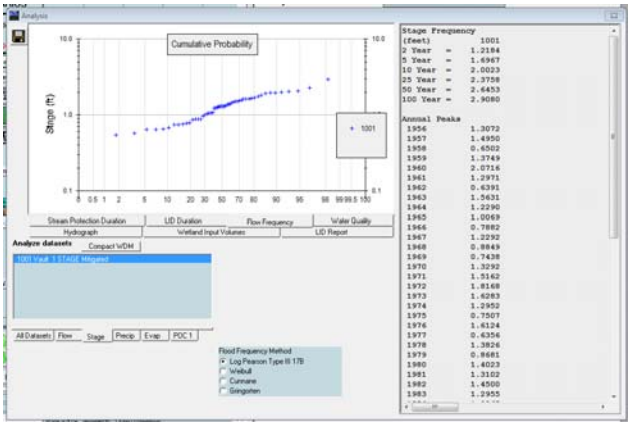


Figure 16: Flow Frequency Graph for the Vault 1 Stage Mitigated Dataset (Iteration 7)

- The third hump in the red line now more closely matches the blue line.

- The red line no longer has a spike on the left side, indicating that it no longer discharges through the riser.
- The Flow Frequency graph shows that the design utilizes most of the live storage depth. When you combine the information from the two graphs, it is apparent that most of the live storage depth is used, but the water does not actually reach the riser overflow.
- This vault design is acceptable, since the red line does not cross the blue line after the inflection point where water begins discharging through the second orifice. However, since the water does not discharge through the riser overflow, we may be able to decrease the live storage volume by shrinking the vault footprint.

We will close the gap further by lowering the third orifice before we shrink the vault size.

Iteration 8:
Vault Size: 48.5' x 48.5' (0.163 acre-ft of live storage volume)
Orifices: 0.5" @ 0', 0.5" @ 1.5', 0.75" @ 2.2'

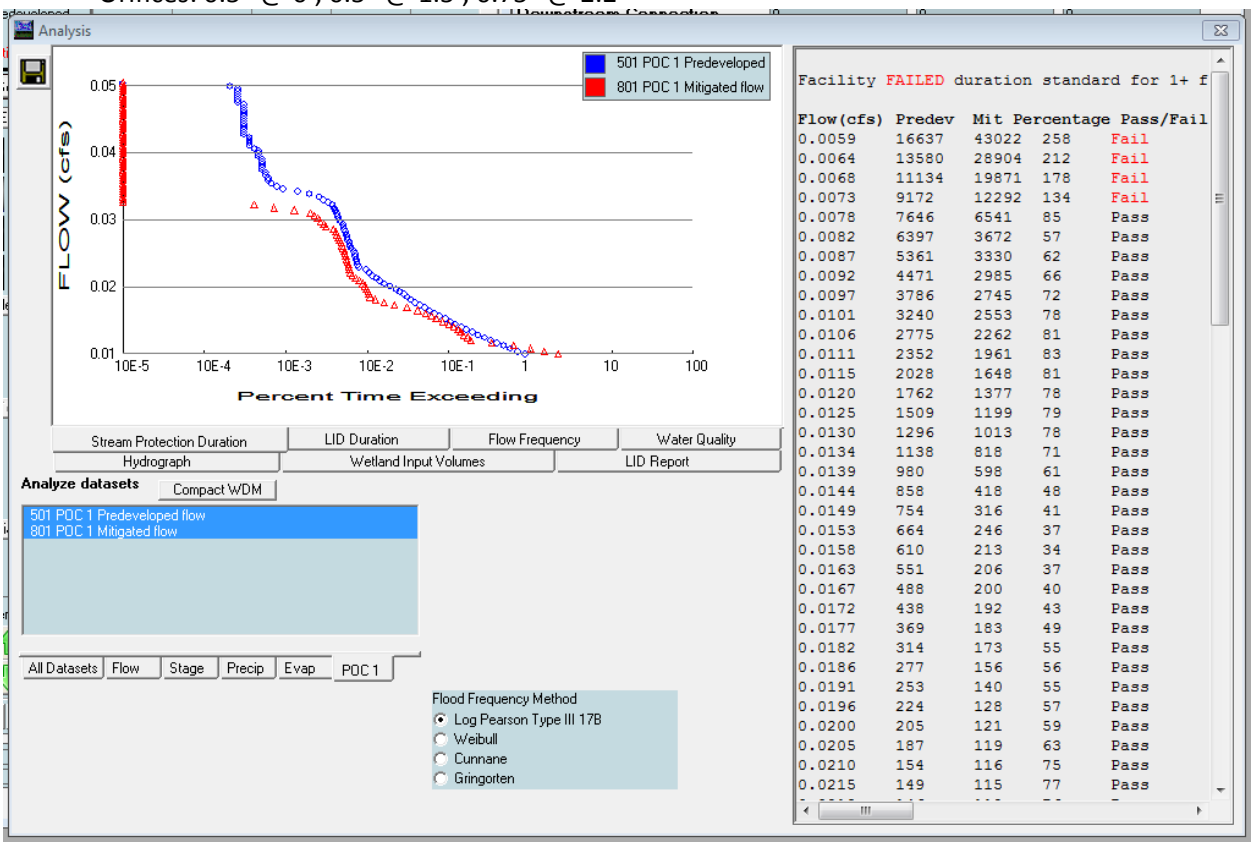


Figure 17: Stream Protection Duration Graph for the Point of Compliance (Iteration 8)

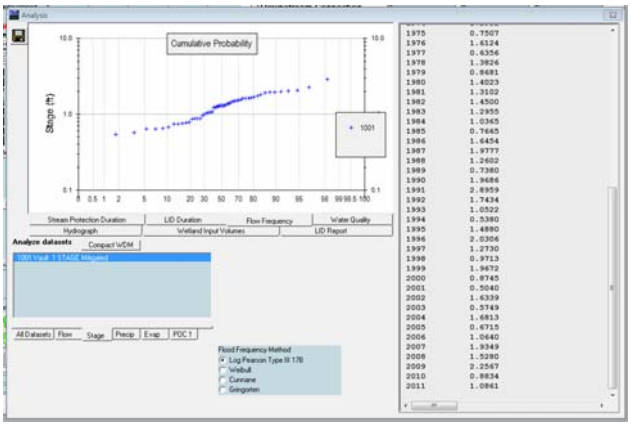
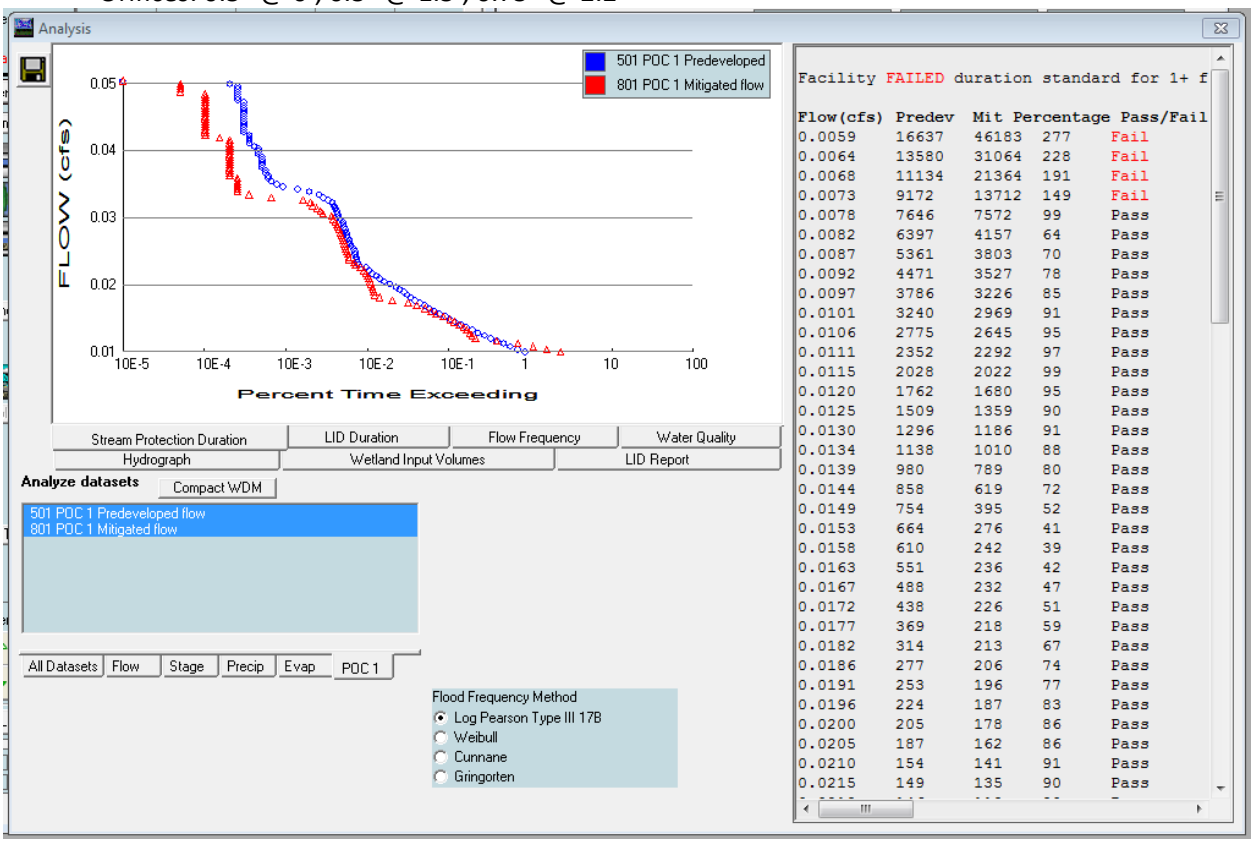


Figure 18: Flow Frequency Graph for the Vault 1 Stage Mitigated Dataset (Iteration 8)

- The third hump in the red line now very closely matches the blue line, without crossing it and causing unacceptable “FAIL”s.
- The red line no longer has a spike on the left side, indicating that it is no longer discharging through the riser.
- The Flow Frequency graph shows that the design utilizes most of the live storage depth. When you combine the information from the two graphs, it is apparent that most of the live storage depth is used, but the water does not actually reach the riser overflow.
- This vault design is acceptable, since the red line does not cross the blue line after the inflection point where water begins discharging through the second orifice. However, since the water does not discharge through the riser, we may be able to decrease the live storage volume by shrinking the vault footprint.

We will now decrease the vault size. We must verify after each decrease that the red line does not cross the blue line after the inflection point where water begins discharging through the second orifice.

Iteration 9:
Vault Size: 47' x 47' (0.153 acre-ft of live storage volume)
Orifices: 0.5" @ 0', 0.5" @ 1.5', 0.75" @ 2.2'



Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0059	16637	46183	277	Fail
0.0064	13580	31064	228	Fail
0.0068	11134	21364	191	Fail
0.0073	9172	13712	149	Fail
0.0078	7646	7572	99	Pass
0.0082	6397	4157	64	Pass
0.0087	5361	3803	70	Pass
0.0092	4471	3527	78	Pass
0.0097	3786	3226	85	Pass
0.0101	3240	2969	91	Pass
0.0106	2775	2645	95	Pass
0.0111	2352	2292	97	Pass
0.0115	2028	2022	99	Pass
0.0120	1762	1680	95	Pass
0.0125	1509	1359	90	Pass
0.0130	1296	1186	91	Pass
0.0134	1138	1010	88	Pass
0.0139	980	789	80	Pass
0.0144	858	619	72	Pass
0.0149	754	395	52	Pass
0.0153	664	276	41	Pass
0.0158	610	242	39	Pass
0.0163	551	236	42	Pass
0.0167	488	232	47	Pass
0.0172	438	226	51	Pass
0.0177	369	218	59	Pass
0.0182	314	213	67	Pass
0.0186	277	206	74	Pass
0.0191	253	196	77	Pass
0.0196	224	187	83	Pass
0.0200	205	178	86	Pass
0.0205	187	162	86	Pass
0.0210	154	141	91	Pass
0.0215	149	135	90	Pass

Figure 19: Stream Protection Duration Graph for the Point of Compliance (Iteration 9)

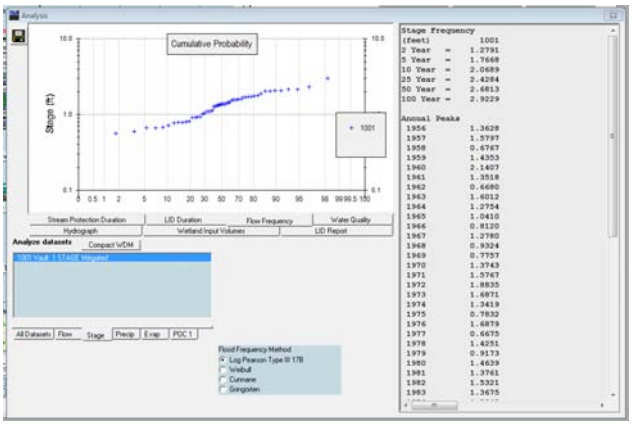


Figure 20: Flow Frequency Graph for the Vault 1 Stage Mitigated Dataset (Iteration 9)

- The red line has a spike on the left side again, indicating that flow is discharging through the riser.
- The Flow Frequency graph confirms that the design utilizes all of the live storage depth.
- This vault design is acceptable, since the red line does not cross the blue line after the inflection point where water begins discharging through the second orifice. However, since there is still a gap between the spike on the red line and the blue line, we may be able to decrease the vault size further.

