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Taco Time

Stormwater Site Plan
Drainage Report

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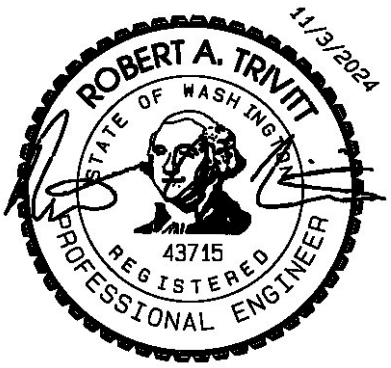

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Section I - Project Overview

Overview:

The site is located on the north side of E Main, east of SR 512. The site address is 1115 E Main. Tax parcel numbers are 784510-003-2, 042027-1-171 & -172. Total parcel area is 4.47 acres. The site is currently developed with a Taco Time Restaurant, primarily on parcel -003-2. The project consists of the construction of a new Taco Time Restaurant building and expansion of the existing parking lot. The existing building will remain for use by other tenants.

Improvements for the project will include the new building, additional parking lot, storm drainage facilities, expansion of existing driveway approach, sanitary sewer service, water service, and other underground utilities.

The site drains into two different Threshold Discharge Areas (TDA). TDA 1 drains to the north and is analyzed under POC 1 in the hydrologic analysis. TDA 2 drains to the south and is analyzed under POC 2 in the hydrologic analysis. The following tables summarize the impervious areas associated with the project.

Existing	POC 1 Area (sf)	POC 2 Area (sf)
Onsite		
Roof	0	3625
Paving	728	23654
Walk	0	197
Total Onsite Impervious	728	27476
Offsite		
Driveway	0	1299
Total Project Site Imp.	728	28775
Ex Driveway		
Remove	0	440
Replace	0	859
Ex Paving		
Remain	728	13863
Remove	0	8932
Replace	0	859

Developed	POC 1 Area (sf)	POC 2 Area (sf)
Onsite		
Roof		
Existing	0	3625
New	648	3941
Total Roof	648	7566
Paving		
Existing	728	13863
New	13758	1966
Total Paving	14486	15829
Walk		
Existing	0	197
New	720	2713
Total Walk	720	2910
Total Onsite Impervious	15854	26305
Total New Onsite Imperviou	15126	8620
Offsite		
Replaced Driveway	0	859
Total New + Replaced Imp.	15126	9479
Total New + Replaced PGHS	13758	2825
Total Project Site Imp.	15854	27164

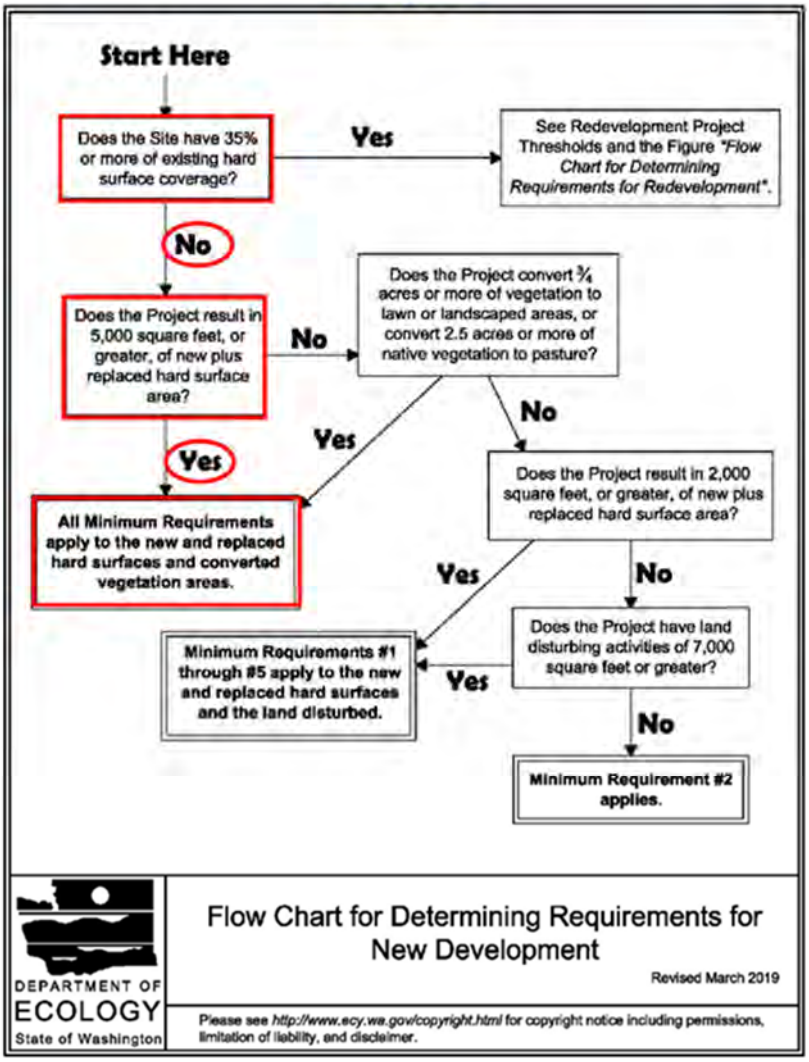
Project Requirements:

Determination of Applicable Minimum Requirements

Per PMC 21.10.040 the City of Puyallup has adopted the Washington State Department of Ecology Stormwater Management Manual for Western Washington (SMMWW), with the version in effect being "the most current version approved for city use by the council." The 2019 DOE Manual has been adopted by the City and is the controlling regulation and is referred to as "the Manual" or "SMMWW" hereinafter.

The project consists of over 25,000 sf of new plus replaced hard surfaces onsite. The existing hard surfaces are less than 35% of the site and therefore, the project is considered new development. Since the total new plus replaced hard surfaces for the project are greater than 5,000 square feet, all minimum requirements apply to the new and replaced hard surfaces and converted vegetation areas.

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



Discussion of Minimum Requirements

The Minimum Requirements per Section I-2.5 of the Manual:

Minimum Requirement #1: Preparation of Stormwater Site Plans

The Stormwater Site Plan consists of a report and construction plans. This report and the associated civil plans satisfy Minimum Requirement #1.

Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPPP)

The SWPPP consist of a narrative and drawings. The narrative is addressed in Section V of this report. The drawings include a TESC plan, notes, and details as part of the site development construction plans.

Minimum Requirement #3: Source Control of Pollution

The proposed use of the site is as a restaurant. A separate document addressing source control for this use per Section IV of the Manual is included with this submittal to address this requirement.

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

Currently, drainage from the original improvements to the site, generally the southwest portion of the site, is collected in a conveyance system that connects to the existing closed conveyance system in E Main. This drainage will remain largely unchanged with the proposed development. Drainage from improvements to the site made in 2003 is collected, routed through a bioswale for treatment, then infiltrated in an underground gallery, with an overflow connection into the original conveyance system. With the proposed development, the bioswale will be filled and replaced with a StormFilter catch basin. The original infiltration trench will remain and drainage to it largely unchanged. The area of the north half of proposed improvements currently sheet flows to the north. The parking lot proposed in this area will route runoff to a dispersion trench that will also disperse flows to the north and the new restaurant roof drainage will be infiltrated, thereby preserving the natural drainage system and outfall.

Minimum Requirement #5: On-site Stormwater Management

Because the project triggers MR #1-9, and is inside the urban growth area, the project must either meet the Low Impact Development Performance Standard, or use List #2 to determine applicable On-Site Stormwater Management BMPs. This project will use List #2. For each surface the BMP's must be considered in the order listed for that type of surface and use the first BMP that is considered feasible.

Lawn and Landscaped Areas:

- All lawn and landscaped areas will meet the requirements of BMP T5.13, Post Construction Soil Quality and Depth with notes on the plans to this effect.

Roofs:

1. BMP T5.30: Full Dispersion – will be used for the new trash enclosure roof on the northside of the improvements. For the new restaurant roof, this is infeasible due to inadequate vegetated area to meet the 65:10 ratio on the south side of the site.
2. BMP T5.10A: Downspout Full Infiltration – will be used for the new restaurant building.

Other Hard Surfaces:

1. BMP T5.30: Full Dispersion – will be used for the north parking lot improvements.

Minimum Requirement #6: Runoff Treatment

Full Dispersion will be used for TDA 1, which automatically results in compliance with MR #6. The new plus replaced PGHS for TDA 2 is 2,460. The existing bioswale meets the basic treatment standard and will be replaced by a StormFilter catch basin with ZPG media which meet basic treatment requirements per GULD designation by DOE. Because the new plus replaced PGHS for TDA 2 is less than 5,000 sf, treatment of runoff in TDA 2 is not required.

Minimum Requirement #7: Flow Control

Full Dispersion will be used for TDA 1, which automatically results in compliance with MR #7. For TDA 2, the total new plus replaced impervious is 9,114 sf. Of this, 3,941 sf of roof will be routed to infiltration for an effective impervious area of 5,173 sf. This is less than the 10,000 sf threshold for this MR. The converted vegetation areas are below the thresholds, and the increase in runoff rates for the 100-year event is less than 0.15 cfs (see Section VI, below). Therefore, this minimum requirement does not apply to TDA 2.

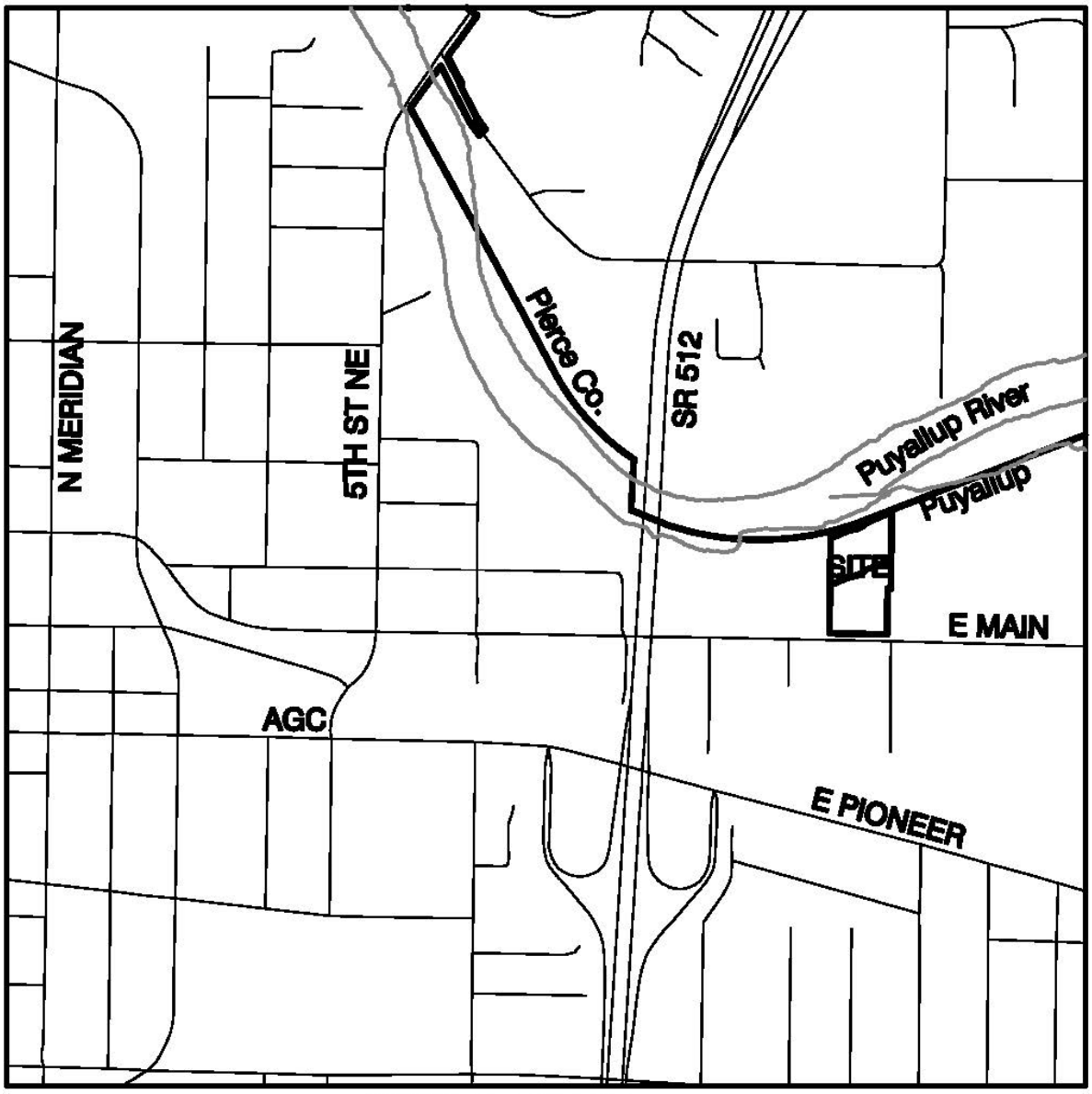
Minimum Requirement #8: Wetlands Protection

There are no wetlands on or near the site.

Minimum Requirement #9: Operation and Maintenance

The stormwater facilities required for this project that require a maintenance plan are: conveyance system, infiltration trench, permeable pavement, and StormFilter catch basin. All onsite stormwater facilities will be owned, operated, and maintained by the property owner. An O&M plan is included as a separate document.

Figure 1. Site Location:



VICINITY MAP

Section II – Existing Conditions Summary

Topography:

In existing conditions the south 150 feet of the site is generally flat, sloping gently to the south with an average slope of less than 1%. The 100 feet to the north of this area slopes moderately to the north with a slope between 5-20%. This area is where most of the proposed construction will occur. From this area to the north the site is nearly flat sloping gently to the north.

Ground Cover:

The site is developed with a restaurant building and parking lot. The area north of the development is forest and brush.

Drainage:

Drainage in the developed area is controlled with existing closed conveyance systems. The area in the southwest collects runoff and connects to the existing public storm line in E Main. The newer parking lot development drainage is collected in a closed conveyance system, directed through a bioswale which releases to an infiltration gallery with overflow into the closed conveyance system in the southwest portion of the site. Drainage from the undeveloped portion of the site currently sheet flows north towards the Puyallup River.

Soils:

The NRCS Soil Survey of Pierce County indicates the soils on the portion of the site to be developed are Puyallup fine sandy loam (31A). Puyallup soils are hydrologic group A. Based on the soils exploration performed by GeoResources, infiltration is feasible on the eastern portion of the development with a design infiltration rate of 1.1 inches per hour. Groundwater monitoring found peak groundwater at depths ranging from 5.3 to 8.8 feet or elevations 43.7 to 47.7. Based on the location of monitoring wells, peak groundwater is estimated at 47.7 at the proposed roof drain infiltration trench.

Floodplain

The site is mapped with an AE floodplain at elevation 46.3. All proposed improvements are outside the mapped floodplain. Reference FEMA FIRM panel 53053C0334E dated 3/7/2017.

Section III – Off-Site Analysis

Upstream

Contours are generally perpendicular to property lines and therefore, there is little potential for upstream runoff entering the site.

Downstream

From the south 150 feet of the project site, runoff generally flows into the existing onsite conveyance system either directly or indirectly to the existing public closed conveyance system in E Main. Drainage from the remainder of the site sheet flows north on the site about 250 feet to a low point onsite near the north property line. From the low point, runoff flows northeast and north approximately 500 feet into the Puyallup River.

Problems

There are no known drainage problems along this downstream route.

Section IV – Permanent Stormwater Control Plan

Existing Site Hydrology

In existing conditions, runoff from the existing development on the south end of the site flows ultimately into the closed conveyance system in E Main. A portion, from the original development of the site, is collected, and tightlined directly into the storm system in E Main. Drainage from parking lot improvements constructed in 2002-2003 is routed through a bioswale, then into an infiltration gallery, with overflow into the existing onsite conveyance system. Drainage from these areas (TDA 2) is connected to POC 2 in the WWHM analysis. Drainage from the area north of the existing improvements (TDA 1) sheet flows north across the site. This area is connected to POC 1 in the WWHM analysis. Slopes in the already developed area are flat. Slopes north of this area are a mix of flat and moderate. The project site is within the 42-inch, East rainfall zone and WWHM is run with 15-minute intervals. The infiltration gallery is modeled based on the as-builts: 114.8 feet long, 16.4 feet wide, 1.98 feet of storage depth before overflow, and 94% voids. The infiltration rate determined for the new improvements, 1.1 in/hr is used.

See Map D1 at back of this report for delineation of sub-basins. The drainage sub-basins in existing conditions are:

EXISTING TO NORTH-POC 1	sf	acre
C, Forest, Flat	3662	0.0841
C, Forest, Mod	15745	0.3615
C, Lawn, Flat	586	0.0135
Total	19993	0.4590

PRE-2003 IMPROVEMENTS		
DIRECT DISCHARGE TO SOUTH/TDA 2-POC 2		
Existing	Area (sf)	acre
C, Lawn, Flat	4401	0.1010
Roof	3625	0.0832
Paving	8532	0.1959
Walk	197	0.0045
Total Impervious	12354	0.2836
Total	16755	0.3846

2003/2004 IMPROVEMENTS		
TO BIOSWALE AND INFIL./TDA 2-POC 2		
Existing	Area (sf)	acre
C, Lawn, Flat	5278	0.1212
Paving	19303	0.4431
Total	24581	0.5643

The peak runoff rates calculated by WWHM2012 for predeveloped conditions are:

Flow Frequency

Flow(cfs)	0501 15m POC 1	0502 15m POC 2
2 Year =	0.0112	0.1091
5 Year =	0.0176	0.1486
10 Year =	0.0218	0.1777
25 Year =	0.0271	0.2179
50 Year =	0.0308	0.2503
100 Year =	0.0345	0.2851

The storage depths in the existing trench are:

Stage Frequency (feet)		1014 15m
2 Year	=	0.4346
5 Year	=	0.7347
10 Year	=	0.9781
25 Year	=	1.3390
50 Year	=	1.6482
100 Year	=	1.9936

See Appendix A for WWHM analysis.

Developed Site Hydrology

The proposed improvements will modify the exact areas draining to existing storm systems. The area draining into the existing bioswale and infiltration gallery will be reduced. The area draining directly into the existing conveyance system will have minor modifications. Roof drainage from the new restaurant will be routed to an infiltration trench. Runoff from the new parking lot and adjacent walkway and trash enclosure roof will be routed to full dispersion. See Map D1 at the end of this report for delineation of drainage sub-basins. The developed drainage basins are:

TO FULL DISPERSION/TDA 1 - POC 1	sf	acre
C, Lawn, Flat	8314	0.1909
New Roof	648	0.0149
Walk, Flat	720	0.0165
Paving, Flat	14486	0.3326
Total Impervious	15854	0.3640
Total Hard Surface	15854	0.3640
Total	24168	0.5548

TO ROOF D.S. INFIL. TRENCH/TDA 2-POC 2	sf	acre
Roof	3941	0.0905
DIRECT DISCHARGE/TDA 2-POC 2		
	sf	acre
C, Lawn, Flat	4731	0.1086
Roof	3625	0.0832
Paving	6039	0.1386
Walk	3256	0.0747
Total Impervious	12920	0.2966
Total	17651	0.4052

TO STORMFILTER & EX. INFIL./TDA 2-	sf	acre
C, Lawn, Flat	3353	0.0770
Paving, Flat	9564	0.2196
Walk, Flat	589	0.0135
Total Impervious	10153	0.2331
Total	13506	0.3101

The peak runoff rates prior to infiltration are:

Flow Frequency

Flow(cfs)	0702 15m	0801 15m
2 Year =	0.1223	0.1427
5 Year =	0.1652	0.1951
10 Year =	0.1965	0.2337
25 Year =	0.2395	0.2871
50 Year =	0.2742	0.3304
100 Year =	0.3111	0.3768

Flow Control – Full Dispersion – TDA 1

Full Dispersion will be used to mitigate runoff from the north parking lot improvements, TDA 1. Full Dispersion requires that no more than 10% of a TDA be impervious and that a dispersion area, to be left in forested/native vegetation must be set aside at a ratio of 6.5:1 of the impervious area. The total area owned by the applicant within TDA 1 is 159,332 sf. The total impervious proposed within TDA 1 is 15,854 sf, or 9.95% of the area. 6.5 times the impervious area is 103,051 sf. The designated dispersion area on the construction drawings is 103,095 sf. Runoff must be dispersed into the dispersion area. Concentrated flow from impervious areas will be collected in a conveyance system and routed through a dispersion trench with a required 100 foot flowpath. The dispersion trench will be 50 feet long with a maximum allowed flow rate of 0.5 cfs. Per the analysis above, the 100-year flow rate is 0.38 cfs. A small area of landscaping will sheet flow into the dispersion area with a required 25 foot flowpath. Appendix E includes all BMP requirements with discussion on how each requirement is addressed. Use of Full Dispersion results in MR #5, #6, & #7 being met and all impervious areas are considered mitigated.

Flow Control – TDA 2

Downspout Infiltration Trench

Roof runoff from the restaurant will be routed to an infiltration trench designed using WWHM. To size an infiltration gallery using WWHM the trench is modeled as a gravel trench/bed. Standard infiltration trenches have 30% voids. The project site is within the 42-inch East rainfall basin. As noted above, a design rate of 1.1 in/hr is used. A standpipe is set at the design depth of the trench, 2 feet, and the trench sized until there is zero discharge through the standpipe.

Per the WWHM analysis in Appendix A, the required trench size is 80 feet long by 8 feet wide by 2 feet deep. The resulting storage depths are:

Stage Frequency (feet)		1003 15m
2 Year	=	0.3151
5 Year	=	0.6056
10 Year	=	0.8396
25 Year	=	1.1766
50 Year	=	1.4545
100 Year	=	1.7531

Existing Infiltration Trench

Routing the developed conditions drainage area through the existing infiltration trench results in the following storage depths:

Stage Frequency (feet)		1010 15m
2 Year	=	0.0992
5 Year	=	0.1757
10 Year	=	0.2444
25 Year	=	0.3561
50 Year	=	0.4604
100 Year	=	0.5854

Flow Control Requirements

The resulting peak flows in developed conditions for TDA 2/POC 2 are:

Flow Frequency Flow(cfs)		0802 15m
2 Year	=	0.1139
5 Year	=	0.1547
10 Year	=	0.1846
25 Year	=	0.2257
50 Year	=	0.2590
100 Year	=	0.2945

Compared to existing conditions, there is a 0.0094 cfs increase in the 100-year runoff rate. Because there is less than a 0.15 cfs increase in the 100-year flow, this TDA is not required to meet MR #6, Flow Control.

