Point Wells Development
Urban Center Submittal

Targeted Stormwater Site Plan Report

March 4, 2011
Revised April 4, 2016
Revised April 18, 2017

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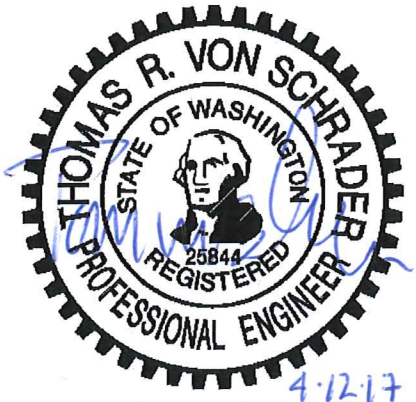

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A. MINIMUM REQUIREMENT 1 – TARGETED STORMWATER SITE PLAN NARRATIVE

Project Overview and Executive Summary

The Point Wells Development Project (Project) is in the southwest corner of unincorporated Snohomish County at the northern end of Richmond Beach Drive. The Project site is bordered by the town of Woodway to the north and east, the City of Shoreline to the south, and Puget Sound to the west (see Figure 1–Vicinity Map). The Burlington Northern Santa Fe Railroad (BNSF) bisects the Project site near its eastern edge.

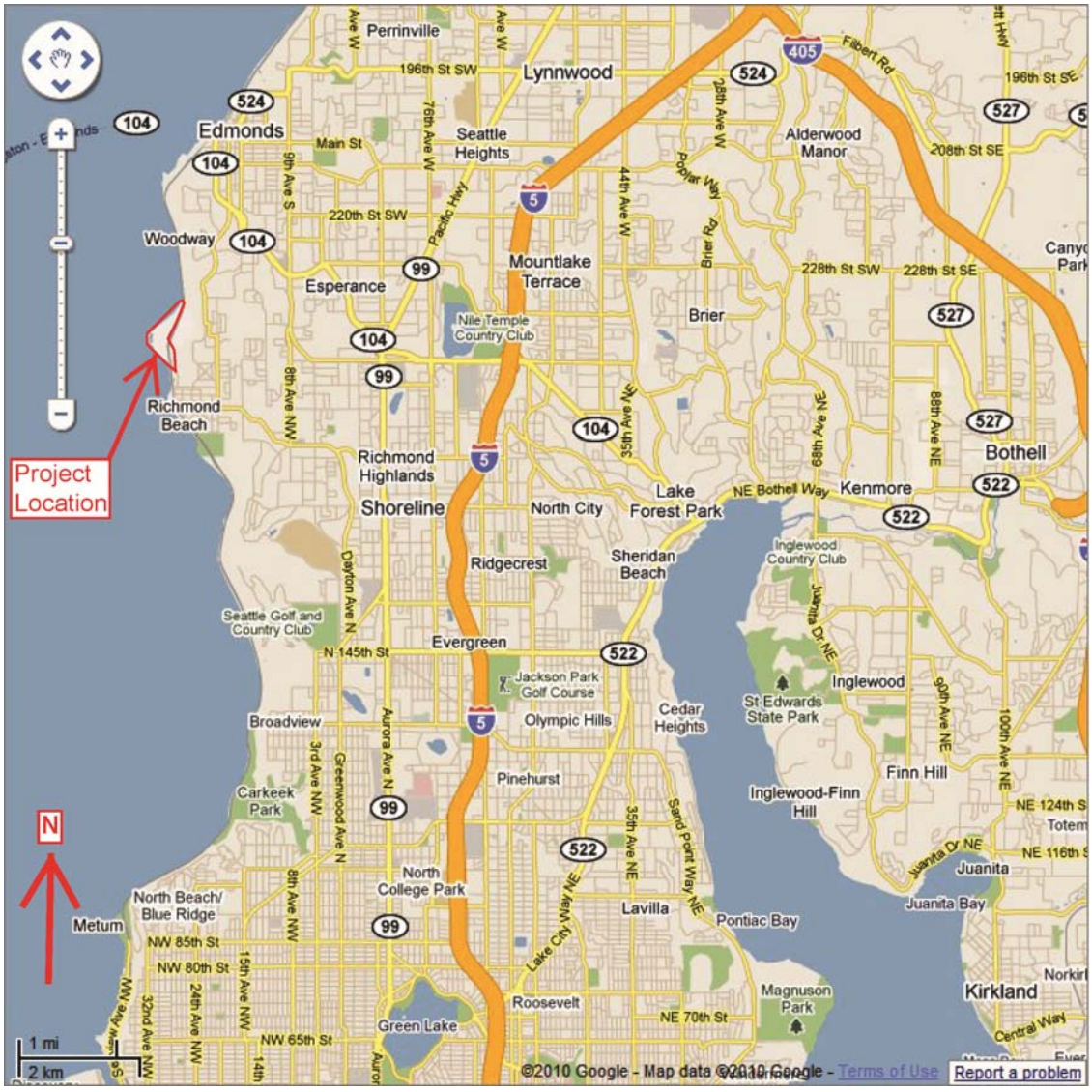


Figure 1– Vicinity Map: Wells Point, Snohomish County, Washington

The Project is in the Point Wells Drainage Basin, a sub-basin of the Snohomish County Puget Sound Drainage Basin, managed by the Snohomish County ("County") Surface

Water Management Division (SWMD). See Appendix A for an on-site drainage basin figure.

Snohomish County (County) has adopted the "2016 Snohomish County Drainage Manual" (SCDM). In accordance with the SCDM, the Project was modeled using DOE's Western Washington Hydraulic Model (WWHM). The Project will be required to meet SWDM Minimum Requirements 1 through 9. To meet these requirements the Project will utilize Low Impact Development (LID) strategies such as bioswales, pervious pavements, dispersion, and soil amendment to infiltrate a portion of the site's stormwater runoff and to provide water quality treatment for the Project where feasible. If soil contaminants are a concern after soil cleanup/remediation, the biofiltration systems may be lined and an underdrain system installed to prevent infiltration into existing soils. Contech Stormfilters will be used to treat stormwater that is unable to be treated using LID strategies due to site constraints. Water quality measures for the site during construction include sediment traps and portable storage tanks with chitosan filtration systems. Additional information on proposed measures to meet the construction water quality requirements can be found in the Project's Stormwater Pollution Prevention Plan (SWPPP) dated March 4, 2011 and previously submitted with the 2011 Urban Center Application to The County. No pollution sources are proposed for the developed site.

Proposed improvements for the site include the construction of multistory, multifamily housing with ground floor retail and underground parking facilities, office and commercial space, and a central energy facility (see Appendix B for draft site plans, including utility and grading plans).

The eastern upper portion of the site will be the main entry to the new development. Transit and vehicles accessing the office and residential buildings will follow a lower to the lower parking garage and transit station. Other vehicles, pedestrians and cyclists will follow a ramp up to the upper road to the new bridge spanning the existing BNSF tracks. A second access for emergency vehicles will also be provided from the east, from the Town of Woodway.

The lower west development will include three separate building masses, each in a crescent shape; referred to as the south, central, and northern crescents. Each crescent will be built up above existing grade and contain a central parking structure.

Upstream land cover is a combination of forest, pasture, and residential neighborhoods. Stormwater is conveyed onto and/or through the site at four locations: a stream near the northeast corner of the site, Chevron Creek, a 24-inch storm drainpipe originating from the Town of Woodway, and South Creek (see A1 On-Site Existing Drainage Basins Map in Appendix A).

There are three existing piped outfalls to Puget Sound located within the Point Wells development which will continue to be utilized for the developed condition. As the proposed Project will result in an overall reduction in impervious surface coverage, the

cumulative amount of runoff from the site will be reduced. On-site conveyance elements will be sized at a future stage of The Project.

Existing Site Conditions Summary

The existing site is approximately 61.2 acres with 5 acres located east of the BNSF Railroad and 56.5 acres located west of BNSF Railroad. The east area is comprised of a few small buildings located on a rectangular bench area. The bench is between elevation 35 and 45 (NAVD88), with the highest elevation on the 5-acre portion of the site at about 92 and the lowest elevation at about 30. At the east edge of the bench begins a vegetated steep slope approximately 150 to 200 feet high. To the west of the bench is a short steep slope down to the BNSF Railroad. There is also a small wetland located off-site to the east of the upper bench.

A geotechnical assessment has been prepared for the Project site by Hart Crowser. Borings conducted as part of the report indicate the site is underlain by approximately five feet of sand and sandy gravel fill. Beneath the fill layer, Colluvium, Pre-Fraser Nonglacial Fluvial Deposits, and Pre-Fraser Nonglacial Lacustrine Deposits were encountered. Groundwater was observed between 1.5 and 7.5 feet below the existing ground surface across the site. Hart Crowser also encountered a strong petroleum hydrocarbon (TPH) odor during the exploration in the lowland at B09-2. Additional soil analysis, meeting the requirements of Volume V, Chapter 5 of the Drainage Manual, will be conducted in a future phase of the Project.

According to the 1983 Soil Survey of Snohomish County Area Washington, prepared by the U.S. Department of Agriculture, the Project site is underlain by Urban Land. Urban Land is defined as "Nearly level to gently sloping areas covered by streets, buildings, parking lots, and other structures that obscure or alter the soils so that identification is not feasible. Soils to the north and east of the Project site are classified as Alderwood-Everett gravelly sandy loam, 25 to 70-percent slopes and Alderwood-Urban land complex, 8 to 15-percent slopes. Both soil types on adjacent parcels are described as moderately well drained. As part of the Project reconnaissance, a targeted drainage plan, dated February 2004 and created by Herrera Environmental Consultants, Inc., in association with HDR, Inc., for the Point Wells Portal and Marine Outfall Project was reviewed. The geotechnical report contained within that document states that the Portal site "is underlain by loose to medium dense silty sand (fill) to a depth of 11 feet, dense to very dense gravely sand and sandy gravel with cobbles to a depth of 42 feet, hard organic silt and peat to a depth of 46 feet, and very dense silty gravel to the bottom of the boring depth of 80.

The west 56 acres contains a petroleum storage, asphalt processing, and distribution plant. The relatively level western area is mostly impervious and consists of several buildings, petroleum storage tanks, roads, and parking lots (see photos in Appendix C). There is also a pier off the west edge of the site. A two-lane bridge currently accesses the west lowland. There is also another bridge to the north that is currently not operational. Both bridges are scheduled to be replaced with the proposed development.

The Mean Higher High Water elevation of Puget Sound is 8.61 (NAVD88). Several types of seawalls separate the sandy beach and the industrial paved site. The types of walls range from a rockery to the north, to a metal coffer dam and concrete wall through the central area, changing then to a rockery to the south. The lower paved area ranges in elevation from 10 feet along the west edge, up to an elevation of 20 feet along the eastern edge.

There are three existing piped outfalls to Puget Sound located within the Point Wells development site. Outfall 1 is the main outfall that discharges all the on-site storm water collected west of the BNSF railroad. Stormwater is collected by catch basins and conveyed through storm drain pipes to an existing Point Wells industrial wastewater treatment system prior to discharging through Outfall 1. Outfall 1 is only exposed at extreme low tides and is located on the north side of the north pier. Outfall 2 is located along the shoreline, near the middle of the site, between the two pier access docks, and discharges stormwater from the eastern, upper bench. This Outfall changes from steel pipe to HDPE pipe and is not exposed even during low tides. Outfall 3 is located along the southern portion of the site and discharges stormwater originating from offsite areas upstream of the Project: Chevron Creek, South Creek and about 3 acres of existing on-site area. Per a David Evans and Associates (DEA) memorandum, dated January 4, 2010, Chevron Creek is classified as a Type N stream. A stream classification for South Creek was not identified in the memo by DEA. The upstream drainage basin for Outfall 3 is approximately 80 acres and consists of the steep slope bordering the Project to the east and residential neighborhoods located at the top of the steep slope, in the Town of Woodway. Outfall 3 is a 24-inch HDPE pipe with steel anchor casings. Based on the rim of existing storm drain manholes being approximately 7 feet above existing grade, it is assumed that the hydraulic grade line for the piped drainage upstream of Outfall 3 is above the average grade of the existing site.

Off-Site Analysis and Mitigation Analysis

Off-site flows will not be managed by on-site stormwater management BMPs; all off-site flows conveyed through the Project Site will remain in piped conveyance system and be discharged directly to Puget Sound through existing outfalls.

Upstream Analysis

Upstream land cover is a combination of forest, pasture, and residential neighborhoods. Stormwater is conveyed onto and/or through the site at four locations: a stream near the northeast corner of the site, Chevron Creek, a 24-inch storm drainpipe originating from the Town of Woodway, and south creek. (See B3 Point Wells Upstream Drainage Basins Map located in Appendix A.)

North Stream

A stream collects stormwater runoff from an upstream area that is approximately 47.2 acres. This area extends from the edge of the BNSF tracks to the west side of 114th Avenue West in Woodway. The basin includes housing, roads, and a forested steep

hillside. Runoff, once collected in a ditch along the east side of BNSF Railroad, is piped under the railroad, north in a stream running along the eastern edge of the Point Wells property, and then west through a stream running along the north boundary of the property before discharging into Puget Sound.

Chevron Creek, 24-inch Pipe and South Creek

Currently, flow from approximately 79.88 acres of upstream offsite is piped through the Point Wells site and discharged at Outfall 3. The Outfall 3 basin area consists of forested land, low density and high density neighborhoods, and roads. Currently most of this flow is conveyed through the site via Chevron Creek and the South Creek. Per conversations with the Town of Woodway, during neighborhood development, some of the flow was diverted to a 24-inch pipe from 24th Avenue SW which is routed through an easement to the upper east bench of Point Wells, under the BNSF Railroad just north of the existing bridge, and then south where it connects to the piped system of Chevron and South Creeks before being discharged at Outfall 3.

Downstream Analysis

All runoff from the Project site will either be infiltrated into the soil or discharged directly into Puget Sound via one of the existing outfalls or sheet flow dispersion. Based on available information, the existing outfalls have capacity for the existing condition . The Project will reduce the amount of impervious area on-site and therefore, the amount of runoff for the developed conditions will be less than that of the existing condition and it's anticipated that developed flows will neither cause significant adverse impact to the Puget Sound nor overwhelm existing outfalls.

B. MINIMUM REQUIREMENT 2 - SWPPP NARRATIVE

The following outlines how each of the applicable 13 SWPPP elements will be addressed on the Project Site:

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 and vegetation that are to be preserved, as well as all sensitive areas and their buffers, shall be clearly delineated, both in the field and on the plans. In general, natural vegetation and native topsoil shall be retained in an undisturbed state to the maximum extent possible.

   Existing trees and vegetation will be preserved as shown on the TESC plans. Tree preservation will be accomplished using chain link fencing positioned around the perimeter of the areas to be preserved. Installation of fencing to delineate and secure each construction phase will occur before the clearing and grubbing operations of each phase commences.

2. **Establish Construction Access** - Construction access or activities occurring on unpaved areas shall be minimized, yet where necessary, access points shall be stabilized to minimize the tracking of sediment onto public and private constructed roads. Wheel washing, street sweeping, and street cleaning shall be employed to prevent sediment from entering waters of the State. All wash wastewater shall be controlled on-site.

   A stabilized construction entrance and wheel wash will be constructed, as located on the TESC plans, at the beginning of each phase of the Project and prior to the commencement of clearing and grubbing. As construction progresses, these facilities will be adjusted/modified by the Contractor to accommodate different stages of construction.

3. **Control Flow Rates** - To protect the properties and waterways downstream of the Project site, stormwater discharges from the site will be controlled. As the Project Site currently outfalls to the Puget Sound, the control of flows will not always be necessary. Bypasses will be installed at the beginning of each phase to reroute storm water runoff that is currently flowing on to the site around the proposed construction in a dedicated system to the existing outfall.

4. **Install Sediment Controls** - All stormwater runoff from disturbed areas shall pass through an appropriate sediment removal BMP before leaving the construction-site or prior to being discharged to an infiltration facility.

   For each phase, interceptor dikes or gravel filter berms will be installed around the perimeter of the construction area. Catch basin filters will be installed in existing and proposed catch basins throughout the site and along Richmond Beach Drive as shown on the TESC plans. Straw wattles will be used, as needed, to disperse stormwater flows and lower the velocities of stormwater in drainage swales and on slopes. Portable water storage tanks and other approved treatment systems may be used to remove sediment from stormwater runoff. Sediment control BMPs will be installed and operational prior to the commencement of clearing and grubbing.

5. **Stabilize Soils** - Exposed and unworked soils shall be stabilized with the application of effective BMPs to prevent erosion throughout the life of the Project.

   For each phase, temporary seeding and mulching will be used, as necessary, to stabilize exposed soils and protect against erosion. Erosion control nets and blankets will be used to line drainage swales and provide erosion protection. Plastic covering will be utilized, as necessary, to protect temporary slopes (such as those created during the construction of retaining walls and stockpiles) and minimize the erosion of top soils and stockpiles during periods of heavy rain. During dry weather periods water will be used to spray down project areas that may generate large amounts of dust. In areas of proposed paving, the gravel base course will be installed as soon as feasible after grading has been completed. The gravel base course will both stabilize soils and provide erosion protection. However, the

base course for porous pavement shall be protected after installation from sediment. All soil stabilization BMPs will be implemented as soon as practical after soil disturbance.

6. **Protect Slopes** - All cut and fill slopes will be designed, constructed, and protected in a manner that minimizes erosion.

   For each phase, grasslined channels, or interceptor dikes and swales will be utilized, as shown on the TESC plans, to intercept and divert stormwater from running down a slope to either the stormwater bypass (for clean offsite runoff) or to a sediment control facility. These BMP's will be constructed prior to slope excavation.

7. **Protect Drain Inlets** - All new and existing 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 will be to keep all access roads free of sediment and to keep street wash water from entering storm drains until treatment can be provided. Storm Drain Inlet Protection (BMP C220) will be implemented for all drainage inlets and culverts that could potentially be impacted by sediment-laden runoff on and near the Project site. All inlet protection measures shall be in place before commencement of soil disturbance activities.

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.

   Either grass or engineered channel lining will be used as lining for interceptor swales. Check dams and Triangular Silt Dikes will be used to slow the velocities in the channels. Outlet protection will protect soils at the outfalls. Due to the topography of the site, it is anticipated that interceptor dikes and channels will drain to sumps, from which they will be pumped via a collection manifold (system of surface placed water tight pipes) to a storage tank/portable treatment system. Installation of these BMPs will immediately follow excavation of swales and be installed before they are subjected to stormwater flows.

9. **Control Pollutants** - All pollutants, including waste materials and demolition debris, that occur on-site shall be handled and disposed of in a manner that does not cause contamination of stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well-organized, and free of debris.

10. **Control Dewatering** - All dewatering water from open cut excavation, tunneling, foundation work, trenching, or underground vaults shall be discharged into a controlled conveyance system prior to being discharged to a sediment trap, sediment pond, or filtration treatment system. Channels will be stabilized, per

Element #8- Stabilize Channels and Outlets. Clean, non-contaminated, non-turbid dewatering water will not be routed through stormwater sediment ponds, and will be discharged to systems tributary to the receiving waters of the State in a manner that does not cause erosion, flooding, or a violation of State water quality standards in the receiving water. Contaminated and/or highly turbid dewatering water from soils known or suspected to be contaminated, or from use of construction equipment, will require additional monitoring and treatment as required for the specific pollutants based on the receiving waters into which the discharge is occurring.

11. **Maintain BMPs** - All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired, as needed, to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with each particular BMP's specification. Visual monitoring of the BMPs will be conducted at least once a day, prior to any forecasted rain and within 24 hours of any rainfall event that causes a discharge from the site. If the site becomes inactive and is temporarily stabilized, the inspection frequency will be reduced to once every month and within 24 hours of any rainfall event that causes a discharge from the site.

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

12. **Manage the Project** - Erosion and sediment control BMPs for this Project have been designed based on the following principles:
    - Design the Project to fit the existing topography, soils, and drainage patterns.
    - Emphasize erosion control rather than sediment control.
    - Minimize the extent and duration of the area exposed.
    - Keep runoff velocities low.
    - Retain sediment on-site.
    - Thoroughly monitor site and maintain all ESC measures.
    - Schedule major earthwork during the dry season, if possible.