We will decrease the vault size again.

Iteration 10:
Vault Size: 46' x 46' (0.147 acre-ft of live storage volume)
Orifices: 0.5" @ 0', 0.5" @ 1.5', 0.75" @ 2.2'

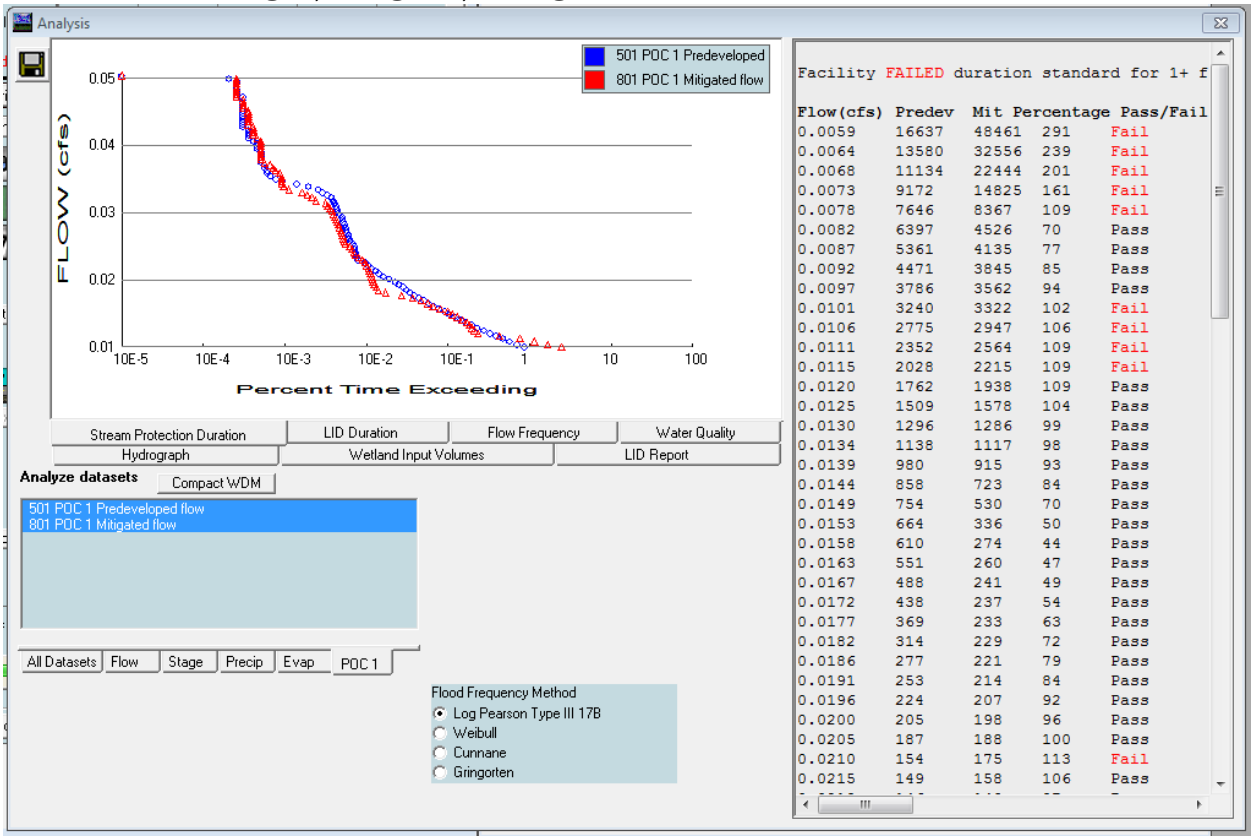


Figure 21: Stream Protection Duration Graph for the Point of Compliance (Iteration 10)

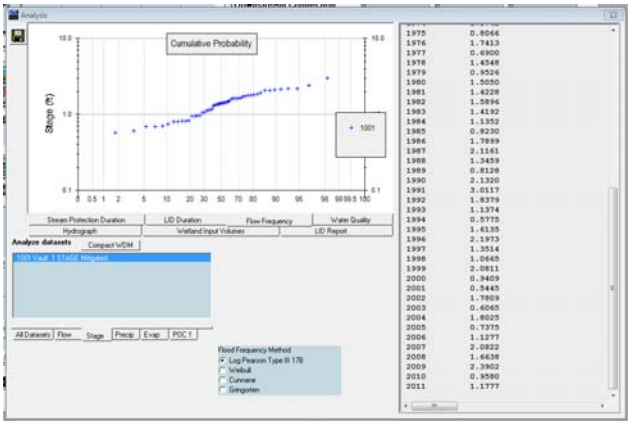


Figure 22: Flow Frequency Graph for the Vault 1 Stage Mitigated Dataset (Iteration 10)

- This vault size is **unacceptable**, because the red line once again crosses the blue line after the inflection point where water begins discharging through the second orifice.
- The Flow Frequency graph confirms that the design utilizes all of the live storage depth.

Iteration 9 is the best-fit vault found during this series of iterations.

Final Vault Size:

Vault Size: 47' x 47' (0.153 acre-ft of live storage volume)
Orifices: 0.5" @ 0', 0.5" @ 1.5', 0.75" @ 2.2'

Section VI – Special Reports and/or Studies

Section VI Summary:

1. Geotechnical Engineering Evaluation by Nelson Geotechnical Associates dated January 09, 2023.

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NELSON GEOTECHNICAL
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(425) 486-1669
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January 9, 2023

Ryan Kilby
VIA Email: ryan@williamsinvest.com

Geotechnical Engineering Evaluation
Rose Hill 12-Unit Mixed-Use Building
730 – 3rd Street
Mukilteo, Washington
NGA File No. 8797B22

Dear Ryan:

We are pleased to submit the attached report titled ***"Geotechnical Engineering Evaluation – Rose Hill 12-Unit Mixed-Use Building – 730 - 3rd Street – Mukilteo, Washington."*** This report summarizes our observations of the existing surface and subsurface conditions within the site and provides general recommendations for the proposed site development. Our services were completed in general accordance with our proposal, which you signed on December 5, 2022.

We previously issued a geotechnical report for the property on August 9, 2013. This evaluation involved two drilled borings and two supplemental hand-augered explorations, where we concluded the site was suitable for the development of a multi-unit mixed use building, after we encountered suitable soils at relatively shallow depths. We revisited the site on November 22, 2022 and December 7, 2022 to re-evaluate site conditions. Our explorations indicated that the site was generally underlain by native glacial soils at depths of 1.0 to 4.0-feet below the existing ground surface.

We have concluded that the site was generally compatible with the planned development. The building could be supported on shallow spread footings placed on the competent glacial soils. These soils should generally be encountered below the existing ground surface, based on our explorations. We should note, however, that deeper areas of loose, undocumented fill could exist in unexplored portions of the site especially in the area of the existing building which could require the removal of such soils and replacement with structural fill. We understand the proposed mixed-use building will be a 22-unit structure with a partial subsurface parking level. Shoring will likely be required to retain the cut for the retaining wall along 3rd Street.

In the attached report, we have included recommendations for foundation support, a shoring wall, erosion control, and surface drainage.

We appreciate the opportunity to provide service to you on this project. Please contact us if you have any questions regarding this report or require further information.

Sincerely,

NELSON GEOTECHNICAL ASSOCIATES, INC.

Khaled M. Shawish, PE
Principal

TABLE OF CONTENTS

LIST OF FIGURES

Geotechnical Engineering Evaluation
Rose Hill 12-Unit Mixed-Use Building
730 – 3rd Street
Mukilteo, Washington

INTRODUCTION

This report presents the results of our geotechnical engineering investigation and evaluation of the Rose Hill Mixed-use Building project located at **730 – 3rd Street in Mukilteo, Washington,** as shown on the Vicinity Map in **Figure 1.** The purpose of this study is to explore and characterize the site's surface and subsurface conditions, and to provide geotechnical recommendations for the planned site development. For our use in preparing this report, we were provided with the following documents:

For our use in preparing this updated geotechnical evaluation, we were provided with a planset titled "Williams Investments – Third and Park," dated July 17, 2022 and drawn by Dykeman Architecture.

The property is rectangular in shape and covers approximately 0.26 acres in area. It is currently vacant. The property is bordered by existing commercial properties to the west, by a side street to the north, by Park Avenue to the east, and by 3rd Street to the south. Topographically, the site slopes gently to the northwest, with isolated steep slopes mapped to the northeast. We previously issued a geotechnical report for the property on August 9, 2013. During this previous evaluation we performed two drilled boreholes at the site, as well as two supplemental hand-augered explorations, and concluded the site was suitable for the development of a multi-unit mixed-use building with subsurface parking levels, after encountering native soils at relatively shallow depths.

We understand that no significant change has occurred on the lot since issuing our previous geotechnical report, except for the removal of a small structure that occupied the property. We have been requested to provide this updated geotechnical report to address the construction of a building that is approximately the same as the building that was previously proposed, which will be a 12-unit mixed-use building with subsurface parking. We have been requested to provide this report to verify subsurface conditions and provide an update to our original report. The existing site layout and the locations of our explorations are shown on the Site Plan in **Figure 2.**

As a part of this project, we also understand that onsite infiltration systems are being considered. We were requested to evaluate the infiltration capacity of the site soils within the property. The City of Mukilteo utilizes the 2019 Department of Ecology (DOE) Stormwater Management in Western Washington Manual to determine the design of infiltration or detention facilities. We attempted to perform one PIT within the site.

SCOPE

The purpose of this study is to explore and characterize the site surface and subsurface conditions and provide an updated report for the site.

Specifically, our scope of services includes the following:

1. Reviewing available soil and geologic maps of the area, as well as our previous report.
2. Reconnoitering existing conditions on the site and verify the subsurface soil and groundwater conditions within the proposed building area with hand-tool explorations, where possible.
3. Performing an onsite small PIT test and calculate long term infiltration rates per the 2019 SMMWW. Excavator and water truck provided by the client.
4. Evaluating the minor steep slopes mapped in the northeast corner of the site.
5. Performing laboratory grain-size sieve analysis on soil samples, as necessary.
6. Providing recommendations for earthwork and foundation support.
7. Providing recommendations for shoring.
8. Providing recommendations for retaining walls.
9. Providing recommendations for temporary and permanent slopes.
10. Providing recommendations for subsurface utilities and pavement subgrade preparation.
11. Providing general recommendations for site drainage and erosion control.
12. Documenting the results of our findings, conclusions, and recommendations in a written updated geotechnical report for the proposed building.

SITE CONDITIONS

Surface Conditions

The site is composed of two rectangular lots and is bound by Park Avenue to the east, 3rd Street to the south, an alley to the north, and a 2-story commercial building to the west. In general, the overall site topography slopes down to the north from 3rd Street towards the alley in the back of the property. The western half of the property is mostly covered with crushed rock. The eastern half is mostly covered with weeds and historically, and older structure is located within the northeastern portion of the property but has since been removed. We did not observe surface water within the site during our site visit on July 23, 2013, or on our subsequent revisit to the site on November 22, 2022 and December 7, 2022.

Subsurface Conditions

Geology: The geologic units for this area are shown on the Distribution and Description of Geologic Units in the Mukilteo Quadrangle, Washington, by James P. Minard (USGS, 1982). The site is mapped as Qtb (Transitional Beds) and Qw (Whidbey Formation). The Transitional Beds deposits are described as thick beds of gray clay, silt, and fine- to very fine sand, however generally contain fine sands and gravels in the lower portions of the deposit. The Whidbey Formation is described as medium- to coarse-grained mostly cross bedded sand. Our explorations generally encountered fine to medium sand with silt underlain by silt and sand with silt layers generally consistent with the description of the lower portion of the transition beds deposit.

Explorations: The subsurface conditions within the site were initially explored on July 23, 2013 by drilling two borings to depths ranging from approximately 21.5 to 24.0 feet below the existing ground surface, using a limited-access drill rig. We also conducted two hand augers within the north-central portion of the property. We revisited the site on November 22, 2022 and December 7, 2022 to evaluate most recent subsurface conditions. The approximate locations of our explorations are shown on the Site Plan in **Figure 2.** A geologist from NGA was present during the explorations, examined the soils and geologic conditions encountered, obtained samples of the different soil types, and maintained logs of the borings and hand augers. For the borings, a Standard Penetration Test (SPT) was performed on each of the samples during drilling to document soil density at depth. The SPT consists of driving a 2-inch outer-diameter, split-spoon sampler 18 inches using a 140-pound hammer with a drop of 30 inches. The number of blows required to drive the sampler the final 12 inches is referred to as the "**N**" value and is presented on the boring logs. The **N** value is used to evaluate the strength and density of the deposit.

The soils were visually classified in general accordance with the Unified Soil Classification System, presented in **Figure 3.** The logs of our explorations are attached to this report and are presented as **Figures 4 and 5.** The logs of our borings are presented in **Figures 6 and 7.** We present a brief summary of the subsurface conditions in the following paragraphs. For a detailed description of the subsurface conditions, the boring and hand auger logs should be reviewed.

July 23, 2013 Explorations: **Boring 1** was located within the southwestern portion of the site. Below approximately 1.5 feet of modified ground, we encountered 12 feet of stiff, silty fine to medium sand grading to stiff silt with sand. Below the silt, we encountered gray, fine to medium sand with silt. We interpreted this material to be native glacial material. **Boring 1** was terminated in the sand with silt at a depth of 24.0 feet.

