# Storm Drainage Report

Lee's Apartments
19807 - 68th Avenue W
Lynnwood, WA  98036
Parcel # 27042000100100

*Prepared by:*

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*Exp. 16 October 2023*

November 2021

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# 1. SITE ANALYSIS

## 1.1 Project Overview

19807 - 68th Avenue W is located within the limits of the City of Lynnwood. The site is bounded by 68th Avenue W on the west, the Lynnwood Ice Centre on the north and east and the Carriage Gardens plat on the south.

The 17,183 ft$^2$ (0.39 acre) property currently has one single-family residence near the centre of the property. The residence is currently occupied. The site drains to the southwest as sheet flow on compacted surfaces and infiltrates elsewhere.

This project will raze the existing building and construct a single structure containing twelve apartments.

The general area is shown in Figure 1.


**Figure 1.** Vicinity map.

The project site includes only the subject property.

## 1.2 Site Analysis

A topographic survey was performed over the site by Plog Engineering, most recently revised in November 2021.

# 2. CONDITIONS AND REQUIREMENTS SUMMARY

### Applicable Site Conditions

A review was made of the City's critical areas maps. There are no erosion or geologic hazards, frequently flooded areas, wetlands or critical aquifer recharge areas near the site. The storm drain in 68th Avenue W is shown as an un-typed stream.

### Native Soil and Vegetation Protection Areas

No native soil or vegetation protection areas exist on the site and none are proposed.

### Applicable Site Requirements

The City of Lynnwood has adopted the 2014 *Stormwater Management Manual for Western Washington* (SWMMWW) by Washington Department of Ecology as the basis of their storm drainage review.

As part of that review, Figure I-3.1, *Flow Chart for Determining Requirements for New Development*, was applied. The result is that all Minimum Requirements need to be addressed.

## 2.1 Minimum Requirement #1: Preparation of Stormwater Site Plans

All projects meeting the thresholds in I-2.4 *Applicability of the Minimum Requirements* shall prepare a Stormwater Site Plan (Storm Drainage Report) for local government review.

This requirement will be satisfied by the acceptance of this report by the City of Lynnwood.

## 2.2 Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPP)

Objective: to control erosion and prevent sediment and other pollutants from leaving the site during the construction phase of a project. To have fully functional stormwater facilities and BMP's for the developed site upon completion of construction.

This requirement is addressed in Section 5, below.

## 2.3 Minimum Requirement #3: Source Control of Pollution

Objective: the intent of source control BMPs is to prevent stormwater from coming in contact with pollutants. They are a cost-effective means of reducing pollutants in stormwater and, therefore, should be a first consideration in all projects.

This requirement is addressed in Section 4.4, below.

## 2.4 Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

Objective: to preserve and utilize natural drainage systems to the fullest extent because of the multiple stormwater benefits these systems provide; and to prevent erosion at and downstream of the discharge location.

The area of this project has been heavily disturbed by suburban development. From modern contours, it appears the area does not readily flow off-site. Any excess flow will be out the driveway, south on 68$^{th}$ Avenue W and in to the existing storm drain.

## 2.5 Minimum Requirement #5: On-site Stormwater Management

Objective: to use practices distributed across a development that reduce the amount of disruption of the natural hydrologic characteristics of the site.

### 2.6 Minimum Requirement #6: Runoff Treatment

Objective: to reduce pollutant loads and concentrations in stormwater runoff using physical, biological and chemical removal mechanisms so that beneficial uses of receiving waters are maintained and, where applicable, restored. When site conditions are appropriate, infiltration can potentially be the most effective BMP for runoff treatment.

This requirement is addressed in Section 4.5, below.

### 2.7 Minimum Requirement #7: Flow Control

Objective: to prevent increases in the stream channel erosion rates that are characteristic of natural conditions (i.e., prior to disturbance by European settlement).

This requirement is addressed in Section 4.6, below.

### 2.8 Minimum Requirement #8: Wetlands Protection

Objective: to ensure that wetlands receive the same level of protection as any other waters of the state.

There are no wetlands on-site or on the adjacent properties.

### 2.9 Minimum Requirement #9: Operation and Maintenance

Objective: to ensure that stormwater control facilities are adequately maintained and operated properly.

**Other Requirements**

No other special requirements, such as re-zones, variances, adjustments or SEPA mitigations are required for this site.

## 3. OFFSITE ANALYSIS

### 3.1 Upstream Analysis

All upslope lands are un-paved. There is flow on to the site from the north, east and south. The areas contributing flow are shown in Figure 3 in Section 4.2.

### 3.2 Downstream Analysis

A downstream analysis was performed per I-2.6.2 Optional Guidance #2: Off Site Analysis and Mitigation of the manual. A site visit on 1 September 2021 included observations upstream and downstream of the project site. Following are the results.

There is flow on to the property from the north, east and south All flows were included in the calculations for the detention tank and is accounted for in Sections 4.5 and 4.6.

Any surface runoff from the site enters 68th Avenue W. About 90 feet to the south is a catch basin on the City's storm drain system. The storm drain main line is on the west side of the street. Flow is south to 200th Street SW and then east.

Discharge of the tank is to the east, through the car parking area for the Lynnwood Ice Centre and their existing drainage system, which continues to near southeast corner of the property.

A follow on site visit on16 November 2021 was made to determine the flow route of the Lynnwood Ice Centre drainage beyond the property. There are two apparent options: a) east through an easement provided by the Campus Point Condominium property along the northerly boundary, emptying in to Gold Park at its northwest corner and b) south through an easement provided by the Campus Point Condominium property along the westerly boundary.

Path a) was assumed to empty in to the creek flowing from north to south through Gold Park. No pipe outfall could be found that would suggest this to be the correct path.

Path b) has a pipe shown on the City GIS, but is not supported by the site's drainage plan. Two grated inlets and a manhole access were found near the northeast corner of the Carriage Gardens site, south of the Lynnwood Ice Centre. It is assumed that the water from the Lynnwood Ice Centre flows through here and through the easement along the west side of the Carriage Gardens to the main line in 200$^{th}$ Street SW, where there is a catch basin. At this point, surface flow from the site and detained flow intersect and continue east in 200$^{th}$ Street SW.

At the location of the stream exiting Gold Park (about ¼-mile from the site), flow is to the south and east, alternating between open and closed conveyance. Drainage enters South Lynnwood Park at 208$^{th}$ Street SW and continues south to the stream that empties Hall's Lake.

All flow between the site and Gold Park is in a closed conveyance.

Resource Review

A request was made to the City for drainage complaints downstream of the project to the City limits, about one-quarter mile. There are no active complaints.

## 4. PERMANENT STORMWATER CONTROL PLAN

### Introduction

The Western Washington Hydrology Model (WHMM) was used for hydrology and to test storm facilities. There is flow on to the site from the north, east and south All flows from these areas were included in the calculations.

### 4.1 Existing Site Hydrology

Land contributing to drainage from the site is limited to the property itself and the stated off-site areas. The distribution of land within the project site is given in Table 1. The existing site conditions are shown in Figure 2.

| Cover type | Area Description | | |
|---|---|---|---|
| | Subject property | 17,184 | sf |
| | Sum of basins | 19,760 | sf |
| | Impervious | | |
| 1 | Roof area and gutters | 1,345 | sf |
| 2 | Walks & steps | 189 | sf |
| 3 | Driveway | 164 | sf |
| 4 | Gravel | 5,636 | sf |
| | Total impervious area | 7,334 | sf |
| | Total % impervious | 42.7 | |
| | Pervious | | |
| 5 | On-site Landscaping | 9,850 | sf |
| 6 | Off-site Landscaping | 2,576 | sf |
| | Total pervious area | 12,426 | sf |
| | Total % pervious | 57.3 | |

**Table 1.** Pre-developed land distribution of the subject property.

### 4.2 Developed Site Hydrology

The proposed site development is shown in Figure 3. It consists of the following major elements:

- One 3-story apartment building with twelve residences,
- paved driveway,
- parking lot with sidewalk and
- landscaping.

The distribution of land within the project site is given in Table 2.

Roof and surface runoff will be collected and routed to the detention tank as described in Section 4.6.

The soils map for the site is given in Appendix A.

POC 1 models the on-site flow control. POC 2 provides the un-mitigated flow rates for sising on-site piping.

| Cover type | Lot area | 17,184 sf |
|---|---|---|
| | Sum of basins | 19,760 sf |
| | Impervious | |
| 1 | Roof area and gutters | 3,302 sf |
| 2 | Walks & steps | 1,239 sf |
| 3 | Parking lot captured | 7,702 sf |
| 4 | Parking lot bypassed | 165 sf |
| | Total impervious area | 12,408 sf |
| | Total % impervious | 72.21 % |
| | Pervious | |
| 5 | On-site Landscaping | 4,776 sf |
| 6 | Off-site Landscaping | 2,576 sf |
| | Total pervious area | 4,776 sf |
| | Total % pervious | 27.79 % |

**Table 2.** Developed land distribution of the subject property.

### 4.3 Low Impact Development

Performance Standards

In accordance with the SWMMWW, stormwater discharges shall match developed discharge durations to predeveloped durations for the range of pre-developed discharge rates from 8% of the 2-year peak flow to 50% of the 2-year peak flow.

As all Minimum Requirements are required, list #2 of on-site stormwater management BMPs is required.

### 4.4 On-site Stormwater Management BMPs

**Lawn and landscaped areas**

Post-Construction Soil Quality and Depth

This will be applied to all planters within the project and the right-of-way in accordance with BMP T5.13

**Roofs**

Full Dispersion

Due to a lack of area for dispersion, Full Dispersion is not viable for this project.

Bioretention

Due to a lack of area for placement, Bioretention is not viable for this project.

Downspout Dispersion Systems

Due to a lack of area for dispersion, Downspout Dispersion is not viable for this project.

Perforated Stub-out Connection

Due to the depth of the drain lines placing them in till, Perforated Stub-out Connection is not viable for this project.

### Other Hard Surfaces

Full Dispersion

Due to a lack of area for dispersion, Full Dispersion is not viable for this project.

Permeable Pavement

There is a four foot high rockery on Lot 5 of Carriage Gardens within three feet of the site. The south side of the site was also used as a construction yard in support of neighbouring projects. It is not known to what extent soils may have been disturbed as a result of this or construction next door. As a result, Permeable Pavement is seen as infeasible.

Bioretention BMP's

Due to a lack of area for placement, Bioretention is not viable for this project.

Sheet Flow Dispersion

Due to a lack of area for dispersion, Sheet Flow Dispersion is not viable for this project.

## 4.5 Runoff Treatment

The parking area is the only Pollution Generating Impervious Surface (PGIS). At 7,700 $ft^2$ this project is required to provide runoff treatment.

Section V-10, "Manufactured Treatment Devices as BMPs" allows the use of approved products as BMPs. The Department of Ecology lists approved products in its General Use Level Designation (GULD). These are technologies whose evaluation report demonstrates confidently it can achieve Ecology's performance goals

Listed is the "StormFilter" product shown in the plans. The GULD approval is given in Appendix B.

## 4.6 Flow Control

In accordance with the SWMMWW, stormwater discharges shall match developed discharge durations to predeveloped durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow.

Following the calculation to satisfy Minimum Requirement 5, the detention tank was sised in WWHM. The entire sediment storage volume is placed in the north-south segment of pipe. The relative areas of pipe are shown in Figure 4. The analysis of the tank is given in the WWHM output at the back of this report.

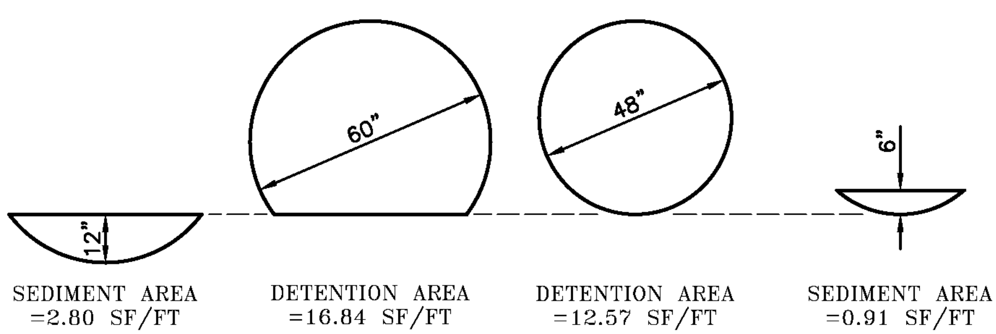



**Figure 4.** Area distribution for detention and sediment storage.

Discharge of the tank is to the east, through the car parking area for the Lynnwood Ice Centre and their existing drainage system.