    In addition, project management will incorporate the following key components: phasing of construction, seasonal work limitations, coordination with utilities and other jurisdictions, and maintaining an updated SWPPP.

13. **Protect Low Impact Development BMPs** - Prior to Project completion, sheet flow will not be directed to LID BMPs; inlets to BMPs will be blocked and flow diversion measures will be implemented to prevent sediment laden water and debris from entering the BMP facilities. Areas to receive LID BMPs will be marked and protected from vehicle traffic and other activities having potential to over compact areas to receive BMPs.

Erosion Control Best Management Practices (BMPs)

A Stormwater Pollution Prevention Plan (SWPPP) has been prepared for the Project development as part of the Project's Urban Center submittal. The SWPPP outlines the proposed Erosion Control BMP's that will be implemented during construction to prevent the transport of sediment and other impacts that increase runoff during the land disturbing activities of clearing and grading. A summary of the erosion and sedimentation control best management practices for the Project included in the SWPPP include the following:

Clearing Limits

Prior to any clearing or grading activities, clearing limits shown on the Plans will be visibly delineated in the field.

Cover Measures

Temporary cover (e.g. plastic cover, mulch, etc.) will be installed if a disturbed area is to remain untouched. Any area to remain undisturbed for more than 30 days shall be seeded, sodded, or covered, unless the County determines that winter weather makes vegetation establishment unfeasible. During the wet season, slopes and stockpiles 3H:1V or steeper, with more than 10-feet of vertical relief, will be covered if they are to remain undisturbed for more than 12 hours.

Perimeter Protections

Silt fence and wattles or other protection will be used along edges of the Project area where existing contours show the possibility for sediment to leave the site during construction. A sediment trap and/or portable tanks will be used for sediment control during construction.

Traffic Area Stabilization

A stabilized construction entrance and wheel wash will be installed to minimize the tracking of dirt off-site.

Sediment Pond and Portable Filtration System

Surface water collected from disturbed areas of the Project area will be filtered or routed to a temporary sediment pond and portable filtration system prior to release from the site. The sediment pond will be sized in accordance with the SCDM.

Surface Water Collection

Interceptor swales, culverts, slope drains, and stabilized ditches will be used to convey surface runoff to the sediment trap. A sand cone discharge pipe will be installed in the

temporary sediment trap to allow sediment-free runoff to connect to the existing storm system.

Dust Control

Water trucks will be used to control dust during construction, as needed. Permanent erosion and sediment control measures will consist of establishing vegetation in landscape areas, installing buildings and paving, and establishing vegetation in areas disturbed by construction.

C. MINIMUM REQUIREMENT 3 - WATER POLLUTION SOURCE CONTROL FOR NEW DEVELOPMENT

For construction source control see the Stormwater Pollution Prevention Plan dated March 4, 2011. No pollution generating activities or uses, as described on Volume IV, Chapters 3 and 4 of the Drainage Manual, are planned for the site neither during nor following construction.

D. MINIMUM REQUIREMENT 4 - PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND OUTFALLS AND PROVISIONS OF OFF-SITE MITIGATION

Historical site conditions consist of a relatively small alluvial deposit with several small creeks coming off the hillside to the east, crossing the project, and discharging into Puget Sound. When the site was developed, a large quantity of fill was brought in to raise the site above sea level and the creeks were tight lined on the east side of the property and then routed to a discharge point along Puget Sound.

Currently most of the site discharges to the Puget Sound at Outfall 1 with the exception of the upper bench which discharges partially to Outfall 2 and partially to Outfall 3.

For the developed condition, natural drainage patterns for the site (both historical and existing) will be restored and/or maintained to the maximum extent practicable. Runoff from roughly 30% of the site will sheet flow directly into Puget Sound. The remaining runoff from the site will be routed to the existing outfalls with the majority going to Outfalls 1 and 2 and only a small portion going to Outfall 3. Sheet flow will be dispersed prior to being discharged into Puget Sound. Existing outfalls 1, 2, and 3 do not require energy dissipation as they are generally submerged in Puget Sound.

E. MINIMUM REQUIREMENT 5 - ON-SITE STORMWATER MANAGEMENT (INCLUDING LID FEASIBILITY ANALYSIS)

On-site stormwater BMPs for the site will be implemented in accordance with SCC 30.63A.525. Per 2.5.5 of the SCDM, the Project must implement List #2 BMPs as the site is a redevelopment project inside an Urban Growth Area. As the Project is exempt from the flow control requirement (Minimum Requirement #7) the LID Performance Standard, bioretention, raingardens, permeable pavement, and full dispersion do not need to be considered per 2.5.5 of the SCDM; however, BMP T5.13 – Post Construction Soil Quality

and Depth, BMP T5.10 – Downspout Full Infiltration Systems, Downspout Dispersion Systems, or Perforated Stub-out Connections, and BMP T5.11 - Concentrated Flow Dispersion or BMP T5.12 – Sheet Flow Dispersion must be implemented if feasible. In addition, the following non-exempt List#2 BMPs must be considered for other hard surfaces: BMP T5.12 – Sheet Flow Dispersion or BMP T5.11 – Concentrated Flow Dispersion.

The following on-site stormwater management BMPs are proposed for the site:

- BMP T5.13 - Post Construction Soil Quality and Depth – Soils on the site will be amended as shown on plan sheet C-020 (See Appendix B).
- BMP T5.10B – Downspout Dispersion Systems – Downspout Dispersion Systems are not feasible for the site due to the limited amount of area which is suitable for dispersion being used to disperse runoff from other, non-roof hard surfaces (See BMP T5.11 below). Perforated stubout connections are also not feasible for the same reason; all areas suitable for for stubout connection installations will be used to disperse runoff from other, non-roof hard surfaces.
- BMP T5.11 – Concentrated Flow Dispersion – Concentrated Flow Dispersion will be applied to other non-roof hard surfaces throughout the site. In general, non-roof runoff from other hard surfaces will be collected in catch basins and then routed to bioretention cells for infiltration via a piped conveyance system. Runoff that is not fully infiltrated in the bioretention cells will then be routed to an adjacent dispersion trench and dispersed into Puget Sound.

F. MINIMUM REQUIREMENT 6 - RUNOFF TREATMENT REQUIREMENTS

Drainage areas were identified utilizing a survey provided by David Evans and Associates, dated April 2006 and updated through December 2009.

Per Volume I, Section 2.5.6 of the SCDM, runoff treatment is required as the project has more than 5,000 sf of pollution generating impervious surface in a threshold discharge area. The Project does not qualify as a “high-use site” per the criteria listed in Volume I, Section 4.2 and therefore, an oil control facility will not be required. Phosphorous treatment will not be required per volume I, Section 4.2 of the SCDM as the Project drains to a saltwater body and a non-fish bearing creek. Enhanced stormwater treatment will also not be required per Volume I, Section 4.2 of the SCDM as the Project does not discharge to fresh waters designated for aquatic life or that have existing aquatic life use, to conveyance systems tributary to such waters, or to stormwater infiltration systems that are not designed to provide treatment in accordance with the requirements of the SCDM and that are within ¼ mile of such waters. Basic water quality treatment will be provided for runoff generated from pollution generating surfaces across the site.

Per Volume V, Chapter 4, Section4.1.2 of the SCDM, stormwater treatment is required for pollution generating surfaces with the design intent of removing 80-percent of total suspended solids (TSS). The water quality flowrate is defined as “the flow rate at or below

which 91% of the runoff volume, as estimated by and approved continuous runoff model, will be treated".

Natural low impact development strategies will be employed where feasible for water quality treatment. Where space, grades and depth of soil will not allow for the installation of bioswales and bioretention cells, the use of cartridge and tree vault systems will be provided. Proposed water quality treatment facilities for the site include stormwater planters, bioswales, and Contech Stormfilter Cartridge systems. If soil contaminants are a concern after soil cleanup/remediation, the biofiltration systems may be lined and an underdrain system installed to prevent the deeper infiltration of contamination into existing soils. Bioretention cells located above underground parking garages will also be lined and have an underdrain. One "typical" water quality facility has been sized for each type of treatment facility being proposed. "Typical" water quality faculty sizing calculations are included in Appendix D. For future calculations, once the proposed design concept has been accepted, the facilities will be broken down further and sized individually based on the proposed grading and drainage plan.

G. MINIMUM REQUIREMENT 7 - FLOW CONTROL

Per Volume 1, Chapter 2, Section 2.5.7 of the SCDM, flow control will not be required for the Project as the site discharges directly to the Puget Sound. Existing and proposed stormwater flows for the site were calculated and are provided in the Drainage Information Summary Table below.

Drainage Information Summary Table

Drainage Basin Information	Individual Basin Information				
	Undisturbed	Outfall_2	Outfall_3	Outfall_1	Sheetflow
On-site Sub-basin Area (Acres)	14.43	12.87	1.05	14.13	18.71
Type of Storage Proposed	N/A	N/A	N/A	N/A	N/A
Approx. Storage Volume (cu. Ft)	N/A	N/A	N/A	N/A	N/A
Soil Type(s)2	Urban Land	Urban Land	Urban Land	Urban Land	Urban Land
Predeveloped Runoff Rates1					
Q(cfs.) 2 yr.	0.010	0.009	0.001	0.010	0.013
10 yr.	0.012	0.011	0.001	0.012	0.016
100 yr.	0.014	0.012	0.001	0.013	0.017
Ex. Coverage Runoff Rates1					
Q(cfs.) 2 yr.	4.170	3.823	0.320	4.272	5.775
10 yr.	6.800	6.235	0.523	6.966	9.416
100 yr.	10.921	10.014	0.839	11.189	15.124
Post Development Runoff Rates1					
Q(cfs.) 2 yr.	4.170	3.443	0.298	3.207	2.010
10 yr.	6.800	5.614	0.486	5.230	3.279
100 yr.	10.921	9.017	0.781	8.400	5.269
Offsite Upstream Area					
Number of Acres	47.20	N/A	79.9	N/A	N/A
Offsite Downstream Flow					
Q(cfs.) 100 yr.	N/A	N/A	N/A	N/A	N/A

See Appendix C for Runoff Rate Calculations

Per 1983 Soil Survey of Snohomish County Area Washington, prepared by the U.S Department of Agriculture

See Appendix B for On-Site Developed Drainage Basins

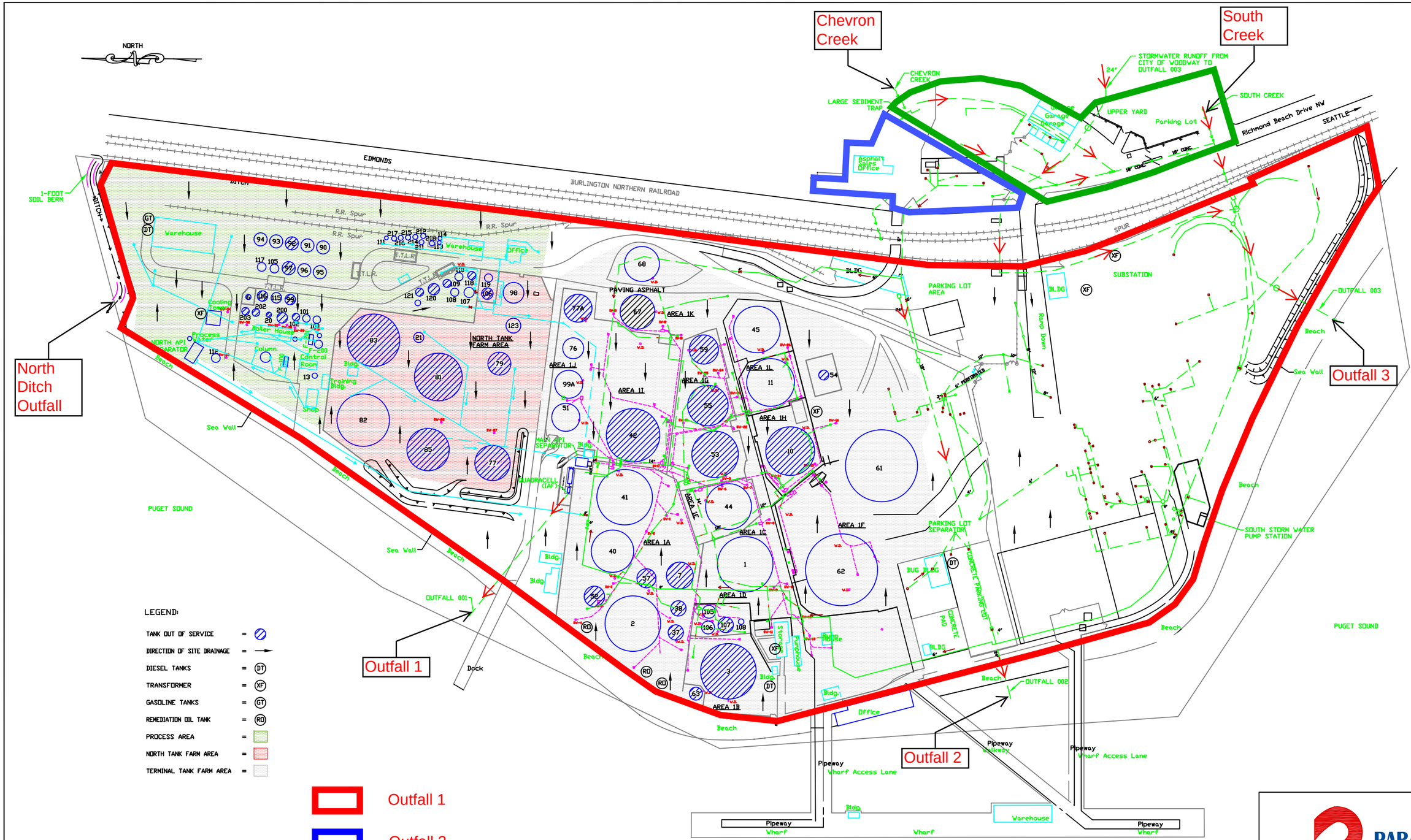
H. MINIMUM REQUIREMENT 8 – STORMWATER DISCHARGES TO WETLANDS

This minimum requirement is not applicable per SCC 30.63A.570 as the Project discharges neither directly nor indirectly to neither a wetland nor a wetland buffer.

I. MINIMUM REQUIREMENT 9 – OPERATIONS AND MAINTENANCE

Drainage facilities will be inspected, operated, and maintained as described in Appendix E of this report.

APPENDIX A
BASIN MAPS



A1 - ON SITE EXISTING DRAINAGE BASINS

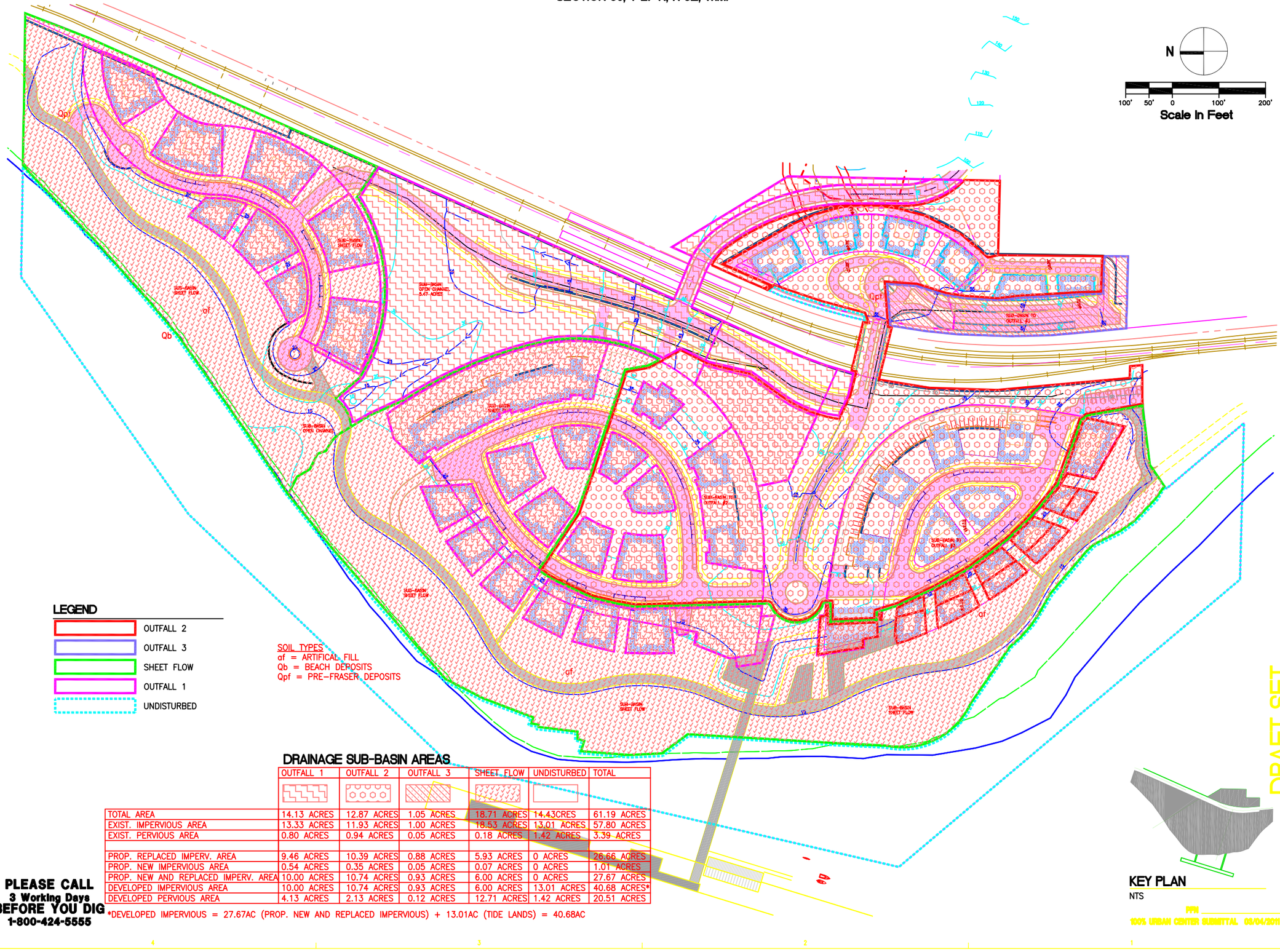
REV.	DATE	ISSUE	BY	CHK	APP
A	9/26/07	SPCC DRAWING	RDB		

PARAMOUNT PETROLEUM

SPCC
DRAWING
RICHMOND BEACH
RICHMOND BEACH, WA

DRN RDB	CHK	SCALE NONE	
DATE 9/26/07	APP	CAD FILE SPCC 2007	
JOB NO.	DWG. NUMBER SPCC 2007	SHEET 1 OF 1	REV. A

SECTION 35, T 27 N, R 3E, W.M.