Boring 2 was located in the southeastern portion of the site. Below the surficial weeds and two feet of silty sand interpreted as fill/modified ground, we encountered about eight feet of medium dense, light orange-brown, fine to coarse sand with silty and gravel to silty sand with gravel. Below this material, we encountered layers of stiff to very stiff silt and silty sand. We interpreted this material to be native glacial material. **Boring 2** was terminated in the sand with silt at a depth of 21.5 feet.

Hand Auger 1 was excavated in the northwestern portion of the site. Below a surficial layer of crushed rock, we encountered approximately 1.7 feet of brown to brown-gray, silty fine to medium sand with varying amounts of gravel. We interpreted this material as fill. Below the fill, we encountered medium dense, silty fine to medium sand which we interpreted as native glacial soil. **Hand Auger 1** was terminated in the silty sand layer at a depth of 1.8 feet.

Hand Auger 2 was excavated in the northeastern portion of the site. Below a surficial layer of weeds and grasses, we encountered approximately 1.3 feet of light brown to orange-brown, silty fine to medium sand with varying amounts of gravel. We interpreted this material as fill. Below the fill, we encountered medium dense, silty fine to medium sand which we interpreted as native glacial soil. **Hand Auger 2** was terminated in the silty sand layer at a depth of 1.8 feet.

November 22, 2022 and December 7, 2022 Explorations: Test Pits 3, 4 and 5, as well as Infiltration **Test Pit One,** were excavated in the northern portion of the site. Within these test pits, 1.0- to 4.5-feet of surficial topsoil and/or undocumented fill was encountered bearing organics and roots and was encountered in a loose to medium dense condition. Underlying this layer, in **Test Pits Three and Four,** we encountered a more granular gray brown fine to medium sand with iron oxide staining was found in a medium dense condition. In most explorations, we broke through this more granular material to encounter a layer of gray to orange-gray to gray silty fine to medium sand with trace gravel in a medium dense or better condition at depth in every exploration. The encountered material generally showed an interbedding of siltier and more granular layers, which matches the description of transitional beds at depth.

Test Pits One and Two were excavated in the southern portion of the site. Here, we encountered 2.0-feet of surficial topsoil and/or undocumented fill with organics. At depth, we encountered a similar interbedding of gray brown to gray fine sand and silty fine to medium sand with trace gravel, matching the description of transition beds at depth.

Our most recent test pits were excavated to depths between 4.5- and 10.0-feet of depth throughout the site.

Hydrogeologic Conditions

Groundwater seepage was encountered in the borings and was measured with a groundwater reader after drilling. We measured the groundwater in **Boring 1** at 12.3 feet and in **Boring 2** at 12.6 feet below the existing ground surface during the dry season and our July 23, 2013 explorations. We returned to the site, and while we did not find groundwater seepage on November 22, 2022 at up to 6.5-feet of depth, we returned to the site on December 7, 2022 to evaluate infiltration and discovered significant perched groundwater at 6.0-feet of depth. Based on these findings, it is likely that if construction takes place during the wet season, groundwater could be encountered within the excavation. We interpreted the water seepage to be perched water. Perched water occurs when surface water infiltrates through less dense, more permeable soils, and accumulates on top of a relatively low permeability material such as the dense silty sand. Perched water does not represent a regional groundwater "table" within the upper soil horizons. Perched water tends to vary spatially and is dependent upon the amount of rainfall. We would expect the amount of perched groundwater to decrease during drier times of the year and increase during wetter periods.

SENSITIVE AREA EVALUATION

Seismic Hazard

We reviewed the 2018 International Building Code (IBC) for seismic site classification for this project. Since dense soils are interpreted to underlie the site at depth, the site best fits the IBC description for Site Class D. **Table 1** below provides seismic design parameters for the site that are in conformance with the 2018 IBC, which specifies a design earthquake having a two percent probability of occurrence in 50 years (return interval of 2,475 years), and the 2008 USGS seismic hazard maps.

Table 1 – 2018 IBC Seismic Design Parameters

Site Class	Spectral Acceleration at 0.2 sec. (g) S_s	Spectral Acceleration at 1.0 sec. (g) S_1	Site Coefficients		Design Spectral Response Parameters	
			F_a	F_v	S_{DS}	S_{D1}
D	1.405	0.500	1.0	null	0.936	null

The spectral response accelerations were obtained from the OSHPD Seismic Design Maps website (ASCE 7-16 data) for the project latitude and longitude. Hazards associated with seismic activity include liquefaction potential and amplification of ground motion. Liquefaction is caused by a rise in pore pressures in a loose, fine sand deposit beneath the groundwater table. It is our opinion that the dense glacial deposits interpreted to underlie the site have a low potential for liquefaction or amplification of ground motion.

Erosion Hazard

The criteria used for determination of the erosion hazard for affected areas include soil type, slope gradient, vegetation cover, and groundwater conditions. The erosion sensitivity is related to vegetative cover and the specific surface soil types, which are related to the underlying geologic soil units. The Soil Survey of Snohomish County Area, Washington, by the Soil Conservation Service (SCS), was reviewed to determine the erosion hazard of the on-site soils. The surface soils for this site were mapped as Kitsap silt loam, 0 to 8 percent slopes. The erosion hazard for this material is listed as slight. It is our opinion that the erosion hazard for site soils should be low in areas where the site is not disturbed.

LABORATORY ANAYLYSIS

We performed one grain-size sieve analysis on a soil sample obtained from Hand Auger 1 at 1.8 feet below the existing ground surface, on June 23, 2013. The results are presented as **Figure 8**.

CONCLUSIONS AND RECOMMENDATIONS

General

It is our opinion from a geotechnical standpoint that the site is compatible with the planned development of a two-story structure with daylight-basement parking. Our explorations indicated that the site is generally underlain by competent glacial soils below a surficial layer of approximately two to four and a half feet of topsoil or undocumented fill. The native soils underlying the site at depth, below this surficial layer should provide adequate support for foundation, slab, and pavement loads. The new building is planned to occupy the vast majority of the site. We recommend that the building be designed utilizing shallow foundations; however, we understand the parking level will be a daylight basement style, where the opening of the garage is proposed to the north, and the level becomes subsurface to the south. Footings should extend through the undocumented fill or loose soil and be founded on the underlying medium dense or better native soil, or structural fill extending to these soils. The medium dense or better soil should typically be encountered approximately two to four and a half feet below the existing surface, based on our explorations. We should note that deeper areas of unsuitable soils and/or undocumented fill could be encountered in the unexplored areas of the site, especially in the area of the old structure that was removed. This condition, if encountered, would require deeper excavations in foundation and slab areas to remove the unsuitable soils.

Cuts up to approximately 10- to 12-feet are planned along the southern and portions of the western and eastern sides of the property for the construction of the parking garage. Since these cuts cannot be sloped back due to site constraints, we recommend that the cuts be shored with a soldier pile retaining wall. This wall could be designed as a permanent wall and incorporated into the building. We provide recommendations for temporary and permanent cut slopes in the Temporary and Permanent Slopes section of this report. We also provide recommendations for the soldier pile wall in the Shoring Wall subsection of this report.

Infiltration capacity of the site soils were re-evaluated in our most recent site visits per the 2019 Department of Ecology (DOE) Stormwater Management Manual of Western Washington. In general, due to the dense silty nature of the site soils, results from testing in the wet season, and the fact that seasonal high groundwater extends at least within 6-feet from the existing ground surface, an infiltration gallery underlying the structure will not be feasible. Drainage should be retained onsite (detention) or connected to a City system, if possible.

The site soils are generally silty in nature and are considered highly moisture sensitive. We recommend that construction take place during the drier summer months, if possible. If construction is to take place during the rainy months, the soils exposed in the excavation will disturb and additional expenses and delays may be expected due to the wet conditions. Moderate to severe groundwater seepage may be encountered in cuts as well, if construction takes place in winter. Additional expenses could include the need for placing a blanket of rock spalls on exposed subgrades. The on-site soils are generally considered unsuitable for use as structural fill. NGA should be retained to determine if the native on-site soils can be used as structural fill material during construction.

Control of groundwater during and after construction will be important for a successful outcome. Most seepage during construction should be able to be controlled using sump-and-pump systems. For the permanent conditions, ample drainage and waterproofing systems should be incorporated into the design. Such systems could include foundation drains, under slab drainage systems, heavy-duty waterproofing of the basement walls, and other systems.

Erosion Control Measures

The erosion hazard for the on-site soils is considered to be slight, but actual erosion potential will be dependent on how the site is graded and how water is allowed to concentrate. Best Management Practices (BMPs) should be used to control erosion. Areas disturbed during construction should be protected from erosion. Erosion control measures may include diverting surface water away from the stripped areas and erecting silt fences and/or straw bales to prevent muddy water from leaving the site. We also recommend that stockpiles and excavation walls be covered with plastic sheeting. The erosion potential of areas not disturbed should be low.

Site Preparation and Grading

After erosion control measures are implemented and the existing structure is removed, site preparation should consist of removing topsoil, fills, and loose soils and undocumented fill from the building area to expose medium dense or better native soils. The excavation for the building should only be attempted after the shoring wall is installed. The stripped soil should be removed from the site. Based on our observations, we anticipate medium dense or better soil to be encountered approximately 2.0- to 4.5-feet across the site, but this depth could increase in unexplored areas of the site and in the vicinity of the existing structure.

The soldier pile wall should be installed prior to cutting along the southern property line down to the planned elevation for the lower level of the building.

After site preparation, if the exposed subgrade is deemed loose, it should be compacted to a non-yielding condition as approved by NGA. Areas observed to pump or weave during compaction should be reworked to structural fill specifications or over-excavated and replaced with properly compacted structural fill or rock spalls. If loose soils are encountered in the pavement areas, the loose soils should be removed and replaced with rock spalls or granular structural fill. If significant surface water flow is encountered during construction, this flow should be diverted around areas to be developed, and the exposed subgrades should be maintained in a semi-dry condition.

If wet conditions are encountered, alternative site grading techniques might be necessary. These could include using large excavators equipped with wide tracks and a smooth bucket to complete site grading and covering exposed subgrade with a layer of crushed rock for protection. If wet conditions are encountered or construction is attempted in wet weather, the subgrade should not be compacted as this could cause further subgrade disturbance. In wet conditions it may be necessary to cover the exposed subgrade with a layer of crushed rock as soon as it is exposed to protect the moisture sensitive soils from disturbance by machine or foot traffic during construction. The prepared subgrade should be protected from construction traffic and surface water should be diverted around areas of prepared subgrade.

We recommend that construction take place during dry weather, if possible. However, if construction takes place during wet weather, additional expenses and delays should be expected due to the wet conditions. Additional expenses could include the need for placing a blanket of rock spalls on exposed subgrades and construction traffic areas. Wet weather grading will also require additional erosion control and site drainage measures. The on-site soils are generally not suitable for use as structural fill. NGA should be retained to evaluate the suitability of all on-site and imported structural fill material during construction.

Temporary and Permanent Slopes

Temporary cut slope stability is a function of many factors, including the type and consistency of soils, depth of the cut, surcharge loads adjacent to the excavation, length of time a cut remains open, and the presence of surface water or groundwater. It is exceedingly difficult under these variable conditions to estimate a stable, temporary, cut slope angle. Therefore, it should be the responsibility of the contractor to maintain safe slope configurations since he is continuously at the job site, able to observe the soil and groundwater conditions encountered, and able to monitor the nature and condition of the cut slopes.

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

For planning purposes, we recommend that temporary cuts in the on-site soils be no steeper than 1.5 Horizontal to 1 Vertical (1.5H:1V). If significant groundwater seepage or surface water flow were encountered, we would expect that flatter inclinations would be necessary. We recommend that cut slopes be protected from erosion. The slope protection measures may include covering cut slopes with plastic sheeting and diverting surface runoff away from the top of cut slopes. We do not recommend vertical slopes for cuts deeper than four feet, if worker access is necessary. We recommend that cut slope heights and inclinations conform to appropriate OSHA/WISHA regulations.

We recommend permanent vertical cuts are planned to be supported by a soldier pile wall as discussed in the **Shoring Wall** subsection. Other permanent cuts and/or fill slopes should be no steeper than 2H:1V, unless specifically approved by NGA. Also, flatter inclinations may be required in areas where loose soils are encountered. Permanent slopes should be vegetated and the vegetative cover maintained until established. This can be discussed with the designers and we can provide recommendations, as needed.

Foundation Support

Conventional shallow spread foundations for the planned building should be placed on medium dense or better native soils, or be supported on structural fill or rock spalls extending to those soils. Medium dense or better soils should be encountered approximately 2.0- to 4.5-feet below the ground surface based on our explorations. Where undocumented fill or less dense soils are encountered at footing bearing elevation, the subgrade should be over-excavated to expose suitable bearing soil. The over-excavation may be filled with structural fill, or the footing may be extended down to the native bearing soils. If footings are supported on structural fill, the fill zone should extend outside the edges of the footing a distance equal to one-half of the depth of the over-excavation below the bottom of the footing.

Footings should extend at least 18 inches below the lowest adjacent finished ground surface for frost protection and bearing capacity considerations. Foundations should be designed in accordance with the 2018 IBC. Footing widths should be based on the anticipated loads and allowable soil bearing pressure. Water should not be allowed to accumulate in footing trenches. All loose or disturbed soil should be removed from the foundation excavation prior to placing concrete.