## 5. CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

Per Minimum Requirement #2, all new development and redevelopment projects are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters. This is achieved through:

<u>Project Requirements - Construction SWPPP Elements</u>

Element 1: Preserve Vegetation/Mark Clearing Limits

- Before beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area.
- Retain the duff layer, native top soil, and natural vegetation in an undisturbed state to the maximum degree practicable.

Element 2: Establish Construction Access

- Limit construction vehicle access and exit to one route, if possible.
- Stabilize access points with a pad of quarry spalls, crushed rock or other equivalent BMPs, to minimize tracking of sediment onto public roads.
- Locate wheel wash or tire baths on site, if the stabilized construction entrance is not effective in preventing tracking sediment onto roads.
- If sediment is tracked off site, clean the affected roadway thoroughly at the end of each day, or more frequently as necessary (for example, during wet weather). Remove sediment from roads by shoveling, sweeping, or pick up and transport the sediment to a controlled sediment disposal area.
- Conduct street washing only after sediment is removed in accordance with the above bullet.
- Control street wash wastewater by pumping back on-site, or otherwise prevent it from discharging into systems tributary to waters of the State.

Element 3: Control Flow Rates

- Protect properties and waterways downstream of development sites from erosion and the associated discharge of turbid waters due to increases in the velocity and peak volumetric flow rate of stormwater runoff from the project site.
- Where necessary to comply with the bullet above, construct stormwater retention or detention facilities as one of the first steps in grading. Assure that detention facilities function properly before constructing site improvements (e.g., impervious surfaces).
- If permanent infiltration ponds are used for flow control during construction, protect these facilities from siltation during the construction phase.

Element 4: Install Sediment Controls

- Design, install, and maintain effective erosion controls and sediment controls to minimize the discharge of pollutants.
- Construct sediment control BMPs (sediment ponds, traps, filters, etc.) as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.

- Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff and soil characteristics, including the range of soil particle sizes expected to be present on the site.
- Direct stormwater runoff from disturbed areas through a sediment pond or other appropriate sediment removal BMP, before the runoff leaves a construction site or before discharge to an infiltration facility. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard in Element #3, bullet #1.
- Locate BMPs intended to trap sediment on-site in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages.
- Where feasible, design outlet structures that withdraw impounded stormwater from the surface to avoid discharging sediment that is still suspended lower in the water column.

Element 5: Stabilize Soils

- Stabilize exposed and unworked soils by application of effective BMPs that prevent erosion. Applicable BMPs include, but are not limited to: temporary and permanent seeding, sodding, mulching, plastic covering, erosion control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base early on areas to be paved, and dust control.
- Control stormwater volume and velocity within the site to minimize soil erosion.
- Control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.
- Soils must not remain exposed and unworked for more than the time periods set forth below to prevent erosion:
    - During the dry season (May 1 - Sept. 30): 7 days
    - During the wet season (October 1 - April 30): 2 days
- Stabilize soils at the end of the shift before a holiday or weekend if needed based on the weather forecast.
- Stabilize soil stockpiles from erosion, protected with sediment trapping measures and, where possible, be located away from storm drain inlets, waterways and drainage channels.
- Minimize the amount of soil exposed during construction activity.
- Minimize the disturbance of steep slopes.
- Minimize soil compaction and, unless infeasible, preserve topsoil.

Element 6: Protect Slopes

- Design and construct cut-and-fill slopes in a manner to minimize erosion. Applicable practices include, but are not limited to, reducing continuous length of slope with terracing and diversions, reducing slope steepness and roughening slope surfaces (for example, track walking).
- Divert off-site stormwater (run-on) or ground water away from slopes and disturbed areas with interceptor dikes, pipes and/or swales. Off-site stormwater should be managed separately from stormwater generated on the site.

- At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion.
    - Temporary pipe slope drains must handle the peak volumetric flow rate calculated using a 10-minute time step from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year and 1-hour flow rate predicted by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model (WWHM) to predict flows, bare soil areas should be modeled as "landscaped" area.
- Place excavated material on the uphill side of trenches, consistent with safety and space considerations.
- Place check dams at regular intervals within constructed channels that are cut down a slope.

Element 7: Protect Drain Inlets

- Protect all storm drain inlets made operable during construction so that stormwater runoff shall not enter the conveyance system without first being filtered or treated to remove sediment.
- Clean or remove and replace inlet protection devices when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

Element 8: Stabilize Channels and Outlets

- Design, construct, and stabilize all on-site conveyance channels to prevent erosion from the following expected peak flows:
    - Channels must handle the peak volumetric flow rate calculated using a 10-minute time step from a Type 1A, 10- year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model (WWHM) to predict flows, bare soil areas should be modeled as "landscaped area.
- Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes and downstream reaches at the outlets of all conveyance systems.

Element 9: Control Pollutants

- Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants.
- Handle and dispose of all pollutants, including waste materials and demolition debris that occur on-site in a manner that does not cause contamination of stormwater.

- Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. On-site fueling tanks must include secondary containment. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume contained in the largest take within the containment structure. Double-walled tanks do not require additional secondary containment.
- Conduct maintenance, fueling, and repair of heavy equipment and vehicles using spill prevention and control measures. Clean contaminated surfaces immediately following any spill incident.
- Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, such as closed-loop recirculation or upland application, or to the sanitary sewer, with local sewer district approval.
- Apply fertilizers and pesticides in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Follow manufacturers' label requirements for application rates and procedures.
- Use BMPs to prevent contamination of stormwater runoff by pH modifying sources. The sources for this contamination include, but are not limited to: bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters.
- Adjust the pH of stormwater if necessary to prevent violations of water quality standards.
- Assure that washout of concrete trucks is performed off-site or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams. Do not dump excess concrete on-site, except in designated concrete washout areas. Concrete spillage or concrete discharge to surface waters of the State is prohibited.
- Obtain written approval from Ecology before using chemical treatment other than CO2 or dry ice to adjust pH.

Element 10: Control De-Watering

- Discharge foundation, vault, and trench de-watering water, which has similar characteristics to stormwater runoff at the site, into a controlled conveyance system before discharge to a sediment trap or sediment pond.
- Discharge clean, non-turbid de-watering water, such as well-point ground water, to systems tributary to, or directly into surface waters of the State, as specified in Element #8, provided the de-watering flow does not cause erosion or flooding of receiving waters. Do not route clean dewatering water through stormwater sediment ponds. Note that "surface waters of the State" may exist on a construction site as well as off site; for example, a creek running through a site.
- Handle highly turbid or otherwise contaminated dewatering water separately from stormwater.
- Other treatment or disposal options may include:

  1. Infiltration.

2. Transport off-site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.
3. Ecology-approved on-site chemical treatment or other suitable treatment technologies.
4. Sanitary or combined sewer discharge with local sewer district approval, if there is no other option.
5. Use of a sedimentation bag that discharges to a ditch or swale for small volumes of localized dewatering.

Element 11: Maintain BMPs

- Maintain and repair all temporary and permanent erosion and sediment control BMPs as needed to assure continued performance of their intended function in accordance with BMP specifications.
- Remove all temporary erosion and sediment control BMPs within 30 days after achieving final site stabilization or after the temporary BMPs are no longer needed.

Element 12: Manage the Project

- Phase development projects to the maximum degree practicable and take into account seasonal work limitations.
- Inspection and monitoring – Inspect, maintain and repair all BMPs as needed to assure continued performance of their intended function. Projects regulated under the Construction Stormwater General Permit must conduct site inspections and monitoring in accordance with Special Condition S4 of the Construction Stormwater General Permit.
- Maintaining an updated construction SWPPP – Maintain, update, and implement the SWPPP.
- Projects that disturb one or more acres must have site inspections conducted by a Certified Erosion and Sediment Control Lead (CESCL). Project sites disturbing less than one acre may have a CESCL or a person without CESCL certification conduct inspections. By the initiation of construction, the SWPPP must identify the CESCL or inspector, who must be present on-site or on-call at all times.
- The CESCL or inspector (project sites less than one acre) must have the skills to assess the:
    - Site conditions and construction activities that could impact the quality of stormwater.
    - Effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.
- The CESCL or inspector must examine stormwater visually for the presence of suspended sediment, turbidity, discoloration, and oil sheen. They must evaluate the effectiveness of BMPs and determine if it is necessary to install, maintain, or repair BMPs to improve the quality of stormwater discharges. Based on the results of the inspection, construction site operators must correct the problems identified by:
    - Reviewing the SWPPP for compliance with the 13 construction SWPPP elements and making appropriate revisions within 7 days of the inspection.
    - Immediately beginning the process of fully implementing and maintaining appropriate source control and/or treatment BMPs as soon as possible, addressing the problems not later than within 10 days of the inspection. If installation of

necessary treatment BMPs is not feasible within 10 days, the construction site operator may request an extension within the initial 10-day response period.
    - Documenting BMP implementation and maintenance in the site log book (sites larger than 1 acre).
- The CESCL or inspector must inspect all areas disturbed by construction activities, all BMPs, and all stormwater discharge points at least once every calendar week and within 24 hours of any discharge from the site. (For purposes of this condition, individual discharge events that last more than one day do not require daily inspections. For example, if a stormwater pond discharges continuously over the course of a week, only one inspection is required that week.) The CESCL or inspector may reduce the inspection frequency for temporary stabilized, inactive sites to once every calendar month.

Element 13: Protect Low Impact Development BMPs

- Protect all Bioretention and Rain Garden BMPs from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into the Bioretention and/or Rain Garden BMPs. Restore the BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the BMP must include removal of sediment and any sediment-laden Bioretention/rain garden soils, and replacing the removed soils with soils meeting the design specification.
- Prevent compacting Bioretention and rain garden BMPs by excluding construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction due to construction equipment.
- Control erosion and avoid introducing sediment from surrounding land uses onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-laden runoff onto permeable pavements or base materials.
- Pavement fouled with sediments or no longer passing an initial infiltration test must be cleaned using procedures in accordance with this manual or the manufacturer's procedures.
- Keep all heavy equipment off existing soils under LID facilities that have been excavated to final grade to retain the infiltration rate of the soils.

## 6. CONVEYANCE SYSTEM ANALYSIS AND DESIGN

The site is drained with pipes ranging in size from four to eight inches. Given the peak flow rate from the entire site, calculated in Section 4.4, the pipes listed were tested for their ability to covey this flow at a slope of one per cent.

Downspouts and area drains will be collected to a central point south of the building and enter a catch basin. On the inlet side will be a Red Valve check valve to prevent flow backing in to the basement areas.

The un-stored flow rate was calculated as POC 2 in the WWHM. The resulting flow is 0.23 $ft^3/s$, which is given in the WWHM output at the back of this report.

Manning's equation was used to analise the on-site storm drain pipes. The results are given in Table 3.

| Line | Diameter (in) | Manning's n | Slope (%) | Pipe Capacity ($ft^3/s$) | $Q_{100}$ ($ft^3/s$) | Pass/Fail |
|---|---|---|---|---|---|---|
| Offsite | 6 | 0.011 | 1.000 | 0.66 | 0.23 | Pass |
| Overflow | 8 | 0.011 | 1.000 | 1.43 | 0.23 | Pass |

**Table 3.** Conveyance analysis.

## 7. SPECIAL REPORTS AND STUDIES

No special studies were prepared for this project.

## 8. OTHER PERMITS

### City of Lynnwood Required Permits

The City of Lynnwood will be the permitting agency for this project. Required permits may include grading, right-of-way, building, electrical, plumbing and demolition permits.