LEGEND

- OUTFALL 2
- OUTFALL 3
- SHEET FLOW
- OUTFALL 1
- UNDISTURBED

SOIL TYPES
af = ARTIFICAL FILL
Qb = BEACH DEPOSITS
Qpf = PRE-FRASER DEPOSITS

DRAINAGE SUB-BASIN AREAS

	OUTFALL 1	OUTFALL 2	OUTFALL 3	SHEET FLOW	UNDISTURBED	TOTAL
TOTAL AREA	14.13 ACRES	12.87 ACRES	1.05 ACRES	18.71 ACRES	14.43CRES	61.19 ACRES
EXIST. IMPERVIOUS AREA	13.33 ACRES	11.93 ACRES	1.00 ACRES	18.53 ACRES	13.01 ACRES	57.80 ACRES
EXIST. PERVIOUS AREA	0.80 ACRES	0.94 ACRES	0.05 ACRES	0.18 ACRES	1.42 ACRES	3.39 ACRES
PROP. REPLACED IMPERV. AREA	9.46 ACRES	10.39 ACRES	0.88 ACRES	5.93 ACRES	0 ACRES	26.66 ACRES
PROP. NEW IMPERVIOUS AREA	0.54 ACRES	0.35 ACRES	0.05 ACRES	0.07 ACRES	0 ACRES	1.01 ACRES
PROP. NEW AND REPLACED IMPERV. AREA	10.00 ACRES	10.74 ACRES	0.93 ACRES	6.00 ACRES	0 ACRES	27.67 ACRES
DEVELOPED IMPERVIOUS AREA	10.00 ACRES	10.74 ACRES	0.93 ACRES	6.00 ACRES	13.01 ACRES	40.68 ACRES*
DEVELOPED PERVIOUS AREA	4.13 ACRES	2.13 ACRES	0.12 ACRES	12.71 ACRES	1.42 ACRES	20.51 ACRES

*DEVELOPED IMPERVIOUS = 27.67AC (PROP. NEW AND REPLACED IMPERVIOUS) + 13.01AC (TIDE LANDS) = 40.68AC

PLEASE CALL
3 Working Days
BEFORE YOU DIG
1-800-424-5555

KEY PLAN
NTS

DRAFT SET

PERKINS +WILL
1221 Second Avenue
Suite 200
Seattle, WA 98101
t 206.623.2000
f 206.443.4628
www.perkinswill.com

Point Wells Development

BSRE Point Wells, LP
c/o Kerr Tuttle Campbell
701 Fifth Avenue, Suite 3300
Seattle, Washington 98104

In association with:

CIVIL ENGINEER

MIG | SvR
615 SECOND AVE, SUITE 280
SEATTLE, WA 98104
T 206.223.0326
F 206.223.0125
www.svrdesign.com

Snohomish County Planning & development Services
APPROVED FOR CONSTRUCTION
By: *Randolph R. Sleight, P.E., P.L.S.*
R/W Permit No. _____

MARK DUANE DAVIES — STATE OF WASHINGTON — PROFESSIONAL ENGINEER

REV.	ISSUE	DATE
1	CORRECTION	04.18.2017

Sheet Information

Date	03/04/2011
Job Number	169009.000
Drawn	
Checked	
Approved	

Title

ON-SITE DEVELOPED DRAINAGE BASINS

Sheet

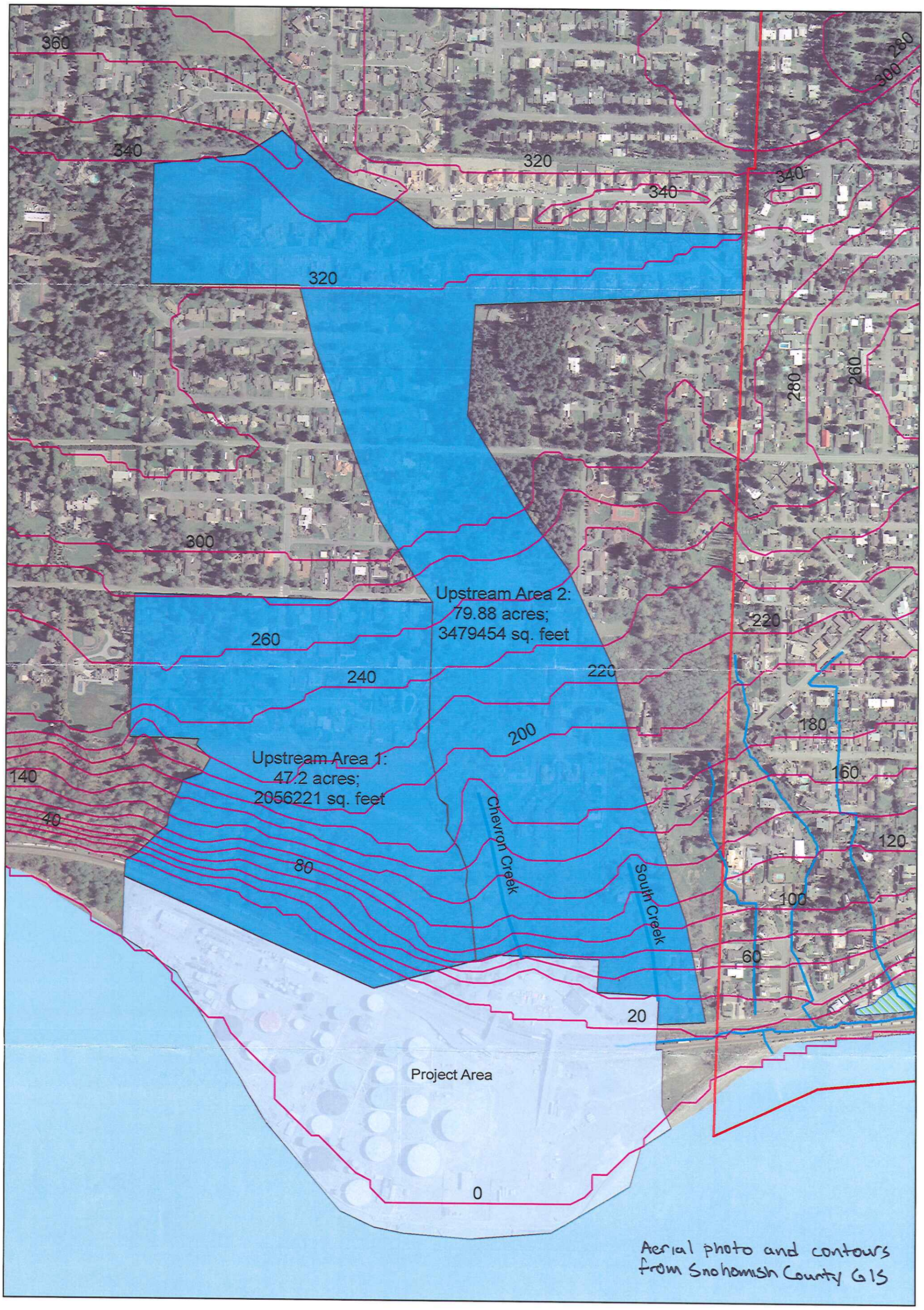
B-300

PPN _____
100% URBAN CENTER SUBMITTAL 03/04/2011

NOT Issued for Construction

Apr 07, 2017 - 9:45am
G:\09s\09038c PWP\Current UC\PWP_B-300-BASINS.dwg
robertm

Point Wells - Upstream Drainage Basins



0 200 400 800 1,200 1,600 Feet

N

February 11, 2011
SvR | Project # 09038

APPENDIX B
DRAFT SITE PLANS

APPENDIX C
SITE PHOTOS

Photo 1. Richmond Beach Drive Looking North Towards Point Wells

Photo 2. Bright Water – South end of Point Wells

Photo 3. Looking North along BNSF Railroad

Photo 4. Looking South along BNSF Railroad

Photo 5. Discharge to east side of BNSF Railroad

Photo 6. Chevron Creek Sediment Basin prior to Conveyance Pipe

Photo 7. Point Wells Northern Petroleum Plant

Photo 8. Point Wells Northern Asphalt Plant

Photo 9. Point Wells northern ditch west side of BNSF Railroad

APPENDIX D
DRAINAGE CALCULATIONS

WWHM2012
PROJECT REPORT

Project Name: Ex_Dev
Site Name:
Site Address:
City :
Report Date: 4/6/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2016/07/25
Version : 4.2.12

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	.8
Pervious Total	**0.8**

Impervious Land Use	acre
ROADS FLAT	13.33
Impervious Total	**13.33**
Basin Total	**14.13**

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	4.13
Pervious Total	4.13

Impervious Land Use	acre
ROADS FLAT	10
Impervious Total	10
Basin Total	14.13

Element Flows To:
Surface Interflow Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.8
Total Impervious Area:13.33

Mitigated Landuse Totals for POC #1
Total Pervious Area:4.13
Total Impervious Area:10

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	4.272008
5 year	5.824257
10 year	6.966061
25 year	8.543926
50 year	9.821106
100 year	11.188606

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	3.206902
5 year	4.372307
10 year	5.229582
25 year	6.414283
50 year	7.373241
100 year	8.400032

WWHM2012
PROJECT REPORT

Project Name: Outfall 1 Predev_Dev
Site Name:
Site Address:
City :
Report Date: 4/6/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2016/07/25
Version : 4.2.12

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Flat	14.13
Pervious Total	14.13

Impervious Land Use	acre
Impervious Total	0
Basin Total	14.13

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	4.13
Pervious Total	4.13

Impervious Land Use	acre
ROADS FLAT	10
Impervious Total	10
Basin Total	14.13

Element Flows To:

Surface	Interflow	Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:14.13
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:4.13
Total Impervious Area:10

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.009958
5 year	0.011533
10 year	0.012233
25 year	0.012871
50 year	0.013222
100 year	0.013497

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	3.206902
5 year	4.372307
10 year	5.229582
25 year	6.414283
50 year	7.373241
100 year	8.400032

WWHM2012
PROJECT REPORT

Project Name: Basin2 Ex_Dev
Site Name:
Site Address:
City :
Report Date: 4/6/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2016/07/25
Version : 4.2.12

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	.94
Pervious Total	**0.94**

Impervious Land Use	acre
ROADS FLAT	11.93
Impervious Total	**11.93**
Basin Total	**12.87**

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	2.13
Pervious Total	2.13

Impervious Land Use	acre
ROADS FLAT	10.74
Impervious Total	10.74
Basin Total	12.87

Element Flows To:
Surface Interflow Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.94
Total Impervious Area:11.93

Mitigated Landuse Totals for POC #1
Total Pervious Area:2.13
Total Impervious Area:10.74

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	3.823469
5 year	5.212749
10 year	6.234678
25 year	7.646889
50 year	8.789984
100 year	10.013917

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	3.442847
5 year	4.69388
10 year	5.614124
25 year	6.885827
50 year	7.915194
100 year	9.017364

WWHM2012
PROJECT REPORT

Project Name: Basin2 Predev_Dev
Site Name:
Site Address:
City :
Report Date: 4/6/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2016/07/25
Version : 4.2.12

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Flat	12.87
Pervious Total	12.87

Impervious Land Use	acre
Impervious Total	0
Basin Total	12.87

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	2.13
Pervious Total	2.13

Impervious Land Use	acre
ROADS FLAT	10.74
Impervious Total	10.74
Basin Total	12.87

Element Flows To:
Surface Interflow Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:12.87
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:2.13
Total Impervious Area:10.74

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.00907
5 year	0.010504
10 year	0.011142
25 year	0.011723
50 year	0.012043
100 year	0.012294

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	3.442847
5 year	4.69388
10 year	5.614124
25 year	6.885827
50 year	7.915194
100 year	9.017364

WWHM2012
PROJECT REPORT

Project Name: Basin 3 Ex_Dev
Site Name:
Site Address:
City :
Report Date: 4/6/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2016/07/25
Version : 4.2.12

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	.05
Pervious Total	**0.05**

Impervious Land Use	acre
ROADS FLAT	1
Impervious Total	**1**
Basin Total	**1.05**

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	.12
Pervious Total	0.12

Impervious Land Use	acre
ROADS FLAT	0.93
Impervious Total	0.93
Basin Total	1.05

Element Flows To:

Surface	Interflow	Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.05
Total Impervious Area:1

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.12
Total Impervious Area:0.93

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.320475
5 year	0.43692
10 year	0.522575
25 year	0.640942
50 year	0.736752
100 year	0.839337

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.298085
5 year	0.406398
10 year	0.486071
25 year	0.596173
50 year	0.685293
100 year	0.780716

WWHM2012
PROJECT REPORT

Project Name: Outfall 3 Predev_Dev
Site Name:
Site Address:
City :
Report Date: 4/6/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2016/07/25
Version : 4.2.12

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Flat	1.05
Pervious Total	1.05

Impervious Land Use	acre
Impervious Total	0
Basin Total	1.05

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	.12
Pervious Total	0.12

Impervious Land Use	acre
ROADS FLAT	0.93
Impervious Total	0.93
Basin Total	1.05

Element Flows To:
Surface Interflow Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:1.05
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.12
Total Impervious Area:0.93

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.00074
5 year	0.000857
10 year	0.000909
25 year	0.000956
50 year	0.000983
100 year	0.001003

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.298085
5 year	0.406398
10 year	0.486071
25 year	0.596173
50 year	0.685293
100 year	0.780716

WWHM2012
PROJECT REPORT

Project Name: Sheet Flow Ex_Dev
Site Name:
Site Address:
City :
Report Date: 4/6/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2016/07/25
Version : 4.2.12

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	.18
Pervious Total	**0.18**

Impervious Land Use	acre
ROADS FLAT	18.53
Impervious Total	**18.53**
Basin Total	**18.71**

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	12.71
Pervious Total	12.71

Impervious Land Use	acre
ROADS FLAT	6
Impervious Total	6
Basin Total	18.71

Element Flows To:
Surface Interflow Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.18
Total Impervious Area:18.53

Mitigated Landuse Totals for POC #1
Total Pervious Area:12.71
Total Impervious Area:6

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	5.937952
5 year	8.095492
10 year	9.68253
25 year	11.875662
50 year	13.650856
100 year	15.551585

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	1.930261
5 year	2.632623
10 year	3.149417
25 year	3.863745
50 year	4.442067
100 year	5.061388

WWHM2012
PROJECT REPORT

Project Name: Sheet Flow Pred_Dev
Site Name:
Site Address:
City :
Report Date: 4/6/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2016/07/25
Version : 4.2.12

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Flat	18.71
Pervious Total	18.71

Impervious Land Use	acre
Impervious Total	0
Basin Total	18.71

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	12.71
Pervious Total	12.71

Impervious Land Use	acre
ROADS FLAT	6
Impervious Total	6
Basin Total	18.71

Element Flows To:
Surface Interflow Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:18.71
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:12.71
Total Impervious Area:6

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.013186
5 year	0.015271
10 year	0.016198
25 year	0.017043
50 year	0.017508
100 year	0.017872

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	1.930261
5 year	2.632623
10 year	3.149417
25 year	3.863745
50 year	4.442067
100 year	5.061388

WWHM2012
PROJECT REPORT

Project Name: Undisturbed
Site Name:
Site Address:
City :
Report Date: 4/6/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 0.80
Version Date: 2016/07/25
Version : 4.2.12

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Flat	14.43
Pervious Total	14.43

Impervious Land Use	acre
Impervious Total	0
Basin Total	14.43

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Flat	1.42
Pervious Total	1.42

Impervious Land Use	acre
ROADS FLAT	13.01
Impervious Total	13.01
Basin Total	14.43

Element Flows To:
Surface Interflow Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:14.43
Total Impervious Area:0

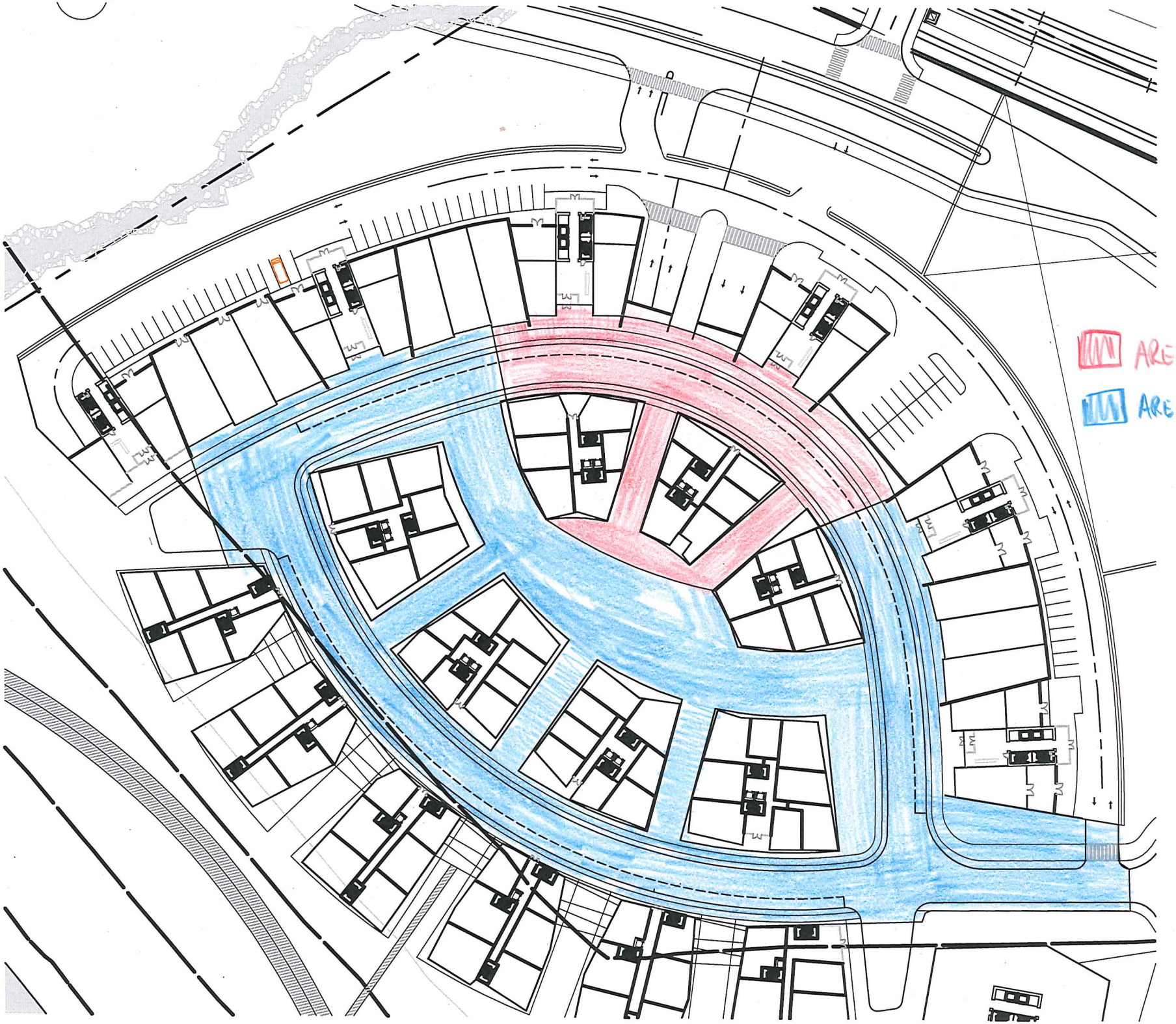
Mitigated Landuse Totals for POC #1
Total Pervious Area:1.42
Total Impervious Area:13.01

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.010169
5 year	0.011778
10 year	0.012493
25 year	0.013144
50 year	0.013503
100 year	0.013784

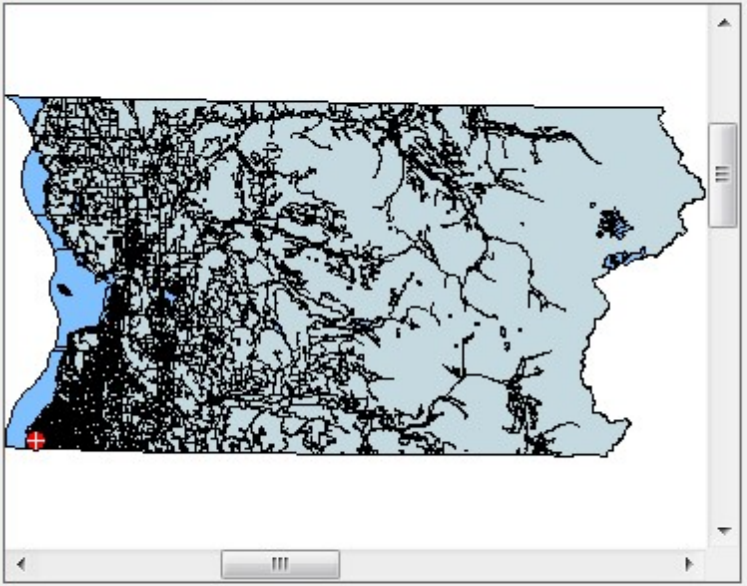
Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	4.169835
5 year	5.684985
10 year	6.799504
25 year	8.339668
50 year	9.586334
100 year	10.921165