Treatment

TDA 1

Use of Full Dispersion of runoff for POC 1 addresses the requirements of MR #6.

TDA 2

The proposed development will eliminate the existing bioswale currently providing treatment for the existing parking lot improvements made in 2002-2003. The bioswale will be replaced with a StormFilter catch basin. To isolate the area routed to treatment in the WWHM model, the sub-basin routed to the infiltration trench is connected directly to POC 3. The treatment flow rate is 0.0279 cfs. This equals 12.52 gpm. Standard cartridges have a design flow rate of 7.5 gpm and therefore 2 cartridges will be required.

Section V – Construction Stormwater Pollution Prevention Plan

Following are the 12 elements of the SWPPP. Where specific BMP's are prescribed, they are explained as shown on the engineering drawings for the project. Alternate BMP's may be acceptable in lieu of, or as a supplement to the prescribed BMP's. Where identified, alternate BMP's are listed and requirements included.

Element #1 – Mark Clearing Limits

Construction fencing will be used to mark clearing limit, except where boundary fencing already exists.

Element #2 – Establish Construction Access

Construction access or activities occurring on unpaved areas shall be minimized, yet where necessary, access points shall be stabilized to minimize the tracking of sediment onto public roads, and wheel washing, street sweeping, and street cleaning shall be employed to prevent sediment from entering state waters. All wash wastewater shall be controlled on site. The existing paved access may be used as a construction access with a trackout pad installed to prevent sediment track-out, see detail in Appendix D.

Alternative BMPs:

- Wheel Wash (C106)

Element #3 – Control Flow Rates

Due to the limited scope of work, no BMPs to control flow rates are required.

Element #4 – Install Sediment Controls

All stormwater runoff from disturbed areas shall pass through an appropriate sediment removal BMP before leaving the construction site or prior to being discharged to an infiltration facility. The specific BMPs to be used for controlling sediment on this project include:

- Silt Fence (C233)

Element #5 – Stabilize Soils

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

- Temporary and Permanent Seeding (C120)Mulching (C121)

Exposed areas and soil stockpiles must be stabilized according to the following schedule:

1. From April 1 to October 31 all disturbed areas at final grade and all exposed areas that are scheduled to remain unworked for more than 30 days shall be stabilized within 10 days.
2. From November 1 to March 31 all exposed soils at final grade shall be stabilized immediately using permanent or temporary measures. Exposed soils with an area greater than 5,000 square feet that are scheduled to remain unworked for more than 24 hours and exposed areas of less than 5,000 square feet that will remain unworked for more than seven (7) days shall be stabilized immediately.

All disturbed areas which are not planned to be constructed on within 90 days from time of clearing and grading shall be revegetated with the native vegetation.

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

Alternate BMP's:

- Plastic Covering (C123)
- Sodding (C124)
- Topsoiling (C125)

Element #6 – Protect Slopes

The slopes within the clearing limits/area to be disturbed are nearly flat. A retaining wall will be constructed early in the construction process, mitigating the need for any slope protection.

Element #7 – Protect Drain Inlets

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

Reference and include mat detail

- Storm Drain Inlet Protection (C220)

Element #8 – Stabilize Channels and Outlets

Where site runoff is to be conveyed in channels or discharged to a stream or some other natural drainage point, efforts will be taken to prevent downstream erosion. No surface channels or outlets are proposed for this project.

Element #9 – Control Pollutants

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

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

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

Specific construction related BMP's to be used include:

- Concrete Handling (C151)
- Sawcutting and Surfaceing Pollution Prevention (C152)
- Material Delivery, Storage and Containment (C153)
- Concrete Washout Area (C154)
- Treating and Disposing of High pH Water (C252)

Element #10 – Control Dewatering

Work will commence during the dry season, therefore no dewatering is likely to be required. If groundwater is encountered during construction, the water from all de-watering systems for trenches and foundations may be disposed of in one of the following manners:

(1) Foundation, vault, and trench de-watering water which have similar characteristics to stormwater runoff at the site shall be discharged into a controlled conveyance system prior to discharge to a sediment trap or sediment pond.

(2) Clean, non-turbid de-watering water, such as well-point ground water, can be discharged to systems tributary to or directly into surface waters of the state, provided the de-watering flow does not cause erosion or flooding of receiving waters. Clean de-watering water should not be routed through stormwater sediment ponds. Other disposal options for clean, non-turbid de-watering water may include:

(a) Infiltration;

(b) Transportation off-site in a vehicle (such as a vacuum flush truck) for legal disposal in a manner that does not pollute state waters;

(c) On-site chemical treatment or other suitable treatment technologies approved by the department and Washington State Department of Ecology;

(d) Sanitary sewer discharge with local sewer district approval, if there is no other option; and

(e) Use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized de-watering water.

Element #11 – Maintain BMPs

All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with each particular BMP's specifications. Visual monitoring of the BMPs will be conducted at least once every calendar week and within 24 hours of any rainfall event (typically around 0.5" in 24-hour period) that causes a discharge from the site. If the site becomes inactive, and is temporarily stabilized, the inspection frequency may be reduced to once every month, during the dry season

All temporary erosion and sediment control BMPs shall be removed within 30 days after the final site stabilization is achieved or after the temporary BMPs are no longer needed. The need for TESC measures continuance or removal shall be determined by the designated site CESC lead person with concurrence of the County inspector. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

Element #12 – Manage the Project

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

- Design the project to fit the existing topography, soils, and drainage patterns.
- Emphasize erosion control rather than sediment control.
- Minimize the extent and duration of the area exposed.
- Keep runoff velocities low.
- Retain sediment on site.
- Thoroughly monitor site and maintain all ESC measures. A Certified Erosion and Sedimentation Control Lead (CESCL) person shall be assigned to the project and will file regular and special inspection reports with the County Planning and Land Services Department.
- Schedule major earthwork during the dry season.

In addition, project management will incorporate the key components listed below:
As this project site is located west of the Cascade Mountain Crest, the project will be managed according to the following key project components:

Phasing of Construction

- The construction project is being phased to the extent practicable in order to prevent soil erosion, and, to the maximum extent possible, the transport of sediment from the site during construction.
- Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities during each phase of construction, per the Scheduling BMP (C 162).

Seasonal Work Limitations

- From October 1 through April 30, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the local permitting authority that silt-laden runoff will be prevented from leaving the site through a combination of the following:
  - ☐ Site conditions including existing vegetative coverage, slope, soil type, and proximity to receiving waters; and
  - ☐ Limitations on activities and the extent of disturbed areas; and
  - ☐ Proposed erosion and sediment control measures.
- Based on the information provided and/or local weather conditions, the local permitting authority may expand or restrict the seasonal limitation on site disturbance.
- The following activities are exempt from the seasonal clearing and grading limitations:
  - ☐ Routine maintenance and necessary repair of erosion and sediment control BMPs;
  - ☐ Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil; and
  - ☐ Activities where there is 100 percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

Coordination with Utilities and Other Jurisdictions

- Care has been taken to coordinate with utilities, other construction projects, and the local jurisdiction in preparing this SWPPP and scheduling the construction work.

Inspection and Monitoring

- All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function. Site inspections shall be conducted by a person who is knowledgeable in the principles and practices of erosion and sediment control. This person has the necessary skills to:
  - ☐ Assess the site conditions and construction activities that could impact the quality of stormwater, and
  - ☐ Assess the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.
- A Certified Erosion and Sediment Control Lead shall be on-site or on-call at all times.
- Whenever inspection and/or monitoring reveals that the BMPs identified in this SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, appropriate BMPs or design changes shall be implemented as soon as possible.

Maintaining an Updated Construction SWPPP

- This SWPPP shall be retained on-site or within reasonable access to the site.
- The SWPPP shall be modified whenever there is a change in the design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.
- The SWPPP shall be modified if, during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The SWPPP shall be modified as necessary to include additional or modified BMPs designed to correct problems identified. Revisions to the SWPPP shall be completed within seven (7) days following the inspection.

Specific management related BMP's to be used include:

- Certified Erosion and Sediment Control Lead (C160)
- Scheduling (C162)

Section VI – Special Reports and Studies

See Geotech report in Appendix B.

Section VII – Other Permits

Building permits will be required for construction of the restaurant building and the retaining wall.

Sewer and water service permits will be required.

Section VIII – Operation and Maintenance Manual

An Operations and Maintenance Manual is required for the StormTank gallery, Filterra, infiltration trench, and conveyance system. The O&M Manual is included as a separate document.

Section IX – Bond Quantities Worksheet

Any required bond amounts will be calculated when required for permit issuance.

APPENDIX A

WWHM Analysis

WWHM2012

PROJECT REPORT

General Model Information

WWHM2012 Project Name: Taco Time 110324

Site Name:	Taco Time
Site Address:	
City:	Puyallup
Report Date:	11/3/2024
Gage:	42 IN EAST
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2024/06/28
Version:	4.3.1

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
Low Flow Threshold for POC3:	50 Percent of the 2 Year
High Flow Threshold for POC3:	50 Year

Landuse Basin Data

Predeveloped Land Use

2003 Improvements

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.1212
Pervious Total	0.1212
Impervious Land Use	acre
PARKING FLAT	0.4431
Impervious Total	0.4431
Basin Total	0.5643

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Ex Trench	Ex Trench	

South Basin

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Flat	0.101
Pervious Total	0.101

Impervious Land Use	acre
ROOF TOPS FLAT	0.0832
SIDEWALKS FLAT	0.0045
PARKING FLAT	0.1959
Impervious Total	0.2836
Basin Total	0.3846

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 2	POC 2	

North Basin

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Flat	0.0135
C, Forest, Flat	0.0841
C, Forest, Mod	0.3615
Pervious Total	0.4591

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.4591

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Basin 4

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.3101
Pervious Total	0.3101
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.3101

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 3	POC 3

Mitigated Land Use

Roof

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROOF TOPS FLAT	0.0905
Impervious Total	0.0905
Basin Total	0.0905

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Downspout Trench	Downspout Trench	

North Basin

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Flat	0.1909
Pervious Total	0.1909

Impervious Land Use	acre
ROOF TOPS FLAT	0.0149
SIDEWALKS FLAT	0.0165
PARKING FLAT	0.3326
Impervious Total	0.364
Basin Total	0.5549

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

Basin 3

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Flat	0.077
Pervious Total	0.077

Impervious Land Use	acre
SIDEWALKS FLAT	0.0135
PARKING FLAT	0.2196
Impervious Total	0.2331
Basin Total	0.3101

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
Ex Trench Developed	Ex Trench Developed	POC 3

South Basin

Bypass:	Yes
GroundWater:	No

Pervious Land Use	acre
C, Lawn, Flat	0.1086
Pervious Total	0.1086

Impervious Land Use	acre
ROOF TOPS FLAT	0.0832
SIDEWALKS FLAT	0.0747
PARKING FLAT	0.1386
Impervious Total	0.2965
Basin Total	0.4051

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 2	POC 2	

Routing Elements
Predeveloped Routing

Ex Trench

Bottom Length:	114.80 ft.
Bottom Width:	16.40 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	4
Pour Space of material for first layer:	0.94
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	1.1
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	225.685
Total Volume Through Riser (ac-ft.):	0.009
Total Volume Through Facility (ac-ft.):	225.694
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	1.98 ft.
Riser Diameter:	8 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.043	0.000	0.000	0.000
0.0444	0.043	0.001	0.000	0.047
0.0889	0.043	0.003	0.000	0.047
0.1333	0.043	0.005	0.000	0.047
0.1778	0.043	0.007	0.000	0.047
0.2222	0.043	0.009	0.000	0.047
0.2667	0.043	0.010	0.000	0.047
0.3111	0.043	0.012	0.000	0.047
0.3556	0.043	0.014	0.000	0.047
0.4000	0.043	0.016	0.000	0.047
0.4444	0.043	0.018	0.000	0.047
0.4889	0.043	0.019	0.000	0.047
0.5333	0.043	0.021	0.000	0.047
0.5778	0.043	0.023	0.000	0.047
0.6222	0.043	0.025	0.000	0.047
0.6667	0.043	0.027	0.000	0.047
0.7111	0.043	0.028	0.000	0.047
0.7556	0.043	0.030	0.000	0.047
0.8000	0.043	0.032	0.000	0.047
0.8444	0.043	0.034	0.000	0.047
0.8889	0.043	0.036	0.000	0.047

0.9333	0.043	0.037	0.000	0.047
0.9778	0.043	0.039	0.000	0.047
1.0222	0.043	0.041	0.000	0.047
1.0667	0.043	0.043	0.000	0.047
1.1111	0.043	0.045	0.000	0.047
1.1556	0.043	0.046	0.000	0.047
1.2000	0.043	0.048	0.000	0.047
1.2444	0.043	0.050	0.000	0.047
1.2889	0.043	0.052	0.000	0.047
1.3333	0.043	0.054	0.000	0.047
1.3778	0.043	0.056	0.000	0.047
1.4222	0.043	0.057	0.000	0.047
1.4667	0.043	0.059	0.000	0.047
1.5111	0.043	0.061	0.000	0.047
1.5556	0.043	0.063	0.000	0.047
1.6000	0.043	0.065	0.000	0.047
1.6444	0.043	0.066	0.000	0.047
1.6889	0.043	0.068	0.000	0.047
1.7333	0.043	0.070	0.000	0.047
1.7778	0.043	0.072	0.000	0.047
1.8222	0.043	0.074	0.000	0.047
1.8667	0.043	0.075	0.000	0.047
1.9111	0.043	0.077	0.000	0.047
1.9556	0.043	0.079	0.000	0.047
2.0000	0.043	0.081	0.020	0.047
2.0444	0.043	0.083	0.115	0.047
2.0889	0.043	0.084	0.248	0.047
2.1333	0.043	0.086	0.397	0.047
2.1778	0.043	0.088	0.541	0.047
2.2222	0.043	0.090	0.660	0.047
2.2667	0.043	0.092	0.744	0.047
2.3111	0.043	0.093	0.797	0.047
2.3556	0.043	0.095	0.857	0.047
2.4000	0.043	0.097	0.907	0.047
2.4444	0.043	0.099	0.954	0.047
2.4889	0.043	0.101	0.998	0.047
2.5333	0.043	0.102	1.041	0.047
2.5778	0.043	0.104	1.082	0.047
2.6222	0.043	0.106	1.121	0.047
2.6667	0.043	0.108	1.160	0.047
2.7111	0.043	0.110	1.196	0.047
2.7556	0.043	0.112	1.232	0.047
2.8000	0.043	0.113	1.267	0.047
2.8444	0.043	0.115	1.301	0.047
2.8889	0.043	0.117	1.334	0.047
2.9333	0.043	0.119	1.366	0.047
2.9778	0.043	0.121	1.398	0.047
3.0222	0.043	0.122	1.429	0.047
3.0667	0.043	0.124	1.459	0.047
3.1111	0.043	0.126	1.488	0.047
3.1556	0.043	0.128	1.517	0.047
3.2000	0.043	0.130	1.546	0.047
3.2444	0.043	0.131	1.574	0.047
3.2889	0.043	0.133	1.601	0.047
3.3333	0.043	0.135	1.628	0.047
3.3778	0.043	0.137	1.655	0.047
3.4222	0.043	0.139	1.681	0.047
3.4667	0.043	0.140	1.706	0.047

3.5111	0.043	0.142	1.732	0.047
3.5556	0.043	0.144	1.757	0.047
3.6000	0.043	0.146	1.781	0.047
3.6444	0.043	0.148	1.806	0.047
3.6889	0.043	0.149	1.829	0.047
3.7333	0.043	0.151	1.853	0.047
3.7778	0.043	0.153	1.876	0.047
3.8222	0.043	0.155	1.900	0.047
3.8667	0.043	0.157	1.922	0.047
3.9111	0.043	0.158	1.945	0.047
3.9556	0.043	0.160	1.967	0.047
4.0000	0.043	0.162	1.989	0.047

Discharge Structure
Riser Height: 1.98 ft.
Riser Diameter: 8 in.
Element Flow Outlets:
Outlet 1 Outlet 2
Outlets Flow To:

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.043	0.000	0.000	0.000
0.0444	0.043	0.001	0.000	0.047
0.0889	0.043	0.003	0.000	0.047
0.1333	0.043	0.005	0.000	0.047
0.1778	0.043	0.007	0.000	0.047
0.2222	0.043	0.009	0.000	0.047
0.2667	0.043	0.010	0.000	0.047
0.3111	0.043	0.012	0.000	0.047
0.3556	0.043	0.014	0.000	0.047
0.4000	0.043	0.016	0.000	0.047
0.4444	0.043	0.018	0.000	0.047
0.4889	0.043	0.019	0.000	0.047
0.5333	0.043	0.021	0.000	0.047
0.5778	0.043	0.023	0.000	0.047
0.6222	0.043	0.025	0.000	0.047
0.6667	0.043	0.027	0.000	0.047
0.7111	0.043	0.028	0.000	0.047
0.7556	0.043	0.030	0.000	0.047
0.8000	0.043	0.032	0.000	0.047
0.8444	0.043	0.034	0.000	0.047
0.8889	0.043	0.036	0.000	0.047
0.9333	0.043	0.037	0.000	0.047
0.9778	0.043	0.039	0.000	0.047
1.0222	0.043	0.041	0.000	0.047
1.0667	0.043	0.043	0.000	0.047
1.1111	0.043	0.045	0.000	0.047
1.1556	0.043	0.046	0.000	0.047
1.2000	0.043	0.048	0.000	0.047
1.2444	0.043	0.050	0.000	0.047
1.2889	0.043	0.052	0.000	0.047
1.3333	0.043	0.054	0.000	0.047
1.3778	0.043	0.056	0.000	0.047
1.4222	0.043	0.057	0.000	0.047

1.4667	0.043	0.059	0.000	0.047
1.5111	0.043	0.061	0.000	0.047
1.5556	0.043	0.063	0.000	0.047
1.6000	0.043	0.065	0.000	0.047
1.6444	0.043	0.066	0.000	0.047
1.6889	0.043	0.068	0.000	0.047
1.7333	0.043	0.070	0.000	0.047
1.7778	0.043	0.072	0.000	0.047
1.8222	0.043	0.074	0.000	0.047
1.8667	0.043	0.075	0.000	0.047
1.9111	0.043	0.077	0.000	0.047
1.9556	0.043	0.079	0.000	0.047
2.0000	0.043	0.081	0.020	0.047
2.0444	0.043	0.083	0.115	0.047
2.0889	0.043	0.084	0.248	0.047
2.1333	0.043	0.086	0.397	0.047
2.1778	0.043	0.088	0.541	0.047
2.2222	0.043	0.090	0.660	0.047
2.2667	0.043	0.092	0.744	0.047
2.3111	0.043	0.093	0.797	0.047
2.3556	0.043	0.095	0.857	0.047
2.4000	0.043	0.097	0.907	0.047
2.4444	0.043	0.099	0.954	0.047
2.4889	0.043	0.101	0.998	0.047
2.5333	0.043	0.102	1.041	0.047
2.5778	0.043	0.104	1.082	0.047
2.6222	0.043	0.106	1.121	0.047
2.6667	0.043	0.108	1.160	0.047
2.7111	0.043	0.110	1.196	0.047
2.7556	0.043	0.112	1.232	0.047
2.8000	0.043	0.113	1.267	0.047
2.8444	0.043	0.115	1.301	0.047
2.8889	0.043	0.117	1.334	0.047
2.9333	0.043	0.119	1.366	0.047
2.9778	0.043	0.121	1.398	0.047
3.0222	0.043	0.122	1.429	0.047
3.0667	0.043	0.124	1.459	0.047
3.1111	0.043	0.126	1.488	0.047
3.1556	0.043	0.128	1.517	0.047
3.2000	0.043	0.130	1.546	0.047
3.2444	0.043	0.131	1.574	0.047
3.2889	0.043	0.133	1.601	0.047
3.3333	0.043	0.135	1.628	0.047
3.3778	0.043	0.137	1.655	0.047
3.4222	0.043	0.139	1.681	0.047
3.4667	0.043	0.140	1.706	0.047
3.5111	0.043	0.142	1.732	0.047
3.5556	0.043	0.144	1.757	0.047
3.6000	0.043	0.146	1.781	0.047
3.6444	0.043	0.148	1.806	0.047
3.6889	0.043	0.149	1.829	0.047
3.7333	0.043	0.151	1.853	0.047
3.7778	0.043	0.153	1.876	0.047
3.8222	0.043	0.155	1.900	0.047
3.8667	0.043	0.157	1.922	0.047
3.9111	0.043	0.158	1.945	0.047
3.9556	0.043	0.160	1.967	0.047
4.0000	0.043	0.162	1.989	0.047

Mitigated Routing

Downspout Trench

Bottom Length:	80.00 ft.
Bottom Width:	8.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	3
Pour Space of material for first layer:	0.3
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	1.1
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	40.825
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	40.825
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	2 ft.
Riser Diameter:	8 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.014	0.000	0.000	0.000
0.0333	0.014	0.000	0.000	0.016
0.0667	0.014	0.000	0.000	0.016
0.1000	0.014	0.000	0.000	0.016
0.1333	0.014	0.000	0.000	0.016
0.1667	0.014	0.000	0.000	0.016
0.2000	0.014	0.000	0.000	0.016
0.2333	0.014	0.001	0.000	0.016
0.2667	0.014	0.001	0.000	0.016
0.3000	0.014	0.001	0.000	0.016
0.3333	0.014	0.001	0.000	0.016
0.3667	0.014	0.001	0.000	0.016
0.4000	0.014	0.001	0.000	0.016
0.4333	0.014	0.001	0.000	0.016
0.4667	0.014	0.002	0.000	0.016
0.5000	0.014	0.002	0.000	0.016
0.5333	0.014	0.002	0.000	0.016
0.5667	0.014	0.002	0.000	0.016
0.6000	0.014	0.002	0.000	0.016
0.6333	0.014	0.002	0.000	0.016
0.6667	0.014	0.002	0.000	0.016
0.7000	0.014	0.003	0.000	0.016
0.7333	0.014	0.003	0.000	0.016