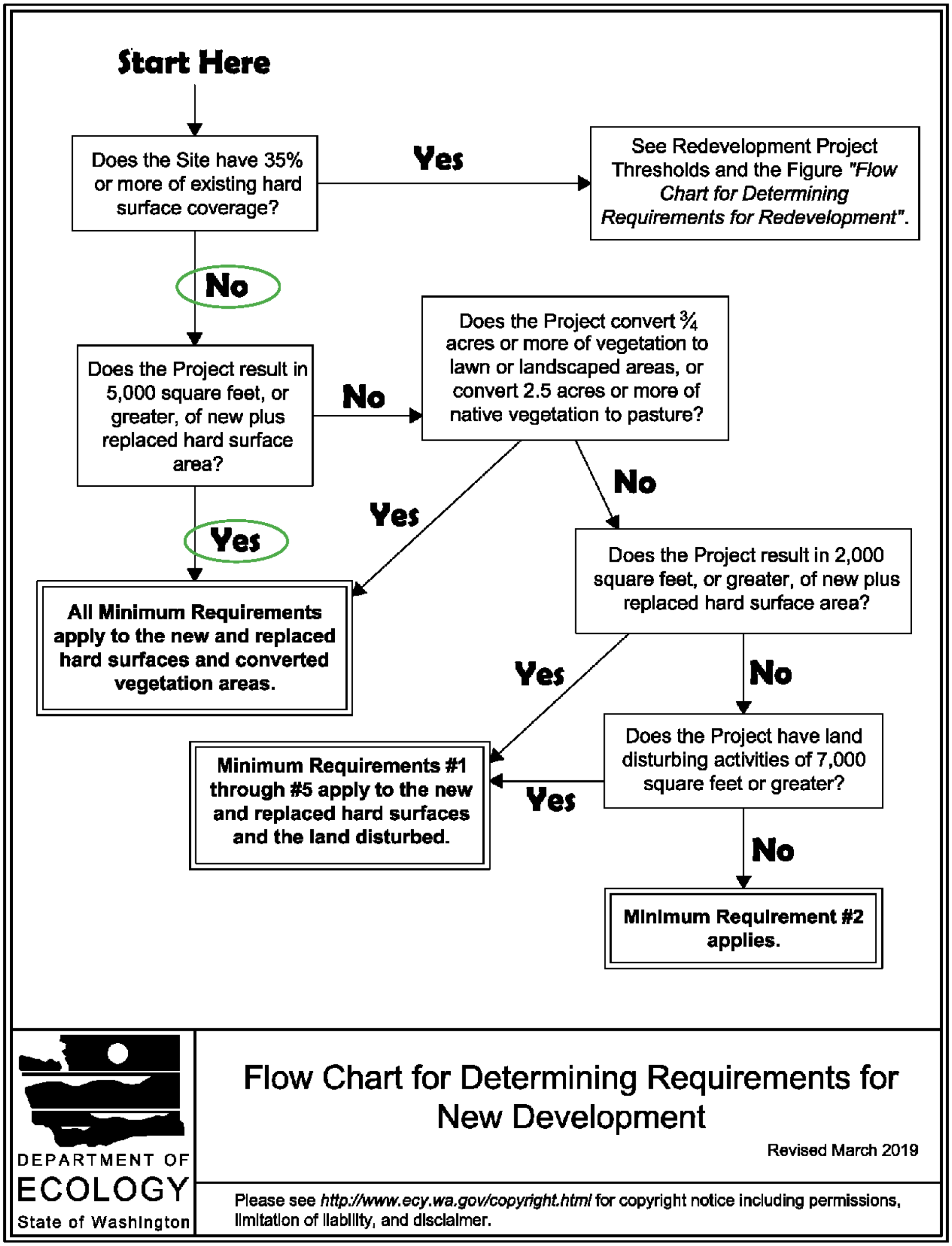
# References

Brown, S.A., et al.; *Urban Drainage Design Manual Hydraulic Engineering Circular 22, Third Edition*; Federal Highway Administration; Washington, D.C.; September 2009.

Washington Department of Ecology Water Quality Program; *Stormwater Management Manual for Western Washington*; Washington Department of Ecology; Olympia, WA; December, 2014

# Appendix A
## Referenced Materials

## Figure I-3.1: Flow Chart for Determining Requirements for New Development



# Snohomish County Area, Washington

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

### Map Unit Setting

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

### Map Unit Composition

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

### Description of Alderwood

#### Setting

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

#### Typical profile

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

#### Properties and qualities

*Slope:* 2 to 8 percent
*Depth to restrictive feature:* 20 to 40 inches to densic material
*Drainage class:* Moderately well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
*Depth to water table:* About 18 to 36 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water supply, 0 to 60 inches:* Low (about 3.0 inches)

#### Interpretive groups

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

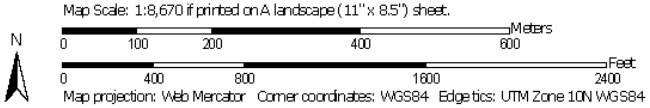
### Minor Components

#### Terric medisaprists, undrained

*Percent of map unit:* 5 percent
*Landform:* Depressions
*Other vegetative classification:* Wet Soils (G002XN102WA)
*Hydric soil rating:* Yes

Custom Soil Resource Report
Soil Map


Map Scale: 1:8,670 if printed on A landscape (11" x 8.5") sheet.




Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

# Appendix B

## StormFilter GULD Approval

WASHINGTON STATE DEPARTMENT OF ECOLOGY

**April 2017**

**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/ft² 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, and sized based on the water quality design flow rate for an off-line system when using an external bypass vault or a treatment vault with an internal bypass. Contech designs their StormFilter systems to maintain treatment of the water quality design flow while routing excess flows around the treatment chamber during periods of peak bypass. 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.**

**Ecology's Conditions of Use:**

**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.

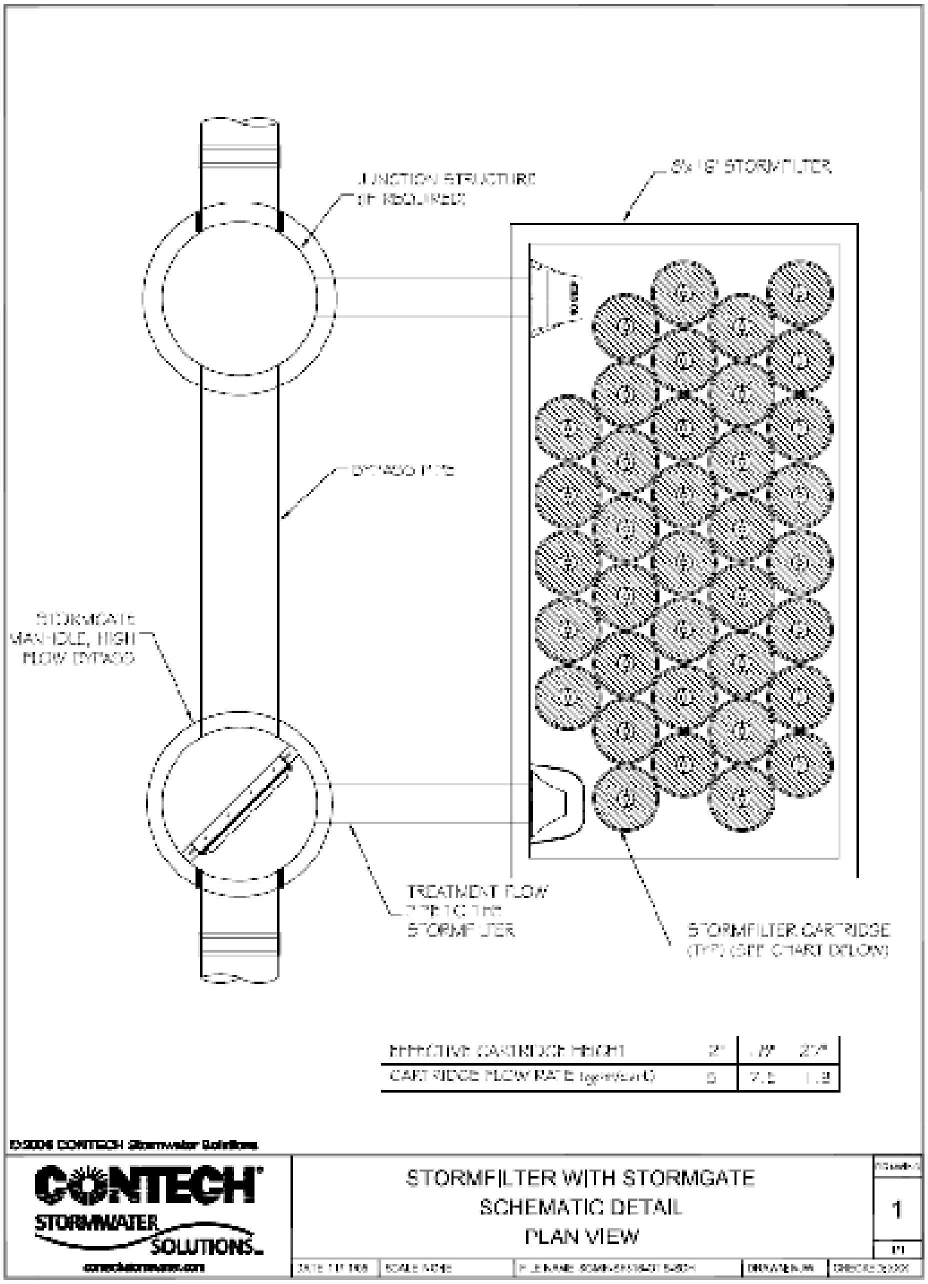



**Figure 1. Stormwater Management StormFilter Configuration with Bypass**

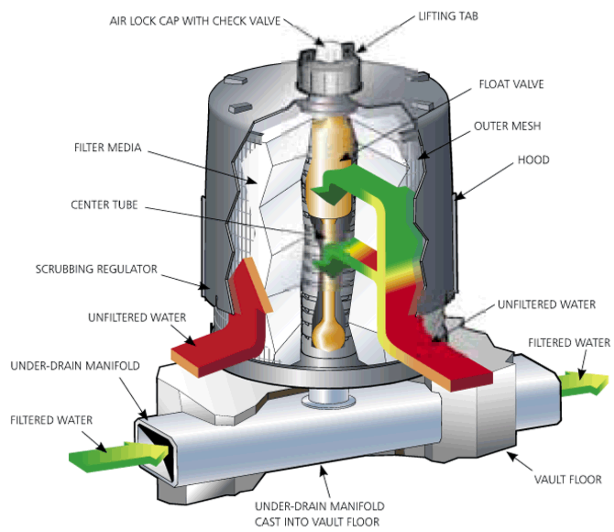



**Figure 2. The StormFilter Cartridge**

### 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
Contech Engineered Solutions
11835 NE Glenn Widing Drive
Portland, OR, 97220
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 |
| April 2017 | Revised sizing language to note sizing based on Off-line calculations |

# Appendix C

## WWHM Output

# WWHM2012

# PROJECT REPORT

# General Model Information

| | |
|---|---|
| Project Name: | 21016_WWHM |
| Site Name: | |
| Site Address: | |
| City: | |
| Report Date: | 9/15/2021 |
| Gage: | Everett |
| Data Start: | 1948/10/01 |
| Data End: | 2009/09/30 |
| Timestep: | 15 Minute |
| Precip Scale: | 1.000 |
| Version Date: | 2019/09/13 |
| Version: | 4.2.17 |

## POC Thresholds

| | |
|---|---|
| Low Flow Threshold for POC1: | 50 Percent of the 2 Year |
| High Flow Threshold for POC1: | 50 Year |
| Low Flow Threshold for POC2: | 50 Percent of the 2 Year |
| High Flow Threshold for POC2: | 50 Year |

# *Landuse Basin Data*
## *Predeveloped Land Use*

### Basin 1

| | |
|---|---|
| Bypass: | No |
| GroundWater: | No |
| Pervious Land Use | acre |
| C, Lawn, Flat | 0.415 |
| Pervious Total | 0.415 |
| Impervious Land Use | acre |
| ROOF TOPS FLAT | 0.031 |
| DRIVEWAYS FLAT | 0.004 |
| SIDEWALKS FLAT | 0.004 |
| Impervious Total | 0.039 |
| Basin Total | 0.454 |

Element Flows To:

| Surface | Interflow | Groundwater |
|---|---|---|

## Basin 2

| | |
|---|---|
| Bypass: | No |
| GroundWater: | No |
| Pervious Land Use | acre |
| C, Lawn, Flat | 0.11 |
| Pervious Total | 0.11 |
| Impervious Land Use | acre |
| ROOF TOPS FLAT | 0.076 |
| SIDEWALKS FLAT | 0.028 |
| PARKING FLAT | 0.176 |
| Impervious Total | 0.28 |
| Basin Total | 0.39 |