AREA 1 (0.573 Ac)
AREA 2 (2.40 Ac)
N
N.T.S
09039
3-8-17
PWP
MIG|SVA

Snohomish2012

Snohomish2012



Site Information

Site Name

Address

City

Gage Everett

Precip Factor 0.800

☐ Use WS-DOT data

Map Controls

WWHM2012 PW Planter 2017-3-7

File Edit View Help Summary Report

Basin Help

Schematic

SCENARIOS

Predeveloped

Mitigated

Run Scenario

Basic Elements

Pro Elements

LID Toolbox

Commercial Toolbox

Move Elements

Save x,y Load x,y

X 40

Y 24

Tue 4:22p - PW Planter 2017-3-7 - Finish Mitigated

Basin 1 Predeveloped

Subbasin Name: Basin 1

Flows To : Surface Interflow Groundwater

Area in Basin

Show Only Selected

Available Pervious	Acres	Available Impervious	Acres
A/B, Forest, Flat	0	ROADS/FLAT	0.573
A/B, Forest, Mod	0	ROADS/MOD	0
A/B, Forest, Steep	0	ROADS/STEEP	0
A/B, Pasture, Flat	0	ROOF TOPS/FLAT	0
A/B, Pasture, Mod	0	DRIVEWAYS/FLAT	0
A/B, Pasture, Steep	0	DRIVEWAYS/MOD	0
A/B, Lawn, Flat	0	DRIVEWAYS/STEEP	0
A/B, Lawn, Mod	0	SIDEWALKS/FLAT	0
A/B, Lawn, Steep	0	SIDEWALKS/MOD	0
C, Forest, Flat	0	SIDEWALKS/STEEP	0
C, Forest, Mod	0	PARKING/FLAT	0
C, Forest, Steep	0	PARKING/MOD	0
C, Pasture, Flat	0	PARKING/STEEP	0
C, Pasture, Mod	0	POND	0
C, Pasture, Steep	0	Porous Pavement	0
C, Lawn, Flat	0		
C, Lawn, Mod	0		
C, Lawn, Steep	0		
SAT, Forest, Flat	0		
SAT, Forest, Mod	0		
SAT, Forest, Steep	0		

Pervious Total	0	Acres
Impervious Total	0.573	Acres
Basin Total	0.573	Acres

Deselect Zero Select By: GO

WWHM2012 PW Planter 2017-3-7

File Edit View Help Summary Report

Basin Help

Schematic

SCENARIOS

Predeveloped

Mitigated

Run Scenario

Basic Elements

Pro Elements

LID Toolbox

Commercial Toolbox

Move Elements

Save x,y Load x,y

X 0

Y 0

Tue 4:22p - PW Planter 2017-3-7 - Finish Mitigated

Basin 1 Mitigated

Subbasin Name: Basin 1 Designate as Bypass for POC:

Flows To :	Surface	Interflow	Groundwater
	Sand Filter 1	Sand Filter 1	

Area in Basin

Show Only Selected

Available Pervious	Acres	Available Impervious	Acres
A/B, Forest, Flat	0	ROADS/FLAT	0.573
A/B, Forest, Mod	0	ROADS/MOD	0
A/B, Forest, Steep	0	ROADS/STEEP	0
A/B, Pasture, Flat	0	ROOF TOPS/FLAT	0
A/B, Pasture, Mod	0	DRIVEWAYS/FLAT	0
A/B, Pasture, Steep	0	DRIVEWAYS/MOD	0
A/B, Lawn, Flat	0	DRIVEWAYS/STEEP	0
A/B, Lawn, Mod	0	SIDEWALKS/FLAT	0
A/B, Lawn, Steep	0	SIDEWALKS/MOD	0
C, Forest, Flat	0	SIDEWALKS/STEEP	0
C, Forest, Mod	0	PARKING/FLAT	0
C, Forest, Steep	0	PARKING/MOD	0
C, Pasture, Flat	0	PARKING/STEEP	0
C, Pasture, Mod	0	POND	0
C, Pasture, Steep	0	Porous Pavement	0
C, Lawn, Flat	0		
C, Lawn, Mod	0		
C, Lawn, Steep	0		
SAT, Forest, Flat	0		
SAT, Forest, Mod	0		
SAT, Forest, Steep	0		

Pervious Total	0	Acres
Impervious Total	0.573	Acres
Basin Total	0.573	Acres

Deselect Zero Select By: GO

WWHM2012 PW Planter 2017-3-7

File Edit View Help Summary Report

Sand Filter Help

Schematic

SCENARIOS

Predeveloped

Mitigated

Run Scenario

Basic Elements

Pro Elements

LID Toolbox

Commercial Toolbox

Move Elements

Save x,y Load x,y

X 30

Y 0

Tue 4:22p - PW Planter 2017-3-7 - Finish Mitigated

Sand Filter 1 Mitigated

Facility Name Sand Filter 1

	Outlet 1	Outlet 2	Outlet 3
Downstream Connections	0	0	0

Facility Type Sand Filter

Precipitation Applied to Facility

Evaporation Applied to Facility

Quick Filter

Facility Dimension Diagram

Facility Dimensions

Bottom Length (ft)	72
Bottom Width (ft)	4
Effective Depth (ft)	0.6
Left Side Slope (H/V)	3
Bottom Side Slope (H/V)	3
Right Side Slope (H/V)	3
Top Side Slope (H/V)	3

Outlet Structure Data

Riser Height (ft)	0.5
Riser Diameter (in)	48
Riser Type	Flat
Notch Type	

Infiltration Yes

Hydraulic Conductivity (in/hr)	3
Filter material depth (ft)	1.5
Total Volume Filtrated (ac-ft)	61.477
Total Volume Through Riser (ac-ft)	5.869
Total Volume (ac-ft)	67.346
Percent Filtered	91.29

Orifice Number	Diameter (in)	Height (ft)
1	0	0
2	0	0
3	0	0

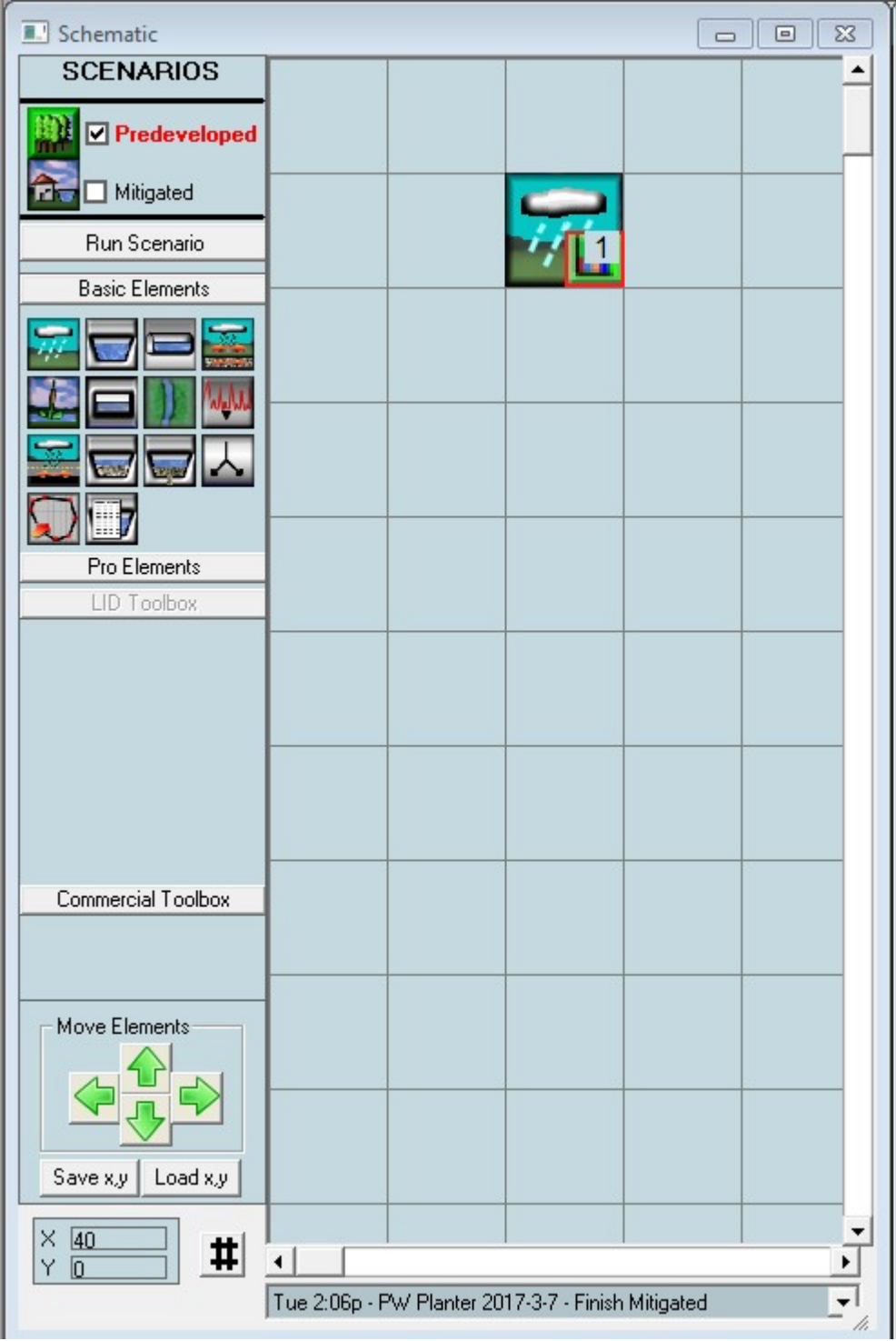
Filter Storage Volume at Riser Head (ac-ft) .006

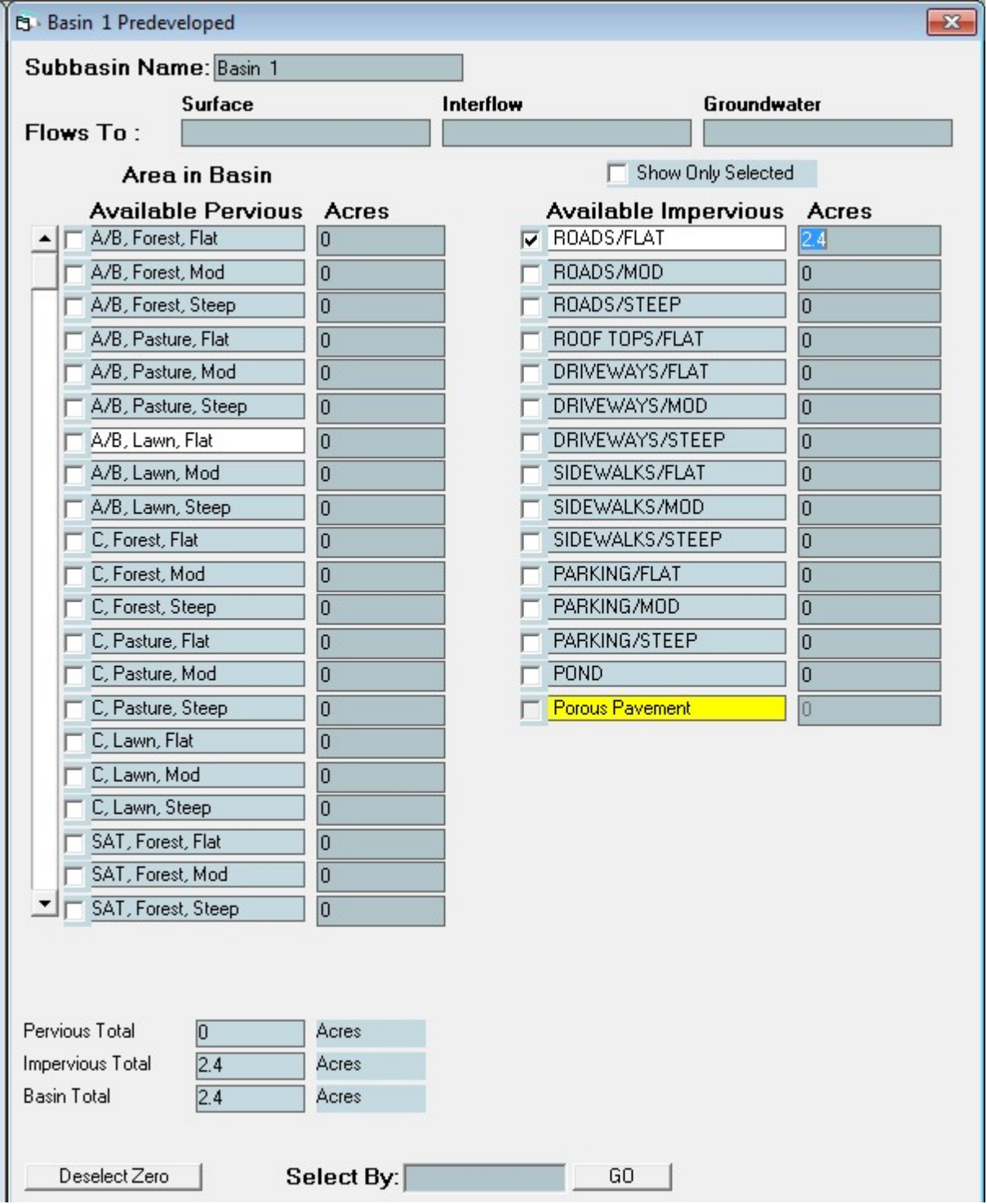
Size Infiltration Basin

Target %: 100

Show Filter Table Open Table

Initial Stage (ft) 0


Schematic
SCENARIOS
Predeveloped
Mitigated
Run Scenario
Basic Elements
Pro Elements
LID Toolbox
Commercial Toolbox
Move Elements
Save x,y
Load x,y
X 40
Y 0
1
Tue 2:06p - PW Planter 2017-3-7 - Finish Mitigated


Basin 1 Predeveloped
Subbasin Name: Basin 1
Flows To :
Surface
Interflow
Groundwater
Area in Basin
Show Only Selected
Available Pervious
Acres
A/B, Forest, Flat 0
A/B, Forest, Mod 0
A/B, Forest, Steep 0
A/B, Pasture, Flat 0
A/B, Pasture, Mod 0
A/B, Pasture, Steep 0
A/B, Lawn, Flat 0
A/B, Lawn, Mod 0
A/B, Lawn, Steep 0
C, Forest, Flat 0
C, Forest, Mod 0
C, Forest, Steep 0
C, Pasture, Flat 0
C, Pasture, Mod 0
C, Pasture, Steep 0
C, Lawn, Flat 0
C, Lawn, Mod 0
C, Lawn, Steep 0
SAT, Forest, Flat 0
SAT, Forest, Mod 0
SAT, Forest, Steep 0
Available Impervious
Acres
ROADS/FLAT 2.4
ROADS/MOD 0
ROADS/STEEP 0
ROOF TOPS/FLAT 0
DRIVEWAYS/FLAT 0
DRIVEWAYS/MOD 0
DRIVEWAYS/STEEP 0
SIDEWALKS/FLAT 0
SIDEWALKS/MOD 0
SIDEWALKS/STEEP 0
PARKING/FLAT 0
PARKING/MOD 0
PARKING/STEEP 0
POND 0
Porous Pavement 0
Pervious Total 0 Acres
Impervious Total 2.4 Acres
Basin Total 2.4 Acres
Deselect Zero
Select By:
GO

Schematic

SCENARIOS

Predeveloped

Mitigated

Run Scenario

Basic Elements

Pro Elements

LID Toolbox

Commercial Toolbox

Move Elements

Save x,y | Load x,y

X 40
Y 12

Tue 2:06p - PW Planter 2017-3-7 - Finish Mitigated

Basin 1 Mitigated

Subbasin Name: Basin 1 — Designate as Bypass for POC:

Flows To :	Surface	Interflow	Groundwater
	Sand Filter 1	Sand Filter 1	

Area in Basin

Show Only Selected

Available Pervious	Acres
A/B, Forest, Flat	0
A/B, Forest, Mod	0
A/B, Forest, Steep	0
A/B, Pasture, Flat	0
A/B, Pasture, Mod	0
A/B, Pasture, Steep	0
A/B, Lawn, Flat	0
A/B, Lawn, Mod	0
A/B, Lawn, Steep	0
C, Forest, Flat	0
C, Forest, Mod	0
C, Forest, Steep	0
C, Pasture, Flat	0
C, Pasture, Mod	0
C, Pasture, Steep	0
C, Lawn, Flat	0
C, Lawn, Mod	0
C, Lawn, Steep	0
SAT, Forest, Flat	0
SAT, Forest, Mod	0
SAT, Forest, Steep	0

Available Impervious	Acres
ROADS/FLAT	2.4
ROADS/MOD	0
ROADS/STEEP	0
ROOF TOPS/FLAT	0
DRIVEWAYS/FLAT	0
DRIVEWAYS/MOD	0
DRIVEWAYS/STEEP	0
SIDEWALKS/FLAT	0
SIDEWALKS/MOD	0
SIDEWALKS/STEEP	0
PARKING/FLAT	0
PARKING/MOD	0
PARKING/STEEP	0
POND	0
Porous Pavement	0

Pervious Total	0	Acres
Impervious Total	2.4	Acres
Basin Total	2.4	Acres

Deselect Zero | Select By: | GO

Schematic

SCENARIOS

Predeveloped

Mitigated

Run Scenario

Basic Elements

Pro Elements

LID Toolbox

Commercial Toolbox

Move Elements

Save x,y | Load x,y

X 40
Y 24

Tue 2:06p - PW Planter 2017-3-7 - Finish Mitigated

Sand Filter 1 Mitigated

Facility Name Sand Filter 1

	Outlet 1	Outlet 2	Outlet 3
Downstream Connections	0	0	0

Facility Type Sand Filter

Precipitation Applied to Facility

Evaporation Applied to Facility

Quick Filter

Facility Dimension Diagram

Facility Dimensions

Bottom Length (ft)	305
Bottom Width (ft)	4
Effective Depth (ft)	0.6
Left Side Slope (H/V)	3
Bottom Side Slope (H/V)	3
Right Side Slope (H/V)	3
Top Side Slope (H/V)	3

Outlet Structure Data

Riser Height (ft)	0.5
Riser Diameter (in)	48
Riser Type	Flat
Notch Type	

Infiltration Yes

Hydraulic Conductivity (in/hr) 3

Filter material depth (ft) 1.5

Total Volume Filtrated (ac-ft)	258.981
Total Volume Through Riser (ac-ft)	23.948
Total Volume (ac-ft)	282.929
Percent Filtered	91.54