0.7667	0.014	0.003	0.000	0.016
0.8000	0.014	0.003	0.000	0.016
0.8333	0.014	0.003	0.000	0.016
0.8667	0.014	0.003	0.000	0.016
0.9000	0.014	0.004	0.000	0.016
0.9333	0.014	0.004	0.000	0.016
0.9667	0.014	0.004	0.000	0.016
1.0000	0.014	0.004	0.000	0.016
1.0333	0.014	0.004	0.000	0.016
1.0667	0.014	0.004	0.000	0.016
1.1000	0.014	0.004	0.000	0.016
1.1333	0.014	0.005	0.000	0.016
1.1667	0.014	0.005	0.000	0.016
1.2000	0.014	0.005	0.000	0.016
1.2333	0.014	0.005	0.000	0.016
1.2667	0.014	0.005	0.000	0.016
1.3000	0.014	0.005	0.000	0.016
1.3333	0.014	0.005	0.000	0.016
1.3667	0.014	0.006	0.000	0.016
1.4000	0.014	0.006	0.000	0.016
1.4333	0.014	0.006	0.000	0.016
1.4667	0.014	0.006	0.000	0.016
1.5000	0.014	0.006	0.000	0.016
1.5333	0.014	0.006	0.000	0.016
1.5667	0.014	0.006	0.000	0.016
1.6000	0.014	0.007	0.000	0.016
1.6333	0.014	0.007	0.000	0.016
1.6667	0.014	0.007	0.000	0.016
1.7000	0.014	0.007	0.000	0.016
1.7333	0.014	0.007	0.000	0.016
1.7667	0.014	0.007	0.000	0.016
1.8000	0.014	0.007	0.000	0.016
1.8333	0.014	0.008	0.000	0.016
1.8667	0.014	0.008	0.000	0.016
1.9000	0.014	0.008	0.000	0.016
1.9333	0.014	0.008	0.000	0.016
1.9667	0.014	0.008	0.000	0.016
2.0000	0.014	0.008	0.000	0.016
2.0333	0.014	0.009	0.043	0.016
2.0667	0.014	0.009	0.121	0.016
2.1000	0.014	0.009	0.219	0.016
2.1333	0.014	0.009	0.329	0.016
2.1667	0.014	0.009	0.441	0.016
2.2000	0.014	0.009	0.547	0.016
2.2333	0.014	0.009	0.639	0.016
2.2667	0.014	0.010	0.711	0.016
2.3000	0.014	0.010	0.762	0.016
2.3333	0.014	0.010	0.808	0.016
2.3667	0.014	0.010	0.847	0.016
2.4000	0.014	0.010	0.885	0.016
2.4333	0.014	0.010	0.921	0.016
2.4667	0.014	0.010	0.956	0.016
2.5000	0.014	0.011	0.989	0.016
2.5333	0.014	0.011	1.022	0.016
2.5667	0.014	0.011	1.053	0.016
2.6000	0.014	0.011	1.084	0.016
2.6333	0.014	0.011	1.114	0.016
2.6667	0.014	0.011	1.143	0.016

2.7000	0.014	0.011	1.171	0.016
2.7333	0.014	0.012	1.198	0.016
2.7667	0.014	0.012	1.225	0.016
2.8000	0.014	0.012	1.252	0.016
2.8333	0.014	0.012	1.277	0.016
2.8667	0.014	0.012	1.303	0.016
2.9000	0.014	0.012	1.328	0.016
2.9333	0.014	0.012	1.352	0.016
2.9667	0.014	0.013	1.376	0.016
3.0000	0.014	0.013	1.399	0.016

Ex Trench Developed

Bottom Length:	114.80 ft.
Bottom Width:	16.40 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	4
Pour Space of material for first layer:	0.94
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	1.1
Infiltration safety factor:	1
Total Volume Infiltrated (ac-ft.):	121.46
Total Volume Through Riser (ac-ft.):	0
Total Volume Through Facility (ac-ft.):	121.46
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	1.98 ft.
Riser Diameter:	8 in.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Gravel Trench Bed Hydraulic Table

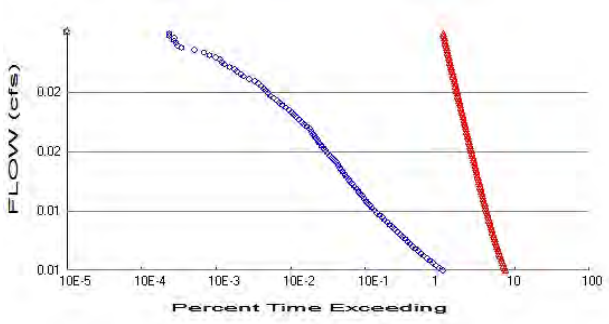
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.043	0.000	0.000	0.000
0.0444	0.043	0.001	0.000	0.047
0.0889	0.043	0.003	0.000	0.047
0.1333	0.043	0.005	0.000	0.047
0.1778	0.043	0.007	0.000	0.047
0.2222	0.043	0.009	0.000	0.047
0.2667	0.043	0.010	0.000	0.047
0.3111	0.043	0.012	0.000	0.047
0.3556	0.043	0.014	0.000	0.047
0.4000	0.043	0.016	0.000	0.047
0.4444	0.043	0.018	0.000	0.047
0.4889	0.043	0.019	0.000	0.047
0.5333	0.043	0.021	0.000	0.047
0.5778	0.043	0.023	0.000	0.047
0.6222	0.043	0.025	0.000	0.047
0.6667	0.043	0.027	0.000	0.047
0.7111	0.043	0.028	0.000	0.047
0.7556	0.043	0.030	0.000	0.047
0.8000	0.043	0.032	0.000	0.047
0.8444	0.043	0.034	0.000	0.047
0.8889	0.043	0.036	0.000	0.047
0.9333	0.043	0.037	0.000	0.047
0.9778	0.043	0.039	0.000	0.047
1.0222	0.043	0.041	0.000	0.047
1.0667	0.043	0.043	0.000	0.047

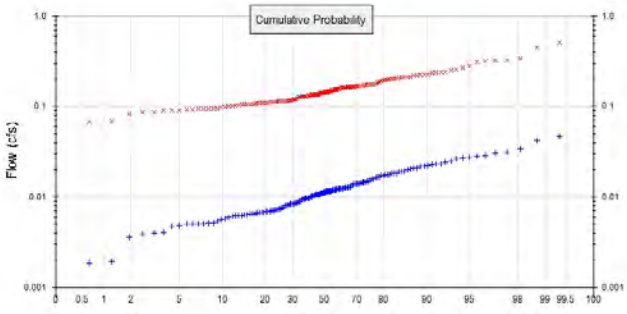
1.1111	0.043	0.045	0.000	0.047
1.1556	0.043	0.046	0.000	0.047
1.2000	0.043	0.048	0.000	0.047
1.2444	0.043	0.050	0.000	0.047
1.2889	0.043	0.052	0.000	0.047
1.3333	0.043	0.054	0.000	0.047
1.3778	0.043	0.056	0.000	0.047
1.4222	0.043	0.057	0.000	0.047
1.4667	0.043	0.059	0.000	0.047
1.5111	0.043	0.061	0.000	0.047
1.5556	0.043	0.063	0.000	0.047
1.6000	0.043	0.065	0.000	0.047
1.6444	0.043	0.066	0.000	0.047
1.6889	0.043	0.068	0.000	0.047
1.7333	0.043	0.070	0.000	0.047
1.7778	0.043	0.072	0.000	0.047
1.8222	0.043	0.074	0.000	0.047
1.8667	0.043	0.075	0.000	0.047
1.9111	0.043	0.077	0.000	0.047
1.9556	0.043	0.079	0.000	0.047
2.0000	0.043	0.081	0.020	0.047
2.0444	0.043	0.083	0.115	0.047
2.0889	0.043	0.084	0.248	0.047
2.1333	0.043	0.086	0.397	0.047
2.1778	0.043	0.088	0.541	0.047
2.2222	0.043	0.090	0.660	0.047
2.2667	0.043	0.092	0.744	0.047
2.3111	0.043	0.093	0.797	0.047
2.3556	0.043	0.095	0.857	0.047
2.4000	0.043	0.097	0.907	0.047
2.4444	0.043	0.099	0.954	0.047
2.4889	0.043	0.101	0.998	0.047
2.5333	0.043	0.102	1.041	0.047
2.5778	0.043	0.104	1.082	0.047
2.6222	0.043	0.106	1.121	0.047
2.6667	0.043	0.108	1.160	0.047
2.7111	0.043	0.110	1.196	0.047
2.7556	0.043	0.112	1.232	0.047
2.8000	0.043	0.113	1.267	0.047
2.8444	0.043	0.115	1.301	0.047
2.8889	0.043	0.117	1.334	0.047
2.9333	0.043	0.119	1.366	0.047
2.9778	0.043	0.121	1.398	0.047
3.0222	0.043	0.122	1.429	0.047
3.0667	0.043	0.124	1.459	0.047
3.1111	0.043	0.126	1.488	0.047
3.1556	0.043	0.128	1.517	0.047
3.2000	0.043	0.130	1.546	0.047
3.2444	0.043	0.131	1.574	0.047
3.2889	0.043	0.133	1.601	0.047
3.3333	0.043	0.135	1.628	0.047
3.3778	0.043	0.137	1.655	0.047
3.4222	0.043	0.139	1.681	0.047
3.4667	0.043	0.140	1.706	0.047
3.5111	0.043	0.142	1.732	0.047
3.5556	0.043	0.144	1.757	0.047
3.6000	0.043	0.146	1.781	0.047
3.6444	0.043	0.148	1.806	0.047

3.6889	0.043	0.149	1.829	0.047
3.7333	0.043	0.151	1.853	0.047
3.7778	0.043	0.153	1.876	0.047
3.8222	0.043	0.155	1.900	0.047
3.8667	0.043	0.157	1.922	0.047
3.9111	0.043	0.158	1.945	0.047
3.9556	0.043	0.160	1.967	0.047
4.0000	0.043	0.162	1.989	0.047

Analysis Results

POC 1





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.4591
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.1909
Total Impervious Area: 0.364

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.011215
5 year	0.017611
10 year	0.02184
25 year	0.027062
50 year	0.030831
100 year	0.034486

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.142716
5 year	0.195071
10 year	0.233658
25 year	0.287066
50 year	0.330357
100 year	0.376761

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.011	0.159
1903	0.007	0.176
1904	0.016	0.235
1905	0.006	0.093
1906	0.004	0.099
1907	0.017	0.152
1908	0.012	0.117
1909	0.012	0.135
1910	0.017	0.145
1911	0.011	0.160

1912	0.047	0.311
1913	0.017	0.106
1914	0.005	0.507
1915	0.008	0.095
1916	0.011	0.169
1917	0.004	0.068
1918	0.011	0.134
1919	0.010	0.090
1920	0.011	0.124
1921	0.012	0.105
1922	0.012	0.172
1923	0.010	0.114
1924	0.005	0.192
1925	0.007	0.087
1926	0.011	0.156
1927	0.009	0.134
1928	0.008	0.102
1929	0.018	0.212
1930	0.011	0.202
1931	0.011	0.104
1932	0.008	0.111
1933	0.010	0.110
1934	0.023	0.199
1935	0.010	0.092
1936	0.010	0.135
1937	0.017	0.167
1938	0.010	0.094
1939	0.001	0.111
1940	0.010	0.206
1941	0.007	0.204
1942	0.016	0.171
1943	0.008	0.157
1944	0.019	0.240
1945	0.013	0.167
1946	0.008	0.141
1947	0.006	0.100
1948	0.023	0.142
1949	0.021	0.210
1950	0.007	0.120
1951	0.009	0.178
1952	0.031	0.253
1953	0.028	0.227
1954	0.010	0.116
1955	0.009	0.105
1956	0.005	0.094
1957	0.015	0.113
1958	0.029	0.156
1959	0.019	0.157
1960	0.005	0.111
1961	0.018	0.337
1962	0.011	0.135
1963	0.005	0.095
1964	0.006	0.317
1965	0.021	0.143
1966	0.006	0.110
1967	0.010	0.170
1968	0.010	0.130
1969	0.010	0.120

1970	0.015	0.143
1971	0.022	0.144
1972	0.014	0.447
1973	0.019	0.238
1974	0.012	0.187
1975	0.024	0.223
1976	0.013	0.220
1977	0.006	0.084
1978	0.020	0.166
1979	0.006	0.160
1980	0.012	0.165
1981	0.012	0.144
1982	0.006	0.114
1983	0.018	0.165
1984	0.009	0.162
1985	0.014	0.195
1986	0.011	0.091
1987	0.023	0.152
1988	0.013	0.093
1989	0.012	0.095
1990	0.014	0.119
1991	0.011	0.169
1992	0.014	0.155
1993	0.015	0.174
1994	0.022	0.136
1995	0.005	0.098
1996	0.025	0.138
1997	0.011	0.118
1998	0.012	0.149
1999	0.002	0.148
2000	0.009	0.135
2001	0.005	0.106
2002	0.020	0.228
2003	0.014	0.114
2004	0.012	0.167
2005	0.028	0.324
2006	0.007	0.147
2007	0.008	0.175
2008	0.012	0.143
2009	0.008	0.101
2010	0.007	0.136
2011	0.007	0.128
2012	0.011	0.135
2013	0.007	0.132
2014	0.005	0.118
2015	0.012	0.239
2016	0.004	0.116
2017	0.016	0.203
2018	0.031	0.141
2019	0.034	0.212
2020	0.010	0.161
2021	0.015	0.131
2022	0.006	0.213
2023	0.013	0.255
2024	0.042	0.327
2025	0.011	0.131
2026	0.018	0.184
2027	0.007	0.162

2028	0.006	0.063
2029	0.012	0.113
2030	0.022	0.226
2031	0.007	0.068
2032	0.005	0.110
2033	0.007	0.137
2034	0.007	0.108
2035	0.026	0.155
2036	0.014	0.110
2037	0.004	0.145
2038	0.013	0.161
2039	0.002	0.283
2040	0.007	0.116
2041	0.008	0.147
2042	0.027	0.166
2043	0.013	0.176
2044	0.017	0.127
2045	0.011	0.104
2046	0.013	0.115
2047	0.010	0.133
2048	0.013	0.110
2049	0.012	0.163
2050	0.008	0.132
2051	0.014	0.199
2052	0.007	0.130
2053	0.012	0.110
2054	0.015	0.270
2055	0.006	0.131
2056	0.006	0.177
2057	0.009	0.087
2058	0.011	0.165
2059	0.018	0.202

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0466	0.5072
2	0.0425	0.4470
3	0.0338	0.3374
4	0.0311	0.3266
5	0.0305	0.3240
6	0.0290	0.3171
7	0.0285	0.3106
8	0.0277	0.2827
9	0.0273	0.2698
10	0.0262	0.2549
11	0.0247	0.2529
12	0.0241	0.2400
13	0.0234	0.2393
14	0.0234	0.2383
15	0.0228	0.2345
16	0.0223	0.2280
17	0.0218	0.2270
18	0.0217	0.2261
19	0.0209	0.2230
20	0.0209	0.2197
21	0.0203	0.2133
22	0.0199	0.2117

23	0.0191	0.2116
24	0.0191	0.2100
25	0.0191	0.2065
26	0.0185	0.2040
27	0.0184	0.2029
28	0.0183	0.2019
29	0.0176	0.2016
30	0.0175	0.1995
31	0.0174	0.1990
32	0.0172	0.1950
33	0.0171	0.1921
34	0.0166	0.1874
35	0.0165	0.1844
36	0.0165	0.1782
37	0.0160	0.1772
38	0.0159	0.1761
39	0.0152	0.1760
40	0.0150	0.1748
41	0.0149	0.1741
42	0.0147	0.1717
43	0.0146	0.1714
44	0.0144	0.1698
45	0.0143	0.1692
46	0.0140	0.1689
47	0.0140	0.1674
48	0.0138	0.1674
49	0.0138	0.1670
50	0.0138	0.1657
51	0.0133	0.1656
52	0.0132	0.1653
53	0.0129	0.1653
54	0.0129	0.1649
55	0.0128	0.1635
56	0.0128	0.1624
57	0.0126	0.1620
58	0.0125	0.1609
59	0.0124	0.1606
60	0.0124	0.1597
61	0.0124	0.1597
62	0.0123	0.1586
63	0.0123	0.1574
64	0.0122	0.1574
65	0.0122	0.1560
66	0.0121	0.1558
67	0.0121	0.1550
68	0.0120	0.1548
69	0.0119	0.1521
70	0.0118	0.1521
71	0.0116	0.1492
72	0.0115	0.1479
73	0.0115	0.1471
74	0.0115	0.1468
75	0.0115	0.1450
76	0.0114	0.1448
77	0.0114	0.1440
78	0.0113	0.1439
79	0.0112	0.1431
80	0.0112	0.1426

81	0.0111	0.1425
82	0.0111	0.1419
83	0.0110	0.1405
84	0.0109	0.1405
85	0.0107	0.1385
86	0.0107	0.1372
87	0.0106	0.1358
88	0.0106	0.1357
89	0.0105	0.1354
90	0.0105	0.1354
91	0.0104	0.1353
92	0.0103	0.1350
93	0.0102	0.1348
94	0.0101	0.1345
95	0.0099	0.1335
96	0.0098	0.1330
97	0.0098	0.1325
98	0.0097	0.1316
99	0.0097	0.1314
100	0.0096	0.1314
101	0.0096	0.1308
102	0.0096	0.1305
103	0.0092	0.1299
104	0.0089	0.1281
105	0.0088	0.1271
106	0.0088	0.1242
107	0.0086	0.1203
108	0.0086	0.1201
109	0.0084	0.1188
110	0.0084	0.1180
111	0.0084	0.1177
112	0.0083	0.1174
113	0.0081	0.1162
114	0.0080	0.1159
115	0.0080	0.1156
116	0.0077	0.1153
117	0.0075	0.1145
118	0.0073	0.1142
119	0.0073	0.1140
120	0.0073	0.1131
121	0.0072	0.1126
122	0.0071	0.1112
123	0.0071	0.1111
124	0.0069	0.1111
125	0.0069	0.1104
126	0.0069	0.1101
127	0.0068	0.1101
128	0.0068	0.1099
129	0.0067	0.1098
130	0.0066	0.1096
131	0.0065	0.1076
132	0.0065	0.1061
133	0.0064	0.1056
134	0.0063	0.1050
135	0.0063	0.1047
136	0.0063	0.1044
137	0.0062	0.1040
138	0.0062	0.1024

139	0.0061	0.1009
140	0.0060	0.1002
141	0.0057	0.0986
142	0.0056	0.0978
143	0.0054	0.0955
144	0.0051	0.0954
145	0.0051	0.0950
146	0.0051	0.0942
147	0.0051	0.0941
148	0.0050	0.0934
149	0.0050	0.0929
150	0.0048	0.0917
151	0.0047	0.0913
152	0.0041	0.0900
153	0.0040	0.0869
154	0.0039	0.0866
155	0.0036	0.0839
156	0.0019	0.0681
157	0.0018	0.0679
158	0.0012	0.0633

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0056	60331	418109	693	Fail
0.0059	54564	405976	744	Fail
0.0061	49368	394674	799	Fail
0.0064	44736	383982	858	Fail
0.0066	40592	373844	920	Fail
0.0069	37046	364038	982	Fail
0.0071	33900	354730	1046	Fail
0.0074	30958	346032	1117	Fail
0.0076	28293	337501	1192	Fail
0.0079	26060	329468	1264	Fail
0.0082	23988	321601	1340	Fail
0.0084	22105	314066	1420	Fail
0.0087	20465	307030	1500	Fail
0.0089	18947	300216	1584	Fail
0.0092	17462	293513	1680	Fail
0.0094	16083	287252	1786	Fail
0.0097	14836	281047	1894	Fail
0.0099	13712	275064	2006	Fail
0.0102	12720	269303	2117	Fail
0.0104	11762	263929	2243	Fail
0.0107	10892	258444	2372	Fail
0.0110	10072	253181	2513	Fail
0.0112	9269	247973	2675	Fail
0.0115	8554	243043	2841	Fail
0.0117	7867	238057	3026	Fail
0.0120	7307	233403	3194	Fail
0.0122	6787	228694	3369	Fail
0.0125	6377	224317	3517	Fail
0.0127	5994	219830	3667	Fail
0.0130	5651	215675	3816	Fail
0.0133	5311	211409	3980	Fail
0.0135	4997	207475	4151	Fail
0.0138	4718	203431	4311	Fail
0.0140	4444	199775	4495	Fail
0.0143	4198	195897	4666	Fail
0.0145	3950	192296	4868	Fail
0.0148	3716	188861	5082	Fail
0.0150	3472	185260	5335	Fail
0.0153	3284	181880	5538	Fail
0.0155	3101	178390	5752	Fail
0.0158	2929	175121	5978	Fail
0.0161	2756	171797	6233	Fail
0.0163	2633	168806	6411	Fail
0.0166	2493	165648	6644	Fail
0.0168	2381	162656	6831	Fail
0.0171	2250	159665	7096	Fail
0.0173	2133	156839	7352	Fail
0.0176	1973	153792	7794	Fail
0.0178	1837	151022	8221	Fail
0.0181	1719	148363	8630	Fail
0.0183	1616	145704	9016	Fail
0.0186	1519	142989	9413	Fail
0.0189	1432	140551	9815	Fail
0.0191	1349	137948	10225	Fail