Element Flows To:

| Surface | Interflow | Groundwater |
|---|---|---|

## *Mitigated Land Use*

### Basin 1

| | |
|---|---|
| Bypass: | No |
| GroundWater: | No |
| Pervious Land Use | acre |
| C, Lawn, Flat | 0.11 |
| Pervious Total | 0.11 |
| Impervious Land Use | acre |
| ROOF TOPS FLAT | 0.076 |
| SIDEWALKS FLAT | 0.028 |
| PARKING FLAT | 0.176 |
| Impervious Total | 0.28 |
| Basin Total | 0.39 |

Element Flows To:

| Surface | Interflow | Groundwater |
|---|---|---|
| Tank 1 | | |

## Basin 2

| | |
|---|---|
| Bypass: | No |
| GroundWater: | No |
| Pervious Land Use | acre |
| Pervious Total | 0 |
| Impervious Land Use | acre |
| PARKING FLAT | 0.004 |
| Impervious Total | 0.004 |
| Basin Total | 0.004 |

Element Flows To:

| Surface | Interflow | Groundwater |
|---|---|---|
| Tank 1 | | |

## Basin 3

| | |
|---|---|
| Bypass: | No |
| GroundWater: | No |
| Pervious Land Use | acre |
| C, Lawn, Flat | 0.11 |
| Pervious Total | 0.11 |
| Impervious Land Use | acre |
| ROOF TOPS FLAT | 0.076 |
| SIDEWALKS FLAT | 0.028 |
| PARKING FLAT | 0.176 |
| Impervious Total | 0.28 |
| Basin Total | 0.39 |

Element Flows To:

| Surface | Interflow | Groundwater |
|---|---|---|

# *Routing Elements*
## *Predeveloped Routing*

## *Mitigated Routing*

## Tank 1

Dimensions
Depth: 4 ft.
Tank Type: Circular
Diameter: 4 ft.
Length: 140 ft.
Discharge Structure
Riser Height: 3.9 ft.
Riser Diameter: 8 in.
Notch Type: Rectangular
Notch Width: 0.010 ft.
Notch Height: 1.000 ft.
Orifice 1 Diameter: 0.6562 in. Elevation:0 ft.
Element Flows To:
Outlet 1 Outlet 2

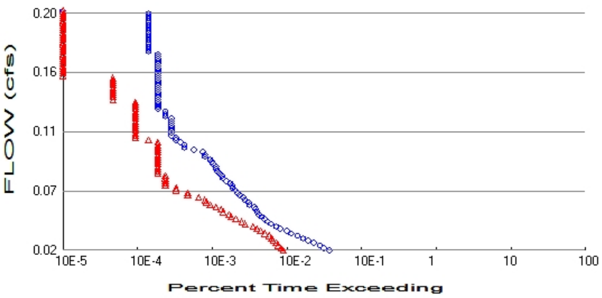
Tank Hydraulic Table

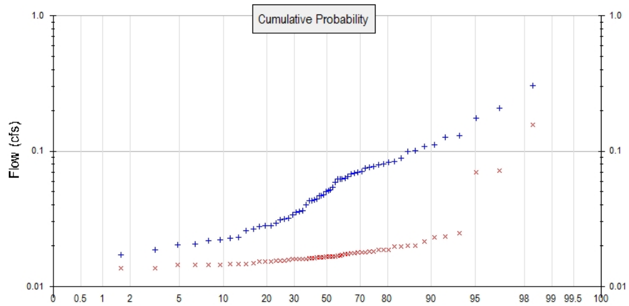
| **Stage(feet)** | **Area(ac.)** | **Volume(ac-ft.)** | **Discharge(cfs)** | **Infilt(cfs)** |
|---|---|---|---|---|
| 0.0000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.0444 | 0.002 | 0.000 | 0.002 | 0.000 |
| 0.0889 | 0.003 | 0.000 | 0.003 | 0.000 |
| 0.1333 | 0.004 | 0.000 | 0.004 | 0.000 |
| 0.1778 | 0.005 | 0.000 | 0.004 | 0.000 |
| 0.2222 | 0.005 | 0.000 | 0.005 | 0.000 |
| 0.2667 | 0.006 | 0.001 | 0.006 | 0.000 |
| 0.3111 | 0.006 | 0.001 | 0.006 | 0.000 |
| 0.3556 | 0.007 | 0.001 | 0.007 | 0.000 |
| 0.4000 | 0.007 | 0.002 | 0.007 | 0.000 |
| 0.4444 | 0.008 | 0.002 | 0.007 | 0.000 |
| 0.4889 | 0.008 | 0.002 | 0.008 | 0.000 |
| 0.5333 | 0.008 | 0.003 | 0.008 | 0.000 |
| 0.5778 | 0.009 | 0.003 | 0.008 | 0.000 |
| 0.6222 | 0.009 | 0.004 | 0.009 | 0.000 |
| 0.6667 | 0.009 | 0.004 | 0.009 | 0.000 |
| 0.7111 | 0.009 | 0.004 | 0.009 | 0.000 |
| 0.7556 | 0.010 | 0.005 | 0.010 | 0.000 |
| 0.8000 | 0.010 | 0.005 | 0.010 | 0.000 |
| 0.8444 | 0.010 | 0.006 | 0.010 | 0.000 |
| 0.8889 | 0.010 | 0.006 | 0.011 | 0.000 |
| 0.9333 | 0.010 | 0.007 | 0.011 | 0.000 |
| 0.9778 | 0.011 | 0.007 | 0.011 | 0.000 |
| 1.0222 | 0.011 | 0.008 | 0.011 | 0.000 |
| 1.0667 | 0.011 | 0.008 | 0.012 | 0.000 |
| 1.1111 | 0.011 | 0.009 | 0.012 | 0.000 |
| 1.1556 | 0.011 | 0.009 | 0.012 | 0.000 |
| 1.2000 | 0.011 | 0.010 | 0.012 | 0.000 |
| 1.2444 | 0.011 | 0.010 | 0.013 | 0.000 |
| 1.2889 | 0.012 | 0.011 | 0.013 | 0.000 |
| 1.3333 | 0.012 | 0.011 | 0.013 | 0.000 |
| 1.3778 | 0.012 | 0.012 | 0.013 | 0.000 |
| 1.4222 | 0.012 | 0.012 | 0.013 | 0.000 |
| 1.4667 | 0.012 | 0.013 | 0.014 | 0.000 |
| 1.5111 | 0.012 | 0.014 | 0.014 | 0.000 |

| | | | | |
|---|---|---|---|---|
| 1.5556 | 0.012 | 0.014 | 0.014 | 0.000 |
| 1.6000 | 0.012 | 0.015 | 0.014 | 0.000 |
| 1.6444 | 0.012 | 0.015 | 0.015 | 0.000 |
| 1.6889 | 0.012 | 0.016 | 0.015 | 0.000 |
| 1.7333 | 0.012 | 0.016 | 0.015 | 0.000 |
| 1.7778 | 0.012 | 0.017 | 0.015 | 0.000 |
| 1.8222 | 0.012 | 0.017 | 0.015 | 0.000 |
| 1.8667 | 0.012 | 0.018 | 0.016 | 0.000 |
| 1.9111 | 0.012 | 0.019 | 0.016 | 0.000 |
| 1.9556 | 0.012 | 0.019 | 0.016 | 0.000 |
| 2.0000 | 0.012 | 0.020 | 0.016 | 0.000 |
| 2.0444 | 0.012 | 0.020 | 0.016 | 0.000 |
| 2.0889 | 0.012 | 0.021 | 0.016 | 0.000 |
| 2.1333 | 0.012 | 0.021 | 0.017 | 0.000 |
| 2.1778 | 0.012 | 0.022 | 0.017 | 0.000 |
| 2.2222 | 0.012 | 0.023 | 0.017 | 0.000 |
| 2.2667 | 0.012 | 0.023 | 0.017 | 0.000 |
| 2.3111 | 0.012 | 0.024 | 0.017 | 0.000 |
| 2.3556 | 0.012 | 0.024 | 0.017 | 0.000 |
| 2.4000 | 0.012 | 0.025 | 0.018 | 0.000 |
| 2.4444 | 0.012 | 0.025 | 0.018 | 0.000 |
| 2.4889 | 0.012 | 0.026 | 0.018 | 0.000 |
| 2.5333 | 0.012 | 0.027 | 0.018 | 0.000 |
| 2.5778 | 0.012 | 0.027 | 0.018 | 0.000 |
| 2.6222 | 0.012 | 0.028 | 0.018 | 0.000 |
| 2.6667 | 0.012 | 0.028 | 0.019 | 0.000 |
| 2.7111 | 0.012 | 0.029 | 0.019 | 0.000 |
| 2.7556 | 0.011 | 0.029 | 0.019 | 0.000 |
| 2.8000 | 0.011 | 0.030 | 0.019 | 0.000 |
| 2.8444 | 0.011 | 0.030 | 0.019 | 0.000 |
| 2.8889 | 0.011 | 0.031 | 0.019 | 0.000 |
| 2.9333 | 0.011 | 0.031 | 0.020 | 0.000 |
| 2.9778 | 0.011 | 0.032 | 0.020 | 0.000 |
| 3.0222 | 0.011 | 0.032 | 0.021 | 0.000 |
| 3.0667 | 0.010 | 0.033 | 0.022 | 0.000 |
| 3.1111 | 0.010 | 0.033 | 0.023 | 0.000 |
| 3.1556 | 0.010 | 0.034 | 0.025 | 0.000 |
| 3.2000 | 0.010 | 0.034 | 0.026 | 0.000 |
| 3.2444 | 0.010 | 0.035 | 0.027 | 0.000 |
| 3.2889 | 0.009 | 0.035 | 0.028 | 0.000 |
| 3.3333 | 0.009 | 0.036 | 0.030 | 0.000 |
| 3.3778 | 0.009 | 0.036 | 0.031 | 0.000 |
| 3.4222 | 0.009 | 0.036 | 0.033 | 0.000 |
| 3.4667 | 0.008 | 0.037 | 0.034 | 0.000 |
| 3.5111 | 0.008 | 0.037 | 0.036 | 0.000 |
| 3.5556 | 0.008 | 0.037 | 0.038 | 0.000 |
| 3.6000 | 0.007 | 0.038 | 0.039 | 0.000 |
| 3.6444 | 0.007 | 0.038 | 0.041 | 0.000 |
| 3.6889 | 0.006 | 0.038 | 0.042 | 0.000 |
| 3.7333 | 0.006 | 0.039 | 0.044 | 0.000 |
| 3.7778 | 0.005 | 0.039 | 0.046 | 0.000 |
| 3.8222 | 0.005 | 0.039 | 0.047 | 0.000 |
| 3.8667 | 0.004 | 0.040 | 0.049 | 0.000 |
| 3.9111 | 0.003 | 0.040 | 0.059 | 0.000 |
| 3.9556 | 0.002 | 0.040 | 0.143 | 0.000 |
| 4.0000 | 0.000 | 0.040 | 0.270 | 0.000 |
| 4.0444 | 0.000 | 0.000 | 0.418 | 0.000 |

## *Analysis Results*

### *POC 1*




\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1

| | |
|---|---|
| Total Pervious Area: | 0.415 |
| Total Impervious Area: | 0.039 |

Mitigated Landuse Totals for POC #1

| | |
|---|---|
| Total Pervious Area: | 0.11 |
| Total Impervious Area: | 0.284 |

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

| **Return Period** | **Flow(cfs)** |
|---|---|
| 2 year | 0.048759 |
| 5 year | 0.084934 |
| 10 year | 0.115622 |
| 25 year | 0.162946 |
| 50 year | 0.204984 |
| 100 year | 0.253335 |

Flow Frequency Return Periods for Mitigated. POC #1

| **Return Period** | **Flow(cfs)** |
|---|---|
| 2 year | 0.017516 |
| 5 year | 0.025127 |
| 10 year | 0.031071 |
| 25 year | 0.039698 |
| 50 year | 0.046994 |
| 100 year | 0.055086 |

## Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

| **Year** | **Predeveloped** | **Mitigated** |
|---|---|---|
| 1949 | 0.076 | 0.016 |
| 1950 | 0.082 | 0.017 |
| 1951 | 0.036 | 0.017 |
| 1952 | 0.048 | 0.015 |
| 1953 | 0.054 | 0.014 |
| 1954 | 0.131 | 0.015 |
| 1955 | 0.081 | 0.019 |
| 1956 | 0.031 | 0.017 |
| 1957 | 0.079 | 0.018 |
| 1958 | 0.174 | 0.019 |

| | | |
|---|---|---|
| 1959 | 0.040 | 0.016 |
| 1960 | 0.059 | 0.018 |
| 1961 | 0.306 | 0.020 |
| 1962 | 0.047 | 0.017 |
| 1963 | 0.108 | 0.018 |
| 1964 | 0.043 | 0.017 |
| 1965 | 0.017 | 0.014 |
| 1966 | 0.022 | 0.015 |
| 1967 | 0.047 | 0.017 |
| 1968 | 0.052 | 0.020 |
| 1969 | 0.206 | 0.017 |
| 1970 | 0.036 | 0.015 |
| 1971 | 0.069 | 0.016 |
| 1972 | 0.100 | 0.018 |
| 1973 | 0.063 | 0.014 |
| 1974 | 0.075 | 0.016 |
| 1975 | 0.070 | 0.016 |
| 1976 | 0.035 | 0.018 |
| 1977 | 0.020 | 0.017 |
| 1978 | 0.022 | 0.013 |
| 1979 | 0.111 | 0.022 |
| 1980 | 0.043 | 0.016 |
| 1981 | 0.029 | 0.015 |
| 1982 | 0.031 | 0.023 |
| 1983 | 0.068 | 0.017 |
| 1984 | 0.044 | 0.017 |
| 1985 | 0.062 | 0.019 |
| 1986 | 0.099 | 0.072 |
| 1987 | 0.051 | 0.020 |
| 1988 | 0.032 | 0.017 |
| 1989 | 0.063 | 0.014 |
| 1990 | 0.027 | 0.015 |
| 1991 | 0.023 | 0.018 |
| 1992 | 0.051 | 0.015 |
| 1993 | 0.028 | 0.016 |
| 1994 | 0.026 | 0.016 |
| 1995 | 0.028 | 0.016 |
| 1996 | 0.063 | 0.020 |
| 1997 | 0.126 | 0.156 |
| 1998 | 0.077 | 0.016 |
| 1999 | 0.023 | 0.015 |
| 2000 | 0.064 | 0.016 |
| 2001 | 0.017 | 0.014 |
| 2002 | 0.019 | 0.015 |
| 2003 | 0.021 | 0.014 |
| 2004 | 0.084 | 0.023 |
| 2005 | 0.028 | 0.018 |
| 2006 | 0.089 | 0.025 |
| 2007 | 0.070 | 0.016 |
| 2008 | 0.044 | 0.070 |
| 2009 | 0.034 | 0.016 |

## Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

| Rank | Predeveloped | Mitigated |
|---|---|---|
| 1 | 0.3062 | 0.1564 |
| 2 | 0.2065 | 0.0719 |
| 3 | 0.1742 | 0.0695 |

| | | |
|---|---|---|
| 4 | 0.1310 | 0.0247 |
| 5 | 0.1264 | 0.0233 |
| 6 | 0.1107 | 0.0232 |
| 7 | 0.1080 | 0.0216 |
| 8 | 0.1003 | 0.0201 |
| 9 | 0.0994 | 0.0201 |
| 10 | 0.0889 | 0.0197 |
| 11 | 0.0840 | 0.0196 |
| 12 | 0.0821 | 0.0187 |
| 13 | 0.0808 | 0.0185 |
| 14 | 0.0788 | 0.0185 |
| 15 | 0.0765 | 0.0182 |
| 16 | 0.0761 | 0.0180 |
| 17 | 0.0746 | 0.0179 |
| 18 | 0.0705 | 0.0177 |
| 19 | 0.0699 | 0.0177 |
| 20 | 0.0687 | 0.0176 |
| 21 | 0.0677 | 0.0175 |
| 22 | 0.0645 | 0.0173 |
| 23 | 0.0627 | 0.0173 |
| 24 | 0.0626 | 0.0172 |
| 25 | 0.0625 | 0.0168 |
| 26 | 0.0621 | 0.0168 |
| 27 | 0.0586 | 0.0167 |
| 28 | 0.0541 | 0.0167 |
| 29 | 0.0516 | 0.0167 |
| 30 | 0.0510 | 0.0166 |
| 31 | 0.0506 | 0.0165 |
| 32 | 0.0476 | 0.0165 |
| 33 | 0.0470 | 0.0165 |
| 34 | 0.0470 | 0.0164 |
| 35 | 0.0443 | 0.0164 |
| 36 | 0.0438 | 0.0163 |
| 37 | 0.0433 | 0.0162 |
| 38 | 0.0431 | 0.0161 |
| 39 | 0.0401 | 0.0160 |
| 40 | 0.0362 | 0.0160 |
| 41 | 0.0360 | 0.0160 |
| 42 | 0.0354 | 0.0160 |
| 43 | 0.0338 | 0.0159 |
| 44 | 0.0319 | 0.0156 |
| 45 | 0.0313 | 0.0155 |
| 46 | 0.0310 | 0.0155 |
| 47 | 0.0294 | 0.0154 |
| 48 | 0.0282 | 0.0153 |
| 49 | 0.0281 | 0.0153 |
| 50 | 0.0277 | 0.0152 |
| 51 | 0.0267 | 0.0149 |
| 52 | 0.0257 | 0.0147 |
| 53 | 0.0230 | 0.0146 |
| 54 | 0.0226 | 0.0146 |
| 55 | 0.0221 | 0.0144 |
| 56 | 0.0219 | 0.0144 |
| 57 | 0.0207 | 0.0144 |
| 58 | 0.0204 | 0.0143 |
| 59 | 0.0186 | 0.0137 |
| 60 | 0.0172 | 0.0137 |
| 61 | 0.0169 | 0.0134 |

## Duration Flows

The Facility PASSED

| Flow(cfs) | Predev | Mit | Percentage | Pass/Fail |
|---|---|---|---|---|
| 0.0244 | 788 | 190 | 24 | Pass |
| 0.0262 | 668 | 178 | 26 | Pass |
| 0.0280 | 586 | 165 | 28 | Pass |
| 0.0299 | 484 | 153 | 31 | Pass |
| 0.0317 | 409 | 140 | 34 | Pass |
| 0.0335 | 349 | 133 | 38 | Pass |
| 0.0353 | 296 | 124 | 41 | Pass |
| 0.0371 | 243 | 108 | 44 | Pass |
| 0.0390 | 212 | 94 | 44 | Pass |
| 0.0408 | 173 | 84 | 48 | Pass |
| 0.0426 | 154 | 75 | 48 | Pass |
| 0.0444 | 132 | 59 | 44 | Pass |
| 0.0463 | 117 | 53 | 45 | Pass |
| 0.0481 | 106 | 44 | 41 | Pass |
| 0.0499 | 98 | 38 | 38 | Pass |
| 0.0517 | 90 | 36 | 40 | Pass |
| 0.0536 | 85 | 30 | 35 | Pass |
| 0.0554 | 80 | 28 | 35 | Pass |
| 0.0572 | 78 | 24 | 30 | Pass |
| 0.0590 | 67 | 20 | 29 | Pass |
| 0.0609 | 65 | 18 | 27 | Pass |
| 0.0627 | 58 | 17 | 29 | Pass |
| 0.0645 | 55 | 14 | 25 | Pass |
| 0.0663 | 50 | 10 | 20 | Pass |
| 0.0682 | 47 | 10 | 21 | Pass |
| 0.0700 | 43 | 7 | 16 | Pass |
| 0.0718 | 40 | 7 | 17 | Pass |
| 0.0736 | 39 | 5 | 12 | Pass |
| 0.0755 | 37 | 5 | 13 | Pass |
| 0.0773 | 33 | 5 | 15 | Pass |
| 0.0791 | 30 | 5 | 16 | Pass |
| 0.0809 | 29 | 5 | 17 | Pass |
| 0.0828 | 27 | 4 | 14 | Pass |
| 0.0846 | 25 | 4 | 16 | Pass |
| 0.0864 | 24 | 4 | 16 | Pass |
| 0.0882 | 24 | 4 | 16 | Pass |
| 0.0901 | 22 | 4 | 18 | Pass |
| 0.0919 | 21 | 4 | 19 | Pass |
| 0.0937 | 20 | 4 | 20 | Pass |
| 0.0955 | 17 | 4 | 23 | Pass |
| 0.0974 | 17 | 4 | 23 | Pass |
| 0.0992 | 16 | 4 | 25 | Pass |
| 0.1010 | 12 | 4 | 33 | Pass |
| 0.1028 | 9 | 4 | 44 | Pass |
| 0.1046 | 9 | 4 | 44 | Pass |
| 0.1065 | 8 | 4 | 50 | Pass |
| 0.1083 | 7 | 3 | 42 | Pass |
| 0.1101 | 7 | 2 | 28 | Pass |
| 0.1119 | 6 | 2 | 33 | Pass |
| 0.1138 | 6 | 2 | 33 | Pass |
| 0.1156 | 6 | 2 | 33 | Pass |
| 0.1174 | 6 | 2 | 33 | Pass |
| 0.1192 | 6 | 2 | 33 | Pass |

| | | | | |
|---|---|---|---|---|
| 0.1211 | 6 | 2 | 33 | Pass |
| 0.1229 | 6 | 2 | 33 | Pass |
| 0.1247 | 6 | 2 | 33 | Pass |
| 0.1265 | 5 | 2 | 40 | Pass |
| 0.1284 | 5 | 2 | 40 | Pass |
| 0.1302 | 5 | 2 | 40 | Pass |
| 0.1320 | 4 | 2 | 50 | Pass |
| 0.1338 | 4 | 2 | 50 | Pass |
| 0.1357 | 4 | 2 | 50 | Pass |
| 0.1375 | 4 | 2 | 50 | Pass |
| 0.1393 | 4 | 1 | 25 | Pass |
| 0.1411 | 4 | 1 | 25 | Pass |
| 0.1430 | 4 | 1 | 25 | Pass |
| 0.1448 | 4 | 1 | 25 | Pass |
| 0.1466 | 4 | 1 | 25 | Pass |
| 0.1484 | 4 | 1 | 25 | Pass |
| 0.1503 | 4 | 1 | 25 | Pass |
| 0.1521 | 4 | 1 | 25 | Pass |
| 0.1539 | 4 | 1 | 25 | Pass |
| 0.1557 | 4 | 1 | 25 | Pass |
| 0.1576 | 4 | 0 | 0 | Pass |
| 0.1594 | 4 | 0 | 0 | Pass |
| 0.1612 | 4 | 0 | 0 | Pass |
| 0.1630 | 4 | 0 | 0 | Pass |
| 0.1648 | 4 | 0 | 0 | Pass |
| 0.1667 | 4 | 0 | 0 | Pass |
| 0.1685 | 4 | 0 | 0 | Pass |
| 0.1703 | 4 | 0 | 0 | Pass |
| 0.1721 | 4 | 0 | 0 | Pass |
| 0.1740 | 4 | 0 | 0 | Pass |
| 0.1758 | 3 | 0 | 0 | Pass |
| 0.1776 | 3 | 0 | 0 | Pass |
| 0.1794 | 3 | 0 | 0 | Pass |
| 0.1813 | 3 | 0 | 0 | Pass |
| 0.1831 | 3 | 0 | 0 | Pass |
| 0.1849 | 3 | 0 | 0 | Pass |
| 0.1867 | 3 | 0 | 0 | Pass |
| 0.1886 | 3 | 0 | 0 | Pass |
| 0.1904 | 3 | 0 | 0 | Pass |
| 0.1922 | 3 | 0 | 0 | Pass |
| 0.1940 | 3 | 0 | 0 | Pass |
| 0.1959 | 3 | 0 | 0 | Pass |
| 0.1977 | 3 | 0 | 0 | Pass |
| 0.1995 | 3 | 0 | 0 | Pass |
| 0.2013 | 3 | 0 | 0 | Pass |
| 0.2032 | 3 | 0 | 0 | Pass |
| 0.2050 | 3 | 0 | 0 | Pass |