Size Infiltration Basin

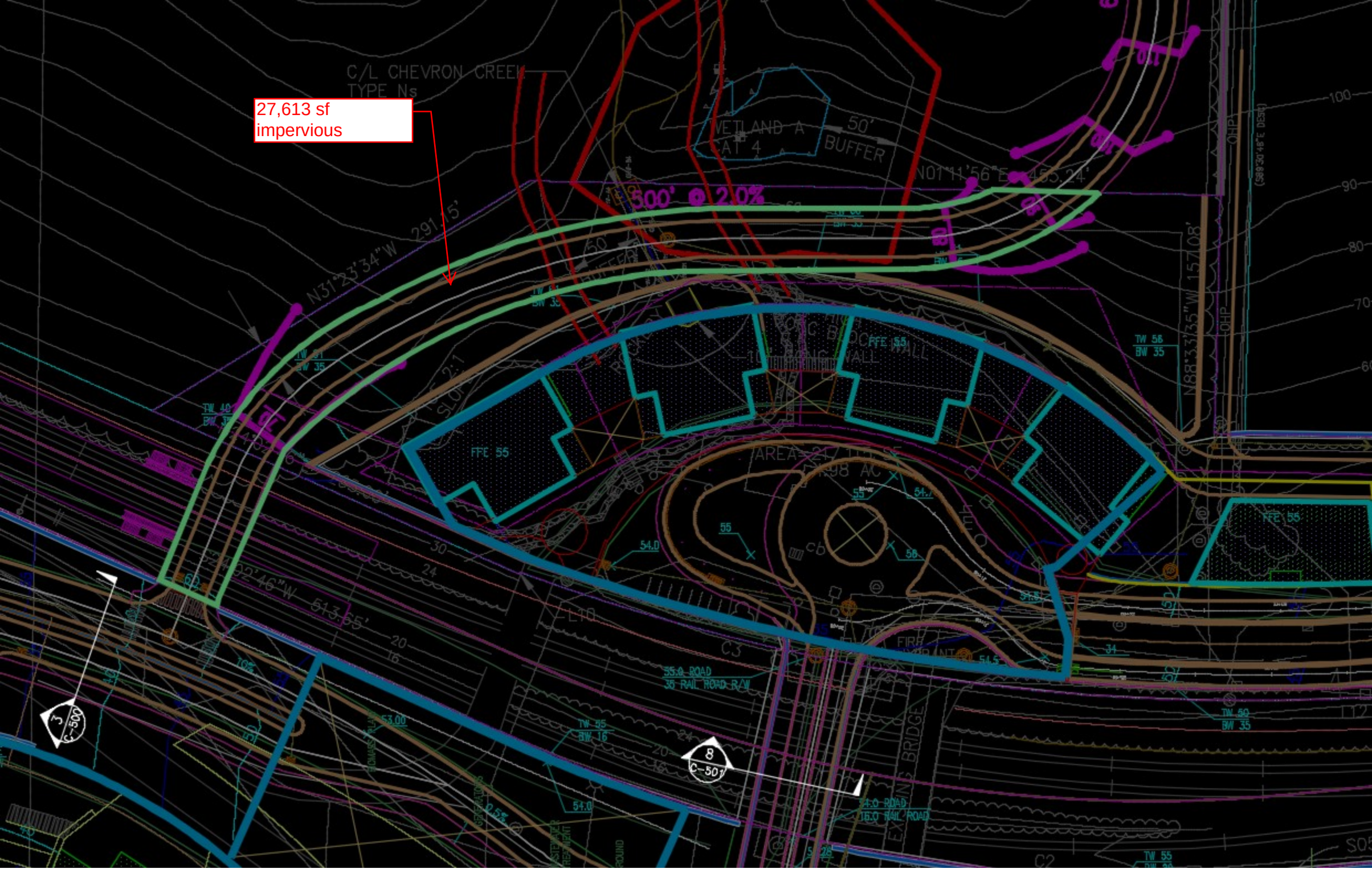
Target %: 100

Orifice Number	Diameter (in)	Height (ft)
1	0	0
2	0	0
3	0	0

Filter Storage Volume at Riser Head (ac-ft) .025

Show Filter Table Open Table

Initial Stage (ft) 0


27,613 sf
impervious
C/L CHEVRON CREEK
TYPE Ns
WETLAND A
CAT 4
50'
BUFFER
500'
2.0%
FFE 55
AREA 24
1.98 AC
35.0 ROAD
35 RAIL ROAD R/W
54.0 ROAD
15.0 RAIL ROAD
EXIST. BRIDGE
C1
C2
C3
TW 58
BW 35
TW 50
BW 35
TW 55
TW 35
BW 16
TW 40
TW 51
OHP

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	default[12]
Site Name:	
Site Address:	
City:	
Report Date:	3/27/2017
Gage:	Everett
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.800
Version Date:	2016/07/25
Version:	4.2.12

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS STEEP	0.64
Impervious Total	0.64
Basin Total	0.64

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS STEEP	0.64
Impervious Total	0.64
Basin Total	0.64

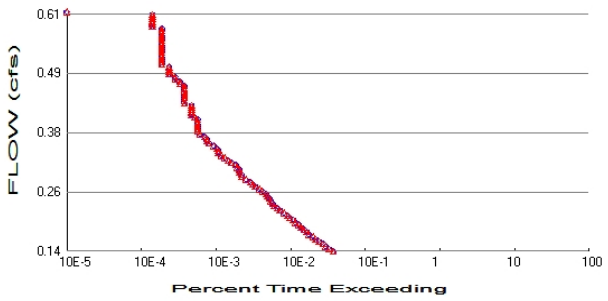
Element Flows To:

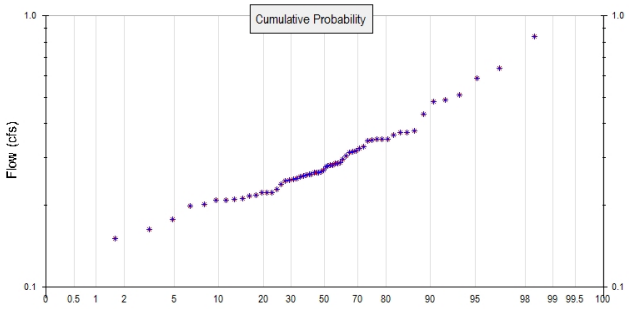
Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 0.64

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 0.64

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.277056
5 year	0.372412
10 year	0.441791
25 year	0.536827
50 year	0.613157
100 year	0.694384

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.277056
5 year	0.372412
10 year	0.441791
25 year	0.536827
50 year	0.613157
100 year	0.694384

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.278	0.278
1950	0.266	0.266
1951	0.371	0.371
1952	0.265	0.265
1953	0.296	0.296
1954	0.434	0.434
1955	0.351	0.351
1956	0.151	0.151
1957	0.229	0.229
1958	0.587	0.587

1959	0.259	0.259
1960	0.254	0.254
1961	0.837	0.837
1962	0.304	0.304
1963	0.285	0.285
1964	0.202	0.202
1965	0.249	0.249
1966	0.245	0.245
1967	0.491	0.491
1968	0.239	0.239
1969	0.510	0.510
1970	0.216	0.216
1971	0.270	0.270
1972	0.350	0.350
1973	0.282	0.282
1974	0.372	0.372
1975	0.280	0.280
1976	0.212	0.212
1977	0.209	0.209
1978	0.178	0.178
1979	0.329	0.329
1980	0.350	0.350
1981	0.210	0.210
1982	0.257	0.257
1983	0.281	0.281
1984	0.265	0.265
1985	0.364	0.364
1986	0.345	0.345
1987	0.312	0.312
1988	0.287	0.287
1989	0.252	0.252
1990	0.218	0.218
1991	0.323	0.323
1992	0.264	0.264
1993	0.223	0.223
1994	0.247	0.247
1995	0.222	0.222
1996	0.377	0.377
1997	0.317	0.317
1998	0.348	0.348
1999	0.141	0.141
2000	0.640	0.640
2001	0.162	0.162
2002	0.198	0.198
2003	0.260	0.260
2004	0.482	0.482
2005	0.223	0.223
2006	0.314	0.314
2007	0.284	0.284
2008	0.259	0.259
2009	0.209	0.209

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.8367	0.8367
2	0.6401	0.6401
3	0.5867	0.5867

4	0.5102	0.5102
5	0.4909	0.4909
6	0.4823	0.4823
7	0.4343	0.4343
8	0.3771	0.3771
9	0.3716	0.3716
10	0.3709	0.3709
11	0.3641	0.3641
12	0.3515	0.3515
13	0.3500	0.3500
14	0.3499	0.3499
15	0.3479	0.3479
16	0.3446	0.3446
17	0.3289	0.3289
18	0.3233	0.3233
19	0.3169	0.3169
20	0.3142	0.3142
21	0.3120	0.3120
22	0.3036	0.3036
23	0.2956	0.2956
24	0.2874	0.2874
25	0.2850	0.2850
26	0.2844	0.2844
27	0.2818	0.2818
28	0.2808	0.2808
29	0.2799	0.2799
30	0.2779	0.2779
31	0.2703	0.2703
32	0.2662	0.2662
33	0.2648	0.2648
34	0.2646	0.2646
35	0.2639	0.2639
36	0.2599	0.2599
37	0.2593	0.2593
38	0.2588	0.2588
39	0.2565	0.2565
40	0.2544	0.2544
41	0.2516	0.2516
42	0.2488	0.2488
43	0.2472	0.2472
44	0.2451	0.2451
45	0.2394	0.2394
46	0.2287	0.2287
47	0.2232	0.2232
48	0.2226	0.2226
49	0.2223	0.2223
50	0.2178	0.2178
51	0.2161	0.2161
52	0.2115	0.2115
53	0.2098	0.2098
54	0.2088	0.2088
55	0.2086	0.2086
56	0.2022	0.2022
57	0.1984	0.1984
58	0.1777	0.1777
59	0.1624	0.1624
60	0.1512	0.1512
61	0.1406	0.1406

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1385	798	798	100	Pass
0.1433	703	703	100	Pass
0.1481	632	632	100	Pass
0.1529	575	575	100	Pass
0.1577	511	511	100	Pass
0.1625	465	465	100	Pass
0.1673	425	425	100	Pass
0.1721	375	375	100	Pass
0.1769	351	351	100	Pass
0.1817	319	319	100	Pass
0.1865	295	295	100	Pass
0.1913	274	274	100	Pass
0.1961	249	249	100	Pass
0.2009	231	231	100	Pass
0.2056	207	207	100	Pass
0.2104	192	192	100	Pass
0.2152	174	174	100	Pass
0.2200	154	154	100	Pass
0.2248	142	142	100	Pass
0.2296	127	127	100	Pass
0.2344	122	122	100	Pass
0.2392	116	116	100	Pass
0.2440	110	110	100	Pass
0.2488	104	104	100	Pass
0.2536	101	101	100	Pass
0.2584	89	89	100	Pass
0.2632	81	81	100	Pass
0.2680	72	72	100	Pass
0.2728	66	66	100	Pass
0.2776	62	62	100	Pass
0.2824	54	54	100	Pass
0.2871	47	47	100	Pass
0.2919	46	46	100	Pass
0.2967	44	44	100	Pass
0.3015	44	44	100	Pass
0.3063	41	41	100	Pass
0.3111	39	39	100	Pass
0.3159	34	34	100	Pass
0.3207	31	31	100	Pass
0.3255	28	28	100	Pass
0.3303	25	25	100	Pass
0.3351	23	23	100	Pass
0.3399	23	23	100	Pass
0.3447	22	22	100	Pass
0.3495	20	20	100	Pass
0.3543	17	17	100	Pass
0.3591	16	16	100	Pass
0.3639	16	16	100	Pass
0.3687	15	15	100	Pass
0.3734	13	13	100	Pass
0.3782	12	12	100	Pass
0.3830	12	12	100	Pass
0.3878	12	12	100	Pass

0.3926	12	12	100	Pass
0.3974	12	12	100	Pass
0.4022	12	12	100	Pass
0.4070	11	11	100	Pass
0.4118	10	10	100	Pass
0.4166	10	10	100	Pass
0.4214	10	10	100	Pass
0.4262	10	10	100	Pass
0.4310	10	10	100	Pass
0.4358	8	8	100	Pass
0.4406	8	8	100	Pass
0.4454	8	8	100	Pass
0.4502	8	8	100	Pass
0.4549	8	8	100	Pass
0.4597	8	8	100	Pass
0.4645	8	8	100	Pass
0.4693	8	8	100	Pass
0.4741	7	7	100	Pass
0.4789	7	7	100	Pass
0.4837	6	6	100	Pass
0.4885	6	6	100	Pass
0.4933	5	5	100	Pass
0.4981	5	5	100	Pass
0.5029	5	5	100	Pass
0.5077	5	5	100	Pass
0.5125	4	4	100	Pass
0.5173	4	4	100	Pass
0.5221	4	4	100	Pass
0.5269	4	4	100	Pass
0.5317	4	4	100	Pass
0.5364	4	4	100	Pass
0.5412	4	4	100	Pass
0.5460	4	4	100	Pass
0.5508	4	4	100	Pass
0.5556	4	4	100	Pass
0.5604	4	4	100	Pass
0.5652	4	4	100	Pass
0.5700	4	4	100	Pass
0.5748	4	4	100	Pass
0.5796	4	4	100	Pass
0.5844	4	4	100	Pass
0.5892	3	3	100	Pass
0.5940	3	3	100	Pass
0.5988	3	3	100	Pass
0.6036	3	3	100	Pass
0.6084	3	3	100	Pass
0.6132	3	3	100	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.052 acre-feet
On-line facility target flow:	0.0958 cfs.
Adjusted for 15 min:	0.0958 cfs.
Off-line facility target flow:	0.0542 cfs.
Adjusted for 15 min:	0.0542 cfs.

WASHINGTON STATE DEPARTMENT OF ECOLOGY

November 2016

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS) TREATMENT

For

CONTECH Engineered Solutions
Stormwater Management StormFilter®
With ZPG Media at 1 gpm/sq ft media surface area

Ecology's Decision:

Based on the CONTECH Engineered Solutions' (CONTECH) application submissions, Ecology hereby issues a General Use Level Designation (GULD) for the Stormwater Management StormFilter® (StormFilter):

1. **As a basic stormwater treatment practice for total suspended solids (TSS) removal,**
   - **Using ZPG™ media (zeolite/perlite/granular activated carbon), with the size distribution described below,**
   - **Sized at a hydraulic loading rate of 1 gpm/ft^2 of media surface area, per Table 1, and**
   - **Internal bypassing needs to be consistent with the design guidelines in CONTECH's current product design manual.**

Table 1. StormFilter Design Flow Rates per Cartridge

Effective Cartridge Height (inches)	12	18	27
Cartridge Flow Rate (gpm/cartridge)	5	7.5	11.3

2. **Ecology approves StormFilter systems containing ZPG™ media for treatment at the hydraulic loading rates shown in Table 1, to achieve the maximum water quality design flow rate. The water quality design flow rates are calculated using the following procedures:**
   - **Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.**

- **Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.**
- **Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.**

3. **This designation has no expiration date, but Ecology may amend or revoke it.**

<u>Ecology's Conditions of Use</u>:

The StormFilter with ZPG media shall comply with the following conditions:

1. **Design, install, operate, and maintain the StormFilter with ZPG media in accordance with applicable Contech Engineered Solutions manuals, documents, and the Ecology Decision.**

2. **Install StormFilter systems to bypass flows exceeding the water quality treatment rate. Additionally, high flows will not re-suspend captured sediments. Design StormFilter systems in accordance with the performance goals in Ecology's most recent Stormwater Manual and CONTECH's *Product Design Manual Version 4.1 (April 2006)*, or most current version, unless otherwise specified.**

3. **Owners must follow the design, pretreatment, land use application, and maintenance criteria in CONTECH's Design Manual.**

4. **Pretreatment of TSS and oil and grease may be necessary, and designers shall provide pre-treatment in accordance with the most current versions of the CONTECH's *Product Design Manual (April 2006)* or the applicable Ecology Stormwater Manual. Design pre-treatment using the performance criteria and pretreatment practices provided on Ecology's "Evaluation of Emerging Stormwater Treatment Technologies" website.**

5. **Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.**

    - **Typically, CONTECH designs StormFilter systems for a target filter media replacement interval of 12 months. Maintenance includes removing accumulated sediment from the vault, and replacing spent cartridges with recharged cartridges.**

- **Indications of the need for maintenance include effluent flow decreasing to below the design flow rate, as indicated by the scumline above the shoulder of the cartridge.**
- **Owners/operators must inspect StormFilter with ZPG media for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.**
- **Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.**
- **When inspections are performed, the following findings typically serve as maintenance triggers:**
    - **Accumulated vault sediment depths exceed an average of 2 inches, or**
    - **Accumulated sediment depths on the tops of the cartridges exceed an average of 0.5 inches, or**
    - **Standing water remains in the vault between rain events, or**
    - **Bypass occurs during storms smaller than the design storm.**
- **Note: If excessive floatables (trash and debris) are present, perform a minor maintenance consisting of gross solids removal, not cartridge replacement.**

6. **CONTECH shall maintain readily available reports listed under "Application Documents" (above) as public, as well as the documentation submitted with its previous conditional use designation application. CONTECH shall provide links to this information from its corporate website, and make this information available upon request, at no cost and in a timely manner.**

7. **ZPG™ media used shall conform with the following specifications:**

- **Each cartridge contains a total of approximately 2.6 cubic feet of media. The ZPG™ cartridge consists of an outer layer of perlite that is approximately 1.3 cubic feet in volume and an inner layer, consisting of a mixture of 90% zeolite and 10% granular activated carbon, which is approximately 1.3 cubic feet in volume.**
- **Perlite Media: Perlite media shall be made of natural siliceous volcanic rock free of any debris or foreign matter. The expanded perlite shall**

have a bulk density ranging from 6.5 to 8.5 lbs per cubic foot and particle sizes ranging from 0.09" (#8 mesh) to 0.38" (3/8" mesh).

- **Zeolite Media: Zeolite media shall be made of naturally occurring clinoptilolite. The zeolite media shall have a bulk density ranging from 44 to 50 lbs per cubic foot and particle sizes ranging from 0.13" (#6 mesh) to 0.19" (#4 mesh). Additionally, the cation exchange capacity (CEC) of zeolite shall range from approximately 1.0 to 2.2 meq/g.**

- **Granular Activated Carbon: Granular activated carbon (GAC) shall be made of lignite coal that has been steam-activated. The GAC media shall have a bulk density ranging from 28 to 31 lbs per cubic foot and particle sizes ranging from a 0.09" (#8 mesh) to 0.19" (#4 mesh).**

Approved Alternate Configurations

Peak Diversion StormFilter

1. The Peak Diversion StormFilter allows for off-line bypass within the StormFilter structure. Design capture flows and peak flows enter the inlet bay which contains an internal weir. The internal weir allows design flows to enter the cartridge bay through a transfer hole located at the bottom of the inlet bay while the unit routs higher flows around the cartridge bay.
2. To select the size of the Peak Diversion StormFilter unit, the designer must determine the number of cartridges required and size of the standard StormFilter using the site-specific water quality design flow and the **StormFilter Design Flow Rates per Cartridge** as described above.
3. New owners may not install the Peak Diversion StormFilter at an elevation or in a location where backwatering may occur.

Applicant: Contech Engineered Solutions

Applicant's Address: 11835 NE Glenn Widing Dr.
Portland, OR 97220

Application Documents:

The applicant's master report, titled, "The Stormwater Management StormFilter Basic Treatment Application for General Use Level Designation in Washington", Stormwater Management, Inc., November 1, 2004, includes the following reports:

- (Public) *Evaluation of the Stormwater Management StormFilter Treatment System: Data Validation Report and Summary of the Technical Evaluation Engineering Report (TEER) by Stormwater Management Inc*., October 29, 2004
Ecology's technology assessment protocol requires the applicant to hire an independent consultant to complete the following work:

1. Complete the data validation report.
2. Prepare a TEER summary, including a testing summary and conclusions compared with the supplier's performance claims.
3. Provide a recommendation of the appropriate technology use level.
4. Work with Ecology to post recommend relevant information on Ecology's website.
5. Provide additional testing recommendations, if needed."
6. This report, authored by Dr. Gary Minton, Ph. D., P.E., Resource Planning Associates, satisfies the Ecology requirement.

- (Public) "Performance of the Stormwater Management StormFilter Relative to the Washington State Department of Ecology Performance Goals for Basic Treatment," is a summary of StormFilter performance that strictly adheres to the criteria listed in the Guidance for Evaluating Emerging Stormwater Treatment Technologies, Technology Assessment Protocol – Ecology (TAPE).
- "Heritage Marketplace Field Evaluation: Stormwater Management StormFilter with ZPG™ Media," is a report showing all of the information collected at Site A as stated in the SMI Quality Assurance Project Plan (QAPP). This document contains detailed information regarding each storm event collected at this site, and it provided a detailed overview of the data and project.
- "Lake Stevens Field Evaluation: Stormwater Management StormFilter with ZPG™ Media," is a report that corresponds to Site E as stated in the SMI QAPP. This document contains detailed information regarding each storm collected at this site, and includes a detailed overview of the data and project.
- (Public) "Evaluation of the Stormwater Management StormFilter for the removal of SIL-CO-SIL 106, a standardized silica product: ZPG™ at 7.5 GPM" is a report that describes laboratory testing at full design flow.
- "Factors Other Than Treatment Performance."
- "State of Washington Installations."
- "Peak Diversion StormFilter" is a technical document demonstrating the Peak Diversion StormFilter system complies with the Stormwater Management Manual for Western Washington Volume V Section 4.5.1.

Above-listed documents noted as "public" are available by contacting CONTECH.

Applicant's Use Level Request:

That Ecology grant a General Use Level Designation for Basic Treatment for the StormFilter using ZPG™ media (zeolite/perlite/granular activated carbon) at a hydraulic loading rate of 1 gpm/ft^2 of media surface area in accordance with Ecology's 2011 *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE).*

Applicant's Performance Claim:

The combined data from the two field sites reported in the TER (Heritage Marketplace and Lake Stevens) indicate that the performance of a StormFilter system configured for inline bypass with ZPG™ media and a hydraulic loading rate of 1 gpm/ft^2 of media surface area meets Ecology performance goals for Basic Treatment.