For foundations constructed as outlined above, we recommend an allowable design bearing pressure of not more than 3,000 pounds per square foot (psf) be used for the design of footings founded on the medium dense or better native soils or structural fill extending to the competent native material. The foundation bearing soil should be evaluated by a representative of NGA. We should be consulted if higher bearing pressures are needed. Current IBC guidelines should be used when considering increased allowable bearing pressure for short-term transitory wind or seismic loads. Potential foundation settlement using the recommended allowable bearing pressure is estimated to be less than one-inch total and ½-inch differential between adjacent footings or across a distance of about 20 feet, based on our experience with similar projects.

Lateral loads may be resisted by friction on the base of the footing and passive resistance against the subsurface portions of the foundation. A coefficient of friction of 0.35 may be used to calculate the base friction and should be applied to the vertical dead load only. Passive resistance may be calculated as a triangular equivalent fluid pressure distribution. An equivalent fluid density of 200 pounds per cubic foot (pcf) should be used for passive resistance design for a level ground surface adjacent to the footing. This level surface should extend a distance equal to at least three times the footing depth. These recommended values incorporate safety factors of 1.5 and 2.0 applied to the estimated ultimate values for frictional and passive resistance, respectively. To achieve this value of passive resistance, the foundations should be poured “neat” against the native medium dense soils or compacted fill should be used as backfill against the front of the footing. We recommend that the upper one foot of soil be neglected when calculating the passive resistance.

Structural Fill

General: Fill placed beneath foundations, pavement, or other settlement-sensitive structures should be placed as structural fill. Structural fill, by definition, is placed in accordance with prescribed methods and standards, and is monitored by an experienced geotechnical professional or soils technician. Field monitoring procedures would include the performance of a representative number of in-place density tests to document the attainment of the desired degree of relative compaction. The area to receive the fill should be suitably prepared as described in the **Site Preparation and Grading** subsection of this report prior to beginning fill placement.

Materials: Structural fill should consist of a good quality, granular soil, free of organics and other deleterious material, and be well graded to a maximum size of about three inches. All-weather structural fill should contain no more than five-percent fines (soil finer than U.S. No. 200 sieve, based on that fraction passing the U.S. 3/4-inch sieve). The use of on-site soils as structural fill is not recommended. We should be retained to evaluate proposed structural fill material prior to placement.

Fill Placement: Following subgrade preparation, placement of structural fill may proceed. All fill placements should be accomplished in uniform lifts up to eight inches thick. Each lift should be spread evenly and be thoroughly compacted prior to placement of subsequent lifts. All structural fill underlying building areas and pavement subgrade should be compacted to a minimum of 95 percent of its maximum dry density. Maximum dry density, in this report, refers to that density as determined by the ASTM D-1557 Compaction Test procedure. The moisture content of the soils to be compacted should be within about two percent of optimum so that a readily compactable condition exists. It may be necessary to over-excavate and remove wet soils in cases where drying to a compactable condition is not feasible. All compaction should be accomplished by equipment of a type and size sufficient to attain the desired degree of compaction.

Shoring Wall

General: We recommend that a soldier pile wall be used to support the cuts on the southern and portions of the eastern and western sides of the building. This wall can be used as a permanent wall and incorporated into the building. We anticipate cuts up to approximate 10- to 12-feet that would be supported by this wall.

A solider pile wall typically consists of a series of steel H-beams placed vertically at a certain spacing from one another (typically six to ten feet). The beams are usually placed in drilled shafts that are filled with structural concrete or a lean mix. The concrete shafts are typically embedded below the bottom of the planned excavation a distance equals one to two times the exposed height of the wall. The steel beams are extended above finished ground surface to provide shoring capabilities for the area to be retained. The beams are typically spanned by pressure treated timber lagging or concrete panels. The H-beam size, shaft diameter, shaft embedment, and pile spacing are dependent on the nature of the soils anticipated to be retained by the wall and the soils at depth, wall height, drainage conditions, and the final geometry. A schematic detail of the wall is shown on the Conceptual Soldier Pile Wall Detail in **Figure 9.**

Wall Design: The shoring wall should be designed by an experienced structural engineer licensed in the State of Washington. The lateral earth pressure acting on the shoring wall will be dependent on the nature and density of the soil behind the wall, structure and traffic loads on the wall, and the amount of lateral wall movement that may occur as material is excavated from the front of the wall. If the shoring wall is free to yield at least one-thousandth of the retained height, an "active" loading condition develops. If the wall is restrained from movement by stiffness or bracing, the wall is considered in an "at-rest" loading condition. Active and at-rest earth pressure can be calculated based on equivalent fluid densities.

The shoring wall should be designed to resist a lateral load resulting from a fluid with a unit weight of 40 and 60 pounds per cubic foot (pcf) for the active and at-rest loading conditions, respectively. These loads should be applied across the pile spacing above the excavation line. These loads can be resisted by a passive pressure of 200 pcf for the medium dense/stiff or better soils. The passive pressure should be applied on two-pile diameters under the excavation line. These values of the passive pressure incorporate a factor of safety of 2.0. The upper one-foot of wall embedment should be neglected when calculating the passive resistance.

The above load should be applied on the full center-to-center pile spacing above the base of the exposed portion of the wall. A 50 percent reduction of this value can be applied for the purpose of designing the wall lagging. The below-grade portion of the wall should not be shorter than 1.5 times the wall stick-up height.

The above pressures assume that the on-site soils retained by the shoring wall are mostly granular in nature and that hydrostatic forces are not allowed to build up behind the wall. These values do not include the effects of surcharges; such as due to foundation loads, traffic, or other surface loads. Surcharge effects should be considered where appropriate. The retained soils should be readily drained and collected water should be routed into a permanent storm system. Adequate gaps should be maintained between the lagging elements to allow for water seepage through the wall.

The wall designer should calculate the predicted wall deflection, including deflection resulting from the below-grade movement of the piles. The predicted deflection values should be confirmed in the field through a monitoring program. Also, existing surrounding structures and roads should be monitored for any adverse effects resulting from shoring wall installation. We should be retained to discuss wall and surrounding structure monitoring plans.

Shoring Wall Installation: The shoring wall should be installed by a shoring contractor experienced with this type of system. We anticipate that an open-hole drilling method may prove difficult to achieve for installing the soldier piles in the on-site soils, and therefore we recommend that the shoring contractor be capable of casing the holes as sloughing and/or water seepage will likely be encountered. It might be prudent to perform one or more "test" holes to confirm installation conditions prior to finalizing budget and work plans. Any sloughing or water that may collect in the drilled holes should be removed prior to pouring grout. Grout should be readily available on site at the time the holes are drilled and cased.

If groundwater seepage is encountered, we recommend that water be pumped out of the holes and the concrete be tremied from the bottom of the excavations to displace the groundwater to the surface. Extra Portland Cement may also be placed in the bottom of the excavations to reduce the effects of seepage. The spoils from the soldier pile excavations are expected to be moisture-sensitive materials and should be removed from the site along with all slide debris found on the downhill side of the wall. We should be retained to monitor onsite activities during the shoring wall installation on a full-time basis.

The wall should be lagged using pressure-treated timber. Adequate gaps, typically by placing lagging nails between the boards, should be maintained between the lagging elements to allow water flow through the face of the wall.

Other Retaining Walls

If the soldier pile wall is not designed as a permanent wall, separate retaining walls will need to be constructed. For those walls and other retaining walls, the lateral pressure acting on subsurface retaining walls is dependent on the nature and density of the soil behind the wall, the amount of lateral wall movement which can occur as backfill is placed, wall drainage conditions, the inclination of the backfill, and other possible surcharge loads. For walls that are free to yield at the top at least one thousandth of the height of the wall (active condition), soil pressures will be less than if movement is limited by such factors as wall stiffness or bracing (at-rest condition). We recommend that walls supporting horizontal backfill and not subjected to hydrostatic forces be designed using a triangular earth pressure distribution equivalent to that exerted by a fluid with a density of 40 pcf for yielding (active condition) walls, and 60 pcf for non-yielding (at-rest condition) walls.

These recommended lateral earth pressures are for a drained granular backfill and are based on the assumption of a horizontal ground surface behind the wall for a distance of at least the subsurface height of the wall, and do not account for surcharge loads. Additional lateral earth pressures should be considered for surcharge loads acting adjacent to subsurface walls and within a distance equal to the subsurface height of the wall. This would include the effects of surcharges such as traffic loads, floor slab, foundation loads, slopes, or other surface loads. Also, hydrostatic and buoyant forces should be included if the walls could not be drained. We could consult with the structural engineer regarding additional loads on retaining walls during final design, if needed.

The lateral pressures on walls may be resisted by friction between the foundation and subgrade soil and by passive resistance acting on the below-grade portion of the foundation. Recommendations for frictional and passive resistance to lateral loads are presented in the Foundation Support subsection of this report.

All wall backfill should be well-compacted as outlined in the **Structural Fill** subsection of this report. Care should be taken to prevent the building up of excess lateral soil pressures due to over-compaction of the wall backfill. This can be accomplished by placing wall backfill in thin loose lifts and compacting it with small, hand-operated compactors within a distance behind the wall equal to at least one-half the height of the wall. The thickness of the loose lifts should be reduced to accommodate the lower compactive energy of the hand-operated equipment. The recommended level of compaction should still be maintained.

Permanent drainage should be installed for retaining walls. Recommendations for these systems are found in the **Subsurface Drainage** subsection of this report. We recommend that we be retained to evaluate the proposed wall drain backfill material and drainage system installation.

Pavements

The pavement subgrade should be prepared as recommended in the **Site Preparation and Grading** and **Structural Fill** subsections of this report, including proof-rolling the subgrade with a loaded dump truck and repairing areas observed to pump or weave during the proof-roll test. Also, all fill placed within the pavement areas, including utility trench backfill, should be compacted to 95 percent of the Maximum Dry Density (Modified Proctor). We should be retained to observe the proof-roll test. Any areas observed to pump or weave under the wheels of the loaded dump truck should be over-excavated and replaced with crushed rock.

Slab-on-Grade

Slab-on-grade should be supported on subgrade soils prepared as described in the **Site Preparation and Grading** subsection of this report. We recommend that all floor slabs be underlain by at least six inches of free-draining gravel with less than three percent by weight of the material passing Sieve #200 for use as a capillary break. We recommend that the capillary break be hydraulically connected to the footing drain system to allow free drainage from under the slab. A suitable vapor barrier, such as heavy plastic sheeting (6-mil minimum), should be placed over the capillary break material. An additional 2-inch thick moist sand layer may be used to cover the vapor barrier. This sand layer is optional and is intended to protect the vapor barrier membrane during construction.

Site Drainage

Infiltration Testing: We attempted to perform a small PIT test per the 2019 Stormwater Management Manual for Western Washington. We excavated the test hole down to 7.0-feet of depth and encountered silty fine sand with trace gravel in a dense condition with a generally high moisture content. We also excavated Test Pit Five nearby to a depth of 10.0 feet to observe groundwater conditions. We encountered moderate groundwater seepage at a depth of 6.0 feet. At the start of the day, we filled the Infiltration Test Pit with 12-inches of water for the soaking period. After waiting an hour, and adding no additional water to the hole, the water level had increased by ¼ inch. The test was terminated prematurely due to water infiltrating into the hole, resulting in the water level rising instead. It is our opinion that stormwater infiltration within the site is not feasible due to the seasonal high groundwater table being relatively shallow, and due to the silty and compact nature of the transition beds deposit. We recommend that the water be detained onsite or routed to a nearby City of Mukilteo storm system, if feasible.

Surface Drainage: The finished ground surface should be graded such that runoff is directed to an appropriate stormwater collection system. Water should not be allowed to collect in any areas where footings, slabs, or pavements are to be constructed. Final site grades should allow for drainage away from the structure. We suggest that the finished ground be sloped at a minimum gradient of three percent, for a distance of at least 10 feet away from the structures. Surface water generated from paved areas and roof drains should be collected by permanent catch basins and drain lines and be routed into an appropriate discharge system.

Subsurface Drainage: If groundwater is encountered during construction, we recommend that the contractor slope the bottom of the excavation and collect the water into ditches and small sump pits where the water can be pumped from the excavation and routed to a suitable discharge point. We recommend the use of footing drains around the structure and behind all retaining walls. Footing drains should be installed at least one foot below the planned finished floor elevation. The drains should consist of a minimum 4-inch-diameter, rigid, slotted or perforated, PVC pipe surrounded by free-draining material wrapped in a filter fabric. We recommend that the free-draining material consist of an 18-inch-wide zone of clean (less than three-percent fines), granular material placed along the back of walls. Washed rock is an acceptable drain material, or a drainage composite may be used instead. The free-draining material or the drainage composite should extend up the wall to one foot below the finished surface. The top foot of backfill should consist of low permeability soil placed over plastic sheeting or building paper to minimize the migration of surface water or silt into the footing drain. Footing drains should discharge into tightlines leading to an appropriate collection and discharge point with convenient cleanouts to prolong the useful life of the drains. Roof drains should not be connected to wall or footing drains.