## Water Quality

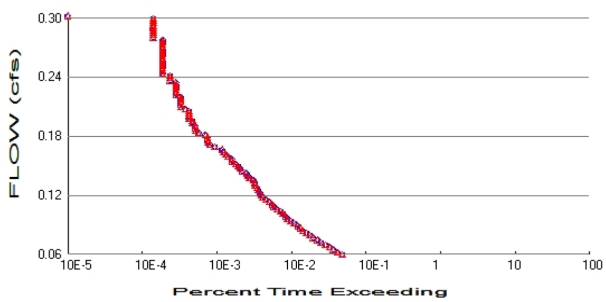
Water Quality BMP Flow and Volume for POC #1

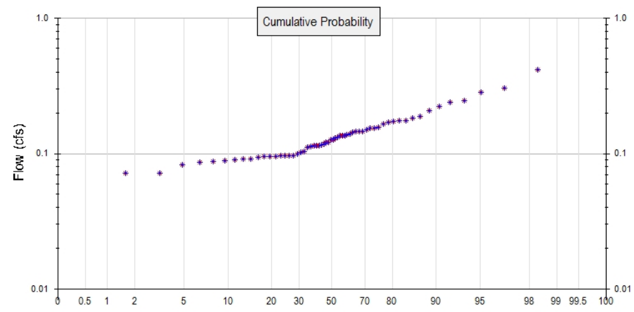
| | |
|---|---|
| On-line facility volume: | 0.0133 acre-feet |
| On-line facility target flow: | 0.0134 cfs. |
| Adjusted for 15 min: | 0.0134 cfs. |
| Off-line facility target flow: | 0.0088 cfs. |
| Adjusted for 15 min: | 0.0088 cfs. |

# LID Report

| LID Technique | Used for Treatment ? | Total Volume Needs Treatment (ac-ft) | Volume Through Facility (ac-ft) | Infiltration Volume (ac-ft) | Cumulative Volume Infiltration Credit | Percent Volume Infiltrated | Water Quality | Percent Water Quality Treated | Comment |
|---|---|---|---|---|---|---|---|---|---|
| Tank 1 POC | ☐ | 40.36 | | | ☐ | 0.00 | | | |
| Total Volume Infiltrated | | 40.36 | 0.00 | 0.00 | | 0.00 | 0.00 | 0% | No Treat. Credit |
| Compliance with LID Standard 8% of 2-yr to 50% of 2-yr | | | | | | | | | Duration Analysis Result = Passed |
| | | | | | | | | | |

## *POC 2*




+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 0.11
Total Impervious Area: 0.28

Mitigated Landuse Totals for POC #2
Total Pervious Area: 0.11
Total Impervious Area: 0.28

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

| **Return Period** | **Flow(cfs)** |
|---|---|
| 2 year | 0.12536 |
| 5 year | 0.174191 |
| 10 year | 0.21064 |
| 25 year | 0.261608 |
| 50 year | 0.303295 |
| 100 year | 0.348301 |

Flow Frequency Return Periods for Mitigated. POC #2

| **Return Period** | **Flow(cfs)** |
|---|---|
| 2 year | 0.12536 |
| 5 year | 0.174191 |
| 10 year | 0.21064 |
| 25 year | 0.261608 |
| 50 year | 0.303295 |
| 100 year | 0.348301 |

## Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

| **Year** | **Predeveloped** | **Mitigated** |
|---|---|---|
| 1949 | 0.137 | 0.137 |
| 1950 | 0.157 | 0.157 |
| 1951 | 0.139 | 0.139 |
| 1952 | 0.115 | 0.115 |
| 1953 | 0.154 | 0.154 |
| 1954 | 0.209 | 0.209 |
| 1955 | 0.146 | 0.146 |
| 1956 | 0.065 | 0.065 |
| 1957 | 0.120 | 0.120 |
| 1958 | 0.305 | 0.305 |
| 1959 | 0.113 | 0.113 |

| | | |
|---|---|---|
| 1960 | 0.116 | 0.116 |
| 1961 | 0.418 | 0.418 |
| 1962 | 0.136 | 0.136 |
| 1963 | 0.175 | 0.175 |
| 1964 | 0.089 | 0.089 |
| 1965 | 0.097 | 0.097 |
| 1966 | 0.099 | 0.099 |
| 1967 | 0.240 | 0.240 |
| 1968 | 0.131 | 0.131 |
| 1969 | 0.283 | 0.283 |
| 1970 | 0.097 | 0.097 |
| 1971 | 0.146 | 0.146 |
| 1972 | 0.188 | 0.188 |
| 1973 | 0.150 | 0.150 |
| 1974 | 0.184 | 0.184 |
| 1975 | 0.146 | 0.146 |
| 1976 | 0.095 | 0.095 |
| 1977 | 0.095 | 0.095 |
| 1978 | 0.071 | 0.071 |
| 1979 | 0.174 | 0.174 |
| 1980 | 0.092 | 0.092 |
| 1981 | 0.097 | 0.097 |
| 1982 | 0.095 | 0.095 |
| 1983 | 0.138 | 0.138 |
| 1984 | 0.121 | 0.121 |
| 1985 | 0.170 | 0.170 |
| 1986 | 0.174 | 0.174 |
| 1987 | 0.144 | 0.144 |
| 1988 | 0.115 | 0.115 |
| 1989 | 0.126 | 0.126 |
| 1990 | 0.091 | 0.091 |
| 1991 | 0.114 | 0.114 |
| 1992 | 0.117 | 0.117 |
| 1993 | 0.089 | 0.089 |
| 1994 | 0.093 | 0.093 |
| 1995 | 0.088 | 0.088 |
| 1996 | 0.127 | 0.127 |
| 1997 | 0.155 | 0.155 |
| 1998 | 0.166 | 0.166 |
| 1999 | 0.072 | 0.072 |
| 2000 | 0.246 | 0.246 |
| 2001 | 0.086 | 0.086 |
| 2002 | 0.082 | 0.082 |
| 2003 | 0.111 | 0.111 |
| 2004 | 0.224 | 0.224 |
| 2005 | 0.102 | 0.102 |
| 2006 | 0.136 | 0.136 |
| 2007 | 0.129 | 0.129 |
| 2008 | 0.096 | 0.096 |
| 2009 | 0.104 | 0.104 |

## Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated.  POC #2

| **Rank** | **Predeveloped** | **Mitigated** |
|---|---|---|
| 1 | 0.4180 | 0.4180 |
| 2 | 0.3047 | 0.3047 |
| 3 | 0.2832 | 0.2832 |
| 4 | 0.2460 | 0.2460 |

| | | |
|---|---|---|
| 5 | 0.2395 | 0.2395 |
| 6 | 0.2241 | 0.2241 |
| 7 | 0.2088 | 0.2088 |
| 8 | 0.1882 | 0.1882 |
| 9 | 0.1842 | 0.1842 |
| 10 | 0.1746 | 0.1746 |
| 11 | 0.1741 | 0.1741 |
| 12 | 0.1740 | 0.1740 |
| 13 | 0.1701 | 0.1701 |
| 14 | 0.1660 | 0.1660 |
| 15 | 0.1568 | 0.1568 |
| 16 | 0.1551 | 0.1551 |
| 17 | 0.1541 | 0.1541 |
| 18 | 0.1500 | 0.1500 |
| 19 | 0.1462 | 0.1462 |
| 20 | 0.1455 | 0.1455 |
| 21 | 0.1455 | 0.1455 |
| 22 | 0.1442 | 0.1442 |
| 23 | 0.1391 | 0.1391 |
| 24 | 0.1381 | 0.1381 |
| 25 | 0.1367 | 0.1367 |
| 26 | 0.1364 | 0.1364 |
| 27 | 0.1357 | 0.1357 |
| 28 | 0.1314 | 0.1314 |
| 29 | 0.1295 | 0.1295 |
| 30 | 0.1268 | 0.1268 |
| 31 | 0.1263 | 0.1263 |
| 32 | 0.1205 | 0.1205 |
| 33 | 0.1205 | 0.1205 |
| 34 | 0.1173 | 0.1173 |
| 35 | 0.1160 | 0.1160 |
| 36 | 0.1152 | 0.1152 |
| 37 | 0.1150 | 0.1150 |
| 38 | 0.1141 | 0.1141 |
| 39 | 0.1128 | 0.1128 |
| 40 | 0.1106 | 0.1106 |
| 41 | 0.1041 | 0.1041 |
| 42 | 0.1019 | 0.1019 |
| 43 | 0.0987 | 0.0987 |
| 44 | 0.0971 | 0.0971 |
| 45 | 0.0967 | 0.0967 |
| 46 | 0.0965 | 0.0965 |
| 47 | 0.0963 | 0.0963 |
| 48 | 0.0953 | 0.0953 |
| 49 | 0.0953 | 0.0953 |
| 50 | 0.0951 | 0.0951 |
| 51 | 0.0935 | 0.0935 |
| 52 | 0.0915 | 0.0915 |
| 53 | 0.0907 | 0.0907 |
| 54 | 0.0894 | 0.0894 |
| 55 | 0.0886 | 0.0886 |
| 56 | 0.0878 | 0.0878 |
| 57 | 0.0857 | 0.0857 |
| 58 | 0.0822 | 0.0822 |
| 59 | 0.0715 | 0.0715 |
| 60 | 0.0713 | 0.0713 |
| 61 | 0.0646 | 0.0646 |

## Duration Flows
The Facility PASSED

| Flow(cfs) | Predev | Mit | Percentage | Pass/Fail |
|---|---|---|---|---|
| 0.0627 | 1023 | 1023 | 100 | Pass |
| 0.0651 | 886 | 886 | 100 | Pass |
| 0.0675 | 774 | 774 | 100 | Pass |
| 0.0700 | 691 | 691 | 100 | Pass |
| 0.0724 | 612 | 612 | 100 | Pass |
| 0.0748 | 531 | 531 | 100 | Pass |
| 0.0773 | 478 | 478 | 100 | Pass |
| 0.0797 | 418 | 418 | 100 | Pass |
| 0.0821 | 378 | 378 | 100 | Pass |
| 0.0846 | 340 | 340 | 100 | Pass |
| 0.0870 | 302 | 302 | 100 | Pass |
| 0.0894 | 281 | 281 | 100 | Pass |
| 0.0918 | 260 | 260 | 100 | Pass |
| 0.0943 | 232 | 232 | 100 | Pass |
| 0.0967 | 210 | 210 | 100 | Pass |
| 0.0991 | 188 | 188 | 100 | Pass |
| 0.1016 | 178 | 178 | 100 | Pass |
| 0.1040 | 165 | 165 | 100 | Pass |
| 0.1064 | 153 | 153 | 100 | Pass |
| 0.1089 | 137 | 137 | 100 | Pass |
| 0.1113 | 124 | 124 | 100 | Pass |
| 0.1137 | 117 | 117 | 100 | Pass |
| 0.1162 | 107 | 107 | 100 | Pass |
| 0.1186 | 97 | 97 | 100 | Pass |
| 0.1210 | 87 | 87 | 100 | Pass |
| 0.1234 | 84 | 84 | 100 | Pass |
| 0.1259 | 80 | 80 | 100 | Pass |
| 0.1283 | 76 | 76 | 100 | Pass |
| 0.1307 | 73 | 73 | 100 | Pass |
| 0.1332 | 69 | 69 | 100 | Pass |
| 0.1356 | 69 | 69 | 100 | Pass |
| 0.1380 | 65 | 65 | 100 | Pass |
| 0.1405 | 58 | 58 | 100 | Pass |
| 0.1429 | 55 | 55 | 100 | Pass |
| 0.1453 | 53 | 53 | 100 | Pass |
| 0.1477 | 46 | 46 | 100 | Pass |
| 0.1502 | 43 | 43 | 100 | Pass |
| 0.1526 | 41 | 41 | 100 | Pass |
| 0.1550 | 38 | 38 | 100 | Pass |
| 0.1575 | 34 | 34 | 100 | Pass |
| 0.1599 | 34 | 34 | 100 | Pass |
| 0.1623 | 30 | 30 | 100 | Pass |
| 0.1648 | 28 | 28 | 100 | Pass |
| 0.1672 | 26 | 26 | 100 | Pass |
| 0.1696 | 25 | 25 | 100 | Pass |
| 0.1721 | 20 | 20 | 100 | Pass |
| 0.1745 | 17 | 17 | 100 | Pass |
| 0.1769 | 16 | 16 | 100 | Pass |
| 0.1793 | 16 | 16 | 100 | Pass |
| 0.1818 | 16 | 16 | 100 | Pass |
| 0.1842 | 15 | 15 | 100 | Pass |
| 0.1866 | 12 | 12 | 100 | Pass |
| 0.1891 | 11 | 11 | 100 | Pass |