Ecology's Recommendations:

Based on the weight of the evidence and using its best professional judgment, Ecology finds that:

- StormFilter, using ZPG™ media and operating at a hydraulic loading rate of no more than 1 gpm/ft^2 of media surface area, is expected to provide effective stormwater treatment achieving Ecology's Basic Treatment (TSS removal) performance goals. Contech demonstrated this is through field and laboratory testing performed in accordance with the approved protocol. StormFilter is deemed satisfactory with respect to factors other than treatment performance (e.g., maintenance; see the protocol's Appendix B for complete list).

Findings of Fact:

- Influent TSS concentrations and particle size distributions were generally within the range of what Ecology considers "typical" for western Washington (silt-to-silt loam).
- Contech sampled thirty-two (32) storm events at two sites for storms from April 2003 to March 2004, of which Contech deemed twenty-two (22) as "qualified" and were therefore included in the data analysis set.
- Statistical analysis of these 22 storm events verifies the data set's adequacy.
- Analyzing all 22 qualifying events, the average influent and effluent concentrations and aggregate pollutant load reduction are 114 mg/L, 25 mg/L, and 82%, respectively.
- Analyzing all 22 qualifying events based on the *estimated average* flow rate during the event (versus the *measured peak* flow rate), and more heavily weighting those events near the design rate (versus events either far above or well below the design rate) does not significantly affect the reported results.
- For the 7 qualifying events with influent TSS concentrations greater than 100 mg/L, the average influent and effluent concentrations and aggregate pollutant load reduction are 241 mg/L, 34 mg/L, and 89%, respectively. If we exclude the 2 of 7 events that exceed the maximum 300 mg/L specified in Ecology's guidelines, the average influent and effluent concentrations and aggregate pollutant load reduction are 158 mg/L, 35 mg/L, and 78%, respectively.
- For the 15 qualifying events with influent TSS concentrations less than 100 mg/L, the average influent and effluent concentrations and aggregate pollutant load reduction are 55 mg/L, 20 mg/L, and 61%, respectively. If the 6 of 15 events that fall below the minimum 33 mg/L TSS specified in Ecology's guidelines are excluded, the average

influent and effluent concentrations and aggregate pollutant load reduction are 78 mg/L, 26 mg/L, and 67%, respectively.

- For the 8 qualifying events with peak discharge exceeding design flow (ranging from 120 to 257% of the design rate), results ranged from 52% to 96% TSS removal, with an average of 72%.
- Due to the characteristics of the hydrographs, the field results generally reflect flows below (ranging between 20 and 60 percent of) the tested facilities' design rate. During these sub-design flow rate periods, some of the cartridges operate at or near their *individual* full design flow rate (generally between 4 and 7.5 GPM for an 18" cartridge effective height) because their float valves have opened. Float valves remain closed on the remaining cartridges, which operate at their base "trickle" rate of 1 to 1.5 GPM.
- Laboratory testing using U.S. Silica's Sil-Co-Sil 106 fine silica product showed an average 87% TSS removal for testing at 7.5 GPM per cartridge (100% design flow rate).
- Other relevant testing at I-5 Lake Union, Greenville Yards (New Jersey), and Ski Run Marina (Lake Tahoe) facilities shows consistent TSS removals in the 75 to 85% range. *Note that the evaluators operated the I-5 Lake Union at 50%, 100%, and 125% of design flow*.
- SMI's application included a satisfactory "Factors other than treatment performance" discussion.

Note: Ecology's 80% TSS removal goal applies to 100 mg/l and greater influent TSS. Below 100 mg/L influent TSS, the goal is 20 mg/L effluent TSS.

Technology Description:

The Stormwater Management StormFilter® (StormFilter), a flow-through stormwater filtration system, improves the quality of stormwater runoff from the urban environment by removing pollutants. The StormFilter can treat runoff from a wide variety of sites including, but not limited to: retail and commercial development, residential streets, urban roadways, freeways, and industrial sites such as shipyards, foundries, etc.

Operation:

The StormFilter is typically comprised of a vault that houses rechargeable, media-filled, filter cartridges. Various media may be used, but this designation covers only the zeolite-perlite-granulated activated carbon (ZPG™) medium. Stormwater from storm drains percolates through these media-filled cartridges, which trap particulates and may remove pollutants such as dissolved metals, nutrients, and hydrocarbons. During the filtering process, the StormFilter system also removes surface scum and floating oil and grease. Once filtered through the media, the treated stormwater is directed to a collection pipe or discharged to an open channel drainage way.

This document includes a bypass schematic for flow rates exceeding the water quality design flow rate on page 8.

StormFilter Configurations:

Contech offers the StormFilter in multiple configurations: precast, high flow, catch basin, curb inlet, linear, volume, corrugated metal pipe, drywell, and CON/Span form. Most configurations use pre-manufactured units to ease the design and installation process. Systems may be either uncovered or covered underground units.

The typical precast StormFilter unit is composed of three sections: the energy dissipater, the filtration bay, and the outlet sump. As Stormwater enters the inlet of the StormFilter vault through the inlet pipe, piping directs stormwater through the energy dissipater into the filtration bay where treatment will take place. Once in the filtration bay, the stormwater ponds and percolates horizontally through the media contained in the StormFilter cartridges. After passing through the media, the treated water in each cartridge collects in the cartridge's center tube from where piping directs it into the outlet sump by a High Flow Conduit under-drain manifold. The treated water in the outlet sump discharges through the single outlet pipe to a collection pipe or to an open channel drainage way. In some applications where you anticipate heavy grit loads, pretreatment by settling may be necessary.

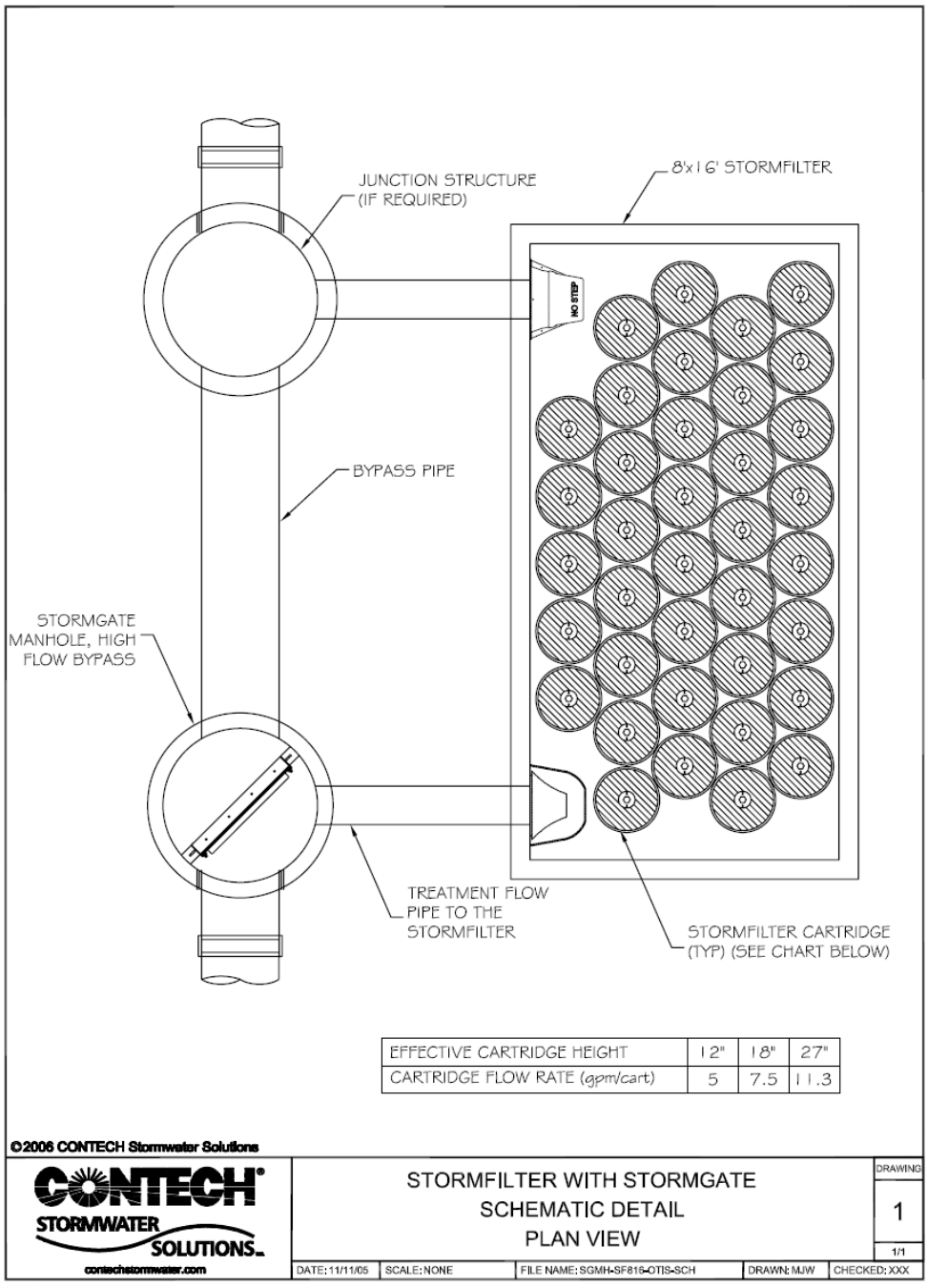


Figure 1. Stormwater Management StormFilter Configuration with Bypass

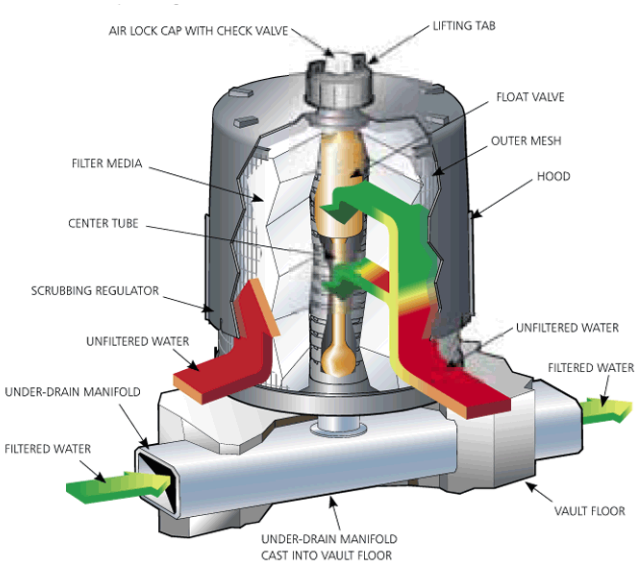


Figure 2. The StormFilter Cartridge

Cartridge Operation:

As the water level in the filtration bay begins to rise, stormwater enters the StormFilter cartridge. Stormwater in the cartridge percolates horizontally through the filter media and passes into the cartridge's center tube, where the float in the cartridge is in a closed (downward) position. As the water level in the filtration bay continues to rise, more water passes through the filter media and into the cartridge's center tube. Water displaces the air in the cartridge and it purges from beneath the filter hood through the one-way check valve located in the cap. Once water fills the center tube there is enough buoyant force on the float to open the float valve and allow the treated water to flow into the under-drain manifold. As the treated water drains, it tries to pull in air behind it. This causes the check valve to close, initiating a siphon that draws polluted water throughout the full surface area and volume of the filter. Thus, water filters through the entire filter cartridge throughout the duration of the storm, regardless of the water surface elevation in the filtration bay. This continues until the water surface elevation drops to the elevation of the scrubbing regulators. At this point, the siphon begins to break and air quickly flows beneath the hood through the scrubbing regulators, causing energetic bubbling between the inner surface of the hood and the outer surface of the filter. This bubbling agitates and cleans the surface of the filter, releasing accumulated sediments on the surface, flushing them from beneath the hood, and allowing them to settle to the vault floor.

Adjustable cartridge flow rate:

Inherent to the design of the StormFilter is the ability to control the individual cartridge flow rate with an orifice-control disc placed at the base of the cartridge. Depending on the treatment requirements and on the pollutant characteristics of the influent stream as

specified in the CONTECH *Product Design Manual*, operators may adjust the flow rate through the filter cartridges. By decreasing the flow rate through the filter cartridges, the influent contact time with the media is increased and the water velocity through the system is decreased, thus increasing both the level of treatment and the solids removal efficiencies of the filters, respectively (de Ridder, 2002).

Recommended research and development:

Ecology encourages CONTECH to pursue continuous improvements to the StormFilter. To that end, CONTECH recommends the following actions:

- Determine, through laboratory testing, the relationship between accumulated solids and flow rate through the cartridge containing the ZPG™ media. **Completed 11/05.**
- Determine the system's capabilities to meet Ecology's enhanced, phosphorus, and oil treatment goals.
- Develop easy-to-implement methods of determining that a StormFilter facility requires maintenance (cleaning and filter replacement).

Contact Information:

Applicant Contact: Jeremiah Lehman
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503-258-3136
jlehman@conteches.com

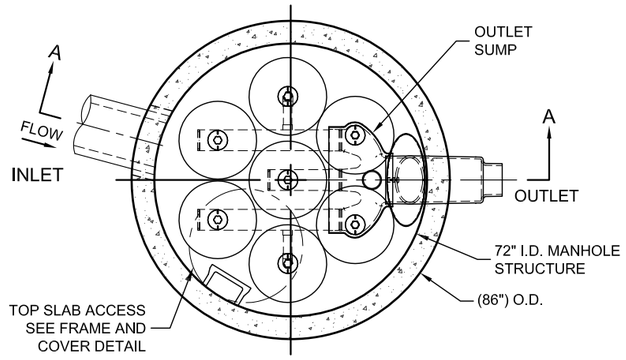
Applicant Web link http://www.conteches.com/

Ecology web link: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

Ecology Contact: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

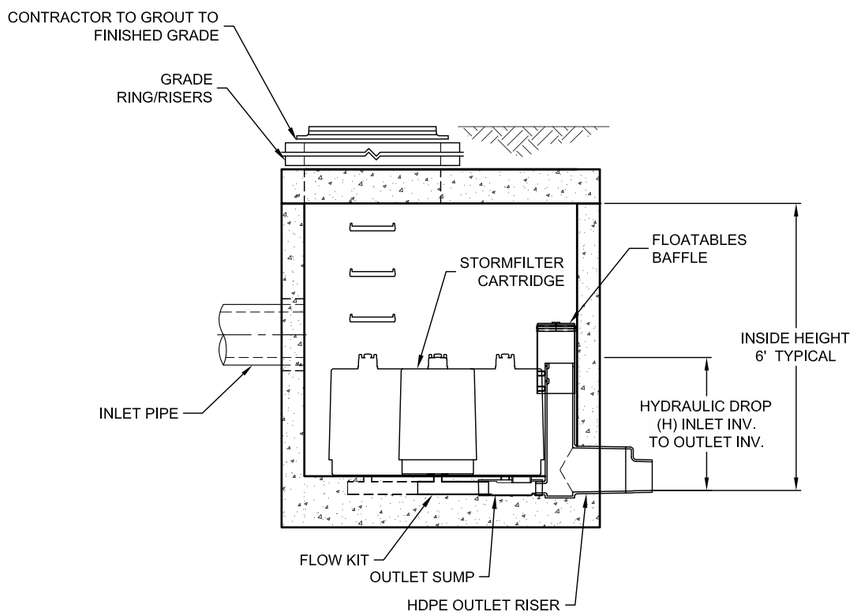
Revision History

Date	Revision
Jan 2005	Original Use Level Designation
Dec 2007	Revision
May 2012	Maintenance requirements updated
November 2012	Design Storm and Maintenance requirements updated
January 2013	Updated format to match Ecology standard format
September 2014	Added Peak Diversion StormFilter Alternate Configuration
November 2016	Revised Contech contact information



PLAN VIEW

STANDARD OUTLET RISER
FLOWKIT: 42A



SECTION A-A

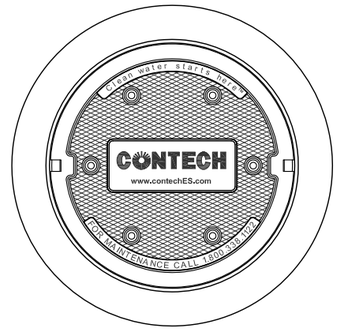
The Stormwater Management StormFilter®

STORMFILTER DESIGN NOTES

STORMFILTER TREATMENTCAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. THE STANDARD MANHOLE STYLE IS SHOWN WITH THE MAXIMUM NUMBER OF CARTRIDGES (7). VOLUME SYSTEM IS ALSO AVAILABLE WITH MAXIMUM 7 CARTRIDGES.
Ø72" MANHOLE STORMFILTER PEAK HYDRAULIC CAPACITY IS 1.5 CFS. IF THE SITE CONDITIONS EXCEED 1.5 CFS AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"		18"		LOW DROP	
RECOMMENDED HYDRAULIC DROP (H)	3.05'		2.3'		1.8'	
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/ft²	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²
CARTRIDGE FLOW RATE (gpm)	22.5	11.25	15	7.5	10	5



FRAME AND COVER

(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	*
WATER QUALITY FLOW RATE (cfs)	*
PEAK FLOW RATE (cfs)	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
# OF CARTRIDGES REQUIRED	*
CARTRIDGE FLOW RATE	*
MEDIA TYPE (CSF, PERLITE, ZPG, GAC, PHS)	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE #1	*	*	*
INLET PIPE #2	*	*	*
OUTLET PIPE	*	*	*

RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR SITE SPECIFIC DRAWINGS WITH DETAILED VAULT DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
4. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 5' AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
6. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 39 SECONDS.
7. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

INSTALLATION NOTES

1. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
2. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER STRUCTURE (LIFTING CLUTCHES PROVIDED).
3. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
4. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET PIPE(S).
5. CONTRACTOR TO PROVIDE AND INSTALL CONNECTOR TO THE OUTLET RISER STUB. STORMFILTER EQUIPPED WITH A DUAL DIAMETER HDPE OUTLET STUB AND SAND COLLAR. IF OUTLET PIPE IS LARGER THAN 8 INCHES, CONTRACTOR TO REMOVE THE 8 INCH OUTLET STUB AT MOLDED IN CUT LINE. COUPLING BY FERNCO OR EQUAL AND PROVIDED BY CONTRACTOR.
6. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

CONTECH®
ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

SFMH72
STORMFILTER
STANDARD DETAIL

APPENDIX E
MAINTENANCE MANUAL

4.6 Maintenance Standards for Drainage Facilities and Catch Basins

4.6.1 Purpose

The purpose of this chapter is to set forth maintenance standards for different components of drainage facilities and catch basins. These standards match specific facility components and features with approved uniform maintenance procedures.

The facility-specific maintenance standards contained in this section are intended to be conditions for determining if maintenance actions are required, as identified through inspection. The following definitions apply to maintenance described in this chapter.

"Drainage facility" means a catch basin or stormwater flow control or treatment facility described in Table 5.3 of this chapter.

"Maintenance" for this chapter shall be used to mean regular maintenance, repair or replacement actions. The maintenance standards are not intended to be measures of a facility's required condition at all times between inspections. In other words, if these conditions are exceeded at any time between inspections and/or maintenance, this does not automatically constitute a violation of these standards.

4.6.2 Applicability

This chapter applies to drainage facilities identified in Table 5.3 of this chapter that are owned or operated by Snohomish County, catch basins owned or operated by the County, and such drainage facilities and catch basins owned by other entities.

4.6.3 Enforcement

Chapter 7.54 Snohomish County Code (SCC) requires any owner or operator of a drainage facility described in this chapter to maintain the facility in accordance with the standards set forth in this chapter.

4.6.4 Tracking Maintenance and Repair Costs

Chapter 7.54 Snohomish County Code (SCC) requires property owners to keep records of their maintenance actions for their drainage facilities. In addition, Snohomish County requests that owners and operators of drainage facilities track the cost of maintenance and repairs and provide these costs to the County. The request for cost information is not a regulatory requirement. The information will be used by the County to estimate general maintenance and repair cost information and to provide that information to members of the public who may need to perform such work and estimate costs. The County does not intend to provide cost information that can be traced to a specific facility.