The shoring wall should be drained by maintaining suitable gaps between the lagging elements to allow water seepage through the wall. Depending on final wall configuration, a drainage composite should be placed along the face of the wall to collect water seeping through the wall face. The collected water would be routed down to the bottom of the wall where a perforated drainpipe should be placed to transmit the collected water into the drainage system. The garage walls can be cast directly on the drainage composite. This concept is shown in **Figure 9.**

Depending on the amount of subsurface water encountered on this site, it may be prudent to install a system of underslab drains underneath the entire building footprint. This system would consist of 4-inch perforated PVC pipes placed within the capillary break layer at roughly 20-foot spacings which are sloped to drain into a main 6-inch solid collector pipe. The main collector pipe would be connected to the drainage system outside the building footprint. Also, ample heavy-duty waterproofing of the basement walls should be incorporated into the project plans.

CONSTRUCTION MONITORING

We recommend that we be retained to provide construction monitoring services to evaluate conditions encountered in the field with respect to anticipated conditions, to provide recommendations for design changes should the conditions differ from anticipated, and to evaluate whether construction activities comply with contract plans and specifications.

USE OF THIS REPORT

NGA has prepared this report for **Ryan Kilby of Williams Investments,** and associated agents, for use in the planning and design of the development planned on this site only. The scope of our work does not include services related to construction safety precautions and our recommendations are not intended to direct the contractors' methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design. There are possible variations in subsurface conditions between the explorations and also with time. Our report, conclusions, and interpretations should not be construed as a warranty of subsurface conditions. A contingency for unanticipated conditions should be included in the budget and schedule.

We recommend that NGA be retained to review project plans as they are being developed. We also recommend that we be retained to provide monitoring and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications. We should be contacted a minimum of one week prior to construction activities and could attend pre-construction meetings if requested.

Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time this report was prepared. No other warranty, expressed or implied, is made. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the owner.

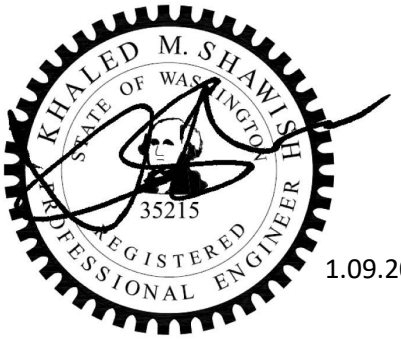
o-o-o

It has been a pleasure to provide service to you on this project. If you have any questions or require further information, please call.

Sincerely,

NELSON GEOTECHNICAL ASSOCIATES, INC.

Katelyn S. Brower, GIT
Project Geologist



1.09.2023

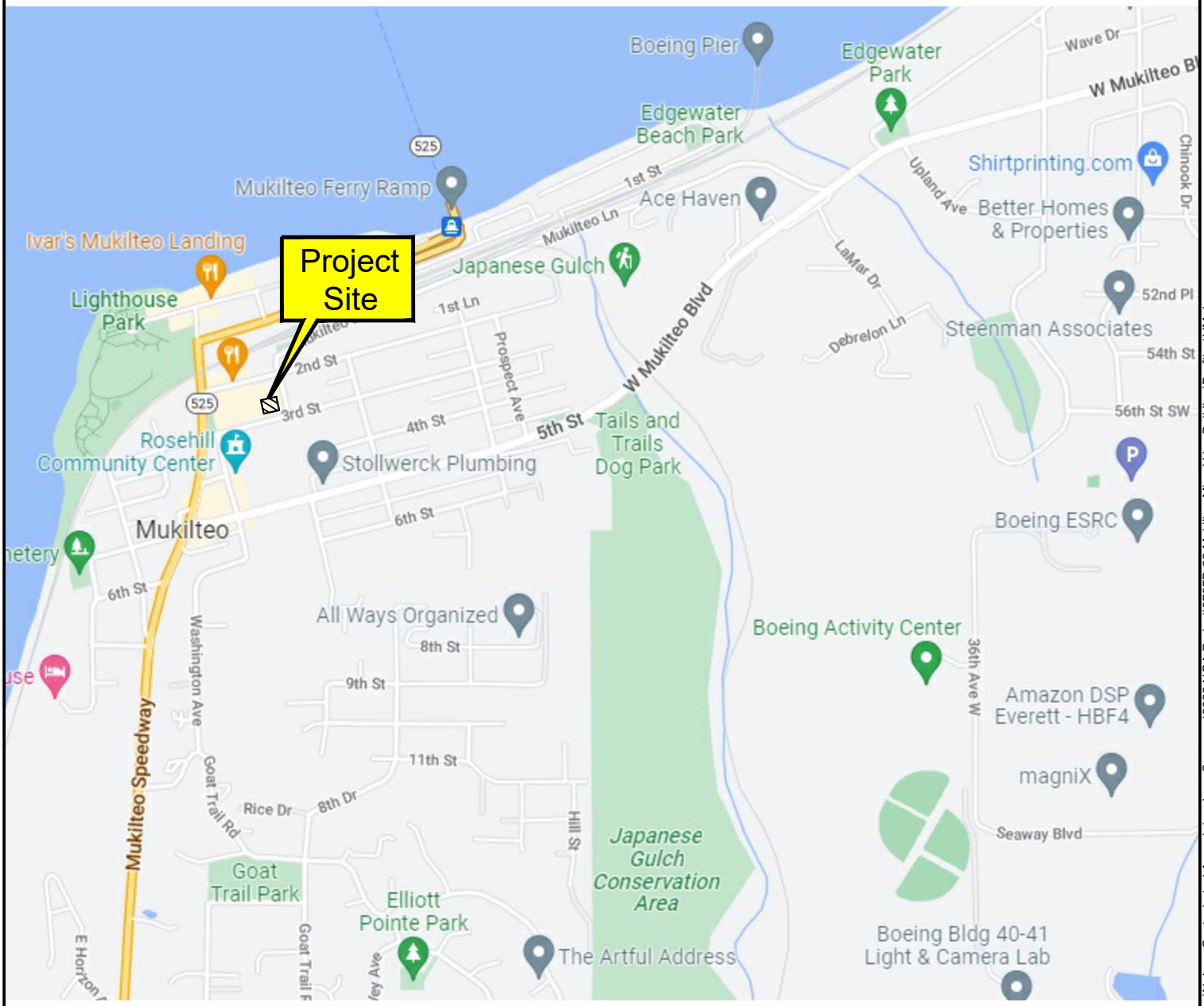
Khaled M. Shawish, PE
Principal

KSB:KMS:dy

Nine Figures Attached

VICINITY MAP

Not to Scale



Mukilteo, WA

Project Number 8797B22	Rose Hill Mixed-Use Building Development Vicinity Map	NELSON GEOTECHNICAL ASSOCIATES, INC	No.	Date	Revision	By	CK
Figure 1			1	12/1/22	Original	FKS	DJO

Woodinville Office
17311-135th Ave. NE, A-500
Woodinville, WA 98072
(425) 486-1669 / Fax: 481-2510

Wenatchee Office
105 Palouse St.
Wenatchee, WA 98801
(509) 665-7696 / Fax: 665-7692

www.nelsongeotech.com

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Site Plan

LEGEND

Property line

TP-1 — Number and approximate location of test pit

INF-1 — Number and approximate location of infiltration test pit

B-1 — Number and approximate location of boring on 7/23/2013

HA-1 — Number and approximate location of hand auger on 7/23/2013

Scale: 1 inch = 20 feet

Reference: Site Plan based on field measurements, observations, and aerial parcel map review.

Project Number	Rose Hill Mixed-Use Building Development Site Plan	NELSON GEOTECHNICAL ASSOCIATES, INC
8797B22		Woodinville Office: 17311-135th Ave. NE, A-500, Woodinville, WA 98072, (425) 486-1669 / Fax: 481-2510
Figure 2		Wenatchee Office: 105 Palouse St., Wenatchee, WA 98801, (509) 665-7696 / Fax: 665-7692
		www.nelsongeotech.com

No.	Date	Revision	By	CK
1	12/1/22	Original	FKS	DJO

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UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE - GRAINED SOILS MORE THAN 50 % RETAINED ON NO. 200 SIEVE	GRAVEL MORE THAN 50 % OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVEL	GW	WELL-GRADED, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND MORE THAN 50 % OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE - GRAINED SOILS MORE THAN 50 % PASSES NO. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50 %	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY LIQUID LIMIT 50 % OR MORE	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1) Field classification is based on visual examination of soil in general accordance with ASTM D 2488-93.

2) Soil classification using laboratory tests is based on ASTM D 2488-93.

3) Descriptions of soil density or consistency are based on interpretation of blowcount data, visual appearance of soils, and/or test data.

SOIL MOISTURE MODIFIERS:

Dry - Absence of moisture, dusty, dry to the touch

Moist - Damp, but no visible water.

Wet - Visible free water or saturated, usually soil is obtained from below water table

Project Number 8797B22	Rose Hill Mixed-Use Building Development Soil Classification Chart	NELSON GEOTECHNICAL ASSOCIATES, INC	
Figure 3		www.nelsongeotech.com **Woodinville Office** 17311-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 486-1669 / Fax: 481-2510 **Wenatchee Office** 105 Palouse St. Wenatchee, WA 98801 (509) 665-7696 / Fax: 665-7692	

No.	Date	Revision	By	CK
1	12/1/22	Original	FKS	DJO

C:\Users\DannyNelson\Nelson Geotechnical Associates, Inc\Nelson Geotechnical Associates, Inc - Company\2022 NGA Project\8797B-22 Mukilteo Mixed Use Building\Drafting\SC.dwg

LOG OF EXPLORATION

DEPTH (FEET)	USCS	SOIL DESCRIPTION
TEST PIT ONE		
0.0 – 2.0		BROWN TO DARK BROWN, SILTY, FINE TO MEDIUM SAND WITH ORGANICS, ROOTS, GRAVEL, AND IRON-OXIDE WEATHERING (LOOSE TO MEDIUM DENSE, DRY TO MOIST) (**FILL**)
2.0 – 5.0	SP	GRAY-BROWN, FINE TO MEDIUM SAND WITH TRACE ROOTS AND IRON-OXIDE STAINING (MEDIUM DENSE TO DENSE, DRY TO MOIST)
5.0 – 6.0	SM	LIGHT GRAY TO TAN, SILTY, FINE TO MEDIUM SAND WITH ROOTS AND IRON-OXIDE STAINING (MEIDUM DENSE TO DENSE, DRY TO MOIST)
		SAMPLE WAS COLLECTED AT 5.5 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 6.0 FEET ON 11/22/2022
TEST PIT TWO		
0.0 – 2.0		**TOPSOIL / FILL**
2.0 – 4.5	SP	GRAY-BROWN, FINE TO MEDIUM SAND WITH TRACE ROOTS AND IRON-OXIDE STAINING (MEDIUM DENSE TO DENSE, MOIST)
4.5 – 5.5	SM	LIGHT GRAY TO GRAY, SILTY, FINE SANDWITH TRACE ROOTS AND IRON-OXIDE STAINING (MEDIUM DENSE TO DENSE, MOIST)
5.5 – 6.5	SP	GRAY TO GRAY-BROWN, FINE TO COARSE SAND WITH GRAVEL (MEDIUM DENSE TO DENSE, MOIST)
		SAMPLE WAS COLLECTED AT 6.5 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 6.5 FEET ON 11/22/2022
TEST PIT THREE		
0.0 – 2.0		**TOPSOIL / FILL**
2.0 – 4.0	SP	GRAY-BROWN, FINE TO MEDIUM SAND WITH TRACE ROOTS AND IRON-OXIDE STAINING (MEDIUM DENSE TO DENSE, MOIST)
4.0 – 6.5	SM	GRAY TO ORANGE-GRAY, SILTY, FINE SAND WITH TRACE ROOTS AND TRACE GRAVEL (MEDIUM DENSE TO DENSE, MOIST)
		SAMPLE WAS COLLECTED AT 5.0 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 6.5 FEET ON 11/22/2022
TEST PIT FOUR		
0.0 – 3.0		**TOPSOIL / FILL**
3.0 – 4.5	SP	GRAY-BROWN, FINE TO MEDIUM SAND WITH TRACE ROOTS AND IRON-OXIDE STAINING (MEDIUM DENSE TO DENSE, MOIST)
		SAMPLES WERE NOT COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 4.5 FEET ON 11/22/2022