| | | | | |
|---|---|---|---|---|
| 0.1915 | 11 | 11 | 100 | Pass |
| 0.1939 | 11 | 11 | 100 | Pass |
| 0.1964 | 10 | 10 | 100 | Pass |
| 0.1988 | 10 | 10 | 100 | Pass |
| 0.2012 | 9 | 9 | 100 | Pass |
| 0.2036 | 9 | 9 | 100 | Pass |
| 0.2061 | 9 | 9 | 100 | Pass |
| 0.2085 | 9 | 9 | 100 | Pass |
| 0.2109 | 8 | 8 | 100 | Pass |
| 0.2134 | 7 | 7 | 100 | Pass |
| 0.2158 | 7 | 7 | 100 | Pass |
| 0.2182 | 7 | 7 | 100 | Pass |
| 0.2207 | 7 | 7 | 100 | Pass |
| 0.2231 | 7 | 7 | 100 | Pass |
| 0.2255 | 6 | 6 | 100 | Pass |
| 0.2280 | 6 | 6 | 100 | Pass |
| 0.2304 | 6 | 6 | 100 | Pass |
| 0.2328 | 6 | 6 | 100 | Pass |
| 0.2352 | 6 | 6 | 100 | Pass |
| 0.2377 | 6 | 6 | 100 | Pass |
| 0.2401 | 5 | 5 | 100 | Pass |
| 0.2425 | 5 | 5 | 100 | Pass |
| 0.2450 | 5 | 5 | 100 | Pass |
| 0.2474 | 4 | 4 | 100 | Pass |
| 0.2498 | 4 | 4 | 100 | Pass |
| 0.2523 | 4 | 4 | 100 | Pass |
| 0.2547 | 4 | 4 | 100 | Pass |
| 0.2571 | 4 | 4 | 100 | Pass |
| 0.2595 | 4 | 4 | 100 | Pass |
| 0.2620 | 4 | 4 | 100 | Pass |
| 0.2644 | 4 | 4 | 100 | Pass |
| 0.2668 | 4 | 4 | 100 | Pass |
| 0.2693 | 4 | 4 | 100 | Pass |
| 0.2717 | 4 | 4 | 100 | Pass |
| 0.2741 | 4 | 4 | 100 | Pass |
| 0.2766 | 4 | 4 | 100 | Pass |
| 0.2790 | 4 | 4 | 100 | Pass |
| 0.2814 | 4 | 4 | 100 | Pass |
| 0.2839 | 3 | 3 | 100 | Pass |
| 0.2863 | 3 | 3 | 100 | Pass |
| 0.2887 | 3 | 3 | 100 | Pass |
| 0.2911 | 3 | 3 | 100 | Pass |
| 0.2936 | 3 | 3 | 100 | Pass |
| 0.2960 | 3 | 3 | 100 | Pass |
| 0.2984 | 3 | 3 | 100 | Pass |
| 0.3009 | 3 | 3 | 100 | Pass |
| 0.3033 | 3 | 3 | 100 | Pass |

## Water Quality

Water Quality BMP Flow and Volume for POC #2

| | |
|---|---|
| On-line facility volume: | 0 acre-feet |
| On-line facility target flow: | 0 cfs. |
| Adjusted for 15 min: | 0 cfs. |
| Off-line facility target flow: | 0 cfs. |
| Adjusted for 15 min: | 0 cfs. |

# LID Report

| LID Technique | Used for Treatment ? | Total Volume Needs Treatment (ac-ft) | Volume Through Facility (ac-ft) | Infiltration Volume (ac-ft) | Cumulative Volume Infiltration Credit | Percent Volume Infiltrated | Water Quality | Percent Water Quality Treated | Comment |
|---|---|---|---|---|---|---|---|---|---|
| Total Volume Infiltrated | | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 | 0% | No Treat. Credit |
| Compliance with LID Standard 8% of 2-yr to 50% of 2-yr | | | | | | | | | Duration Analysis Result = Passed |
| | | | | | | | | | |

# *Model Default Modifications*

Total of 0 changes have been made.

## *PERLND Changes*

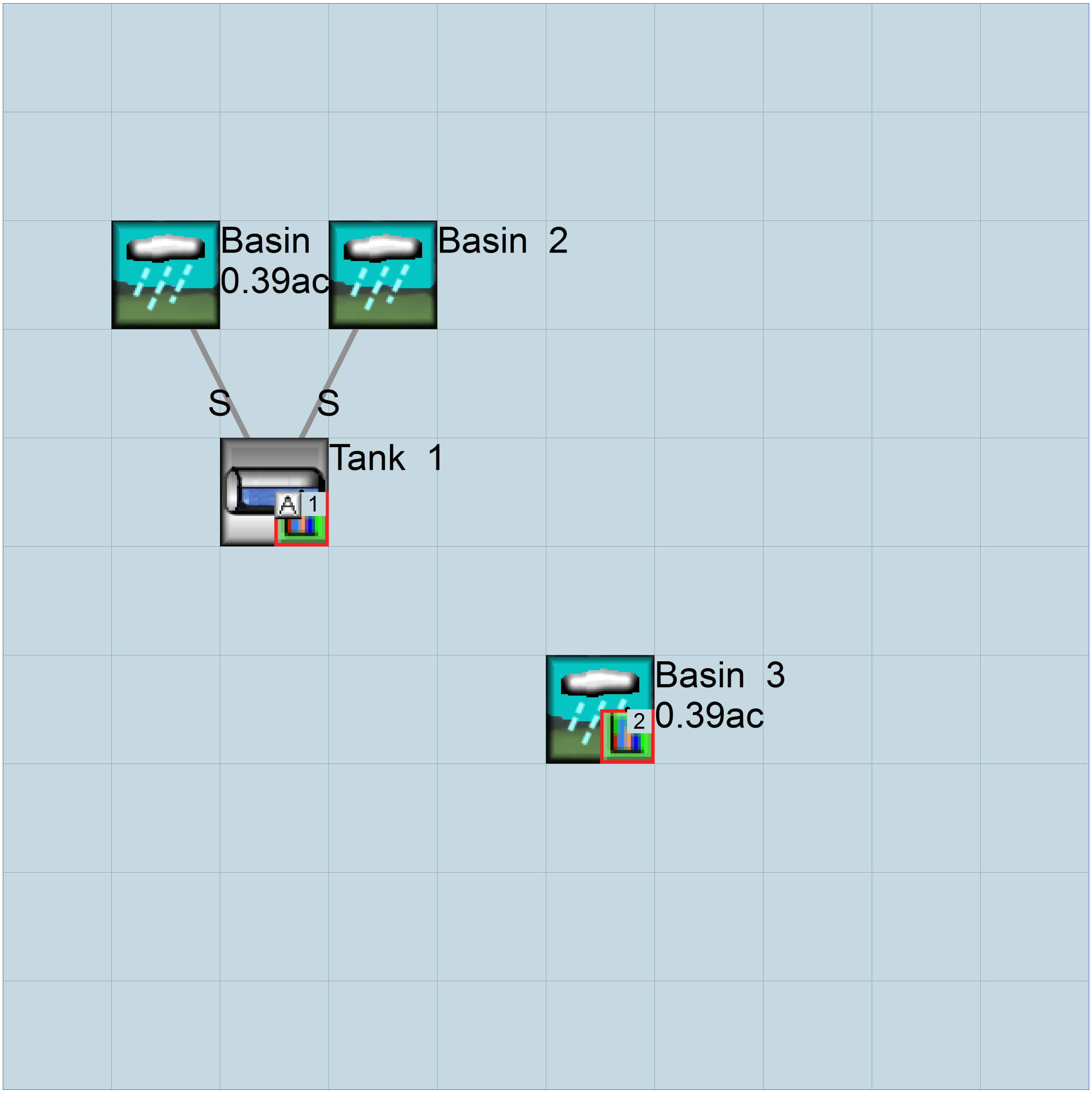
No PERLND changes have been made.

## *IMPLND Changes*

No IMPLND changes have been made.

# Appendix
## Predeveloped Schematic

*Mitigated Schematic*



## Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   21016_WWHM.wdm
MESSU      25   Pre21016_WWHM.MES
           27   Pre21016_WWHM.L61
           28   Pre21016_WWHM.L62
           30   POC21016_WWHM1.dat
           31   POC21016_WWHM2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       4
      IMPLND       5
      IMPLND       8
      IMPLND      11
      COPY       501
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                    MAX                     1    2   30    9
    2        Basin  2                    MAX                     1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1        1    1
  501        1    1
  502        1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   16      C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
```

```
  16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
  16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
  16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  16              0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  16              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  16             0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  16              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out          ***
   4      ROOF TOPS/FLAT          1    1    1   27    0
   5      DRIVEWAYS/FLAT          1    1    1   27    0
   8      SIDEWALKS/FLAT          1    1    1   27    0
  11      PARKING/FLAT            1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
   4         0    0    1    0    0    0
   5         0    0    1    0    0    0
   8         0    0    1    0    0    0
  11         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   *********
   4         0    0    4    0    0    0    1    9
   5         0    0    4    0    0    0    1    9
   8         0    0    4    0    0    0    1    9
  11         0    0    4    0    0    0    1    9
  END PRINT-INFO
```

```
  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI      ***
    4         0    0    0    0    0
    5         0    0    0    0    0
    8         0    0    0    0    0
   11         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    5            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
   11            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4              0         0
    5              0         0
    8              0         0
   11              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4              0         0
    5              0         0
    8              0         0
   11              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                       0.415     COPY   501     12
PERLND  16                       0.415     COPY   501     13
IMPLND   4                       0.031     COPY   501     15
IMPLND   5                       0.004     COPY   501     15
IMPLND   8                       0.004     COPY   501     15
Basin  2***
PERLND  16                        0.11     COPY   502     12
IMPLND   4                       0.076     COPY   502     15
IMPLND   8                       0.028     COPY   502     15
IMPLND  11                       0.176     COPY   502     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1


<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
```

```
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                   ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG              ***
                                      in  out                                  ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                        ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *          ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50         ***
  <------><--------><--------><--------><--------><--------><-------->         ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                           ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC      ENGL    1             PERLND   1 999 EXTNL  PREC
WDM      2 PREC      ENGL    1             IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP      ENGL    0.76          PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP      ENGL    0.76          IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
```