0.0194	1283	135455	10557	Fail
0.0196	1220	132962	10898	Fail
0.0199	1151	130635	11349	Fail
0.0201	1098	128252	11680	Fail
0.0204	1045	126147	12071	Fail
0.0206	985	123876	12576	Fail
0.0209	909	121549	13371	Fail
0.0211	836	119499	14294	Fail
0.0214	771	117394	15226	Fail
0.0217	713	115400	16185	Fail
0.0219	656	113350	17278	Fail
0.0222	612	111411	18204	Fail
0.0224	567	109305	19277	Fail
0.0227	526	107477	20432	Fail
0.0229	482	105594	21907	Fail
0.0232	426	103765	24357	Fail
0.0234	391	101882	26056	Fail
0.0237	360	100164	27823	Fail
0.0240	325	98281	30240	Fail
0.0242	294	96563	32844	Fail
0.0245	273	94846	34742	Fail
0.0247	254	93184	36686	Fail
0.0250	240	91577	38157	Fail
0.0252	223	90026	40370	Fail
0.0255	203	88419	43556	Fail
0.0257	181	86924	48024	Fail
0.0260	154	85317	55400	Fail
0.0262	128	83877	65528	Fail
0.0265	119	82492	69321	Fail
0.0268	106	80940	76358	Fail
0.0270	98	79555	81178	Fail
0.0273	84	78226	93126	Fail
0.0275	72	76896	106800	Fail
0.0278	66	75511	114410	Fail
0.0280	62	74237	119737	Fail
0.0283	54	72907	135012	Fail
0.0285	45	71633	159184	Fail
0.0288	38	70414	185300	Fail
0.0290	28	69195	247125	Fail
0.0293	19	67977	357773	Fail
0.0296	17	66869	393347	Fail
0.0298	16	65650	410312	Fail
0.0301	15	64597	430646	Fail
0.0303	15	63489	423260	Fail
0.0306	13	62437	480284	Fail
0.0308	13	61329	471761	Fail

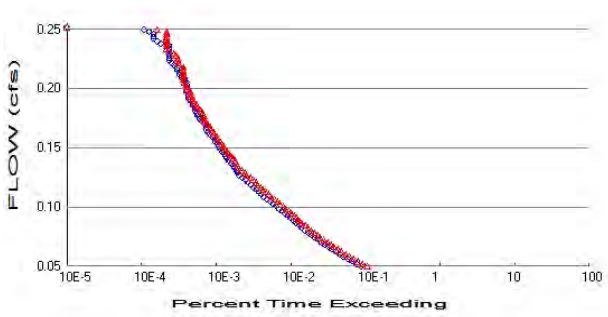
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

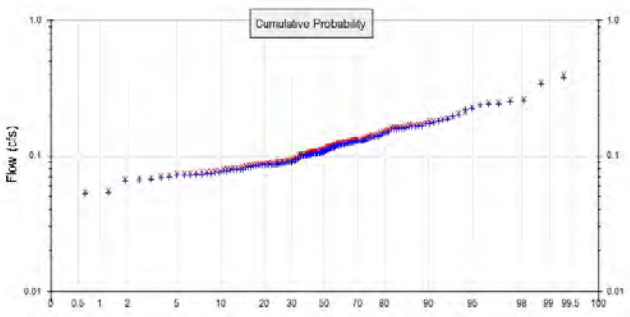
Water Quality

Water Quality BMP Flow and Volume for POC #1

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

POC 2





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 0.2222
Total Impervious Area: 0.7267

Mitigated Landuse Totals for POC #2
Total Pervious Area: 0.1856
Total Impervious Area: 0.6201

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.109097
5 year	0.148635
10 year	0.177703
25 year	0.217855
50 year	0.250343
100 year	0.285119

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	0.113935
5 year	0.154683
10 year	0.18456
25 year	0.225739
50 year	0.258994
100 year	0.294537

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1902	0.123	0.129
1903	0.137	0.143
1904	0.173	0.182
1905	0.071	0.075
1906	0.077	0.080
1907	0.114	0.119
1908	0.089	0.094
1909	0.105	0.110
1910	0.107	0.112
1911	0.121	0.126
1912	0.223	0.234

1913	0.082	0.086
1914	0.379	0.397
1915	0.073	0.076
1916	0.131	0.137
1917	0.053	0.055
1918	0.105	0.109
1919	0.069	0.072
1920	0.093	0.098
1921	0.079	0.083
1922	0.128	0.134
1923	0.086	0.090
1924	0.149	0.156
1925	0.066	0.069
1926	0.121	0.127
1927	0.104	0.109
1928	0.078	0.082
1929	0.160	0.167
1930	0.156	0.163
1931	0.079	0.083
1932	0.085	0.089
1933	0.083	0.087
1934	0.147	0.154
1935	0.071	0.075
1936	0.103	0.107
1937	0.130	0.136
1938	0.073	0.076
1939	0.086	0.090
1940	0.159	0.167
1941	0.158	0.166
1942	0.128	0.134
1943	0.120	0.126
1944	0.180	0.189
1945	0.129	0.135
1946	0.106	0.111
1947	0.077	0.081
1948	0.109	0.114
1949	0.163	0.170
1950	0.094	0.098
1951	0.139	0.145
1952	0.183	0.192
1953	0.166	0.174
1954	0.089	0.093
1955	0.082	0.085
1956	0.073	0.077
1957	0.087	0.091
1958	0.116	0.122
1959	0.117	0.122
1960	0.086	0.090
1961	0.254	0.266
1962	0.104	0.109
1963	0.074	0.078
1964	0.238	0.249
1965	0.107	0.112
1966	0.085	0.089
1967	0.127	0.133
1968	0.100	0.104
1969	0.091	0.096
1970	0.107	0.112

1971	0.107	0.112
1972	0.335	0.351
1973	0.185	0.194
1974	0.142	0.149
1975	0.162	0.170
1976	0.163	0.171
1977	0.065	0.068
1978	0.122	0.128
1979	0.121	0.127
1980	0.123	0.129
1981	0.111	0.116
1982	0.087	0.092
1983	0.124	0.130
1984	0.122	0.128
1985	0.145	0.152
1986	0.069	0.072
1987	0.118	0.124
1988	0.071	0.075
1989	0.074	0.077
1990	0.090	0.094
1991	0.128	0.134
1992	0.121	0.126
1993	0.135	0.142
1994	0.101	0.106
1995	0.075	0.078
1996	0.104	0.109
1997	0.090	0.094
1998	0.112	0.117
1999	0.115	0.120
2000	0.103	0.107
2001	0.082	0.086
2002	0.167	0.175
2003	0.087	0.091
2004	0.129	0.135
2005	0.249	0.261
2006	0.114	0.119
2007	0.133	0.139
2008	0.108	0.113
2009	0.079	0.082
2010	0.104	0.109
2011	0.100	0.104
2012	0.103	0.108
2013	0.100	0.104
2014	0.092	0.096
2015	0.176	0.185
2016	0.090	0.094
2017	0.156	0.163
2018	0.103	0.108
2019	0.241	0.163
2020	0.120	0.126
2021	0.099	0.104
2022	0.163	0.171
2023	0.198	0.207
2024	0.238	0.250
2025	0.102	0.107
2026	0.140	0.147
2027	0.125	0.131
2028	0.049	0.052

2029	0.085	0.089
2030	0.174	0.182
2031	0.052	0.055
2032	0.086	0.090
2033	0.107	0.112
2034	0.084	0.088
2035	0.115	0.121
2036	0.085	0.089
2037	0.113	0.118
2038	0.119	0.125
2039	0.219	0.229
2040	0.088	0.092
2041	0.112	0.117
2042	0.124	0.130
2043	0.137	0.143
2044	0.097	0.102
2045	0.079	0.083
2046	0.088	0.092
2047	0.104	0.108
2048	0.085	0.089
2049	0.127	0.133
2050	0.100	0.104
2051	0.148	0.155
2052	0.101	0.106
2053	0.085	0.089
2054	0.197	0.207
2055	0.101	0.105
2056	0.137	0.144
2057	0.067	0.070
2058	0.129	0.135
2059	0.157	0.164

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	0.3791	0.3974
2	0.3351	0.3512
3	0.2539	0.2660
4	0.2495	0.2610
5	0.2406	0.2496
6	0.2378	0.2490
7	0.2376	0.2341
8	0.2228	0.2295
9	0.2194	0.2073
10	0.1977	0.2068
11	0.1975	0.1938
12	0.1853	0.1920
13	0.1828	0.1886
14	0.1800	0.1846
15	0.1759	0.1820
16	0.1739	0.1820
17	0.1735	0.1749
18	0.1666	0.1738
19	0.1656	0.1712
20	0.1633	0.1707
21	0.1631	0.1702
22	0.1626	0.1701
23	0.1621	0.1671

24	0.1595	0.1667
25	0.1594	0.1657
26	0.1585	0.1643
27	0.1572	0.1632
28	0.1560	0.1631
29	0.1559	0.1629
30	0.1494	0.1562
31	0.1480	0.1552
32	0.1470	0.1542
33	0.1447	0.1517
34	0.1422	0.1489
35	0.1400	0.1466
36	0.1388	0.1451
37	0.1374	0.1437
38	0.1370	0.1432
39	0.1367	0.1429
40	0.1354	0.1416
41	0.1327	0.1390
42	0.1313	0.1373
43	0.1301	0.1360
44	0.1287	0.1346
45	0.1286	0.1345
46	0.1285	0.1345
47	0.1280	0.1340
48	0.1278	0.1340
49	0.1276	0.1338
50	0.1270	0.1328
51	0.1267	0.1328
52	0.1254	0.1311
53	0.1241	0.1301
54	0.1239	0.1299
55	0.1234	0.1290
56	0.1228	0.1288
57	0.1224	0.1283
58	0.1216	0.1276
59	0.1213	0.1269
60	0.1209	0.1266
61	0.1206	0.1264
62	0.1206	0.1262
63	0.1204	0.1261
64	0.1200	0.1256
65	0.1195	0.1253
66	0.1184	0.1238
67	0.1166	0.1223
68	0.1160	0.1216
69	0.1150	0.1206
70	0.1148	0.1201
71	0.1138	0.1191
72	0.1136	0.1190
73	0.1129	0.1181
74	0.1120	0.1172
75	0.1119	0.1172
76	0.1106	0.1157
77	0.1086	0.1137
78	0.1082	0.1133
79	0.1072	0.1124
80	0.1069	0.1120
81	0.1068	0.1119

82	0.1068	0.1118
83	0.1066	0.1117
84	0.1055	0.1106
85	0.1053	0.1101
86	0.1046	0.1094
87	0.1042	0.1090
88	0.1041	0.1090
89	0.1039	0.1087
90	0.1038	0.1086
91	0.1036	0.1085
92	0.1034	0.1083
93	0.1033	0.1082
94	0.1027	0.1075
95	0.1026	0.1074
96	0.1024	0.1070
97	0.1012	0.1061
98	0.1012	0.1058
99	0.1007	0.1054
100	0.0998	0.1045
101	0.0998	0.1045
102	0.0997	0.1044
103	0.0997	0.1043
104	0.0990	0.1037
105	0.0972	0.1018
106	0.0937	0.0980
107	0.0933	0.0978
108	0.0919	0.0961
109	0.0914	0.0957
110	0.0899	0.0941
111	0.0898	0.0941
112	0.0895	0.0936
113	0.0895	0.0936
114	0.0886	0.0927
115	0.0882	0.0923
116	0.0879	0.0921
117	0.0875	0.0915
118	0.0872	0.0913
119	0.0868	0.0908
120	0.0861	0.0901
121	0.0860	0.0901
122	0.0858	0.0897
123	0.0856	0.0895
124	0.0854	0.0893
125	0.0853	0.0892
126	0.0852	0.0891
127	0.0852	0.0891
128	0.0848	0.0888
129	0.0846	0.0885
130	0.0838	0.0877
131	0.0835	0.0874
132	0.0823	0.0861
133	0.0822	0.0860
134	0.0816	0.0853
135	0.0795	0.0832
136	0.0794	0.0831
137	0.0790	0.0828
138	0.0786	0.0822
139	0.0780	0.0817

140	0.0773	0.0809
141	0.0766	0.0801
142	0.0749	0.0784
143	0.0743	0.0777
144	0.0740	0.0774
145	0.0733	0.0767
146	0.0731	0.0765
147	0.0726	0.0760
148	0.0715	0.0748
149	0.0714	0.0747
150	0.0714	0.0746
151	0.0692	0.0725
152	0.0686	0.0718
153	0.0668	0.0699
154	0.0662	0.0693
155	0.0646	0.0676
156	0.0531	0.0555
157	0.0522	0.0547
158	0.0493	0.0516

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0545	4848	5895	121	Fail
0.0565	4215	5062	120	Fail
0.0585	3657	4392	120	Fail
0.0605	3215	3847	119	Fail
0.0625	2817	3390	120	Fail
0.0644	2515	2995	119	Fail
0.0664	2228	2641	118	Fail
0.0684	1983	2379	119	Fail
0.0704	1784	2114	118	Fail
0.0723	1584	1911	120	Fail
0.0743	1418	1722	121	Fail
0.0763	1292	1535	118	Fail
0.0783	1164	1392	119	Fail
0.0803	1047	1271	121	Fail
0.0822	958	1149	119	Fail
0.0842	865	1036	119	Fail
0.0862	772	953	123	Fail
0.0882	718	864	120	Fail
0.0901	657	774	117	Fail
0.0921	604	718	118	Fail
0.0941	556	661	118	Fail
0.0961	510	615	120	Fail
0.0981	468	561	119	Fail
0.1000	424	525	123	Fail
0.1020	384	479	124	Fail
0.1040	352	443	125	Fail
0.1060	321	397	123	Fail
0.1079	296	365	123	Fail
0.1099	264	332	125	Fail
0.1119	241	306	126	Fail
0.1139	223	282	126	Fail
0.1159	205	252	122	Fail
0.1178	193	234	121	Fail
0.1198	176	218	123	Fail
0.1218	162	202	124	Fail
0.1238	147	189	128	Fail
0.1257	137	173	126	Fail
0.1277	124	159	128	Fail
0.1297	113	141	124	Fail
0.1317	109	135	123	Fail
0.1337	105	123	117	Fail
0.1356	99	112	113	Fail
0.1376	94	108	114	Fail
0.1396	88	104	118	Fail
0.1416	83	99	119	Fail
0.1435	77	93	120	Fail
0.1455	75	87	116	Fail
0.1475	71	81	114	Fail
0.1495	67	77	114	Fail
0.1515	62	73	117	Fail
0.1534	61	70	114	Fail
0.1554	58	66	113	Fail
0.1574	55	63	114	Fail
0.1594	54	58	107	Pass

0.1613	50	57	114	Fail
0.1633	46	52	113	Fail
0.1653	43	51	118	Fail
0.1673	41	47	114	Fail
0.1693	41	46	112	Fail
0.1712	40	43	107	Pass
0.1732	38	40	105	Pass
0.1752	35	38	108	Pass
0.1772	33	38	115	Fail
0.1791	31	38	122	Fail
0.1811	30	36	120	Fail
0.1831	29	34	117	Fail
0.1851	29	31	106	Pass
0.1871	27	31	114	Fail
0.1890	27	28	103	Pass
0.1910	25	28	112	Fail
0.1930	24	27	112	Fail
0.1950	24	25	104	Pass
0.1969	24	25	104	Pass
0.1989	22	25	113	Fail
0.2009	22	22	100	Pass
0.2029	22	22	100	Pass
0.2049	22	22	100	Pass
0.2068	22	21	95	Pass
0.2088	21	20	95	Pass
0.2108	19	20	105	Pass
0.2128	18	20	111	Fail
0.2147	18	20	111	Fail
0.2167	17	20	117	Fail
0.2187	17	20	117	Fail
0.2207	15	18	120	Fail
0.2227	14	17	121	Fail
0.2246	13	17	130	Fail
0.2266	13	17	130	Fail
0.2286	13	16	123	Fail
0.2306	13	15	115	Fail
0.2325	13	13	100	Pass
0.2345	13	12	92	Pass
0.2365	13	12	92	Pass
0.2385	10	12	120	Fail
0.2405	9	12	133	Fail
0.2424	8	12	150	Fail
0.2444	8	12	150	Fail
0.2464	8	12	150	Fail
0.2484	7	12	171	Fail
0.2503	6	9	150	Fail

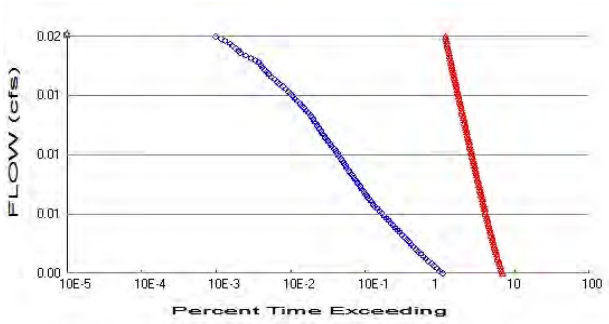
The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

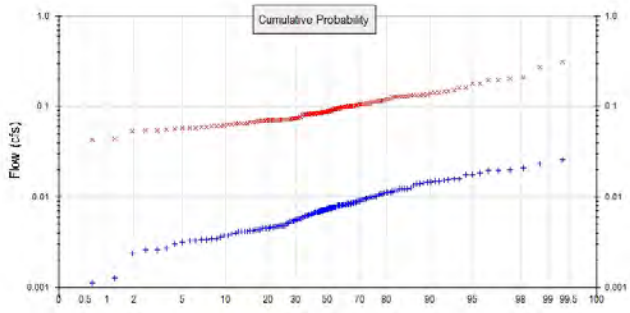
Water Quality

Water Quality BMP Flow and Volume for POC #2

On-line facility volume:	0.0378 acre-feet
On-line facility target flow:	0.0502 cfs.
Adjusted for 15 min:	0.0502 cfs.
Off-line facility target flow:	0.0291 cfs.
Adjusted for 15 min:	0.0291 cfs.

POC 3





\+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #3
Total Pervious Area: 0.3101
Total Impervious Area: 0

Mitigated Landuse Totals for POC #3
Total Pervious Area: 0.077
Total Impervious Area: 0.2331

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #3

Return Period	**Flow(cfs)**
2 year	0.007468
5 year	0.011457
10 year	0.013908
25 year	0.016739
50 year	0.018657
100 year	0.020421

Flow Frequency Return Periods for Mitigated. POC #3

Return Period	**Flow(cfs)**
2 year	0.089158
5 year	0.120866
10 year	0.144087
25 year	0.176063
50 year	0.201866
100 year	0.229425

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #3

Year	**Predeveloped**	**Mitigated**
1902	0.007	0.101
1903	0.005	0.112
1904	0.008	0.141
1905	0.004	0.059
1906	0.002	0.063
1907	0.012	0.093
1908	0.008	0.073
1909	0.008	0.087
1910	0.011	0.087
1911	0.007	0.099
1912	0.026	0.181

1913	0.012	0.068
1914	0.003	0.310
1915	0.005	0.060
1916	0.007	0.108
1917	0.003	0.044
1918	0.008	0.086
1919	0.006	0.056
1920	0.008	0.076
1921	0.008	0.065
1922	0.008	0.104
1923	0.007	0.070
1924	0.003	0.123
1925	0.004	0.054
1926	0.007	0.100
1927	0.006	0.085
1928	0.006	0.064
1929	0.011	0.130
1930	0.007	0.128
1931	0.007	0.065
1932	0.005	0.069
1933	0.006	0.068
1934	0.015	0.120
1935	0.007	0.059
1936	0.007	0.084
1937	0.010	0.107
1938	0.006	0.060
1939	0.001	0.071
1940	0.007	0.131
1941	0.005	0.130
1942	0.011	0.104
1943	0.005	0.098
1944	0.011	0.147
1945	0.008	0.105
1946	0.005	0.086
1947	0.004	0.063
1948	0.016	0.089
1949	0.014	0.134
1950	0.004	0.077
1951	0.006	0.114
1952	0.020	0.148
1953	0.019	0.135
1954	0.007	0.073
1955	0.006	0.067
1956	0.003	0.060
1957	0.010	0.071
1958	0.020	0.095
1959	0.012	0.095
1960	0.003	0.070
1961	0.012	0.208
1962	0.007	0.085
1963	0.003	0.061
1964	0.004	0.194
1965	0.014	0.087
1966	0.004	0.069
1967	0.006	0.103
1968	0.007	0.082
1969	0.006	0.075
1970	0.010	0.087

1971	0.015	0.087
1972	0.010	0.274
1973	0.013	0.152
1974	0.007	0.116
1975	0.015	0.132
1976	0.008	0.133
1977	0.004	0.053
1978	0.013	0.099
1979	0.004	0.099
1980	0.008	0.100
1981	0.008	0.091
1982	0.004	0.072
1983	0.012	0.101
1984	0.006	0.100
1985	0.009	0.118
1986	0.008	0.057
1987	0.014	0.097
1988	0.009	0.059
1989	0.008	0.061
1990	0.010	0.073
1991	0.008	0.105
1992	0.009	0.099
1993	0.010	0.111
1994	0.015	0.083
1995	0.004	0.061
1996	0.016	0.085
1997	0.007	0.074
1998	0.008	0.091
1999	0.001	0.094
2000	0.006	0.084
2001	0.003	0.068
2002	0.011	0.136
2003	0.009	0.071
2004	0.008	0.105
2005	0.015	0.205
2006	0.005	0.093
2007	0.005	0.109
2008	0.008	0.089
2009	0.006	0.065
2010	0.005	0.085
2011	0.004	0.082
2012	0.007	0.085
2013	0.005	0.081
2014	0.003	0.076
2015	0.007	0.143
2016	0.003	0.073
2017	0.011	0.128
2018	0.020	0.084
2019	0.021	0.126
2020	0.006	0.098
2021	0.010	0.081
2022	0.004	0.134
2023	0.009	0.162
2024	0.023	0.194
2025	0.008	0.084
2026	0.012	0.115
2027	0.005	0.103
2028	0.004	0.041