LOG OF EXPLORATION

DEPTH (FEET)	USCS	SOIL DESCRIPTION
TEST PIT FIVE		
0.0 – 4.5		DARK BROWN TO BLACK, SILTY, FINE TO MEDIUM SAND WITH GRAVEL, ROOTS, AND METAL (LOOSE TO MEDIUM DENSE, MOIST) (**FILL**)
4.5 – 6.0	SM	ORANGE-GRAY TO GRAY, SILTY, FINE SAND WITH IRON-OXIDE STAINING, TRACE GRAVEL, AND TRACE ROOTS (MEDIUM DENSE, MOIST)
6.0 – 10.0	SM	GRAY, SILTY, FINE SAND WITH TRACE GRAVEL (MEDIUM DENSE TO DENSE, MOIST)
		SAMPLES WERE NOT COLLECTED GROUNDWATER SEEPAGE WAS ENCOUNTERED AT 6.0 FEET TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 10.0 FEET ON 12/7/2022
INFILTRATION TEST PIT ONE		
0.0 – 1.0		**TOPSOIL / FILL**
1.0 – 2.0	SM	ORANGE-BROWN, SILTY, FINE TO MEDIUM SAND WITH ROOTS, IRON-OXIDE WEATHERING, AND TRACE GRAVEL (LOOSE TO MEDIUM DENSE, MOIST)
2.0 – 5.0	SP-SM	GRAY TO GRAY-BROWN, FINE TO MEDIUM SAND WITH SILT AND TRACE GRAVEL (MEDIUM DENSE TO DENSE, MOIST)
5.0 – 7.0	SM	GRAY, SILTY, FINE SAND WITH TRACE GRAVEL (MEDIUM DENSE TO DENSE, MOIST)
		SAMPLES WERE NOT COLLECTED GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 7.0 FEET ON 12/7/2022
HAND AUGER ONE		
0.0 – 0.9		DARK BROWN, FINE TO MEDIUM SAND WITH SILT AND TRACE GRAVEL (LOOSE TO MEDIUM DENSE, MOIST) (**FILL**)
0.9 – 1.2		LIGHT BROWN, FINE TO MEDIUM SAND WITH SILT AND TRACE GRAVEL (MEDIUM DENSE, MOIST) (**FILL**)
1.2 – 1.7		ORANGE-BROWN, FINE TO MEDIUM SAND WITH SILT AND TRACE GRAVEL (MEDIUM DENSE, MOIST) (**FILL**)
1.7 – 1.9	SP-SM	LIGHT ORANGE-BROWN, FINE TO MEDIUM SAND WITH SILT AND TRACE GRAVEL (MEDIUM DENSE, MOIST)
		SAMPLES WERE COLLECTED AT 0.5, 1.0, 1.5, AND 1.8 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER WAS COMPLETED AT 1.9 FEET ON 7/23/2013
HAND AUGER TWO		
0.0 – 0.9		LIGHT BROWN, FINE TO MEDIUM SAND WITH SILT (LOOSE, DRY TO MOIST) (**FILL**)
0.9 – 1.3	SP-SM	BROWN, FINE TO MEDIUM SAND WITH SILT (MEDIUM DENSE, MOIST)
1.3 – 1.8	SP-SM	DARK BROWN TO ORANGE-BROWN, FINE TO MEDIUM SAND WITH SILT AND TRACE GRAVEL (MEDIUM DENSE, MOIST)
		SAMPLES WERE COLLECTED AT 0.5, 1.0, AND 1.5 FEET GROUNDWATER SEEPAGE WAS NOT ENCOUNTERED HAND AUGER CAVING WAS NOT ENCOUNTERED HAND AUGER WAS COMPLETED AT 1.8 FEET ON 7/23/2013

BORING LOG

B-1

Approximate Ground Surface Elevation: ~72 ft

Soil Profile: Description	Graphic Log	Group Symbol	Sample Data: Blow Count	Sample Location (Depth in feet)
Gray-brown, fine sand, topsoil/modified ground			6	
Orange-brown, fine to medium sand (loose, moist)		SP		
Brown-gray, silty fine to medium sand (loose, moist)		SM	6	
Brown-gray silt with trace iron-oxide staining (medium stiff, moist)		ML		
-becomes stiff			12	
Dark brown silt with fine sand (very stiff, moist)		ML	19	
Gray silt (stiff, moist)		ML		
-with fine sand			9	
Gray, fine to medium sand with silt to silty sand (medium dense, moist to wet)		SP-SM /SM	27	
Gray, fine sand with silt to silty fine sand with fine sand lenses (medium dense, moist to wet)		SP-SM /SM	28	
Boring terminated below existing grade at 24.0 feet on 7/23/13. Groundwater seepage was encountered at 12.3 feet during drilling.				

Penetration Resistance (Blows/foot - ●): 10 20 30 40 50 50+

Moisture Content (Percent - ■): 10 20 30 40 50 50+

Laboratory Testing

Piezometer Installation - Ground Water Data (Depth in Feet)

5 10 15 20 25

Logged by: BD on 7/23/2013

LEGEND

- Depth Driven and Amount Recovered with 2-inch O.D. Split-Spoon Sampler
- Depth Driven and Amount Recovered with 3-inch Shelby Tube Sampler
- Solid PVC Pipe
- Slotted PVC Pipe
- Monument/ Cap to Piezometer
- * Liquid Limit
- + Plastic Limit
- Concrete
- Bentonite
- Native Soil
- Silica Sand
- Water Level
- M Moisture Content
- A Atterberg Limits
- G Grain-size Analysis
- DS Direct Shear
- PP Pocket Penetrometer Readings, tons/ft
- P Sample Pushed
- T Triaxial

NOTE: Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgement. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Project Number	Rose Hill Mixed-Use Building Development Boring Log	NELSON GEOTECHNICAL ASSOCIATES, INC
8797B22		Woodinville Office: 17311-135th Ave. NE, A-500, Woodinville, WA 98072, (425) 486-1669 / Fax: 481-2510
Figure 6		Wenatchee Office: 105 Palouse St., Wenatchee, WA 98801, (509) 665-7696 / Fax: 665-7692
Page 1 of 1		www.nelsongeotech.com

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1	1/6/23	Original	FKS	DJO

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BORING LOG

B-2

Approximate Ground Surface Elevation: ~73 ft

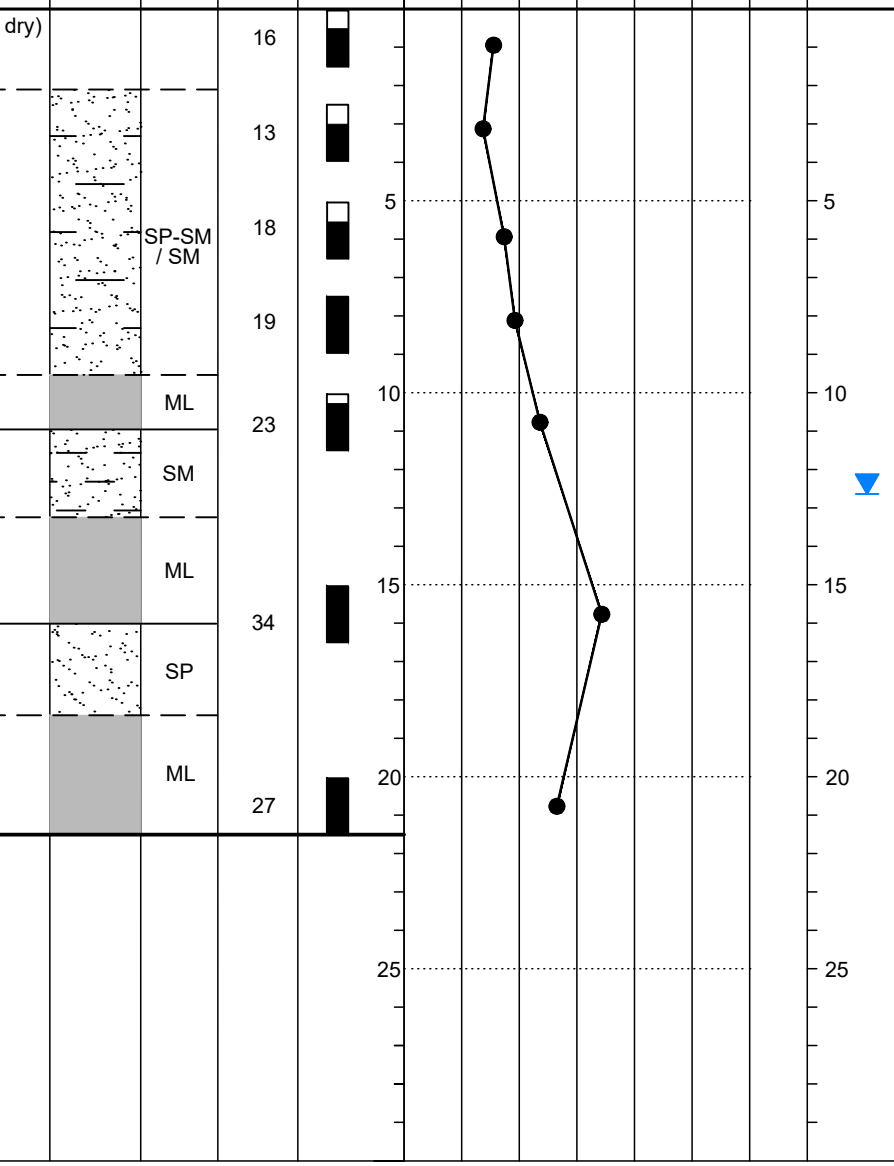
Soil Profile: Description	Graphic Log	Group Symbol	Sample Data: Blow Count	Sample Location (Depth in feet)
Light brown, silty fine to coarse sand (medium dense, dry) (**FILL** / modified ground)			16	
Light orange-brown, fine to coarse sand with silt and gravel to silty sand (medium dense, dry to moist)		SP-SM / SM	13 18 19	
Brown-gray silt (very stiff, moist)		ML	23	
Brown-gray, silty fine to medium sand with trace iron-oxide staining (medium dense, wet)		SM		
Brown-gray silt with fine sand (very dense, moist)		ML	34	
Brown-gray, fine sand with silt (dense, wet)		SP		
Brown-gray silt and silt with fine sand layers (very stiff, moist to wet) Gray sand with silt in tip		ML	27	
Boring terminated below existing grade at 21.5 feet on 7/23/13. Groundwater seepage was encountered at 12.6 feet during drilling.				

Penetration Resistance (Blows/foot - ●): 10 20 30 40 50 50+

Moisture Content (Percent - ■): 10 20 30 40 50 50+

Laboratory Testing

Piezometer Installation - Ground Water Data (Depth in Feet)



Logged by: BD on 7/23/2013

LEGEND

- Depth Driven and Amount Recovered with 2-inch O.D. Split-Spoon Sampler
- Depth Driven and Amount Recovered with 3-inch Shelby Tube Sampler
- Solid PVC Pipe
- Slotted PVC Pipe
- Monument/ Cap to Piezometer
- ✱ Liquid Limit
- \+ Plastic Limit
- Concrete
- Bentonite
- Native Soil
- Silica Sand
- Water Level

M	Moisture Content
A	Atterberg Limits
G	Grain-size Analysis
DS	Direct Shear
PP	Pocket Penetrometer Readings, tons/ft
P	Sample Pushed
T	Triaxial

NOTE: Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgement. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Project Number	Rose Hill Mixed-Use Building Development Boring Log	NELSON GEOTECHNICAL ASSOCIATES, INC
8797B22		Woodinville Office: 17311-135th Ave. NE, A-500, Woodinville, WA 98072, (425) 486-1669 / Fax: 481-2510
Figure 7		Wenatchee Office: 105 Palouse St., Wenatchee, WA 98801, (509) 665-7696 / Fax: 665-7692
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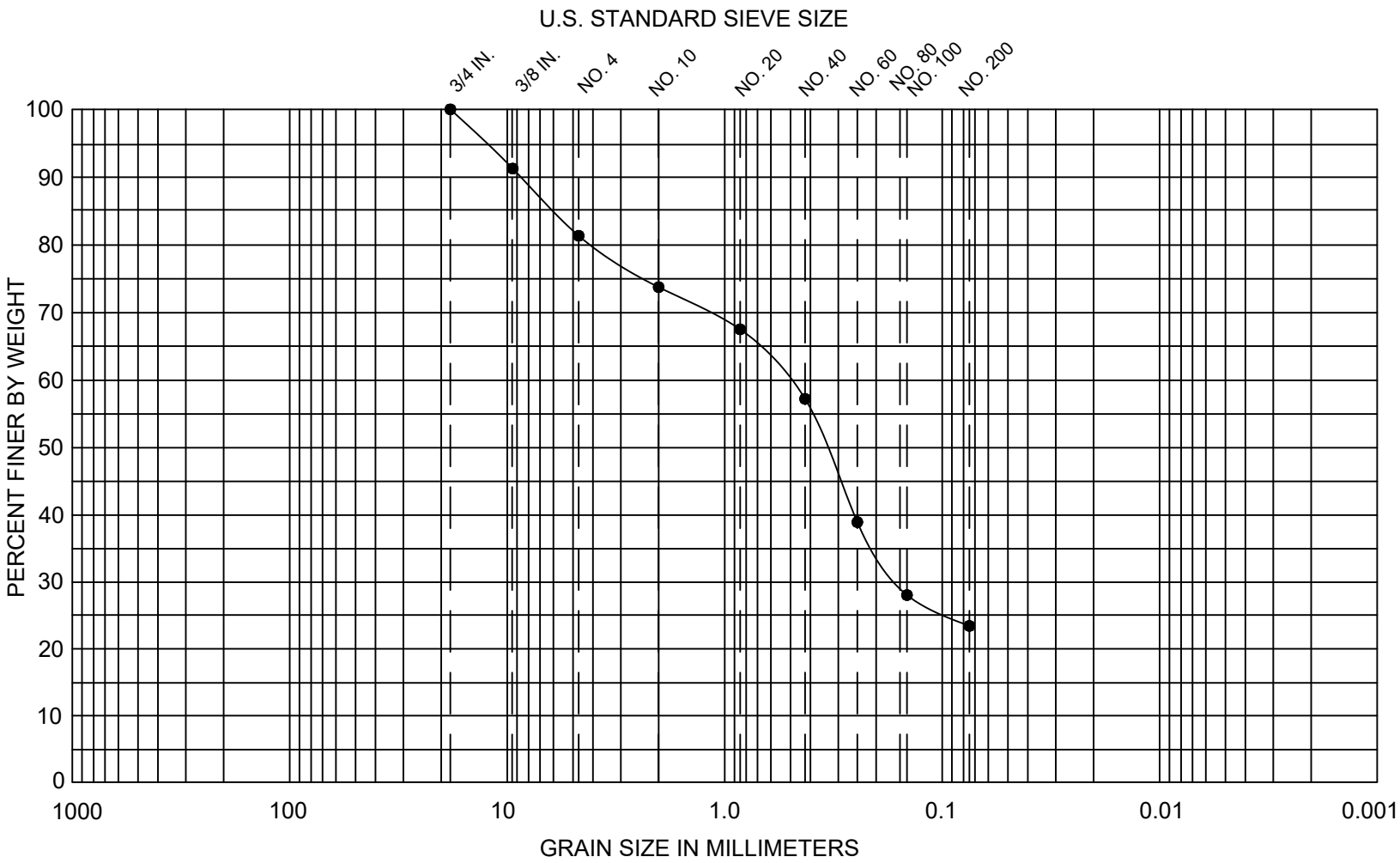
Project Number
8797B22