```
IMPLND     IWATER SURO       0.083333       COPY           INPUT  MEAN
  END MASS-LINK   15

END MASS-LINK

END RUN
```

## *Mitigated UCI File*

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   21016_WWHM.wdm
MESSU      25   Mit21016_WWHM.MES
           27   Mit21016_WWHM.L61
           28   Mit21016_WWHM.L62
           31   POC21016_WWHM2.dat
           30   POC21016_WWHM1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       4
      IMPLND       8
      IMPLND      11
      RCHRES       1
      COPY       502
      COPY         1
      COPY       501
      DISPLY       2
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    2        Basin  3                   MAX                      1    2   31    9
    1        Tank  1                    MAX                      1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1        1    1
  502        1    1
  501        1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   16      C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
```

```
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16              0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                     ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    4      ROOF TOPS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
   11      PARKING/FLAT           1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    4         0    0    1    0    0    0
    8         0    0    1    0    0    0
   11         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    4         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
   11         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
```

```
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    4         0    0    0    0    0
    8         0    0    0    0    0
   11         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    4            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
   11            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    4             0         0
    8             0         0
   11             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    4             0         0
    8             0         0
   11             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                        0.11     RCHRES   1      2
IMPLND   4                       0.076     RCHRES   1      5
IMPLND   8                       0.028     RCHRES   1      5
IMPLND  11                       0.176     RCHRES   1      5
Basin  2***
IMPLND  11                       0.004     RCHRES   1      5
Basin  3***
PERLND  16                        0.11     COPY   502     12
IMPLND   4                       0.076     COPY   502     15
IMPLND   8                       0.028     COPY   502     15
IMPLND  11                       0.176     COPY   502     15

******Routing******
PERLND  16                        0.11     COPY     1     12
IMPLND   4                       0.076     COPY     1     15
IMPLND   8                       0.028     COPY     1     15
IMPLND  11                       0.176     COPY     1     15
IMPLND  11                       0.004     COPY     1     15
RCHRES   1                           1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     INPUT  TIMSER 1
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK
```

```
RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                  ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG             ***
                                           in  out                            ***
    1     Tank  1                1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                       ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *        *  *  *  *  *         ***
    1        0  1  0  0    4  0  0  0  0        0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50        ***
  <------><--------><--------><--------><--------><--------><-------->        ***
    1              1      0.03       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                          ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  0.0  0.0  0.0  0.0        0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.000000  0.000000  0.000000
  0.044444  0.002695  0.000080  0.002463
  0.088889  0.003790  0.000226  0.003484
  0.133333  0.004615  0.000413  0.004267
  0.177778  0.005299  0.000634  0.004927
  0.222222  0.005890  0.000883  0.005508
  0.266667  0.006414  0.001156  0.006034
  0.311111  0.006886  0.001452  0.006518
  0.355556  0.007317  0.001768  0.006968
  0.400000  0.007713  0.002102  0.007390
  0.444444  0.008080  0.002453  0.007790
  0.488889  0.008422  0.002820  0.008170
  0.533333  0.008740  0.003201  0.008534
  0.577778  0.009039  0.003596  0.008882
  0.622222  0.009319  0.004004  0.009217
  0.666667  0.009582  0.004425  0.009541
  0.711111  0.009830  0.004856  0.009854
  0.755556  0.010064  0.005298  0.010157
  0.800000  0.010285  0.005750  0.010451
  0.844444  0.010493  0.006212  0.010738
```

| | | | |
|---|---|---|---|
| 0.888889 | 0.010689 | 0.006683 | 0.011017 |
| 0.933333 | 0.010875 | 0.007162 | 0.011289 |
| 0.977778 | 0.011050 | 0.007649 | 0.011555 |
| 1.022222 | 0.011215 | 0.008144 | 0.011814 |
| 1.066667 | 0.011370 | 0.008646 | 0.012068 |
| 1.111111 | 0.011516 | 0.009155 | 0.012317 |
| 1.155556 | 0.011654 | 0.009670 | 0.012561 |
| 1.200000 | 0.011783 | 0.010190 | 0.012800 |
| 1.244444 | 0.011903 | 0.010717 | 0.013035 |
| 1.288889 | 0.012016 | 0.011248 | 0.013266 |
| 1.333333 | 0.012121 | 0.011785 | 0.013493 |
| 1.377778 | 0.012218 | 0.012326 | 0.013716 |
| 1.422222 | 0.012308 | 0.012871 | 0.013935 |
| 1.466667 | 0.012390 | 0.013420 | 0.014151 |
| 1.511111 | 0.012466 | 0.013972 | 0.014364 |
| 1.555556 | 0.012534 | 0.014528 | 0.014574 |
| 1.600000 | 0.012596 | 0.015086 | 0.014781 |
| 1.644444 | 0.012651 | 0.015647 | 0.014984 |
| 1.688889 | 0.012699 | 0.016210 | 0.015186 |
| 1.733333 | 0.012741 | 0.016776 | 0.015384 |
| 1.777778 | 0.012776 | 0.017343 | 0.015580 |
| 1.822222 | 0.012805 | 0.017911 | 0.015774 |
| 1.866667 | 0.012827 | 0.018481 | 0.015965 |
| 1.911111 | 0.012843 | 0.019052 | 0.016154 |
| 1.955556 | 0.012853 | 0.019623 | 0.016341 |
| 2.000000 | 0.012856 | 0.020194 | 0.016525 |
| 2.044444 | 0.012853 | 0.020765 | 0.016708 |
| 2.088889 | 0.012843 | 0.021336 | 0.016888 |
| 2.133333 | 0.012827 | 0.021907 | 0.017067 |
| 2.177778 | 0.012805 | 0.022476 | 0.017244 |
| 2.222222 | 0.012776 | 0.023045 | 0.017419 |
| 2.266667 | 0.012741 | 0.023612 | 0.017592 |
| 2.311111 | 0.012699 | 0.024177 | 0.017764 |
| 2.355556 | 0.012651 | 0.024741 | 0.017934 |
| 2.400000 | 0.012596 | 0.025302 | 0.018102 |
| 2.444444 | 0.012534 | 0.025860 | 0.018269 |
| 2.488889 | 0.012466 | 0.026416 | 0.018435 |
| 2.533333 | 0.012390 | 0.026968 | 0.018598 |
| 2.577778 | 0.012308 | 0.027517 | 0.018761 |
| 2.622222 | 0.012218 | 0.028062 | 0.018922 |
| 2.666667 | 0.012121 | 0.028603 | 0.019082 |
| 2.711111 | 0.012016 | 0.029139 | 0.019240 |
| 2.755556 | 0.011903 | 0.029671 | 0.019397 |
| 2.800000 | 0.011783 | 0.030197 | 0.019553 |
| 2.844444 | 0.011654 | 0.030718 | 0.019707 |
| 2.888889 | 0.011516 | 0.031233 | 0.019861 |
| 2.933333 | 0.011370 | 0.031742 | 0.020222 |
| 2.977778 | 0.011215 | 0.032244 | 0.020904 |
| 3.022222 | 0.011050 | 0.032738 | 0.021758 |
| 3.066667 | 0.010875 | 0.033226 | 0.022741 |
| 3.111111 | 0.010689 | 0.033705 | 0.023828 |
| 3.155556 | 0.010493 | 0.034176 | 0.025003 |
| 3.200000 | 0.010285 | 0.034637 | 0.026252 |
| 3.244444 | 0.010064 | 0.035090 | 0.027566 |
| 3.288889 | 0.009830 | 0.035532 | 0.028937 |
| 3.333333 | 0.009582 | 0.035963 | 0.030357 |
| 3.377778 | 0.009319 | 0.036383 | 0.031820 |
| 3.422222 | 0.009039 | 0.036791 | 0.033321 |
| 3.466667 | 0.008740 | 0.037187 | 0.034855 |
| 3.511111 | 0.008422 | 0.037568 | 0.036418 |
| 3.555556 | 0.008080 | 0.037935 | 0.038005 |
| 3.600000 | 0.007713 | 0.038286 | 0.039614 |
| 3.644444 | 0.007317 | 0.038620 | 0.041240 |
| 3.688889 | 0.006886 | 0.038936 | 0.042880 |
| 3.733333 | 0.006414 | 0.039231 | 0.044532 |
| 3.777778 | 0.005890 | 0.039505 | 0.046193 |
| 3.822222 | 0.005299 | 0.039754 | 0.047859 |
| 3.866667 | 0.004615 | 0.039975 | 0.049529 |
| 3.911111 | 0.003790 | 0.040162 | 0.059101 |
| 3.955556 | 0.002695 | 0.040308 | 0.143225 |

```
  4.000000  0.001000  0.040388  0.270545
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO      1 1        1     WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE   1 1        1     WDM   1001 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN    1 1     48.4     WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN    1 1     48.4     WDM    801 FLOW     ENGL      REPL
COPY     2 OUTPUT MEAN    1 1     48.4     WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN    1 1     48.4     WDM    802 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16


END MASS-LINK

END RUN
```

*Predeveloped HSPF Message File*

## *Mitigated HSPF Message File*

# Disclaimer

## Legal Notice



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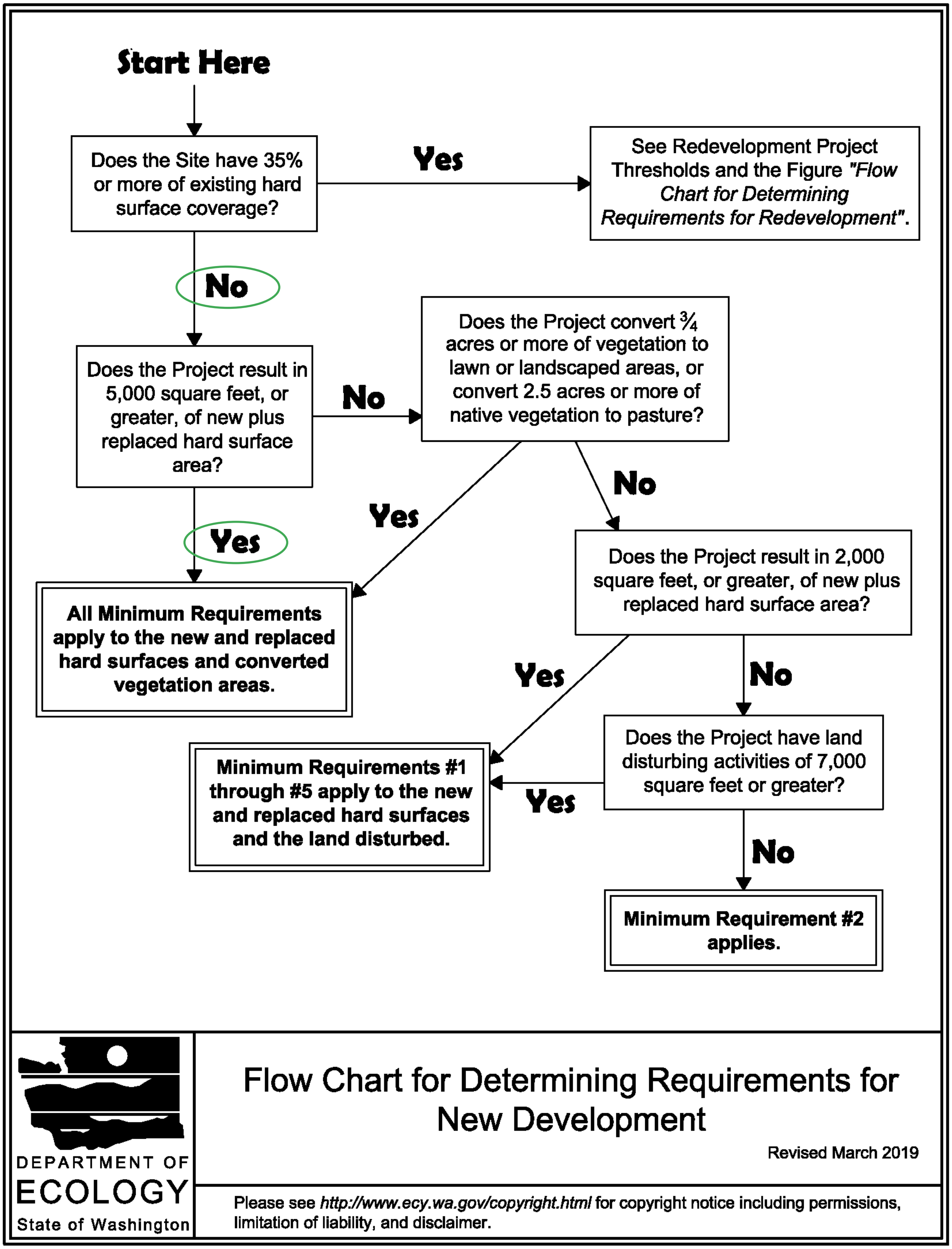
**Figure I-3.1: Flow Chart for Determining Requirements for New Development**



# Custom Soil Resource Report
## Soil Map


Map Scale: 1:8,670 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 100, 200, 400, 600

Feet: 0, 400, 800, 1600, 2400

N

Map projection: Web Mercator   Corner coordinates: WGS84   Edge tics: UTM Zone 10N WGS84

# Snohomish County Area, Washington

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

### Map Unit Setting

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

### Map Unit Composition

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

### Description of Alderwood

#### Setting

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

#### Typical profile

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

#### Properties and qualities

*Slope:* 2 to 8 percent
*Depth to restrictive feature:* 20 to 40 inches to densic material
*Drainage class:* Moderately well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)
*Depth to water table:* About 18 to 36 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water supply, 0 to 60 inches:* Low (about 3.0 inches)

#### Interpretive groups

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

### Minor Components

#### Terric medisaprists, undrained

*Percent of map unit:* 5 percent
*Landform:* Depressions
*Other vegetative classification:* Wet Soils (G002XN102WA)
*Hydric soil rating:* Yes