2029	0.008	0.070
2030	0.015	0.143
2031	0.005	0.043
2032	0.003	0.070
2033	0.005	0.088
2034	0.005	0.069
2035	0.018	0.094
2036	0.009	0.070
2037	0.003	0.093
2038	0.008	0.097
2039	0.001	0.180
2040	0.005	0.072
2041	0.005	0.092
2042	0.018	0.101
2043	0.009	0.113
2044	0.011	0.080
2045	0.007	0.065
2046	0.009	0.072
2047	0.006	0.085
2048	0.009	0.070
2049	0.008	0.104
2050	0.006	0.082
2051	0.009	0.121
2052	0.005	0.083
2053	0.008	0.070
2054	0.010	0.161
2055	0.004	0.083
2056	0.004	0.113
2057	0.006	0.055
2058	0.007	0.106
2059	0.012	0.129

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #3

Rank	Predeveloped	Mitigated
1	0.0257	0.3096
2	0.0231	0.2738
3	0.0208	0.2076
4	0.0201	0.2047
5	0.0197	0.1941
6	0.0196	0.1937
7	0.0185	0.1807
8	0.0177	0.1803
9	0.0175	0.1624
10	0.0159	0.1607
11	0.0157	0.1523
12	0.0154	0.1484
13	0.0152	0.1471
14	0.0150	0.1432
15	0.0149	0.1427
16	0.0146	0.1414
17	0.0145	0.1356
18	0.0143	0.1347
19	0.0140	0.1337
20	0.0140	0.1335
21	0.0134	0.1332
22	0.0125	0.1317
23	0.0124	0.1308

24	0.0123	0.1304
25	0.0122	0.1302
26	0.0122	0.1292
27	0.0118	0.1280
28	0.0117	0.1280
29	0.0115	0.1264
30	0.0114	0.1227
31	0.0113	0.1207
32	0.0113	0.1199
33	0.0111	0.1180
34	0.0108	0.1164
35	0.0107	0.1146
36	0.0106	0.1141
37	0.0102	0.1129
38	0.0101	0.1126
39	0.0100	0.1123
40	0.0100	0.1113
41	0.0098	0.1087
42	0.0098	0.1079
43	0.0096	0.1069
44	0.0096	0.1058
45	0.0094	0.1054
46	0.0094	0.1054
47	0.0092	0.1047
48	0.0090	0.1044
49	0.0089	0.1043
50	0.0089	0.1041
51	0.0086	0.1035
52	0.0086	0.1029
53	0.0086	0.1015
54	0.0085	0.1014
55	0.0084	0.1014
56	0.0084	0.1002
57	0.0084	0.1001
58	0.0083	0.0997
59	0.0082	0.0991
60	0.0082	0.0990
61	0.0082	0.0989
62	0.0081	0.0987
63	0.0081	0.0984
64	0.0081	0.0983
65	0.0081	0.0975
66	0.0080	0.0973
67	0.0080	0.0951
68	0.0080	0.0946
69	0.0077	0.0943
70	0.0077	0.0938
71	0.0077	0.0934
72	0.0076	0.0928
73	0.0076	0.0928
74	0.0076	0.0917
75	0.0076	0.0914
76	0.0076	0.0907
77	0.0075	0.0891
78	0.0074	0.0886
79	0.0074	0.0878
80	0.0074	0.0874
81	0.0073	0.0873

82	0.0072	0.0871
83	0.0071	0.0870
84	0.0071	0.0865
85	0.0071	0.0862
86	0.0071	0.0860
87	0.0070	0.0854
88	0.0070	0.0853
89	0.0070	0.0852
90	0.0069	0.0852
91	0.0068	0.0851
92	0.0068	0.0847
93	0.0067	0.0842
94	0.0066	0.0841
95	0.0066	0.0841
96	0.0065	0.0840
97	0.0065	0.0832
98	0.0064	0.0827
99	0.0064	0.0826
100	0.0063	0.0820
101	0.0063	0.0818
102	0.0062	0.0816
103	0.0061	0.0815
104	0.0059	0.0810
105	0.0059	0.0797
106	0.0058	0.0770
107	0.0057	0.0763
108	0.0057	0.0755
109	0.0056	0.0749
110	0.0056	0.0737
111	0.0055	0.0735
112	0.0054	0.0735
113	0.0053	0.0733
114	0.0053	0.0726
115	0.0051	0.0723
116	0.0050	0.0720
117	0.0048	0.0717
118	0.0048	0.0714
119	0.0048	0.0711
120	0.0048	0.0707
121	0.0047	0.0704
122	0.0047	0.0703
123	0.0047	0.0703
124	0.0046	0.0702
125	0.0046	0.0701
126	0.0046	0.0700
127	0.0045	0.0697
128	0.0045	0.0695
129	0.0045	0.0694
130	0.0044	0.0689
131	0.0043	0.0683
132	0.0043	0.0676
133	0.0043	0.0676
134	0.0042	0.0670
135	0.0042	0.0651
136	0.0042	0.0651
137	0.0041	0.0646
138	0.0041	0.0646
139	0.0040	0.0639

140	0.0039	0.0635
141	0.0038	0.0629
142	0.0037	0.0614
143	0.0036	0.0611
144	0.0034	0.0608
145	0.0034	0.0603
146	0.0034	0.0599
147	0.0033	0.0596
148	0.0033	0.0587
149	0.0033	0.0586
150	0.0032	0.0586
151	0.0030	0.0567
152	0.0027	0.0562
153	0.0026	0.0549
154	0.0026	0.0543
155	0.0024	0.0530
156	0.0012	0.0436
157	0.0011	0.0429
158	0.0007	0.0405

Duration Flows

The Duration Matching Failed

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0037	60054	384037	639	Fail
0.0039	55046	374841	680	Fail
0.0040	50365	365755	726	Fail
0.0042	46165	357168	773	Fail
0.0043	42359	349190	824	Fail
0.0045	38974	341157	875	Fail
0.0046	35994	333623	926	Fail
0.0048	33257	326310	981	Fail
0.0049	30697	319218	1039	Fail
0.0051	28315	312404	1103	Fail
0.0052	26326	305922	1162	Fail
0.0054	24482	299607	1223	Fail
0.0055	22786	293568	1288	Fail
0.0057	21235	287529	1354	Fail
0.0058	19833	281823	1420	Fail
0.0060	18526	276338	1491	Fail
0.0061	17213	270965	1574	Fail
0.0063	16000	265757	1660	Fail
0.0064	14914	260605	1747	Fail
0.0066	13894	255729	1840	Fail
0.0067	12980	250965	1933	Fail
0.0069	12133	246256	2029	Fail
0.0071	11318	241768	2136	Fail
0.0072	10593	237281	2239	Fail
0.0074	9850	232960	2365	Fail
0.0075	9174	228638	2492	Fail
0.0077	8532	224373	2629	Fail
0.0078	7967	220384	2766	Fail
0.0080	7429	216395	2912	Fail
0.0081	6947	212517	3059	Fail
0.0083	6554	208750	3185	Fail
0.0084	6199	205038	3307	Fail
0.0086	5895	201492	3418	Fail
0.0087	5573	198002	3552	Fail
0.0089	5274	194567	3689	Fail
0.0090	5009	191188	3816	Fail
0.0092	4759	187864	3947	Fail
0.0093	4527	184650	4078	Fail
0.0095	4288	181437	4231	Fail
0.0096	4068	178279	4382	Fail
0.0098	3861	175177	4537	Fail
0.0099	3652	172130	4713	Fail
0.0101	3445	169249	4912	Fail
0.0102	3288	166424	5061	Fail
0.0104	3129	163709	5231	Fail
0.0105	2982	160994	5398	Fail
0.0107	2833	158224	5585	Fail
0.0108	2695	155565	5772	Fail
0.0110	2581	152961	5926	Fail
0.0111	2451	150191	6127	Fail
0.0113	2357	147698	6266	Fail
0.0114	2239	145094	6480	Fail
0.0116	2140	142767	6671	Fail
0.0117	1993	140330	7041	Fail

0.0119	1869	138003	7383	Fail
0.0120	1759	135732	7716	Fail
0.0122	1674	133460	7972	Fail
0.0123	1586	131133	8268	Fail
0.0125	1507	128973	8558	Fail
0.0126	1430	126867	8871	Fail
0.0128	1359	124818	9184	Fail
0.0129	1299	122768	9450	Fail
0.0131	1237	120773	9763	Fail
0.0132	1181	118557	10038	Fail
0.0134	1118	116563	10426	Fail
0.0135	1072	114679	10697	Fail
0.0137	1026	112851	10999	Fail
0.0138	967	111078	11486	Fail
0.0140	896	109195	12186	Fail
0.0141	837	107422	12834	Fail
0.0143	783	105649	13492	Fail
0.0144	737	103932	14102	Fail
0.0146	680	102214	15031	Fail
0.0147	631	100552	15935	Fail
0.0149	589	98890	16789	Fail
0.0150	556	97339	17507	Fail
0.0152	510	95622	18749	Fail
0.0153	475	94015	19792	Fail
0.0155	431	92464	21453	Fail
0.0156	389	90968	23385	Fail
0.0158	368	89527	24327	Fail
0.0159	341	88032	25815	Fail
0.0161	305	86591	28390	Fail
0.0162	281	85206	30322	Fail
0.0164	265	83821	31630	Fail
0.0165	248	82381	33218	Fail
0.0167	234	81051	34637	Fail
0.0168	220	79722	36237	Fail
0.0170	206	78503	38108	Fail
0.0171	185	77228	41744	Fail
0.0173	161	75899	47142	Fail
0.0175	139	74791	53806	Fail
0.0176	117	73517	62835	Fail
0.0178	110	72298	65725	Fail
0.0179	101	71190	70485	Fail
0.0181	92	70026	76115	Fail
0.0182	85	68918	81080	Fail
0.0184	73	67921	93042	Fail
0.0185	64	66869	104482	Fail
0.0187	54	65705	121675	Fail

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

Water Quality

Water Quality BMP Flow and Volume for POC #3

On-line facility volume:	0.0279 acre-feet
On-line facility target flow:	0.0361 cfs.
Adjusted for 15 min:	0.0361 cfs.
Off-line facility target flow:	0.0208 cfs.
Adjusted for 15 min:	0.0208 cfs.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

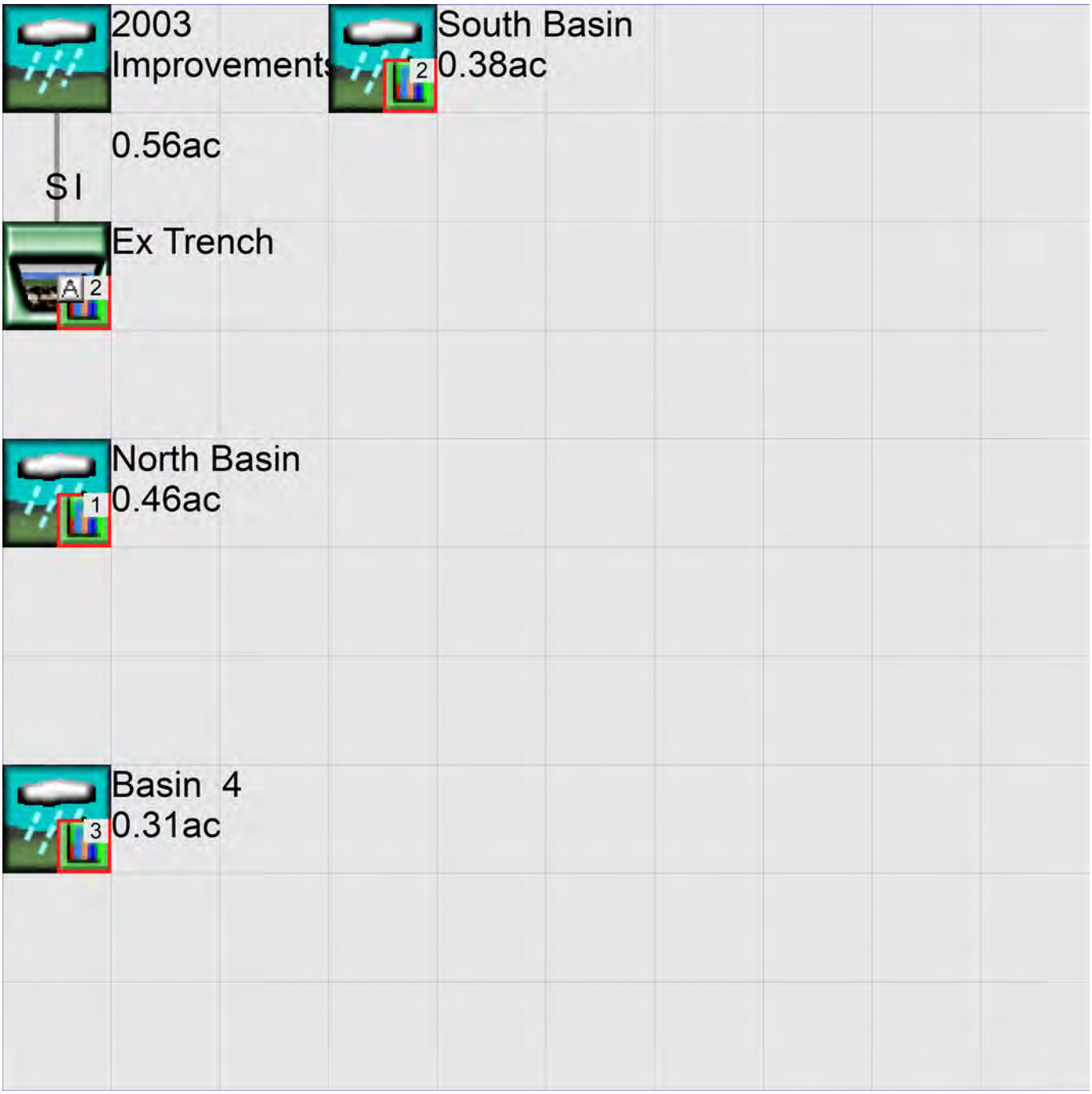
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 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   Taco Time 110324.wdm
MESSU       25   PreTaco Time 110324.MES
            27   PreTaco Time 110324.L61
            28   PreTaco Time 110324.L62
            31   POCTaco Time 1103242.dat
            30   POCTaco Time 1103241.dat
            32   POCTaco Time 1103243.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      PERLND      16
      IMPLND      11
      IMPLND       4
      IMPLND       8
      PERLND      10
      PERLND      11
      RCHRES       1
      COPY       502
      COPY       501
      COPY       503
      DISPLY       2
      DISPLY       1
      DISPLY       3
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    2        South Basin                MAX                    1    2   31    9
    1        North Basin                MAX                    1    2   30    9
    3        Basin  4                   MAX                    1    2   32    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  502         1    1
  501         1    1
  503         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
   10     C, Forest, Flat         1    1    1    1   27    0
   11     C, Forest, Mod          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
   10         0    0    1    0    0    0    0    0    0    0    0    0
   11         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
   10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   11         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
   10         0    0    0    0    0    0    0    0    0    0    0
   11         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
   10              0       4.5      0.08       400      0.05       0.5     0.996
   11              0       4.5      0.08       400       0.1       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
   10              0         0         2         2         0         0         0
   11              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
   10            0.2       0.5      0.35         6       0.5       0.7
   11            0.2       0.5      0.35         6       0.5       0.7
  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
   10              0         0         0         0       2.5          1         0
   11              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           ***
   11      PARKING/FLAT           1    1    1   27    0
```

```
    4      ROOF TOPS/FLAT         1    1    1   27    0
    8      SIDEWALKS/FLAT         1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

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

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
   11         0    0    4    0    0    0    1    9
    4         0    0    4    0    0    0    1    9
    8         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     ***
   11         0    0    0    0    0
    4         0    0    0    0    0
    8         0    0    0    0    0
  END IWAT-PARM1

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

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

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

END IMPLND

SCHEMATIC
<-Source->                <--Area-->     <-Target->   MBLK   ***
<Name>   #                <-factor->     <Name>   #   Tbl#   ***
2003 Improvements***
PERLND  16                    0.1212     RCHRES   1      2
PERLND  16                    0.1212     RCHRES   1      3
IMPLND  11                    0.4431     RCHRES   1      5
South Basin***
PERLND  16                     0.101     COPY   502     12
PERLND  16                     0.101     COPY   502     13
IMPLND   4                    0.0832     COPY   502     15
IMPLND   8                    0.0045     COPY   502     15
IMPLND  11                    0.1959     COPY   502     15
North Basin***
PERLND  16                    0.0135     COPY   501     12
```

```
PERLND  16                      0.0135     COPY   501     13
PERLND  10                      0.0841     COPY   501     12
PERLND  10                      0.0841     COPY   501     13
PERLND  11                      0.3615     COPY   501     12
PERLND  11                      0.3615     COPY   501     13
Basin  4***
PERLND  10                      0.3101     COPY   503     12
PERLND  10                      0.3101     COPY   503     13