Figure 8

Rose Hill Mixed-Use
Building Development
Sieve Analysis



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

U.S.C. SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH	SOIL DESCRIPTION	SOIL DISTRIBUTION
●SM	HA-1	1.8 feet	Light brown, silty fine to medium sand with gravel	Gravel = 19% Sand = 58% Silt/Clay = 23%

NELSON GEOTECHNICAL ASSOCIATES, INC

Woodinville Office
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Wenatchee, WA 98801
(509) 665-7696 / Fax: 665-7692

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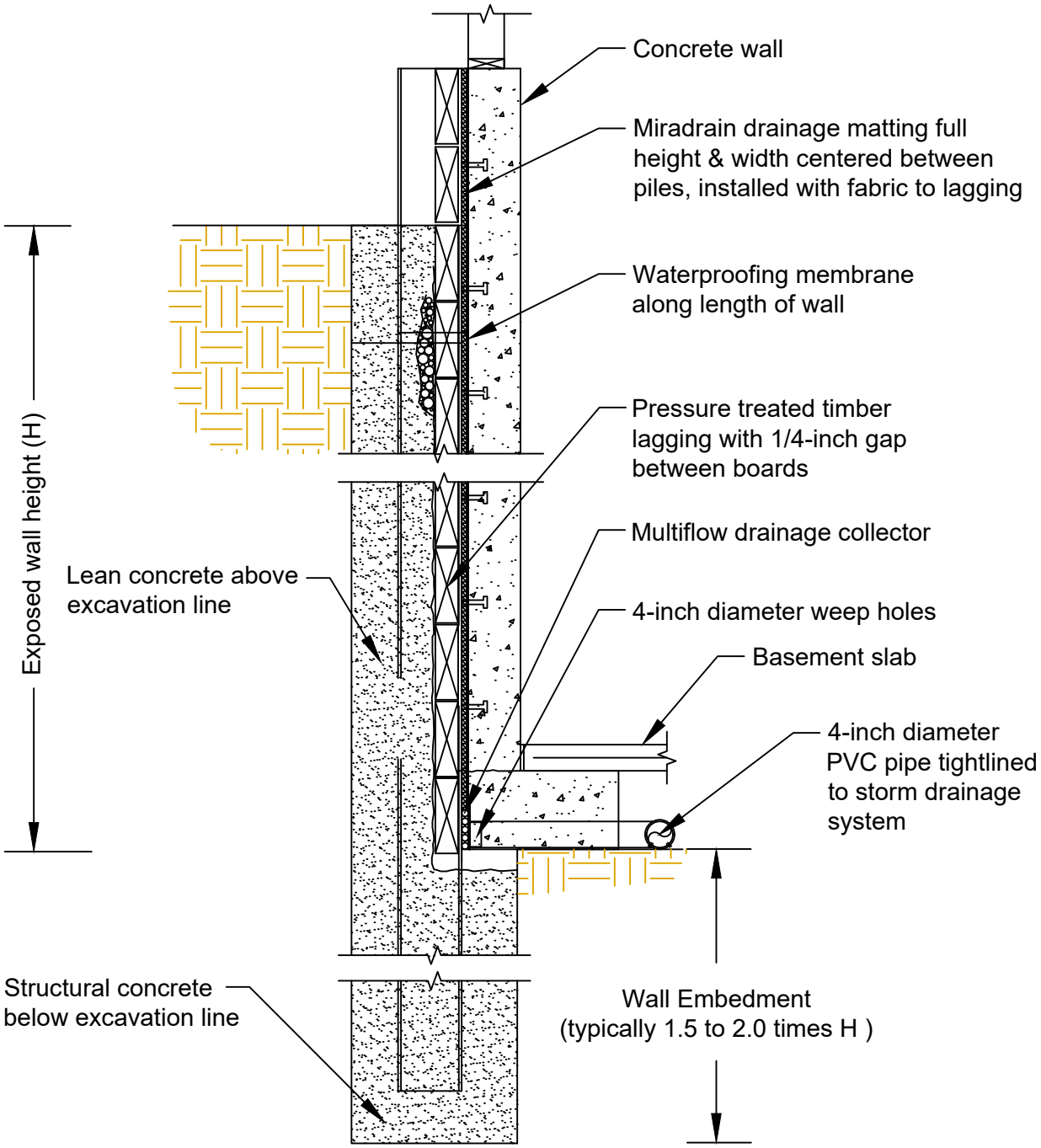
Conceptual Soldier Pile Wall Detail

NOT FOR CONSTRUCTION USE



NOT TO SCALE

Project Number 8797B22	Rose Hill Mixed-Use Building Development Soldier Pile Wall Detail	NELSON GEOTECHNICAL ASSOCIATES, INC	No.	Date	Revision	By	CK
Figure 9		Woodinville Office 17311-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 486-1669 / Fax: 481-2510	1	1/5/23	Original	FKS	DJO
		Wenatchee Office 105 Palouse St. Wenatchee, WA 98801 (509) 665-7696 / Fax: 665-7692					
		www.nelsongeotech.com					

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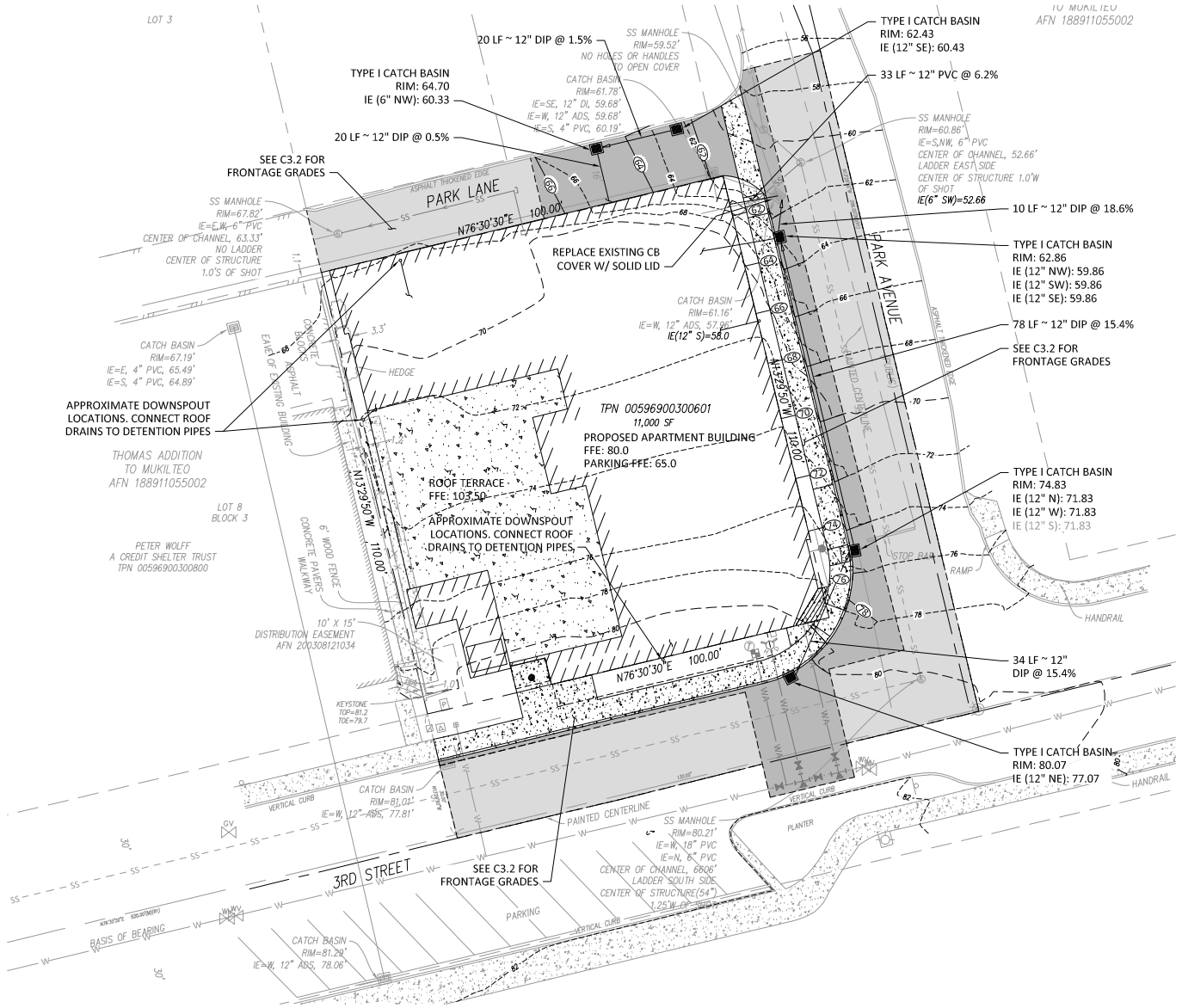
Section VII – Operation and Maintenance Manual

Section VII Summary:

Narrative
Grading & Drainage Plan (11x17)

The Operation and Maintenance Manual is a standalone document that will be given to the owner following the construction of the project. The contractor will be responsible for the maintenance and operation of all stormwater structures and BMPs requiring maintenance during construction and responsibility will pass to the owner after construction. Upon request by the City, it shall be made available for their inspection. It is generally expected that few to none of these defects will be present upon the yearly inspection of each facility.

SW 1/4, NE 1/4, SECTION 4, TOWNSHIP 28 NORTH, RANGE 4 EAST, W.M.



1 GRADING & DRAINAGE PLAN

SCALE: 1" = 20'

20 0 10 20 40

DRAINAGE PLAN NOTES:

1. SOILS REPORT
   REPORT NUMBER: 879713
   PREPARED BY: NELSON GEOTECHNICAL ASSOCIATES, INC
   DATED: 09/09/13
2. ALL DISTURBED AREAS ON AND OFF-SITE SHALL BE COMPOST- AMENDED PER THE REQUIREMENTS OF BMP T5.13 IN THE STORMWATER MANUAL VOLUME V, CHAPTER 5.
3. A MINIMUM OF 3' HORIZONTAL SEPARATION AND 1' VERTICAL SEPARATION IS REQUIRED BETWEEN DRY UTILITIES (POWER, GAS, PHONE, CABLE, ETC) AND SEWER, WATER AND STORM, AND A MINIMUM OF 5' HORIZONTAL SEPARATION AND 1' VERTICAL SEPARATION FROM ANY CITY-OWNED LINES.
4. A TYPE II CATCH BASIN IS REQUIRED WHENEVER RIM TO INVERT EXCEEDS 5'.
5. A MINIMUM OF 2' OF COVER IS REQUIRED FOR ALL PIPES LOCATED UNDER DRIVEABLE SURFACES AND 1' OF COVER UNDER LANDSCAPE SURFACES.
6. PRIOR TO PLACING ANY SURFACING MATERIAL ON THE ROADWAY, IT WILL BE THE RESPONSIBILITY OF THE DEVELOPER/CONTRACTOR TO PROVIDE DENSITY TEST REPORTS CERTIFIED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF WASHINGTON.
7. NEW/REPLACED IMPERVIOUS SURFACE (INCLUDING ROW): 19,074 SF
   --NEW BUILDING: 10,585 SF ROOF AREA (INCLUDES OVERHANGS). RUNOFF ROUTED TO DETENTION PIPE THROUGH ROOF DRAINS.
   --NEW/REPLACED SIDEWALK: 1,173 SF. DETENTION PIPE SIZED TO INCLUDE SIDEWALK AREA EVEN THOUGH PORTIONS OF THE SIDEWALK RUNOFF WILL FLOW INTO THE GUTTER AND PUBLIC STORM SYSTEM. ALL OTHER NEW SIDEWALK AREAS WILL FLOW TO DETENTION PIPE.
   --NEW/REPLACED ASPHALT: 7,316 SF. DETENTION PIPE SIZED TO INCLUDE ASPHALT AREA EVEN THOUGH PORTIONS OF THE ASPHALT RUNOFF WILL FLOW INTO THE GUTTER AND PUBLIC STORM SYSTEM. ALL OTHER NEW ASPHALT AREAS WILL FLOW TO DETENTION PIPE.
8. SEE C3.4 FOR CATCH BASIN DETAILS.