4.6.5 Drainage Facility Maintenance Schedule

A) Maintenance actions to be completed within thirty days of the date of notice

1) When a County-initiated inspection of a flow control structure finds that the hydraulic function of the structure is significantly impaired, the owner or operator shall have thirty days from the date of the notice issued by the County in which to complete maintenance actions required by the notice.

2) If, after thirty days, the required maintenance actions have not been completed, the owner or operator will be in violation of County code and will be subject to enforcement action by the County. In such cases, the County may, at its option, perform the necessary maintenance actions, in which case the owner or operator will be charged for all costs the County incurs for performing these maintenance actions.

B) Maintenance actions to be completed within one year of the date of notice

1) In addition to the requirements of section 4.6.5A, when a County-initiated inspection of a drainage facility identifies one or more conditions for any component listed in Table 5.3 for which maintenance is needed, and for which the necessary maintenance actions are estimated to cost less than $25,000, the owner or operator has one year from the date of the notice issued by the County in which to complete maintenance actions required by the notice. If maintenance of a flow control structure is required under section 4.6.5A, the cost of those maintenance actions shall be considered part of the total maintenance cost for the entire drainage facility.

2) The owner or operator is responsible for obtaining all required permits and permissions before starting work.

3) If, after one year from the date of the notice, the required maintenance actions have not been completed, the owner or operator will be subject to enforcement action by the County. In such cases, the County may, at its option, perform the necessary maintenance actions, in which case the owner or operator will be charged for all costs the County incurs for performing these maintenance actions.

4) With the exception of work described in 4.6.5A and 4.6.5D, maintenance actions may not be allowed the period from October 1 to April 30 in order to ensure that downstream property and stream corridors will not be subject to flooding, habitat degradation, or pollutant contamination as a result of these actions.

5) Depending on the scope of work and seasonal conditions, the County reserves the right to require the owner or operator to complete necessary maintenance actions in the first year during the period from May 1 to September 30.

C) Maintenance actions to be completed within two years of the date of notice

1) In addition to the requirements of section 4.6.5A, when a County-initiated inspection of a drainage facility identifies one or more conditions for any component listed in Table 5.3 for which maintenance is needed, and for which the necessary maintenance actions are estimated to cost $25,000 or more, the owner or operator has two years from the date of the notice issued by the County in which to complete maintenance actions required by the notice as well as any other actions needed to produce the expected results in Table 5.3. If maintenance of a flow control

structure is required under section 4.6.5A, the cost of those maintenance actions shall considered part of the total maintenance cost for the entire drainage facility.

2) The owner or operator shall be responsible for acquiring all needed permits and permissions before commencing work.

3) If, after two years from the date of the notice, the required maintenance actions have not been completed, the owner or operator will be subject to enforcement action by the County. In such cases, the County may, at its option, perform the necessary maintenance actions, in which case the owner or operator will be charged for all costs the County incurs for performing these maintenance actions.

4) With the exception of work described in 4.6.5A and 4.6.5D, maintenance actions may not be allowed the period from October 1 to April 30 in order to ensure that downstream property and stream corridors will not be subject to flooding, habitat degradation, or pollutant contamination as a result of these actions.

5) Depending on the scope of work and seasonal conditions, the County reserves the right to require the owner or operator to complete necessary maintenance actions in the first year during the period from May 1 to September 30.

6) In order for the owner or operator of the drainage facility to receive two (2) years to perform the necessary maintenance actions, he/she must provide the County with a good faith estimate or bid for the total cost of these maintenance actions no later than the 60th day after the date of the notice.

D) Emergency orders

1) In addition to any requirements described above, and in accordance with the provisions of Chapter 30.85 SCC, if the County determines that a condition exists at a drainage facility that endangers public or private property, creates an immediate hazard, creates a violation of critical areas provisions or surface water protection, or threatens the health and safety of the occupants of any premises or members of the public, the County may issue an emergency order. Upon issuance of an emergency order, the owner or operator of the drainage facility shall remedy the condition immediately.

4.6.6 Maintenance Standards

Maintenance standards are set forth in Table 5.3.

Table 5.3 – Maintenance Standards

No. 1 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Function of facility is impaired by or likely to be impaired by trash and debris.	Trash and debris is removed.
	Vegetation	Function of facility is impaired by vegetation.	Vegetation is removed or managed to restore proper function of facility. Use of herbicides shall be in accordance with applicable regulations.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants Note: Coordinate removal/cleanup with local and/or state water quality response agency.	Contaminants or pollutants are removed
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. Note: Contact Snohomish County Surface Water Management if removal of beavers is contemplated.
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects are destroyed or removed from site. Use of pesticides shall be in accordance with applicable regulations
	Tree Growth and Hazard Trees	Function of facility is impaired by trees. Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove Hazard trees (i.e., dead, diseased, or dying trees) need to be identified Note: A certified Arborist may be needed to determine health of trees or removal requirements.	Trees are removed or managed to restore proper function of facility. Trees do not hinder maintenance activities. Hazard trees are identified and those that pose an imminent danger are removed.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.	Slopes are stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.
General	Liner (If Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner is repaired or replaced. Liner is fully covered.
Berms	Settling	Any part of a berm which has settled at least 4 inches lower than the design elevation. If settlement is apparent, measure berm to determine amount of settlement. Settling can be an indication of more severe problems with the berm or outlet works. Note: A licensed civil engineer may be needed to determine the cause of the settlement.	Berm is repaired and restored to the design elevation.

No. 1 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Erosion	Any erosion observed on a compacted structural berm embankment. Note: A licensed civil engineer may be needed to inspect, evaluate and recommend a repair plan.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.
	Piping	Discernable water flow through a compacted structural berm. Ongoing erosion with potential for erosion to continue. Tree growth on a compacted structural berm over 4 feet in height may lead to piping through the berm which could lead to failure of the berm. Evidence of rodent holes in berm, and/or water piping through berm via rodent holes Note: A geotechnical engineer may be needed to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
Emergency Overflow/ Spillway	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. Note: A licensed civil engineer may be needed to determine proper berm/spillway restoration.
	Rock Armoring	Rock layer on subgrade is less than 1.0 feet deep and/or subgrade is exposed	Rocks and pad depth are restored to a minimum depth of 1.0 feet.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.	Slopes are stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.

NOTE: The above maintenance standards also apply to naturally-occurring closed depressions used to meet the flow control requirements set forth in SCC 30.63A.550.

No. 2 – Infiltration Facilities

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Function of facility is impaired by or likely to be impaired by trash and debris.	Trash and debris is removed.
	Vegetation	Function of facility is impaired by vegetation.	Vegetation is removed or managed to restore proper function of facility. Use of herbicides shall be in accordance with applicable regulations.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants Note: Coordinate removal/cleanup with local and/or state water quality response agency.	Contaminants or pollutants are removed
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.	Slopes are stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.
Storage Area	Sediment	Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration. (A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. If two inches or more sediment is present, remove).	Sediment is removed and/or facility is cleaned so that infiltration system works according to design.
Filter Bags (if applicable)	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 "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Berms	Settling	Any part of a berm which has settled at least 4 inches lower than the design elevation. If settlement is apparent, measure berm to determine amount of settlement. Settling can be an indication of more severe problems with the berm or outlet works. Note: A licensed civil engineer may be needed to determine the cause of the settlement.	Berm is repaired and restored to the design elevation.
	Erosion	Any erosion observed on a compacted structural berm embankment. Note: A licensed civil engineer may be needed to inspect, evaluate and recommend a repair plan.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.

No. 2 – Infiltration Facilities

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Piping	Discernable water flow through a compacted structural berm. Ongoing erosion with potential for erosion to continue. Tree growth on a compacted structural berm over 4 feet in height may lead to piping through the berm which could lead to failure of the berm. Evidence of rodent holes in berm, and/or water piping through berm via rodent holes Note: A geotechnical engineer may be needed to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow Spillway	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. Note: A licensed civil engineer may be needed to determine proper berm/spillway restoration.
	Rock Armoring	Rock layer on subgrade is less than 1.0 feet deep and/or subgrade is exposed	Rocks and pad depth are restored to a minimum depth of 1.0 feet.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.	Slopes are stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	The settling area or sump contains sediment/debris up to a depth of either 6 inches or the sedimentation design depth.	Sediment/debris is removed.

No. 3 – Underground Detention Pipes/Tanks

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	The average sediment depth measured at multiple locations exceeds 10% of the detention pipe diameter (or the depth of the storage area) or the sediment depth measured at any single point exceeds 15% of the pipe diameter. (Example: The sediment depth in a 60-inch diameter detention pipe is measured at three locations. The sediment would need to be removed if the average depth of the three measurements is at least 6 inches or if the depth of any single measurement is at least 9 inches.	All sediment, debris, and organic matter removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids at section joint allowing material to seep into or water to leak out of facility. Note: This may need an engineering analysis to assess the structural stability.	All joints between tank/pipe sections are sealed.
	Tank or Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. Note: This may need an engineering analysis to assess the structural stability.	Tank/pipe section is repaired or replaced to design.
	Tank/Pipe Material	Any visible holes or cracks wider than a quarter of an inch or evidence of material seeping into or water leaking out of pipe wall, or qualified maintenance or inspection personnel determine that tank/pipe is not structurally sound.	Tank/pipe is repaired or replaced to design specifications and is structurally sound.
Access Hole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Locking mechanism cannot be opened or lock bolts cannot be removed by one maintenance person with proper hand tools.	Mechanism or lock bolts open with proper hand tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, cracked/broken rungs, misalignment, rungs not securely attached to structure wall, rust, or cracks.	Ladder meets design standards and allows maintenance person safe access.
Catch Basins	See "Catch Basins" (No. 5)	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).
Standpipe, Cleanout Gate, Orifice Plate	Obstructions, Damaged, or Missing	See "Control Structure/Flow Restrictors" (No. 4)	See "Control Structure/Flow Restrictors" (No. 4)

No. 4 – Control Structure/Flow Restrictors

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Standpipe	Obstructions	Any material blocking (or having the potential of blocking) the pipe overflow.	Pipe is free of all obstructions and works as designed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure is securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure is in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes other than designed holes in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	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.
Access Hole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Locking mechanism cannot be opened or lock bolts cannot be removed by one maintenance person with proper hand tools.	Mechanism or lock bolts open with proper hand tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, cracked/broken rungs, misalignment, rungs not securely attached to structure wall, rust, or cracks.	Ladder meets design standards and allows maintenance person safe access.

No. 4 – Control Structure/Flow Restrictors

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Catch Basin	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).
	Sediment & Debris	Sediment, trash, vegetation, and/or other debris material exceeds 25% of the catch basin sump depth or is 1 foot below the orifice plate.	Control structure orifice is not blocked. All sediment and debris removed.

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Sediment & Debris	Sediment, trash, and/or other debris material is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No sediment or debris is located immediately in front of catch basin or on grate opening.
		Sediment, trash, and/or other debris material (located in the catch basin) 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.	No sediment or debris is in the catch basin.
		Sediment, trash, and/or other debris material located in any inlet or outlet pipe is blocking more than 1/3 of its height.	Inlet and outlet pipes are free of sediment and debris.
		Dead animals or vegetation that impair catch basin function or that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation are present within 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 seeping into the catch basin).	Top slab is free of holes and cracks. No water and/or soil is seeping into the catch 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	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Catch basin is replaced or repaired to design standards.
		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.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	Settlement of misalignment of the catch basin causes a safety, function, or design problem.	Catch basin is replaced or repaired to design standards.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants Note: Coordinate removal/cleanup with local and/or state water quality response agency.	Contaminants or pollutants are removed.
Access Hole Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is fully in place
	Locking Mechanism Not Working	Locking mechanism cannot be opened or lock bolts cannot be removed by one maintenance person with proper hand tools.	Mechanism or lock bolts open with proper hand tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools. Intent is keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, cracked/broken rungs, 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)	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 and meets design standards.

No. 6 – Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Barrier replaced or repaired to design standards.
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe	Barrier firmly attached to pipe

No. 7 – Energy Dissipaters

Maintenance Components	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil where pad was originally installed.	Rock pad replaced to design standards.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
Rock Gabion Structures	Wire basket matrix deteriorated or broken	Deterioration determined to be near to breaking. Broken wire results in hole large enough to allow rocks to protrude out of basket	Rewire area of concern or replace basket and/or rocks as necessary
	Wire basket misaligned	Baskets have shifted and no longer providing full energy dissipations or may be prone to tipping or collapse	Realign or relocate as necessary to meet design intent
Dispersion Trench	Perforated Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth or over 1/3 of perforations in pipe are plugged.	Pipe cleaned/flushed so that it matches design.
	Not Discharging Water Properly	Water is discharging at a few concentrated points along the top of the trench rather than flowing uniformly along the entire length of trench lip.	Trench redesigned or rebuilt to standards.
	"Distributor" Catch Basin Overflows	Water is observed or reported to be flowing out of top of basin during any storm less than the design storm.	Facility rebuilt or redesigned to standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Catch Basins	Other Defects	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

No. 8 – Typical Biofiltration Swales

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits on grass treatment area of the swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased. Reseed any bare spots as needed in loosened, fertile soil.
	Standing Water	When water stands in the swale between storms and does not drain freely.	Any of the following may apply: remove sediment or trash blockages, improve grade from head to foot of swale, remove clogged check dams, add underdrains or convert to a wet biofiltration swale.
	Flow spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire swale width.	Level the spreader and clean so that flows are spread evenly over entire swale width.
	Constant Baseflow	When small quantities of water continually flow through the swale, even when it has been dry for weeks and an eroded, muddy channel has formed in the swale bottom.	Add a low-flow pea-gravel drain the length of the swale or by-pass the baseflow around the swale.
	Poor Vegetation Coverage	When grass is sparse or bare or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Replant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals. Or reseed into loosened, fertile soil.
	Vegetation	When the grass becomes excessively tall (greater than 10-inches); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
	Excessive Shading	Grass growth is poor because sunlight does not reach swale.	If possible, trim back overhanging limbs and remove brushy vegetation on adjacent slopes. In addition, reseed bare spots with shade tolerant grass seed mix and/or replant with plugs of slough sedge or other sedges.
	Inlet/Outlet	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
	Trash and Debris Accumulation	Trash and debris accumulated in the bio-swale.	Remove trash and debris from swale.
	Erosion/Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12 inches wide, the swale should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.

No. 9 – Wet Biofiltration Swales

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation	Sediment depth exceeds 2 inches in 10% of the swale treatment area.	Remove sediment deposits in treatment area.
	Water Depth	Water not retained to a depth of about 4 inches during the wet season.	Build up or repair outlet berm so that water is retained in the wet swale.
	Wetland Vegetation	Vegetation becomes sparse and does not provide adequate filtration, OR vegetation is crowded out by very dense clumps of cattail, which do not allow water to flow through the clumps.	Determine cause of lack of vigor of vegetation and correct. Replant as needed with wetland plants. For excessive cattail growth, cut cattail shoots back and compost offsite. Note: normally wetland vegetation does not need to be harvested unless die-back is causing oxygen depletion in downstream waters.
	Inlet/Outlet	Inlet/outlet area clogged with sediment and/or debris.	Remove clogging or blockage in the inlet and outlet areas.
	Erosion/Scouring	Swale has eroded or scoured due to flow channelization, or higher flows.	Check design flows to assure swale is large enough to handle flows. Bypass excess flows or enlarge swale. Replant eroded areas with fibrous-rooted plants such as Juncus effusus (soft rush) in wet areas or snowberry (Symphoricarpos albus) in dryer areas.

No. 10 – Filter Strips

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits, re-level so slope is even and flows pass evenly through strip. Reseed any bare spots as needed in loosened, fertile soil.
	Vegetation	When the grass becomes excessively tall (greater than 10 inches); when nuisance weeds and/or other vegetation starts to take over.	Mow grass, control nuisance vegetation, such that flow is not impeded. Grass should be mowed to a height between 3-4 inches.
	Erosion/Scouring	Eroded or scoured areas due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the filter strip should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident.
	Flow spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire filter width.	Level the spreader and clean so that flows are spread evenly over entire filter width.

No. 11 – Wetponds

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Water level	First cell is empty, doesn't hold water.	Line the first cell to maintain water per the original design. Although the second cell may drain, the first cell must remain full to control turbulence of the incoming flow and reduce sediment resuspension.
	Inlet/Outlet Pipe	Inlet/Outlet pipe clogged with sediment and/or debris material.	No clogging or blockage in the inlet and outlet piping.
	Sediment Accumulation in Pond Bottom	Sediment accumulations in pond bottom that exceeds the depth of sediment zone plus 6 inches, usually in the first cell.	Sediment removed from pond bottom.
	Oil Sheen on Water	Prevalent and visible oil sheen.	Oil removed from water using oil-absorbent pads or vactor truck. Source of oil located and corrected. If chronic low levels of oil persist, plant wetland plants such as Juncus effusus (soft rush) which can uptake small concentrations of oil.
	Erosion	Erosion of the pond's side slopes and/or scouring of the pond bottom that exceeds 6 inches, or where continued erosion is prevalent.	Slopes stabilized using proper erosion control measures and repair methods.
Berms	Settling	Any part of a berm which has settled at least 4 inches lower than the design elevation. If settlement is apparent, measure berm to determine amount of settlement. Settling can be an indication of more severe problems with the berm or outlet works. Note: A licensed civil engineer may be needed to determine the cause of the settlement.	Berm is repaired and restored to the design elevation.
	Internal Berm	Berm dividing cells should be level.	Berm surface is leveled so that water flows evenly over entire length of berm.
	Erosion	Any erosion observed on a compacted structural berm embankment. Note: A licensed civil engineer may be needed to inspect, evaluate and recommend a repair plan.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.

No. 11 – Wetponds

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Piping	Discernable water flow through a compacted structural berm. Ongoing erosion with potential for erosion to continue. Tree growth on a compacted structural berm over 4 feet in height may lead to piping through the berm which could lead to failure of the berm. Evidence of rodent holes in berm, and/or water piping through berm via rodent holes Note: A geotechnical engineer may be needed to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. Note: A licensed civil engineer may be needed to determine proper berm/spillway restoration.
	Rock Armoring	Rock layer on subgrade is less than 1.0 feet deep and/or subgrade is exposed	Rocks and pad depth are restored to a minimum depth of 1.0 feet
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.	Slopes are stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.

No. 12 – Wetvaults

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash/Debris Accumulation	Trash and debris accumulated in vault, pipe or inlet/outlet (includes floatables and non-floatables).	Remove trash and debris from vault.
	Sediment Accumulation	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6 inches.	Remove sediment from vault.
	Damaged Pipes	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Access Hole Cover Damaged/Not Working	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Ventilation	Ventilation area blocked or plugged.	Blocking material removed or cleared from ventilation area. Specified % of the vault surface area provides ventilation to the vault interior (see design 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 qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is 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 repaired so that no cracks exist wider than 1/4 inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by qualified maintenance or inspection personnel.	Baffles repaired or replaced to specifications.
	Access Ladder Damage	Ladder is corroded or deteriorated, not functioning properly, not attached to structure wall, missing rungs, has cracked/broken rungs and/or is misaligned. Confined space warning sign missing.	Ladder replaced or repaired to specifications, and allows maintenance person safe access. Replace sign warning of confined space entry requirements. Ladder and entry notification complies with OSHA standards.