******Routing******
RCHRES   1                          1     COPY   502     17
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
COPY   503 OUTPUT MEAN   1 1   48.4        DISPLY   3     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     Ex Trench              2    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  5  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      0.02       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  5.0  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
   92   5
     Depth   Area   Volume Outflow1 Outflow2 Velocity Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (cfs)   (ft/sec)   (Minutes)***
  0.000000 0.043221 0.000000 0.000000 0.000000
  0.044444 0.043221 0.001806 0.000000 0.047940
  0.088889 0.043221 0.003611 0.000000 0.047940
  0.133333 0.043221 0.005417 0.000000 0.047940
  0.177778 0.043221 0.007223 0.000000 0.047940
  0.222222 0.043221 0.009028 0.000000 0.047940
  0.266667 0.043221 0.010834 0.000000 0.047940
  0.311111 0.043221 0.012640 0.000000 0.047940
  0.355556 0.043221 0.014446 0.000000 0.047940
  0.400000 0.043221 0.016251 0.000000 0.047940
  0.444444 0.043221 0.018057 0.000000 0.047940
  0.488889 0.043221 0.019863 0.000000 0.047940
  0.533333 0.043221 0.021668 0.000000 0.047940
  0.577778 0.043221 0.023474 0.000000 0.047940
  0.622222 0.043221 0.025280 0.000000 0.047940
  0.666667 0.043221 0.027085 0.000000 0.047940
  0.711111 0.043221 0.028891 0.000000 0.047940
  0.755556 0.043221 0.030697 0.000000 0.047940
  0.800000 0.043221 0.032502 0.000000 0.047940
  0.844444 0.043221 0.034308 0.000000 0.047940
  0.888889 0.043221 0.036114 0.000000 0.047940
  0.933333 0.043221 0.037919 0.000000 0.047940
  0.977778 0.043221 0.039725 0.000000 0.047940
  1.022222 0.043221 0.041531 0.000000 0.047940
  1.066667 0.043221 0.043337 0.000000 0.047940
  1.111111 0.043221 0.045142 0.000000 0.047940
  1.155556 0.043221 0.046948 0.000000 0.047940
  1.200000 0.043221 0.048754 0.000000 0.047940
  1.244444 0.043221 0.050559 0.000000 0.047940
  1.288889 0.043221 0.052365 0.000000 0.047940
  1.333333 0.043221 0.054171 0.000000 0.047940
  1.377778 0.043221 0.055976 0.000000 0.047940
  1.422222 0.043221 0.057782 0.000000 0.047940
  1.466667 0.043221 0.059588 0.000000 0.047940
  1.511111 0.043221 0.061393 0.000000 0.047940
  1.555556 0.043221 0.063199 0.000000 0.047940
  1.600000 0.043221 0.065005 0.000000 0.047940
  1.644444 0.043221 0.066811 0.000000 0.047940
  1.688889 0.043221 0.068616 0.000000 0.047940
  1.733333 0.043221 0.070422 0.000000 0.047940
  1.777778 0.043221 0.072228 0.000000 0.047940
  1.822222 0.043221 0.074033 0.000000 0.047940
  1.866667 0.043221 0.075839 0.000000 0.047940
  1.911111 0.043221 0.077645 0.000000 0.047940
  1.955556 0.043221 0.079450 0.000000 0.047940
  2.000000 0.043221 0.081256 0.020000 0.047940
  2.044444 0.043221 0.083062 0.115089 0.047940
  2.088889 0.043221 0.084867 0.248020 0.047940
  2.133333 0.043221 0.086673 0.397134 0.047940
  2.177778 0.043221 0.088479 0.541144 0.047940
  2.222222 0.043221 0.090285 0.660654 0.047940
  2.266667 0.043221 0.092090 0.744321 0.047940
  2.311111 0.043221 0.093896 0.797293 0.047940
  2.355556 0.043221 0.095702 0.857855 0.047940
  2.400000 0.043221 0.097507 0.907197 0.047940
  2.444444 0.043221 0.099313 0.953990 0.047940
  2.488889 0.043221 0.101119 0.998593 0.047940
  2.533333 0.043221 0.102924 1.041287 0.047940
  2.577778 0.043221 0.104730 1.082298 0.047940
  2.622222 0.043221 0.106536 1.121811 0.047940
  2.666667 0.043221 0.108341 1.159979 0.047940
  2.711111 0.043221 0.110147 1.196930 0.047940
  2.755556 0.043221 0.111953 1.232774 0.047940
  2.800000 0.043221 0.113758 1.267605 0.047940

```
  2.844444  0.043221  0.115564  1.301504  0.047940
  2.888889  0.043221  0.117370  1.334543  0.047940
  2.933333  0.043221  0.119176  1.366783  0.047940
  2.977778  0.043221  0.120981  1.398279  0.047940
  3.022222  0.043221  0.122787  1.429082  0.047940
  3.066667  0.043221  0.124593  1.459235  0.047940
  3.111111  0.043221  0.126398  1.488777  0.047940
  3.155556  0.043221  0.128204  1.517744  0.047940
  3.200000  0.043221  0.130010  1.546169  0.047940
  3.244444  0.043221  0.131815  1.574080  0.047940
  3.288889  0.043221  0.133621  1.601505  0.047940
  3.333333  0.043221  0.135427  1.628469  0.047940
  3.377778  0.043221  0.137232  1.654993  0.047940
  3.422222  0.043221  0.139038  1.681098  0.047940
  3.466667  0.043221  0.140844  1.706805  0.047940
  3.511111  0.043221  0.142650  1.732130  0.047940
  3.555556  0.043221  0.144455  1.757090  0.047940
  3.600000  0.043221  0.146261  1.781700  0.047940
  3.644444  0.043221  0.148067  1.805975  0.047940
  3.688889  0.043221  0.149872  1.829928  0.047940
  3.733333  0.043221  0.151678  1.853571  0.047940
  3.777778  0.043221  0.153484  1.876917  0.047940
  3.822222  0.043221  0.155289  1.899976  0.047940
  3.866667  0.043221  0.157095  1.922758  0.047940
  3.911111  0.043221  0.158901  1.945273  0.047940
  3.955556  0.043221  0.160706  1.967531  0.047940
  4.000000  0.043221  0.162512  1.989540  0.047940
  4.044444  0.043221  0.164433  2.011308  0.047940
  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    1             PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1             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   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
COPY   503 OUTPUT MEAN   1 1     48.4      WDM    503 FLOW     ENGL      REPL
RCHRES   1 HYDR   RO     1 1        1      WDM   1011 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      1 1        1      WDM   1012 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      2 1        1      WDM   1013 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1014 STAG     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        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  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       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

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 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   Taco Time 110324.wdm
MESSU       25   MitTaco Time 110324.MES
            27   MitTaco Time 110324.L61
            28   MitTaco Time 110324.L62
            30   POCTaco Time 1103241.dat
            32   POCTaco Time 1103243.dat
            31   POCTaco Time 1103242.dat
END FILES

OPN SEQUENCE
    INGRP               INDELT 00:15
      IMPLND       4
      PERLND      16
      IMPLND       8
      IMPLND      11
      RCHRES       1
      RCHRES       2
      COPY       501
      COPY       503
      COPY         2
      COPY       502
      COPY       602
      DISPLY       1
      DISPLY       3
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        North Basin                MAX                    1    2   30    9
    3        Basin  3                   MAX                    1    2   32    9
    2        Downspout Trench           MAX                    1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  503         1    1
    2         1    1
  502         1    1
  602         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    4    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#   ***
Roof***
IMPLND   4                     0.0905     RCHRES   1      5
Basin  3***
PERLND  16                      0.077     RCHRES   2      2
PERLND  16                      0.077     RCHRES   2      3
IMPLND   8                     0.0135     RCHRES   2      5
IMPLND  11                     0.2196     RCHRES   2      5
North Basin***
PERLND  16                     0.1909     COPY   501     12
PERLND  16                     0.1909     COPY   501     13
IMPLND   4                     0.0149     COPY   501     15
IMPLND   8                     0.0165     COPY   501     15
IMPLND  11                     0.3326     COPY   501     15
Basin  3***
PERLND  16                      0.077     COPY   503     12
PERLND  16                      0.077     COPY   503     13
IMPLND   8                     0.0135     COPY   503     15
IMPLND  11                     0.2196     COPY   503     15
South Basin***
PERLND  16                     0.1086     COPY   502     12
PERLND  16                     0.1086     COPY   602     12
PERLND  16                     0.1086     COPY   502     13
PERLND  16                     0.1086     COPY   602     13
IMPLND   4                     0.0832     COPY   502     15
IMPLND   4                     0.0832     COPY   602     15
```

```
IMPLND   8                      0.0747     COPY   502     15
IMPLND   8                      0.0747     COPY   602     15
IMPLND  11                      0.1386     COPY   502     15
IMPLND  11                      0.1386     COPY   602     15

******Routing******
IMPLND   4                      0.0905     COPY     2     15
PERLND  16                       0.077     COPY     2     12
IMPLND   8                      0.0135     COPY     2     15
IMPLND  11                      0.2196     COPY     2     15
PERLND  16                       0.077     COPY     2     13
RCHRES   1                           1     COPY   502     17
RCHRES   2                           1     COPY   502     17
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   503 OUTPUT MEAN   1 1   48.4        DISPLY   3     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                             ***
    1     Downspout Trench-013    2    1    1    1   28    0    1
    2     Ex Trench Develo-014    2    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
    2         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
    2         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  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    2        0  1  0  0    4  5  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      0.02       0.0       0.0       0.5       0.0
    2              2      0.02       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  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  5.0  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
   92    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.014692  0.000000  0.000000  0.000000
  0.033333  0.014692  0.000147  0.000000  0.016296
  0.066667  0.014692  0.000294  0.000000  0.016296
  0.100000  0.014692  0.000441  0.000000  0.016296
  0.133333  0.014692  0.000588  0.000000  0.016296
  0.166667  0.014692  0.000735  0.000000  0.016296
  0.200000  0.014692  0.000882  0.000000  0.016296
  0.233333  0.014692  0.001028  0.000000  0.016296
  0.266667  0.014692  0.001175  0.000000  0.016296
  0.300000  0.014692  0.001322  0.000000  0.016296
  0.333333  0.014692  0.001469  0.000000  0.016296
  0.366667  0.014692  0.001616  0.000000  0.016296
  0.400000  0.014692  0.001763  0.000000  0.016296
  0.433333  0.014692  0.001910  0.000000  0.016296
  0.466667  0.014692  0.002057  0.000000  0.016296
  0.500000  0.014692  0.002204  0.000000  0.016296
  0.533333  0.014692  0.002351  0.000000  0.016296
  0.566667  0.014692  0.002498  0.000000  0.016296
  0.600000  0.014692  0.002645  0.000000  0.016296
  0.633333  0.014692  0.002792  0.000000  0.016296
  0.666667  0.014692  0.002938  0.000000  0.016296
  0.700000  0.014692  0.003085  0.000000  0.016296
  0.733333  0.014692  0.003232  0.000000  0.016296
  0.766667  0.014692  0.003379  0.000000  0.016296
  0.800000  0.014692  0.003526  0.000000  0.016296
  0.833333  0.014692  0.003673  0.000000  0.016296
  0.866667  0.014692  0.003820  0.000000  0.016296
  0.900000  0.014692  0.003967  0.000000  0.016296
  0.933333  0.014692  0.004114  0.000000  0.016296
  0.966667  0.014692  0.004261  0.000000  0.016296
  1.000000  0.014692  0.004408  0.000000  0.016296
  1.033333  0.014692  0.004555  0.000000  0.016296
  1.066667  0.014692  0.004702  0.000000  0.016296
  1.100000  0.014692  0.004848  0.000000  0.016296
  1.133333  0.014692  0.004995  0.000000  0.016296
  1.166667  0.014692  0.005142  0.000000  0.016296
  1.200000  0.014692  0.005289  0.000000  0.016296
  1.233333  0.014692  0.005436  0.000000  0.016296
  1.266667  0.014692  0.005583  0.000000  0.016296
  1.300000  0.014692  0.005730  0.000000  0.016296
  1.333333  0.014692  0.005877  0.000000  0.016296
  1.366667  0.014692  0.006024  0.000000  0.016296
  1.400000  0.014692  0.006171  0.000000  0.016296
  1.433333  0.014692  0.006318  0.000000  0.016296
  1.466667  0.014692  0.006465  0.000000  0.016296
  1.500000  0.014692  0.006612  0.000000  0.016296
  1.533333  0.014692  0.006758  0.000000  0.016296
  1.566667  0.014692  0.006905  0.000000  0.016296
  1.600000  0.014692  0.007052  0.000000  0.016296
  1.633333  0.014692  0.007199  0.000000  0.016296
  1.666667  0.014692  0.007346  0.000000  0.016296
  1.700000  0.014692  0.007493  0.000000  0.016296
  1.733333  0.014692  0.007640  0.000000  0.016296
  1.766667  0.014692  0.007787  0.000000  0.016296
  1.800000  0.014692  0.007934  0.000000  0.016296
  1.833333  0.014692  0.008081  0.000000  0.016296
```

```
1.866667  0.014692  0.008228  0.000000  0.016296
1.900000  0.014692  0.008375  0.000000  0.016296
1.933333  0.014692  0.008522  0.000000  0.016296
1.966667  0.014692  0.008669  0.000000  0.016296
2.000000  0.014692  0.008815  0.000000  0.016296
2.033333  0.014692  0.008962  0.042996  0.016296
2.066667  0.014692  0.009109  0.121030  0.016296
2.100000  0.014692  0.009256  0.219469  0.016296
2.133333  0.014692  0.009403  0.329384  0.016296
2.166667  0.014692  0.009550  0.441835  0.016296
2.200000  0.014692  0.009697  0.547841  0.016296
2.233333  0.014692  0.009844  0.639435  0.016296
2.266667  0.014692  0.009991  0.711272  0.016296
2.300000  0.014692  0.010138  0.762603  0.016296
2.333333  0.014692  0.010285  0.808195  0.016296
2.366667  0.014692  0.010432  0.847643  0.016296
2.400000  0.014692  0.010579  0.885334  0.016296
2.433333  0.014692  0.010725  0.921485  0.016296
2.466667  0.014692  0.010872  0.956270  0.016296
2.500000  0.014692  0.011019  0.989833  0.016296
2.533333  0.014692  0.011166  1.022295  0.016296
2.566667  0.014692  0.011313  1.053758  0.016296
2.600000  0.014692  0.011460  1.084308  0.016296
2.633333  0.014692  0.011607  1.114021  0.016296
2.666667  0.014692  0.011754  1.142961  0.016296
2.700000  0.014692  0.011901  1.171186  0.016296
2.733333  0.014692  0.012048  1.198748  0.016296
2.766667  0.014692  0.012195  1.225689  0.016296
2.800000  0.014692  0.012342  1.252051  0.016296
2.833333  0.014692  0.012489  1.277869  0.016296
2.866667  0.014692  0.012635  1.303176  0.016296
2.900000  0.014692  0.012782  1.328001  0.016296
2.933333  0.014692  0.012929  1.352370  0.016296
2.966667  0.014692  0.013076  1.376307  0.016296
3.000000  0.014692  0.013223  1.399836  0.016296
3.033333  0.014692  0.013713  1.422975  0.016296
END FTABLE  1
FTABLE      2
 92    5
   Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
0.000000  0.043221  0.000000  0.000000  0.000000
0.044444  0.043221  0.001806  0.000000  0.047940
0.088889  0.043221  0.003611  0.000000  0.047940
0.133333  0.043221  0.005417  0.000000  0.047940
0.177778  0.043221  0.007223  0.000000  0.047940
0.222222  0.043221  0.009028  0.000000  0.047940
0.266667  0.043221  0.010834  0.000000  0.047940
0.311111  0.043221  0.012640  0.000000  0.047940
0.355556  0.043221  0.014446  0.000000  0.047940
0.400000  0.043221  0.016251  0.000000  0.047940
0.444444  0.043221  0.018057  0.000000  0.047940
0.488889  0.043221  0.019863  0.000000  0.047940
0.533333  0.043221  0.021668  0.000000  0.047940
0.577778  0.043221  0.023474  0.000000  0.047940
0.622222  0.043221  0.025280  0.000000  0.047940
0.666667  0.043221  0.027085  0.000000  0.047940
0.711111  0.043221  0.028891  0.000000  0.047940
0.755556  0.043221  0.030697  0.000000  0.047940
0.800000  0.043221  0.032502  0.000000  0.047940
0.844444  0.043221  0.034308  0.000000  0.047940
0.888889  0.043221  0.036114  0.000000  0.047940
0.933333  0.043221  0.037919  0.000000  0.047940
0.977778  0.043221  0.039725  0.000000  0.047940
1.022222  0.043221  0.041531  0.000000  0.047940
1.066667  0.043221  0.043337  0.000000  0.047940
1.111111  0.043221  0.045142  0.000000  0.047940
1.155556  0.043221  0.046948  0.000000  0.047940
1.200000  0.043221  0.048754  0.000000  0.047940
1.244444  0.043221  0.050559  0.000000  0.047940
```

```
  1.288889  0.043221  0.052365  0.000000  0.047940
  1.333333  0.043221  0.054171  0.000000  0.047940
  1.377778  0.043221  0.055976  0.000000  0.047940
  1.422222  0.043221  0.057782  0.000000  0.047940
  1.466667  0.043221  0.059588  0.000000  0.047940
  1.511111  0.043221  0.061393  0.000000  0.047940
  1.555556  0.043221  0.063199  0.000000  0.047940
  1.600000  0.043221  0.065005  0.000000  0.047940
  1.644444  0.043221  0.066811  0.000000  0.047940
  1.688889  0.043221  0.068616  0.000000  0.047940
  1.733333  0.043221  0.070422  0.000000  0.047940
  1.777778  0.043221  0.072228  0.000000  0.047940
  1.822222  0.043221  0.074033  0.000000  0.047940
  1.866667  0.043221  0.075839  0.000000  0.047940
  1.911111  0.043221  0.077645  0.000000  0.047940
  1.955556  0.043221  0.079450  0.000000  0.047940
  2.000000  0.043221  0.081256  0.020000  0.047940
  2.044444  0.043221  0.083062  0.115089  0.047940
  2.088889  0.043221  0.084867  0.248020  0.047940
  2.133333  0.043221  0.086673  0.397134  0.047940
  2.177778  0.043221  0.088479  0.541144  0.047940
  2.222222  0.043221  0.090285  0.660654  0.047940
  2.266667  0.043221  0.092090  0.744321  0.047940
  2.311111  0.043221  0.093896  0.797293  0.047940
  2.355556  0.043221  0.095702  0.857855  0.047940
  2.400000  0.043221  0.097507  0.907197  0.047940
  2.444444  0.043221  0.099313  0.953990  0.047940
  2.488889  0.043221  0.101119  0.998593  0.047940
  2.533333  0.043221  0.102924  1.041287  0.047940
  2.577778  0.043221  0.104730  1.082298  0.047940
  2.622222  0.043221  0.106536  1.121811  0.047940
  2.666667  0.043221  0.108341  1.159979  0.047940
  2.711111  0.043221  0.110147  1.196930  0.047940