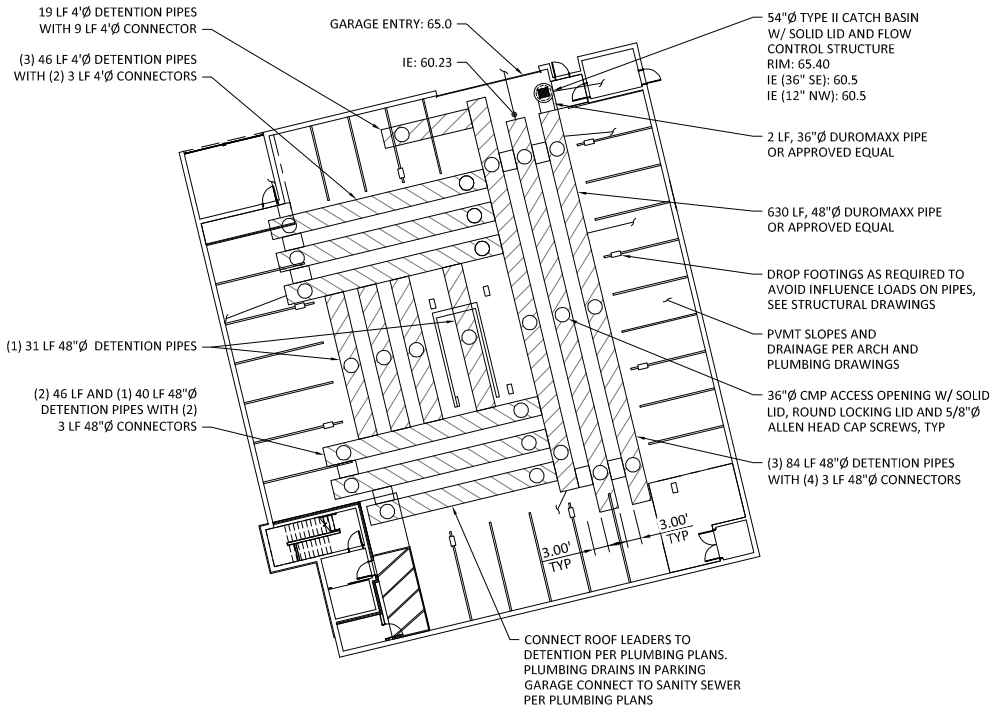
GRADING QUANTITIES

TOTAL EXCAVATION (CUT) -	3160.0 CU YDS TOTAL
EMBANKMENT (FILL) -	580.0 CU YDS
TOTAL	3740.0 CU YDS

THE QUANTITIES SHOWN ABOVE ARE FOR THE PERMIT PROCESS ONLY. THESE VALUES ARE APPROXIMATE. DO NOT USE FOR BIDDING, PAYMENT, OR ESTIMATING PURPOSES.

PAVING LEGEND

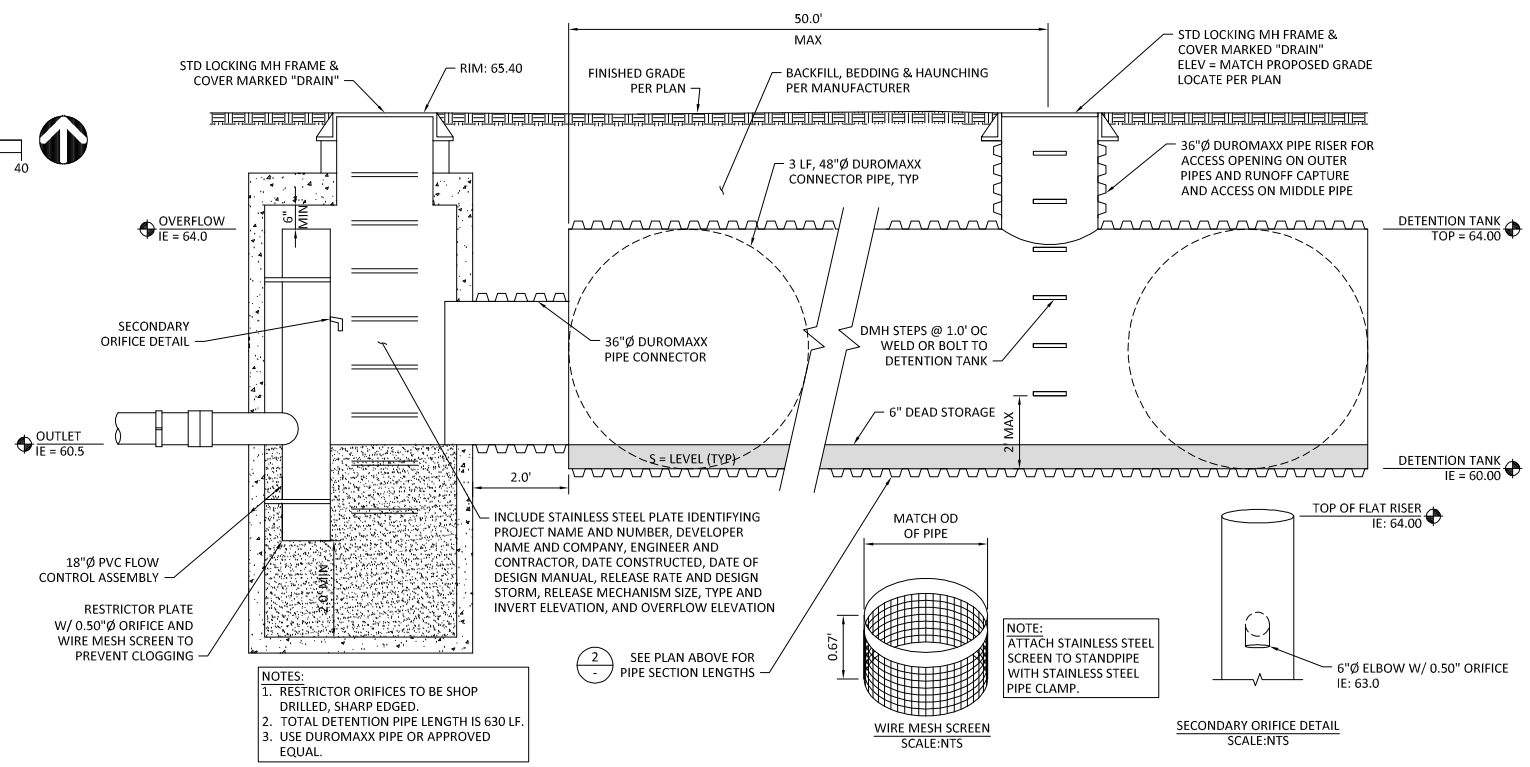
- NEW ASPHALT/UTILITY SAWCUT
- OVERLAY EXISTING ASPHALT
- NEW CONCRETE



2 PARKING GRADING & DRAINAGE PLAN

SCALE: 1" = 20'

20 0 10 20 40



NOTES:
1. RESTRICTOR ORIFICES TO BE SHOP DRILLED, SHARP EDGED.
2. TOTAL DETENTION PIPE LENGTH IS 630 LF.
3. USE DUROMAXX PIPE OR APPROVED EQUAL.

3 FLOW CONTROL STRUCTURE WITH DETENTION TANK - SECTION

SCALE: NTS

CG ENGINEERING
250 4TH AVE. S., SUITE 200
EDMONDS, WASHINGTON 98020
PHONE (425) 778-8500
FAX (425) 778-5536

GREG GUILLEN STATE OF WASHINGTON 25385 REGISTERED PROFESSIONAL ENGINEER

01/27/23

MARK	DATE	DESCRIPTION
	01/27/23	PERMIT SUBMITTAL

DESIGN:	NAT
DRAWN:	JCP
CHECK:	JPU
JOB NO:	22332.20
DATE:	01/27/23

ROSE HILL APARTMENTS
3RD & PARK AVE
MUKILTEO, WA 98275

GRADING & DRAINAGE PLANS AND DETAILS

FILE NAME:

SHEET:

C3.1

Rose Hill Apartments
Park Ave & 3rd Street
Mukilteo, WA 98275

OPERATION AND MAINTENANCE MANUAL

Date: January 2023

ENGINEERING

250 4th Avenue South, Suite 200
Edmonds, WA 98020
ph. 425.778.8500 | f. 425.778.5536
www.cgengineering.com

Operation and Maintenance Manual

This Operation and Maintenance Manual has been created for the stormwater management system associated with this project. The proposed stormwater structures include conveyance pipes, catch basins, and a detention vault. Included in this Operation and Maintenance Manual is an 11" x 17" grading and drainage plan sheet showing the locations of stormwater structures. Please note that this map is generated during the design phase and may not reflect all changes made in permitting and construction. CG Engineering may be contacted for an updated copy of this map once the as-built drawings are completed for the site. The contractor will be responsible for the maintenance and operation of all stormwater structures and BMPs requiring maintenance during construction and responsibility will pass to the owner after construction.

Attached at the end of this section are maintenance sheets taken from the 2019 Stormwater Management Manual for Western Washington

Maintenance sheets are included for the following facilities:

Catch Basins: A chamber or well, usually built at the curb line of a street, for the admission of surface water to a sewer or subdrain, having at its base a sediment sump designed to retain grit and detritus below the point of overflow.

Catchbasin Inserts: Storm drain inlet protection prevents coarse sediment from entering drainage systems prior to permanent stabilization of the disturbed area.

Detention Vault w/ Flow Restrictor: Detention vaults are underground storage facilities designed to collect and detain stormwater runoff so it can be released at controlled rates.

Conveyance Storm Pipes: Pipes used to transport water downstream.

Most maintenance tasks are generally reactionary to a defect being found, rather than a matter of constant upkeep. It is generally expected that few to none of these defects will be present upon the yearly inspection of each facility. The facility sheets list the potential conditions warranting maintenance and the expected result following any maintenance. Several engineer's notes for specific tasks are provided within the facility sheets. **Unless otherwise noted on the facility sheets the maintenance tasks should be performed on an "as needed" basis:**

(a) When the described defect is visible to whomever performs the yearly inspection,

(b) Should any defect become apparent between inspections.

Table V-A.17: Maintenance Standards - Coalescing Plate Oil/Water Separators

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Effluent discharge from vault should be clear with no thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6-inches in depth and/or visible signs of sediment on plates.	No sediment deposits on vault bottom and plate media, which would impede flow through the vault and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulation that exceeds 1-inch at the water surface.	Oil is extracted from vault using vactoring methods. Coalescing plates are cleaned by thoroughly rinsing and flushing. Should be no visible oil depth on water.
	Damaged Coalescing Plates	Plate media broken, deformed, cracked and/or showing signs of failure.	A portion of the media pack or the entire plate pack is replaced depending on severity of failure.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and or replaced.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Vault Structure Damage - Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

Table V-A.18: Maintenance Standards - Catch Basin Inserts

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.	No sediment cap on the insert media and its unit.
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.	Trash and debris removed from insert unit. Runoff freely flows into catch basin.
	Media Insert Not Removing Oil	Effluent water from media insert has a visible sheen.	Effluent water from media insert is free of oils and has no visible sheen.
	Media Insert Water Saturated	Catch basin insert is saturated with water and no longer has the capacity to absorb.	Remove and replace media insert
	Media Insert-Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.	Remove and replace media insert.
	Media Insert Use Beyond Product Life	Media has been used beyond the typical average life of media insert product.	Remove and replace media at regular intervals, depending on insert product.

Table V-A.19: Maintenance Standards - Media Filter Drain (MFD)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation on grass filter strip	Sediment depth exceeds 2 inches or creates uneven grading that interferes with sheet flow.	Remove sediment deposits on grass treatment area of the embankment. When finished, embankment should be level from side to side and drain freely toward the toe of the embankment slope. There should be no areas of standing water once inflow has ceased.
	No-vegetation	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire embankment width.	Level the spreader and clean to spread flows evenly over entire embankment width.

Table V-A.5: Maintenance Standards - Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No Trash or debris located immediately in front of catch basin or on grate opening. No trash or debris in the catch basin. Inlet and outlet pipes free of trash or debris. No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin). Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Top slab is free of holes and cracks. Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound. Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Basin replaced or repaired to design standards. Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening. Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation blocking opening to basin. No vegetation or root growth present.
	Contamination and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Cover/grate is in place, meets design standards, and is secured
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place, meets the design standards, and is installed and aligned with the flow path.

Table V-A.2: Maintenance Standards - Infiltration (continued)

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
		(A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. Test every 2 to 5 years. If two inches or more sediment is present, remove).	
Filter Bags (if applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag is replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Side Slopes of Pond	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway and Berms over 4 feet in height.	Tree Growth	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Piping	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Emergency Overflow Spillway	Rock Missing	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Erosion	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	6" or designed sediment trap depth of sediment.	Sediment is removed.

Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)	All sediment and debris removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability).	All joint between tank/pipe sections are sealed.
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability).	Tank/pipe repaired or replaced to design.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	Vault replaced or repaired to design specifications and is structurally sound. No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.

Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults) (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.4: Maintenance Standards - Control Structure/Flow Restrictor

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall. Structure is not in upright position (allow up to 10% from plumb). Connections to outlet pipe are not watertight and show signs of rust. Any holes - other than designed holes - in the structure.	Structure securely attached to wall and outlet pipe. Structure in correct position. Connections to outlet pipe are water tight; structure repaired or replaced and works as designed. Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing. Gate cannot be moved up and down by one maintenance person. Chain/rod leading to gate is missing or damaged. Gate is rusted over 50% of its surface area.	Gate is watertight and works as designed. Gate moves up and down easily and is watertight. Chain is in place and works as designed. Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)
Catch Basin	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

SAMPLE ACTIVITY LOG

DATE	FACILITY	MAINTENANCE PERFORMED	RESULTS / NOTES

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