No. 13 – Sand Filters (above ground/open)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Above Ground (open sand filter)	Sediment Accumulation on top layer	Sediment depth exceeds 1/2 inch.	No sediment deposit on top layer of sand filter that would impede permeability of the filter section.
	Trash and Debris Accumulations	Trash and debris accumulated on sand filter bed.	Trash and debris removed from sand filter bed.
	Sediment/ Debris in Clean-Outs	When the clean-outs become fully or partially plugged with sediment and/or debris.	Sediment removed from clean-outs.
	Sand Filter Media	Drawdown of water through the sand filter media takes longer than 24 hours, and/or flow through the overflow pipes occurs frequently.	Top several inches of sand are scraped. May require replacement of entire sand filter depth depending on extent of plugging (a sieve analysis is helpful to determine if the lower sand has too high a proportion of fine material).
	Prolonged Flows	Sand is saturated for prolonged periods of time (several weeks) and does not dry out between storms due to continuous base flow or prolonged flows from detention facilities.	Low, continuous flows are limited to a small portion of the facility by using a low wooden divider or slightly depressed sand surface.
	Short Circuiting	When flows become concentrated over one section of the sand filter rather than dispersed.	Flow and percolation of water through sand filter is uniform and dispersed across the entire filter area.
	Erosion Damage to Slopes	Erosion over 2 inches deep where cause of damage is prevalent or potential for continued erosion is evident.	Slopes stabilized using proper erosion control measures.
	Rock Pad Missing or Out of Place	Soil beneath the rock is visible.	Rock pad replaced or rebuilt to design specifications.
	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed across sand filter.	Spreader leveled and cleaned so that flows are spread evenly over sand filter.
	Damaged Pipes	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired or replaced.

No. 14 –Sand Filters (below ground/enclosed)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault.	Sediment Accumulation on Sand Media Section	Sediment depth exceeds 1/2 inch.	No sediment deposits on sand filter section that would impede permeability of the filter section.
	Sediment Accumulation in Presettling Portion of Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6 inches.	No sediment deposits in first chamber of vault.
	Trash/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.
	Sediment/Debris in Drain Pipes/Cleanouts	Sediment, trash, and/or other debris material located in any inlet, outlet, or cleanout pipe is blocking more than 1/3 of its height.	Sediment and debris removed.
	Short Circuiting	When seepage/flow occurs along the vault walls and corners. Sand eroding near inflow area.	Sand filter media section re-laid and compacted along perimeter of vault to form a semi-seal. Erosion protection added to dissipate force of incoming flow and curtail erosion.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Access Hole Cover Damaged/Not Working	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Ventilation	Ventilation area blocked or plugged	Blocking material removed or cleared from ventilation area. Specified % of the vault surface area provides ventilation to the vault interior (see design specifications).
	Vault Structure Damaged; 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 qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is 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 repaired so that no cracks exist wider than 1/4 inch at the joint of the inlet/outlet pipe.
	Baffles/Internal walls	Baffles or walls corroding, cracking, warping and/or showing signs of failure as determined by qualified maintenance or inspection personnel.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, has cracked/broken rungs, and/or is misaligned.	Ladder replaced or repaired to specifications, and allows maintenance person safe access.

No. 15 – Stormfilter™

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault	Sediment Accumulation on Media.	Sediment depth exceeds 1/4 inch.	No sediment deposits which would impede permeability of the compost media.
	Sediment Accumulation in Vault	Sediment depth exceeds 6 inches in first chamber.	No sediment deposits in vault bottom of first chamber.
	Trash/Debris Accumulation	Trash and debris accumulated on compost filter bed.	Trash and debris removed from the compost filter bed.
	Sediment/Debris in Drain Pipes/Cleanouts	Sediment, trash, and/or other debris material located in any inlet, outlet, or cleanout pipe is blocking more than 1/3 of its height.	Sediment and debris removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced.
	Access Hole Cover Damaged/Not Working	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Vault Structure Includes Cracks in Wall, 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 qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is 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 repaired so that no cracks exist wider than 1/4 inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking warping, and/or showing signs of failure as determined by qualified maintenance or inspection personnel.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, has cracked/broken rungs, and/or is misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.
Below Ground Cartridge Type	Media clogged	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges replaced.
	Flow short Circuited	Flows do not properly enter filter cartridges.	Filter cartridges replaced.

Check manufacturer's operation and maintenance manual for complete maintenance instructions.

No. 16 – API Baffle Oil/Water Separators

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Discharged Water Not Clean	Water discharged from facility has obvious signs of poor water quality.	Treated stormwater discharged from vault should be clear without thick visible sheen.
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6 inches in depth.	No sediment deposits on vault bottom that would impede flow through the vault and reduce separation efficiency.
	Trash and Debris Accumulation	Trash and debris accumulation in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.
	Oil Accumulation	Oil accumulations that exceed 1 inch, at the surface of the water.	Extract oil from vault by vactoring. Disposal in accordance with state and local regulations.
	Damaged Pipes	Inlet or outlet pipes damaged or broken and in need of repair.	Pipes repaired or replaced.
	Access Hole Cover Damaged/Not Working	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	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 qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is 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 repaired so that no cracks exist wider than 1/4 inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by qualified maintenance or inspection personnel.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, has cracked/broken rungs, and/or is misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

No. 17 – Coalescing Plate Oil/Water Separators

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Discharged Water Not Clean	Water discharged from facility has obvious signs of poor water quality.	Treated stormwater discharged 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 pipes damaged or broken and in need of repair.	Pipes repaired and or replaced.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by qualified maintenance or 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 qualified maintenance or inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is 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 repaired so that no cracks exist wider than 1/4 inch at the joint of the inlet/outlet pipe.
	Access Hole Cover Damaged/Not Working	One maintenance person cannot remove lid after applying normal lifting pressure with proper hand tools.	Cover can be removed and reinstalled by one maintenance person with proper hand tools.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, has cracked/broken rungs, and/or is misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.

No. 18 – Catchbasin 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 Normal 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.

No. 19 – Media Filter Drain

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits on grass treatment area of the swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased. Reseed any bare spots as needed in loosened, fertile soil.
	Poor Vegetation Coverage	When grass is sparse or bare or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Replant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals. Or reseed into loosened, fertile soil.
	Vegetation	When the grass becomes excessively tall (greater than 10-inches); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
	Inlet/Outlet	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
	Trash and Debris Accumulation	Trash and debris accumulated in the bio-swale.	Remove trash and debris from swale.
	Erosion/Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12 inches wide, the swale should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.

No. 20 – Compost Amended Vegetated Filter Strip (CAVFS)

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits on grass treatment area of the swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased. Reseed any bare spots as needed in loosened, fertile soil.
	Poor Vegetation Coverage	When grass is sparse or bare or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Replant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals. Or reseed into loosened, fertile soil.
	Vegetation	When the grass becomes excessively tall (greater than 10-inches); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
	Inlet/Outlet	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
	Trash and Debris Accumulation	Trash and debris accumulated in the bio-swale.	Remove trash and debris from swale.
	Erosion/Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12 inches wide, the swale should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.

No. 21 – Bioretention Facilities

Component	Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
Inlet	Energy dissipaters are damaged	Visible soil, missing rock, or other evidence of damage	Replace or rebuild energy dissipaters to design specifications
	Inlet is blocked	Flow into bioretention bed is impeded	Remove blockage to restore flow
Bioretention bed / plants	Sediment accumulation	Sediment depth exceeds 1 inch	Remove sediment to restore permeability
	Trash or debris accumulation	Trash or debris are accumulated on bed	Remove trash and debris
	Excessive drawdown time	Drawdown time > 48 hours	Remove and replace mulch or bioretention soil mix to restore permeability, and/or clean underdrain
	Uneven ponding	Water does not pond evenly on bed	Remove, replace, or reposition mulch to restore even ponding
	Bioretention plants	Bioretention plants are missing, diseased, or dead	Replace plants with healthy bioretention plants selected per the planting plan
	Weeds or invasive plants	Weeds or invasive plants growing in bioretention facility	Remove weeds and invasive plants, replace with bioretention plants or cover affected areas with mulch, as appropriate
	Mulch is inadequate	Mulch is missing	Replace mulch to maintain 2-3 inch depth in mulched areas of bioretention system
	Bed compaction	Bed is compacted due to foot or vehicle traffic or other reason	Loosen compacted bed material, or replace as needed, to restore permeability
Sidewalls, check dams, weirs	Visible damage or erosion	Sidewalls, check dams, or weirs have visible erosion or other structural damage	Repair to bring into conformance with facility design
	Flow over check dams or weirs is blocked	Flow is blocked so that design ponding depth is exceeded	Clear blockage to restore design ponding depth
	Flow around check dams or weirs	Flow is going around check dams or weirs so that design ponding depth is not attained	Repair check dams, weirs, and sidewalls to restore design ponding depth
	Grade board or weir top not level	Uneven flow over check dams or weirs so that design ponding depth is not attained	Repair check dams and weirs to restore design ponding depth
Overflow	Energy dissipaters are damaged	Visible soil, missing rock, or other evidence of damage	Replace or rebuild energy dissipaters to design specifications
	Overflow is blocked	Flow is blocked so that standing pool depth is above design depth	Clear overflow structure to restore design ponding depth
Underdrain system	Underdrain is blocked or damaged	Flow does not pass as designed through underdrain system	Clean or repair underdrain system to restore design flow capacity

No. 22 – Permeable Pavement

Pavement type	Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
All types	Unstable soil on adjacent area	Runoff from adjacent areas deposits soil, mulch, or sediment on permeable pavement	Remove deposited material from pavement, and stabilize adjacent areas so that further deposition of material on pavement will not occur.
	Adjacent vegetation is covering permeable pavement	Vegetation impedes infiltration in permeable pavement	Trim or remove vegetation so that infiltration is not impeded
	Unwanted vegetation or moss is growing in or on permeable pavement	Unwanted vegetation impedes infiltration in permeable pavement or displaced desired vegetation	Remove unwanted vegetation, repair permeable pavement as needed, replace desired vegetation as needed
	None (routine maintenance)	N/A	Vacuum or sweep according to equipment manufacturer's specifications so that infiltration is not impeded
	Debris or sediment on pavement	Sediment or debris deposits are visible on pavement	Remove sediment or debris and vacuum or sweep according to equipment manufacturer's specifications so that infiltration is not impeded
	Infiltration capacity is reduced	Water ponds on pavement or runs off pavement during rain events	Vacuum or sweep according to equipment manufacturer's specifications so that infiltration is not impeded
	Settlement	Settlement of pavement impedes infiltration	Restore pavement to design grade
Porous asphalt and pervious concrete	Cracks in pavement	Pavement spalls or ravels at crack edges	Patch or cut and replace the affected area with paving material similar to the original pavement. Replace in-kind where feasible. Porous asphalt may be replaced with conventional asphalt if it is a small percentage of the total permeable pavement area and does not impact the overall permeable pavement function.
Permeable pavers	Paving block missing or damaged	Paving block missing or damaged	Repair or replace missing or damaged pavers according to manufacturer's specifications
Open-celled paving grid	Paving grid missing or damaged	Three or more adjacent rings in paving grid missing or damaged	Repair or replace missing or damaged paving grid according to manufacturer's specifications
	Loss of aggregate in paving grid	Loss of aggregate in paving grid	Replenish aggregate material in grid to manufacturer's specifications
	Poor / missing grass in vegetated paving grid	Poor / missing grass in vegetated paving grid	Replace growing medium in grid, replant or reseed with grass
Pipe inlet / outlet / underdrain system	Pipe system is blocked or damaged	Flow does not pass as designed through pipe system	Clean or repair pipe system to restore design flow capacity

No. 20 – Vortechs Systems

Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed Or Not Needed
General	Sediment Accumulation	Sediment depth is within 12 through 18 inches of dry weather water surface elevation.	Accumulated sediment should be removed.
	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.
	See Wet Vaults (No. 12)		

Check manufacturer's operation and maintenance manual for complete maintenance instructions.

No. 21 - Conveyance Storm Pipes

Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed Or Not Needed
General	Obstructions, Including Roots	Root enters or deforms pipe, reducing flow.	Use mechanical methods to remove root if possible. Use of chemicals to remove roots shall be done in accordance with applicable regulations. If necessary, remove the vegetation over the line.
	Pipe Dented or Broken	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Pipe Rusted or Deteriorated	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired and/or replaced.
	Sediment & Debris	Sediment depth is greater than 20% of pipe diameter.	Install upstream debris traps (where applicable) then clean pipe and remove material.
	Debris barrier or Trash Rack Missing	A debris barrier or trash rack that had been installed on the end of a drainage pipe is missing	Debris barrier or trash rack is replaced.
	Joint/Seal Problems	The joint between pipe sections is separated and/or the seal at the joint is cracked or broken.	The joint and/or seal is repaired so that joint is not separated and is properly sealed.

No. 22 - Facility Discharge Points

Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed Or Not Needed
Monitoring	Inspection of Discharge Water for Obvious Signs of Poor Water Quality.	Sheen, obvious oil or other contaminants present.	Identify and eliminate pollution source AND report discharge to Snohomish County Surface Water Management Division. Effluent discharge from facility should be clear.
	Receiving Area Saturated	Water in receiving area is causing substrate to become saturated and unstable.	Receiving area sound.
General	Rock Pad - Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil where pad was originally installed.	Rock pad replaced to design standards.
	Rock Pad - Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
	Obstructions, Including Roots	Roots or debris enters pipe or deforms pipe, reducing flow	Use mechanical methods to remove root if possible. Use of chemicals to remove roots shall be done in accordance with applicable regulations. If necessary, remove the vegetation over the line
	Pipe Rusted or Deteriorated	Any part of the pipe that is broken, crushed or deformed more than 20% or any other failure to the piping	Pipe repaired or replaced.

No. 23 – Access Gates

Maintenance Component	Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
General	Damaged or missing components	Gate and/or locking mechanism condition is such that access is impeded.	Gate and locking mechanism are fully functional for access purposes.
	Damaged or missing components	Broken or missing hinges such that gate cannot be easily opened and closed by a maintenance person.	Hinges intact and lubed. Gate is working freely.
	Damaged or missing components	Gate is out of plumb more than 6 inches and more than 1 foot out of design alignment.	Gate is aligned and vertical (plumb).
	Damaged or missing components	Missing stretcher bands, and ties.	Stretcher bar, bands, and ties in place.

No. 24 – Access Roads

Maintenance Component	Defect	Condition When Maintenance is Needed	Maintenance Action and Expected Results
General	Road Surface	Condition of road surface may lead to erosion of the facility or limit access.	Road repaired.
	Erosion of Ground Surface	Noticeable rills are seen in landscaped areas.	Causes of erosion are identified and steps taken to slow down/spread out the water. Eroded areas are filled, contoured, and seeded. If needed, regrade affected areas.
	Vegetation	Function of road is impaired by vegetation	Vegetation is removed or managed to restore proper function of facility. Use of herbicides shall be in accordance with applicable regulations.
	Tree Growth	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove.	Trees do not hinder maintenance activities.
		Trees or shrubs that have fallen over road.	Fallen trees or shrubs removed from road.

APPENDIX F
SOIL MANAGEMENT WORKSHEETS

Print Form

4/6/2017

Soil Management Plan Summary Form

For Post-construction Soil Standard — Snohomish County Planning and Development Services

Use **Achieving the Post-construction Soil Standard** booklet instructions to carry out this Soil Management Plan.

Project Information *Complete all information on page 1, only site address and permit number on additional pages.*

Site address/Lot No. 20500 Richmond Beach Dr NW

Permit Type Urban Center

Permit Number

Permit Holder BSRE Point Wells, LP C/O Karr Tuttle Campbell

Phone (206) 223-1313(Doug Luetjen)

Mailing Address 701 Fifth Avenue, Suit 3300

Contact Person Mark Davies

Phone (206) 223-0326

Plan Prepared By Mark Davies, MIG|SvR

Attachments - attach the following to this plan:

* Scale stormwater site plan drawings that include areas to be treated with Soil Treatment Options 1, 2, 3, 4.

* Completed Compost and Topsoil Calculation Worksheet results.

* Original compost and/or topsoil test results reports demonstrating that products contain adequate organic matter (for soil treatment options 2) and meet topsoil soil quality standard.

Note: Retain original delivery tickets for compost and/or topsoil products for verifi cation purposes.

Soil Treatment Options for Areas Identified on Site Plan

Soil treatment options available:

***Option 1** – Leave native soil undisturbed, and protect from compaction during construction.

***Option 2** – Amend existing soil in place.

***Option 3** – For native soil: stockpile site duff and topsoil, and reapply after grading and construction.

***Option 4** – Import topsoil mix with 8-13% soil organic matter content.

FOR PDS USE ONLY **Plan Approval Record**

Date: _____ Reviewer: _____ Approved: _____

Revisions Required: _____

Date: _____ Reviewer: _____ Approved: _____

Revisions Required: _____

Area: A (refer to lettered areas mapped on site plan)

Square footage: 663,900

Selected soil treatment option: ☐ Option 1 ☐ Option 2 ☐ Option 3 ☒ Option 4

If using option 2, select type of amendment rate:

☐ Pre-approved (2") ☐ Custom with _____ % Target Soil Organic Matter

Area: B (refer to lettered areas mapped on site plan)

Square footage: 694,900

Selected soil treatment option: ☒ Option 1 ☐ Option 2 ☐ Option 3 ☐ Option 4

If using option 2, select type of amendment rate:

☐ Pre-approved (2") ☐ Custom with _____ % Target Soil Organic Matter

Area: _____ (refer to lettered areas mapped on site plan)

Square footage: _____

Selected soil treatment option: ☐ Option 1 ☐ Option 2 ☐ Option 3 ☐ Option 4

If using option 2, select type of amendment rate:

☐ Pre-approved (2") ☐ Custom with _____ % Target Soil Organic Matter

Record the compost and/or topsoil products to be used

Compost Product #1: _____

Test Results % organic matter: _____ Quantity in cubic yards _____

Supplier _____

Compost Product #2: _____

Test Results % organic matter: _____ Quantity in cubic yards _____

Supplier _____

Topsoil Product #3: _____

Test Results % organic matter: _____ Quantity in cubic yards _____

Supplier _____

Topsoil Product #4: _____

Test Results % organic matter: 8-13% Quantity in cubic yards 16,598

Supplier Cedar Grove

Total cubic yards compost: _____ **Total cubic yards topsoil:** 16,598

Compost and Topsoil Calculation Worksheet for the Pre-approved Amendment Rate

NOTE: For Options 2 and 3, use this worksheet if you plan to use the pre-approved compost amendment rate of 2 inches. This worksheet should not be used if a custom compost amendment rate is selected for Options 2 and/or 3.

Option 1

Leave native soil undisturbed, and protect from compaction during construction.

- Enter lettered areas from site plan where this option will be used:

B

No calculations for compost or topsoil are necessary for this option.

Option 2

Amend existing soil in-place (2-inch layer of compost).

- Enter lettered areas from site plan where this option will be used:

_____

- Enter combined square footage of lettered areas in thousands _____ — (example: for 4,525 sq ft, enter 4.525; for 500 sq ft, enter 0.5)
- Multiply combined square footage by **6.2** and enter product in box A :

A	=Cubic Yards

AMOUNT OF COMPOST NEEDED FOR THESE AREAS

Note: MR 5 is triggered on sites with more than 2,000 sq. ft. of new, replaced, or new plus replaced impervious surface, or 7,000 sq. ft. or greater of land disturbing activity.

Option 3

Native Soil – stockpile site duff and topsoil and reapply after grading and construction.

- Enter lettered areas from site plan where this option will be used:

_____ _____ _____ _____ _____ _____

- Enter combined square footage of lettered areas in thousands _____
(example: for 4,525 sq ft, enter 4.525; for 500 sq ft, enter 0.5)

- Multiply **combined square footage** by **25** and enter product in box B :

B	=Cubic Yards

AMOUNT OF TOPSOIL TO BE STOCKPILED AND REAPPLIED IN THESE AREAS

Option 4

Import topsoil.

- Enter lettered areas from site plan where this option will be used:

A _____ _____ _____ _____ _____

- Enter combined square footage of lettered areas in thousands 663.900
(example: for 4,525 sq ft, enter 4.525; for 500 sq ft, enter 0.5)

- Multiply **combined square footage** by **25** and enter product in box C:

C	16,598 =Cubic Yards

AMOUNT OF IMPORTED TOPSOITHESE NEEDED FOR THESE AREAS

Order

Order These Amounts:

- Enter amount in Box **A:** _____ **Cubic Yards of Compost**

- Enter amount in Box **C :** 16,598 **Cubic Yards of Topsoil**

Note: MR 5 is triggered on sites with more than 2,000 sq. ft. of new, replaced, or new plus replaced impervious surface, or 7,000 sq. ft. or greater of land disturbing activity.

4/6/2017