  2.755556  0.043221  0.111953  1.232774  0.047940
  2.800000  0.043221  0.113758  1.267605  0.047940
  2.844444  0.043221  0.115564  1.301504  0.047940
  2.888889  0.043221  0.117370  1.334543  0.047940
  2.933333  0.043221  0.119176  1.366783  0.047940
  2.977778  0.043221  0.120981  1.398279  0.047940
  3.022222  0.043221  0.122787  1.429082  0.047940
  3.066667  0.043221  0.124593  1.459235  0.047940
  3.111111  0.043221  0.126398  1.488777  0.047940
  3.155556  0.043221  0.128204  1.517744  0.047940
  3.200000  0.043221  0.130010  1.546169  0.047940
  3.244444  0.043221  0.131815  1.574080  0.047940
  3.288889  0.043221  0.133621  1.601505  0.047940
  3.333333  0.043221  0.135427  1.628469  0.047940
  3.377778  0.043221  0.137232  1.654993  0.047940
  3.422222  0.043221  0.139038  1.681098  0.047940
  3.466667  0.043221  0.140844  1.706805  0.047940
  3.511111  0.043221  0.142650  1.732130  0.047940
  3.555556  0.043221  0.144455  1.757090  0.047940
  3.600000  0.043221  0.146261  1.781700  0.047940
  3.644444  0.043221  0.148067  1.805975  0.047940
  3.688889  0.043221  0.149872  1.829928  0.047940
  3.733333  0.043221  0.151678  1.853571  0.047940
  3.777778  0.043221  0.153484  1.876917  0.047940
  3.822222  0.043221  0.155289  1.899976  0.047940
  3.866667  0.043221  0.157095  1.922758  0.047940
  3.911111  0.043221  0.158901  1.945273  0.047940
  3.955556  0.043221  0.160706  1.967531  0.047940
  4.000000  0.043221  0.162512  1.989540  0.047940
  4.044444  0.043221  0.164433  2.011308  0.047940
  END FTABLE  2
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    1             PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1             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     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   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL       REPL
COPY     3 OUTPUT MEAN   1 1     48.4      WDM    703 FLOW     ENGL       REPL
COPY   503 OUTPUT MEAN   1 1     48.4      WDM    803 FLOW     ENGL       REPL
COPY   603 OUTPUT MEAN   1 1     48.4      WDM    903 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
COPY   602 OUTPUT MEAN   1 1     48.4      WDM    902 FLOW     ENGL       REPL
RCHRES   1 HYDR   RO     1 1        1      WDM   1003 FLOW     ENGL       REPL
RCHRES   1 HYDR   O      1 1        1      WDM   1004 FLOW     ENGL       REPL
RCHRES   1 HYDR   O      2 1        1      WDM   1005 FLOW     ENGL       REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1006 STAG     ENGL       REPL
RCHRES   2 HYDR   RO     1 1        1      WDM   1007 FLOW     ENGL       REPL
RCHRES   2 HYDR   O      1 1        1      WDM   1008 FLOW     ENGL       REPL
RCHRES   2 HYDR   O      2 1        1      WDM   1009 FLOW     ENGL       REPL
RCHRES   2 HYDR   STAGE  1 1        1      WDM   1010 STAG     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        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  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       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

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY           INPUT  MEAN
  END MASS-LINK   17


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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APPENDIX B

Soil Reports

GEORESOURCES
earth science & geotechnical engineering
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September 23, 2022

Taco Time Northwest
3401 Lind Avenue SW
Renton, Washington 98057

Attn: Robby Tonkin
(206) 499-1360
rtonkin@tacotimenw.com

Final Soils Report
Proposed Restaurant
1115 & 1129 East Main
Puyallup, Washington
PN: 7845100032 & 0420271171
Doc ID: TacoTimeNorthwest.EMainSt.SR

INTRODUCTION

This *Final Soils Report* summarizes our site observations and geotechnical data review, and addresses the feasibility of stormwater infiltration for the proposed restaurant to be constructed at 1115 and 1129 East Main in Puyallup, Washington. The approximate site location is shown on Figure 1.

Our understanding of the project is based on our correspondence with you and Azure Green Consultants, our review of the provided site plan, our October 14, 2021 subsurface explorations, our July 6, 2022 infiltration tests, our review of the *Preliminary Storm, SS, & Water Plan* prepared by Azure Green Consultants dated June 21, 2022, our understanding of the City of Puyallup's development codes, and our experience in the site area. We understand that you propose to construct a new restaurant on the undeveloped portion of the site. Development will also include expanding parking and converting the existing restaurant into a separate retail space. We anticipate that the new structure will be a one- to two-story, wood-framed structure supported by conventional shallow foundations.

SCOPE

The purpose of our services was to evaluate the surface and subsurface conditions across the site as a basis for providing geotechnical recommendations and design criteria for the proposed restaurant. Specifically, the scope of services for this project included the following:

1. Reviewing the available geologic, hydrogeologic, and geotechnical data for the site area;
2. Exploring surface and subsurface conditions by reconnoitering the site and monitoring the excavation of a series of three test pits at select locations across the site and installed shallow (less than 10 feet) groundwater monitoring stand pipes in each of the test pits;
3. Return to the site and performing two small scale pilot infiltration tests (PITs) in accordance with the 2014 SWMMWW;

4. Describing surface and subsurface conditions, including soil type, depth to groundwater, if encountered, and an estimate of seasonal high groundwater levels;
5. Monitoring groundwater levels bi-weekly throughout the wet season;
6. Perform 2 small-scale Pilot Infiltration Tests (PITs) at select locations at the site;
7. Providing our opinion about the feasibility of onsite infiltration in accordance with the 2014 SWMMWW, including a preliminary design infiltration rate based on grain size analysis, as applicable; and,
8. Preparing this *Soils Report* that satisfies the 2014 SWMMWW requirements and summarizes our site observations and conclusions, and our geotechnical recommendations, along with the supporting data.

SITE CONDITIONS

Surface Conditions

As mentioned above, the site is located at 1115 and 1129 East Main in Puyallup, Washington, within an area of existing commercial development. The site consists of two tax parcels, that when combined is generally trapezoidal in shape, measures approximately 480 to 570 feet long (north to south) by approximately 275 feet wide (east to west), and encompasses approximately 3.3 acres. The site is bounded by the Puyallup River to the north, E Main St to the south, an RV park to the west, and commercial and non-developed parcels to the east. The southern portion of the site is currently developed with an existing Taco Time building in the southwestern portion of the site. The remaining area of the southern portion of the site is developed with automobile parking. The northern portion of the site is undeveloped.

Based on topographic information obtained from Pierce County Public GIS and our site observations, the ground surface of the site generally slopes down to the north. In the southern portion of the site, in the area of the existing commercial development, the ground surface is relatively level. In the central portion of the site, the ground surface slopes down to the north at approximately 4 to 8 percent. These slopes continue at similar inclinations throughout the northern portion of the site. The total topographic relief of the site is on the order of approximately 15 feet. The existing site configuration and topography are shown on the Site & Exploration Map, Figure 2 and Site Vicinity Map, Figure 3.

Vegetation in the southern portion of the site generally consists of commercial landscaping in the parking lot area with some scattered coniferous and deciduous trees with areas of maintained grass. In the central and northern portion of the site, vegetation generally consists of a moderate stand of coniferous and deciduous trees with a moderately dense understory of native and invasive plants and shrubs. No seeps, springs, or standing water was observed at the time of our site reconnaissance. No areas of surficial erosion or slope movement were observed at the time of our site visit.

Site Soils

The Natural Resource Conservation Service (NRCS) Web Soil Survey maps the site as being underlain by Pilchuck fine sandy loam (29A) and Puyallup sandy loam (31A). Detailed descriptions of the above listed soil types are included below. A copy of the NRCS soils map is included as Figure 4.

Pilchuck fine sandy loam (29A): The Pilchuck soils are mapped across the northern portion of the site. These soils are derived from mixed alluvium under hardwoods and conifers, form on slopes of less

than 3 percent, have a "none" erosion hazard when exposed, and are included in hydrologic soils group C.

Puyallup sandy loam (31A): The Puyallup fine sandy loam soils are mapped across the southern portion of the site. These soils are derived from alluvium, form on slopes of 0 to 3 percent, have a "slight" erosion hazard when exposed, and are included in hydrologic soils group A.

Site Geology

According to the *draft Geologic map of the Puyallup 7.5-minute Quadrangle, Washington* by Troost, (in review) the site is mapped as being underlain by Quaternary Alluvium (Qal). A detailed description of the geologic unit is included below. An excerpt from the geologic map is included as Figure 5.

Quarternary Alluvium (Qal): Alluvial soils generally consist of normally consolidated, stratified deposits of sand, silt, clay, and occasional peat that were deposited along the Puyallup River channel. The existing topography, as well as the surficial and shallow soils in the area, are the result of fluvial action, including down-cutting by the river, channel meandering and migration, and flood deposits.

Subsurface Explorations

On October 14, 2021, a field representative from GeoResources visited the site and monitored the excavation of three test pits to depths of about 9½ to 10½ feet below the existing ground surface, logged the subsurface conditions encountered in each test pit, and obtained representative soil samples. The test pits were excavated by a small track-mounted excavator operated by a licensed operated working under subcontract to GeoResources. The soil densities presented on the logs were based on the difficulty of excavation and our experience. The number and location of the test pits were selected in the field based on project information provided by Azure Green Consultants, consideration for underground utilities, existing site conditions, and current site usage. An open standpipe piezometer (OSP) was installed in each test pit and backfilled with the excavated soils and bucket tamped, but not otherwise compacted.

On July 6, 2022, we returned to the site to perform two pilot infiltration tests (PITs) at depths of approximately 4 feet below existing ground surface. As part of the test, we logged subsurface conditions encountered in each exploration, and obtained representative soil samples. The PITs were excavated by a small track-mounted excavator operated by a licensed earthwork contractor working for you and GeoResources. The soil densities presented on the logs were based on the difficulty of excavation and our experience. Each PIT was then backfilled with the excavated soils and bucket tamped, but not otherwise compacted.

The subsurface explorations excavated as part of this evaluation indicate the subsurface conditions at specific locations only, as actual subsurface conditions can vary across the site. Furthermore, the nature and extent of such variation would not become evident until additional explorations are performed or until construction activities have begun. Based on our experience in the area and extent of prior explorations in the area, it is our opinion that the soils encountered in the explorations are generally representative of the soils at the site.

The soils encountered were visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM D: 2488. The approximate locations of our test pits are indicated on the attached Site & Exploration Map, Figure 2. The USCS is included in Appendix A as

Figure A-1, while the descriptive logs of our test pits and PITs are included as Figures A-2 through A-4.

Subsurface Conditions

At the locations of our test pits we encountered uniform subsurface conditions that in our opinion generally confirmed the mapped stratigraphy at the site. Our test pits generally encountered approximately ¾ to 1 foot of topsoil. Underlying the topsoil in test pit TP-1 we encountered approximately 4½ feet of brown silty sand with significant amounts of concrete, some metal, and trace organics. We interpret these soils to be undocumented fill. Underlying the topsoil in test pit TP-2 we encountered brown poorly graded sand with some silt and gravel in a loose to medium dense, moist condition. We interpret these soils be weathered alluvium. Underlying the topsoil in test pit TP-3 and the weathered alluvium in test pit TP-2, we encountered brown-grey to grey fine silty sand in a medium dense, moist condition. We interpret these soils to be alluvium and were encountered to the full depth explored in test pit TP-2. Underlying the undocumented fill in test pit TP-1 and the alluvium in test pit TP-3, we encountered brown grey sandy silt in a stiff, moist condition. We interpret these soils to be consistent with alluvium deposits. These soils were encountered to the full depth explored.

At the locations of our Pilot Infiltration Tests (PITs) we encountered relatively uniform subsurface conditions that, in our opinion, generally confirmed the mapped stratigraphy and the encountered stratigraphy in our previously excavated test pits. Our PITs encountered approximately ¾ feet of topsoil mantling approximately 1 to 1 ¼ feet of brown poorly graded sand with some silt and gravel to dark brown silty sand in a loose to medium dense, moist condition. We interpret these soils to be weathered alluvium. Underlying the weathered alluvium in PIT-1 we encountered approximately 3¾ feet of brown-grey sandy silt in a medium stiff, moist condition. We interpret these soils to be alluvium. Underlying the weathered alluvium in PIT-2 and the sandy silt alluvium in PIT-1, we encountered brown-grey silty sand in a medium dense, moist condition. We interpret these soils to be alluvium and these soils were encountered to the full depth explored.

Laboratory Testing

Geotechnical laboratory tests were performed on two samples retrieved from the test pits to estimate index engineering properties of the soils encountered. Laboratory testing included visual soil classification per ASTM D: 2487 and ASTM D: 2488, moisture content determinations per ASTM D: 2216, and grain size analyses per ASTM D: 6913 standard procedures. The results of the laboratory tests are included in Appendix B.

Groundwater Conditions

At the locations and time of our test pit explorations we did not encounter groundwater seepage within the depths explored. However, we did observe iron-oxide staining/discoloration, otherwise known as mottling, at approximately 4 to 5¼ feet below existing ground surface. Mottling is generally indicative of a seasonal or fluctuating groundwater surface, often associated with perched groundwater. Perched groundwater table develops when the vertical infiltration of precipitation through a more permeable soil, is slowed at depth by a deeper, less permeable soil type. We anticipate fluctuations in the local groundwater levels will occur in response to precipitation patterns, off-site construction activities, and site utilization. We performed wet season monitoring of the groundwater elevation on a bi-weekly basis throughout the 2021/2022 wet season. Table 1,

below, summarizes the depth and elevation of groundwater encountered during our wet season monitoring.

TABLE 1:
APPROXIMATE DEPTH AND ELEVATION OF ENCOUNTERED GROUNDWATER

Date	OSP-1 (47.92')		OSP-2 (49.91')		OSP-3 (54.06')	
	Measured Depth to Water (feet)	Water Elevation (feet)	Measured Depth to Water (feet)	Water Elevation (feet)	Measured Depth to Water (feet)	Water Elevation (feet)
12/28/2021	6.9	42.1	6.6	43.9	9.7	46.8
1/14/2022	6.1	42.9	5.7	44.8	8.8	47.7
1/28/2022	7.1	41.9	6.8	43.7	9.7	46.8
2/11/2022	7.8	41.3	7.5	43.0	10.0	46.5
2/23/2022	8.3	40.9	7.9	42.6	10.0	46.5
3/1/2022	5.3	43.7	5.5	45.0	9.3	47.2
3/9/2022	6.4	42.6	6.5	44.0	9.5	47.0
3/21/2022	7.0	42.0	6.7	43.8	9.7	46.8

Notes:
1= Elevations of OSP's provided by Azure Green Consultants

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our data review, site reconnaissance, and subsurface explorations, it is our opinion that the infiltration of stormwater runoff generated onsite by the new impervious surfaces may be feasible for this project.

Infiltration Recommendations

Based on our site observations and subsurface explorations, it is our opinion that stormwater infiltration via a trench or basin type system may be feasible at the site. Per Volume 3.1.1 of the 2014 SWMMWW, downspout infiltration is considered feasible on lots or sites if 3 feet or more of permeable soil from the proposed final grade to the seasonal high ground water table exists and at least 1 foot of clearance from the expected bottom elevation of the infiltration facility to the seasonal high ground water table can be met. For the purposes of this infiltration feasibility evaluation, we have assumed that, at a minimum, the standard infiltration trench section (6 inches of topsoil over a 2 foot deep trench) and the standard permeable pavement section (6 inches of pavement over 6 inches of storage course) would be used for a total depth of 3.5 feet. Deeper trenches and thicker storage courses may be designed by a civil engineer where the vertical separation requirements can be met. The silty sand to sandy silt alluvium soils encountered in test pits TP-2 and TP-3 encountered mottling at approximately 4 to 5 feet below existing ground surface. We interpret the mottling to be indicative of seasonal high groundwater. Test pit TP-1 encountered approximately 4½ feet of undocumented fill, therefore infiltration is not feasible near this location.

The City of Puyallup uses the 2012 Stormwater Management Manual for Western Washington, with 2014 updates (2014 SWMMWW). Volume III Section 3.4.2 of the 2014 SWMMWW requires at least 1 foot of separation from the bottoms of rain gardens and permeable pavement to

seasonal high groundwater. A 1 foot or 3 foot minimum vertical separation from the bottom of bioretention is required depending upon the drainage area. For the purposes of this evaluation, a standard permeable pavement section (6 inches of pavement over 6 inches of storage course) would be used. Based on the above, shallow infiltration facilities such as rain gardens, bioretention, and permeable pavement appear to be feasible. Deeper trenches and thicker storage courses may be designed by a civil engineer where the vertical separation requirements can be met.

We performed two small scale Pilot Infiltration Tests (PITs) in the area of the parking lot infiltration gallery (PIT-1) and the proposed roof Infiltration area (PIT-2). After applying correction factors of 0.5 for test method, 0.5 for site variability, and 0.9 for maintenance, we recommend a long term design infiltration rate of approximately 0.3 inches per hour within the sandy silt of PIT-1 and 1.1 inches per hour within the silty sand of PIT-2. All minimum vertical separations, horizontal setback requirements, and infeasibility criteria per 2014 SWMMWW should be considered prior to the selection, design and location of any stormwater facility for the proposed development.

Construction Considerations

Appropriate design, construction and maintenance measures will be required to ensure the infiltration rate can be effectively maintained over time. Stormwater Best Management Practices (BMPs) in accordance with the 2014 SWMMWW should be included in the project plans and specifications to minimize the potential for fines contamination of Low Impact Development BMPs utilized at the site.

Suspended solids could clog the underlying soil and reduce the infiltration rate. To reduce potential clogging of the infiltration systems, the infiltration system should not be connected to the stormwater runoff system until after construction is complete and the site area is landscaped, paved or otherwise protected. Additional measures may also be taken during construction to minimize the potential of fines contamination of the proposed infiltration system, such as utilizing an alternative storm water management location during construction or leaving the bottom of the permanent systems 1 to 2 feet high, and subsequently excavating to the finished grade once the site soils have been stabilized. All contractors working on the site (builders and subcontractors) should divert sediment laden stormwater away from proposed infiltration facilities during construction and landscaping activities. No concrete trucks should be washed or cleaned, and washout areas should not be within the vicinity of the proposed infiltration facilities. After construction activities have been completed, periodic sweeping of the paved areas will help extend the life of the infiltration system.

LIMITATIONS

We have prepared this report for use by Taco Time NW and other members of the design team, for use in the permitting and design of a portion of this project. The data used in preparing this report and this report should be provided to prospective contractors for their bidding or estimating purposes only. Our report, conclusions and interpretations are based on subsurface explorations and data from others and limited site reconnaissance, and should not be construed as a warranty of the subsurface conditions.

Variations in subsurface conditions are possible between the explorations and may also occur with time. A contingency for unanticipated conditions should be included in the budget and schedule. Sufficient monitoring, testing and consultation should be provided by our firm during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to

provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork and foundation installation activities comply with contract plans and specifications.

The scope of our services does not include services related to environmental remediation and construction safety precautions. Our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design.

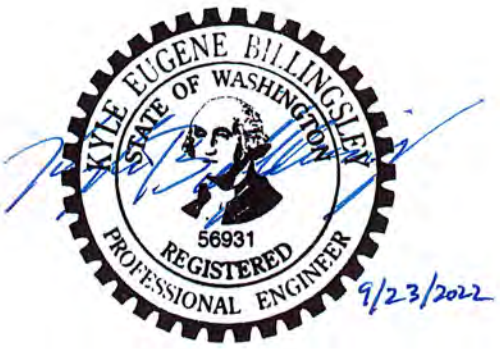
If there are any changes in the loads, grades, locations, configurations or type of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide written modifications or verifications, as appropriate.

◆ ◆ ◆

We have appreciated the opportunity to be of service to you on this project. If you have any questions or comments, please do not hesitate to call at your earliest convenience.

Respectfully submitted,
GeoResources, LLC

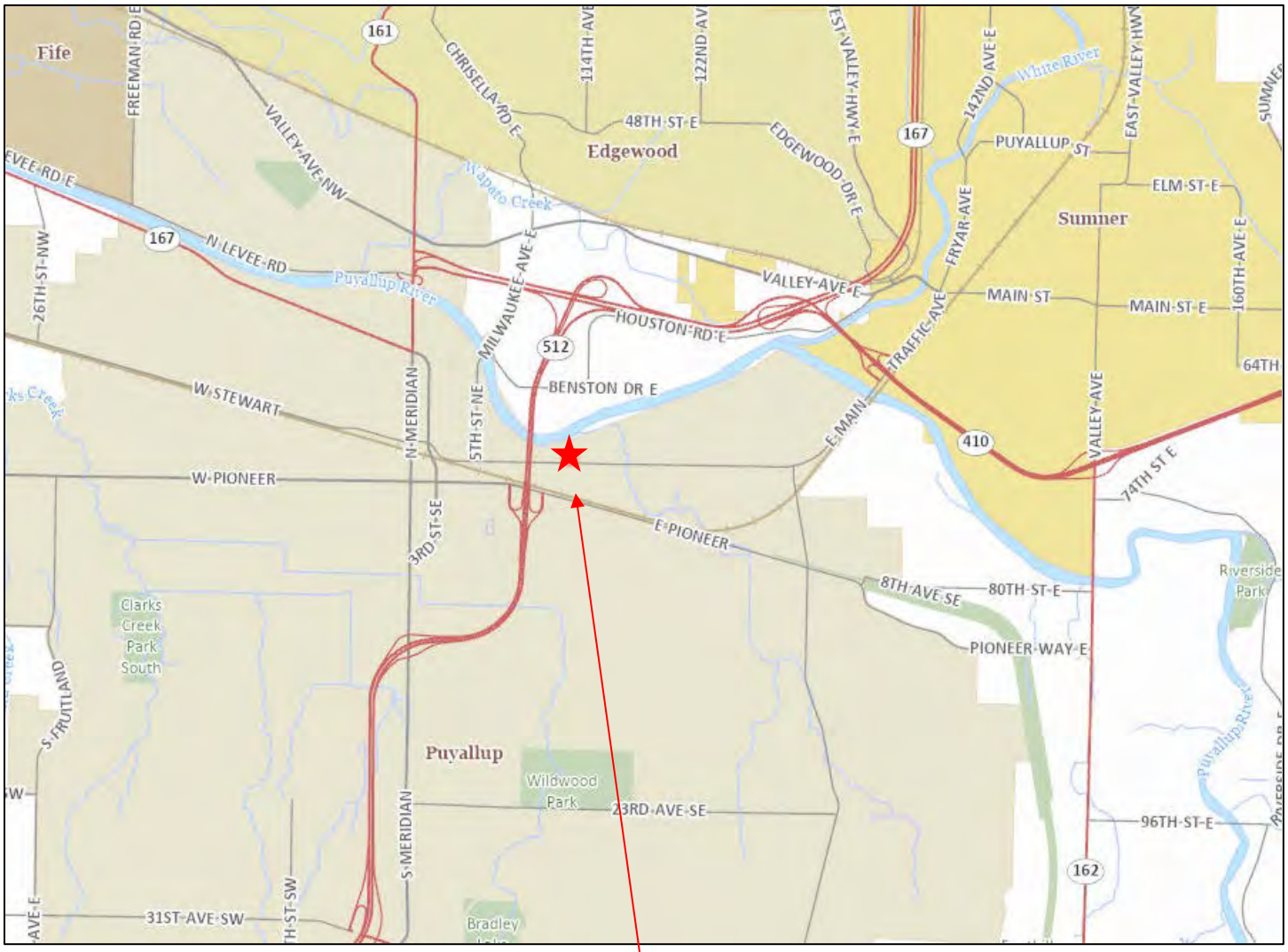
Davis Carlsen, GIT
Staff Geologist



Kyle E. Billingsley, PE
Project Engineer

Eric W. Heller, PE, LG
Senior Geotechnical Engineer

DC:KEB:EWH/dc
DocID: TacoTimeNorthwest.EMainSt.SR
Attachments:
Figure 1: Site Vicinity Map
Figure 2: Site & Exploration Plan
Figure 3. Site Vicinity Map
Figure 4: NRCS Soils Map
Figure 5: Geologic Map
Appendix A – Subsurface Explorations
Appendix B – Laboratory Test Results



Approximate Site Location

Map created from Peirce County Public GIS (https://matterhornwab.co.pierce.wa.us/publicgis/)

Not to Scale

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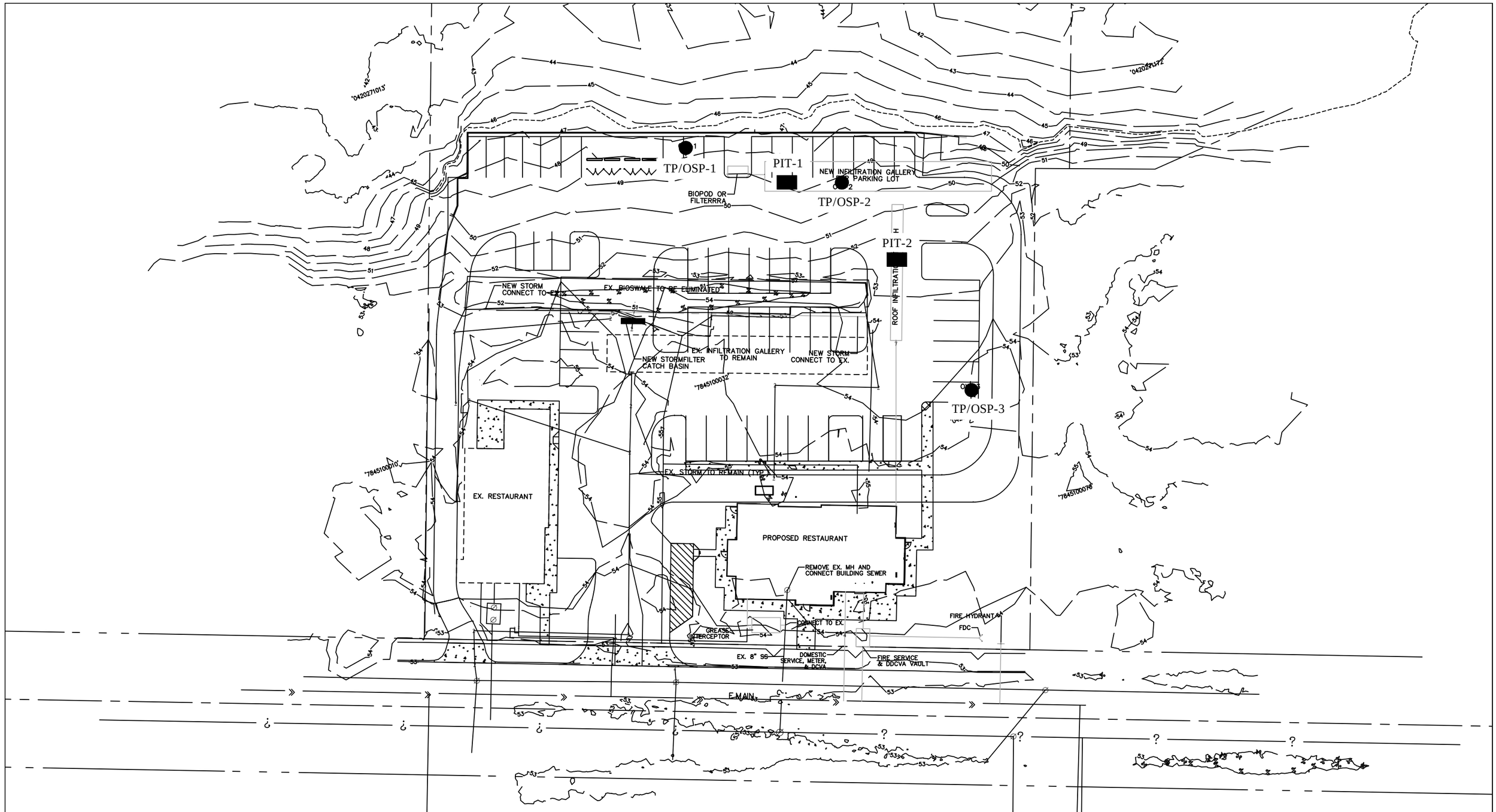
Site Location Map

Proposed Taco Time
1115 & 1129 East Main
Puyallup, Washington
PN: 7845100032 & 0420271171

DocID: TacoTimeNorthwest.EMainSt.F.docx	September 2022	Figure 1



● TP/OSP - # Test Pit/ Open Standpipe Piezometer number and approximate location

■ PIT - # Pilot Infiltration Test number and approximate location

Notes:
Site plan prepared by Azure Green Consultants dated August 1, 2022.

Scale:1" = 40'

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Site & Exploration Plan
1115 & 1129 East Main
Puyallup, Washington
PN: 7845100032 & 0420271171

TacoTimeNorthwest.EMaint.F2	September 2022	Figure 2

Approximate Site Location

Map created from Peirce County Public GIS (https://matterhornwab.co.pierce.wa.us/publicgis/)

Not to Scale

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Site Vicinity Map

Proposed Taco Time
1115 & 1129 East Main
Puyallup, Washington
PN: 7845100032 & 0420271171

DocID: TacoTimeNorthwest.EMainSt.F	September 2022	Figure 3

Approximate Site Location

Map created from Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

Soil Type	Soil Name	Parent Material	Slopes	Erosion Hazard	Hydrologic Soils Group
W	Water	-	-	-	-
29A	Pilchuck fine sandy loam	Mixed alluvium under hardwoods and conifers	<3	None	C
31A	Puyallup fine sandy loam	Alluvium	0 to 3	Slight	A

Not to Scale

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NRCS Soils Map

Proposed Taco Time
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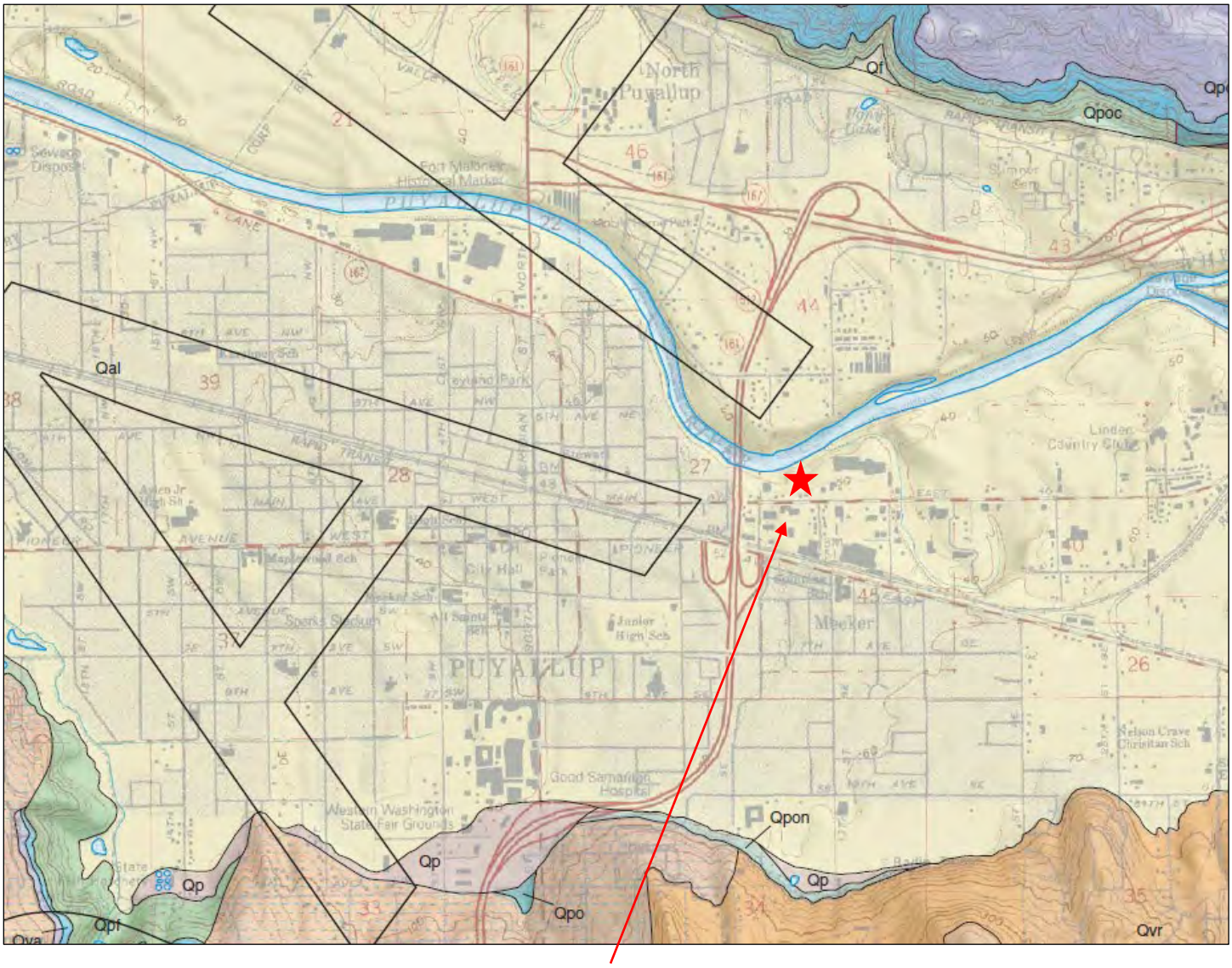
PN: 7845100032 & 0420271171



Approximate Site Location

Excerpt from the draft *Geologic Map of the Puyallup 7.5-Minute Quadrangle, Washington*
By Troost, K.G. (in review)

Qal	Alluvium

Not to Scale

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Geologic Map

Proposed Taco Time
1115 & 1129 East Main
Puyallup, Washington
PN: 7845100032 & 0420271171

DocID: TacoTimeNorthwest.EMainSt.F	September 2022	Figure 5

Appendix A

Subsurface Explorations

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More than 50% Retained on No. 200 Sieve	GRAVEL More than 50% Of Coarse Fraction Retained on No. 4 Sieve	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND More than 50% Of Coarse Fraction Passes No. 4 Sieve	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% Passes No. 200 Sieve	SILT AND CLAY Liquid Limit Less than 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY Liquid Limit 50 or more	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-90.
2. Soil classification using laboratory tests is based on ASTM D2487-90.
3. Description of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and or test data.

SOIL MOISTURE MODIFIERS:

Dry- Absence of moisture, dry to the touch

Moist- Damp, but no visible water

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

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Unified Soils Classification System

Proposed Taco Time
1115 & 1129 East Main
Puyallup, Washington
PN: 7845100032 & 0420271171

Test Pit/ Open Standpipe Piezometer TP/OSP-1

Location: North of existing structure
Approximate Elevation: 47'

Depth (ft)			Soil Type	Soil Description
0	-	¾	-	Topsoil/rootzone
¾	-	5¼	SM	Brown silty SAND with significant amounts of cement fragments, some metal, and trace organics (Undocumented fill) (medium dense, moist)
5¼	-	10½	ML	Brown-grey sandy SILT (alluvium deposits) (stiff, moist)

Terminated at 10½ feet below ground surface.
Mottling observed at approximately 5¼ feet below existing ground surface
No significant caving observed at the time of excavation.
No seepage observed at the time of excavation.

Test Pit/ Open Standpipe Piezometer TP/OSP-2

Location: East-central portion of site
Approximate Elevation: 49

Depth (ft)			Soil Type	Soil Description
0	-	¾	-	Topsoil/rootzone
¾	-	1¾	SP-SM	Brown poorly graded SAND with some silt and gravel (Weathered Alluvium) (loose to medium dense, moist)
1¾	-	10	SM	Grey silty fine SAND (Alluvium) (medium dense, moist)

Terminated at 10 feet below ground surface.
Mottling observed at approximately 5 feet below existing ground surface
No significant caving observed at the time of excavation.
No seepage observed at the time of excavation.

Logged by: DC **Excavated on: October 14, 2021**

Test Pit/Open Standpipe Piezometer TP/OSP-3

Location: Southeast portion of site
Approximate Elevation: 54'

Depth (ft)			Soil Type	Soil Description
0	-	1	-	Topsoil/rootzone
1	-	7	ML	Brown-grey sandy SILT (medium dense, moist) (alluvium)
7	-	9½	ML	Brown-grey sandy SILT (Stiff, moist) (alluvium deposits)

Terminated at 9½ feet below ground surface.
Mottling observed at approximately 4 feet below existing ground surface
No significant caving observed at the time of excavation.
No seepage observed at the time of excavation.

Logged by: DC **Excavated on: October 14, 2021**

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Test Pit Logs

Proposed Taco Time
1115 & 1129 East Main
Puyallup, Washington
PN: 7845100032 & 0420271171

Pilot Infiltration Test PIT-1

Location: Parking Lot Infiltration Gallery
Approximate Elevation: 49'

Depth (ft)			Soil Type	Soil Description
0	-	¾	-	Topsoil/rootzone
¾	-	1¾	SM	Dark Brown silty SAND (loose to medium dense, moist) (weathered alluvium)
1¾	-	5½	ML	Brown-grey sandy SILT (alluvium deposits) (medium stiff, moist)
5½	-	7½	SM	Brown-grey silty SAND (alluvium deposits) (medium dense, moist)

Terminated at 7½ feet below ground surface (BGS)
Mottling observed at approximately 2 feet below existing ground surface
No significant caving observed at the time of excavation.
No seepage observed at the time of excavation.

Pilot Infiltration Test PIT-2

Location: Roof Infiltration Trench
Approximate Elevation: 53

Depth (ft)			Soil Type	Soil Description
0	-	¾	-	Topsoil/rootzone
¾	-	2	SP-SM	Brown poorly graded SAND with some silt and gravel (Weathered Alluvium) (loose to medium dense, moist)
2	-	7¾	SM	Brown-grey silty SAND (alluvium deposits) (medium dense, moist)

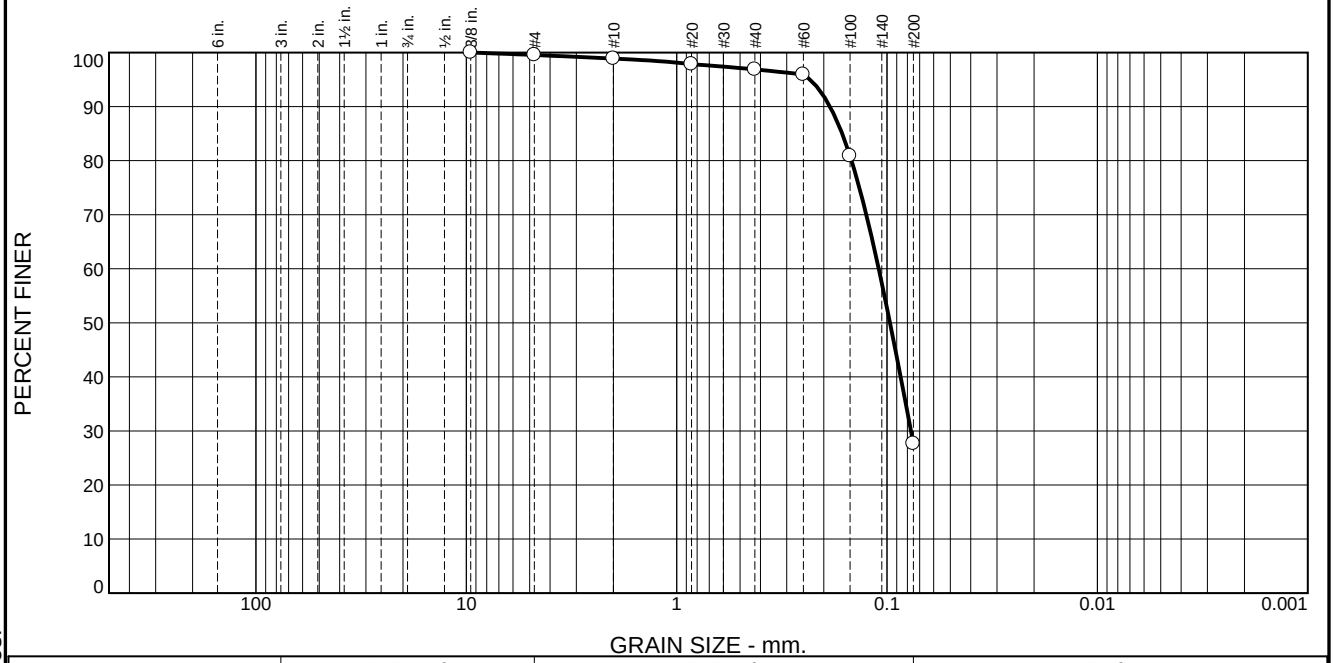
Terminated at 7¾ feet below ground surface (BGS)
Mottling observed at approximately7 feet below existing ground surface
No significant caving observed at the time of excavation.
No seepage observed at the time of excavation.

Logged by: DC **Excavated on: July 6, 2022**

Appendix B

Laboratory results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.5	0.6	2.0	69.2	27.7	

Test Results (ASTM D 6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.375	100.0		
#4	99.5		
#10	98.9		
#20	97.8		
#40	96.9		
#60	95.9		
#100	80.9		
#200	27.7		

* (no specification provided)

Material Description

Silty SAND (SM)

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.1868 D_{85}= 0.1634 D_{60}= 0.1095
D_{50}= 0.0969 D_{30}= 0.0770 D_{15}=
D_{10}= C_u= C_c=

Remarks

Natural Moisture: 5.7%

Date Received: 10/19/21 **Date Tested:** 10/19/21

Tested By: MAW

Checked By: KEB

Title: PM

Location: TP-2, S-1 **Date Sampled:** 10/19/21
Sample Number: 102580 **Depth:** 4'

GeoResources, LLC

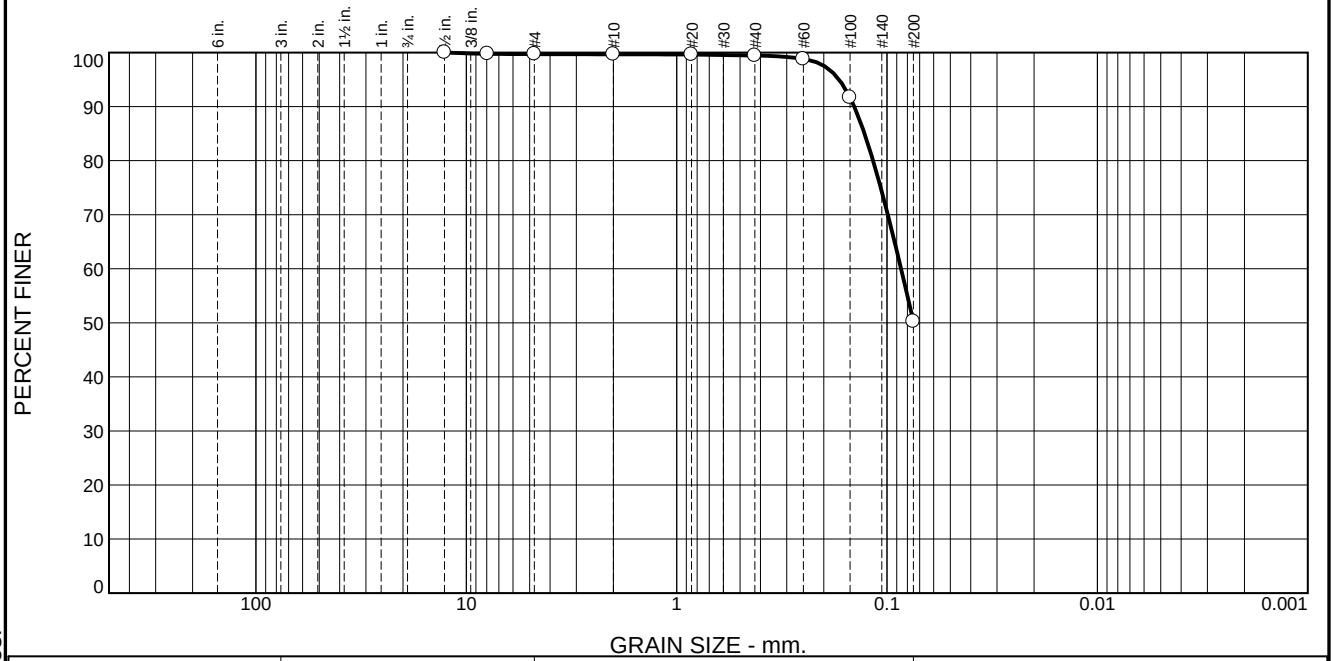
Fife, WA

Client: Taco Time Northwest
Project: Proposed Taco Time

Project No: TacoTimeNorthwest.EMainSt **Figure** B-1

Tested By: _____ **Checked By:** _____

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	0.0	0.3	49.1	50.3	

Test Results (ASTM D 6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.5	100.0		
.3125	99.8		
#4	99.7		
#10	99.7		
#20	99.6		
#40	99.4		
#60	98.8		
#100	91.7		
#200	50.3		

* (no specification provided)

Material Description

Sandy SILT (ML)

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.1432 D_{85}= 0.1279 D_{60}= 0.0858
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Natural Moisture: 15.3%

Date Received: 10/19/21 **Date Tested:** 10/19/21

Tested By: MAW

Checked By: KEB

Title: PM

Location: TP-3 S-1
Sample Number: 102581 **Depth:** 3'

Date Sampled: 10/19/21

GeoResources, LLC

Fife, WA

Client: Taco Time Northwest
Project: Proposed Taco Time

Project No: TacoTimeNorthwest.EMainSt **Figure** B-2

Tested By: _____ **Checked By:** _____

APPENDIX C

StormFilter GULD

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/ft^2 of media surface area, per Table 1, and**
   - **Internal bypassing needs to be consistent with the design guidelines in CONTECH's current product design manual.**

Table 1. StormFilter Design Flow Rates per Cartridge

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

2. **Ecology approves StormFilter systems containing ZPG™ media for treatment at the hydraulic loading rates shown in Table 1, 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.**

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

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

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

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

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

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

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

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

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

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

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

- **Each cartridge contains a total of approximately 2.6 cubic feet of media. The ZPG™ cartridge consists of an outer layer of perlite that is approximately 1.3 cubic feet in volume and an inner layer, consisting of a mixture of 90% zeolite and 10% granular activated carbon, which is approximately 1.3 cubic feet in volume.**

- **Perlite Media: Perlite media shall be made of natural siliceous volcanic rock free of any debris or foreign matter. The expanded perlite shall**

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

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

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

Approved Alternate Configurations

Peak Diversion StormFilter

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

Applicant: Contech Engineered Solutions

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

Application Documents:

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

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

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

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

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

Applicant's Use Level Request:

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

Applicant's Performance Claim:

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

Ecology's Recommendations:

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

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

Findings of Fact:

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

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

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

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

Technology Description:

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

Operation:

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

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

StormFilter Configurations:

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

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

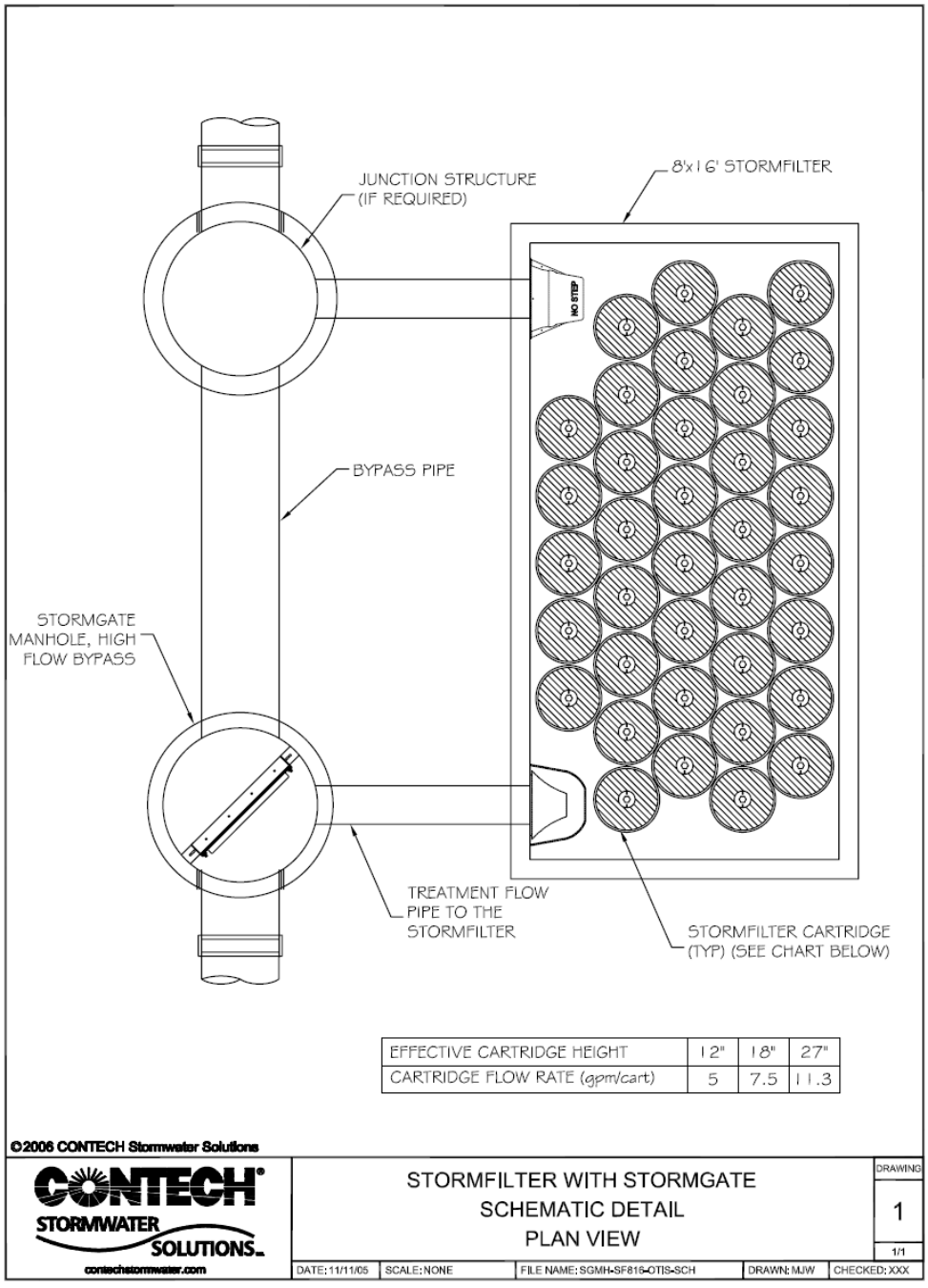


Figure 1. Stormwater Management StormFilter Configuration with Bypass

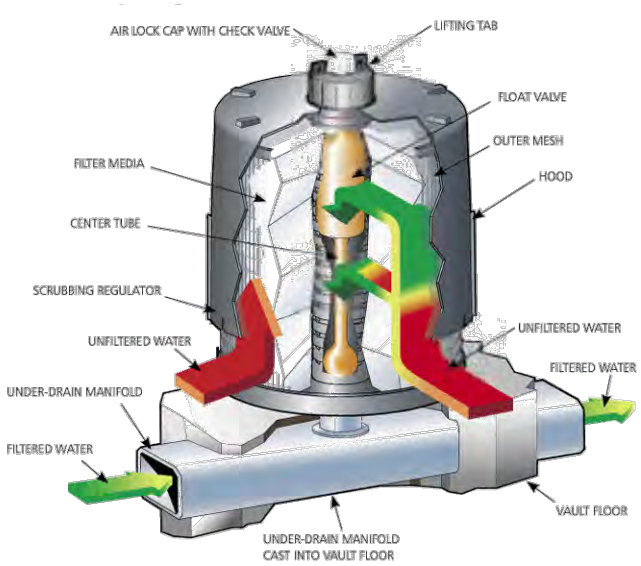


Figure 2. The StormFilter Cartridge

Cartridge Operation:

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

Adjustable cartridge flow rate:

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

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

Recommended research and development:

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

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

Contact Information:

Applicant Contact: Jeremiah Lehman
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 D

CSWPPP BMPs

Construction Stormwater Site Inspection Form

Project Name _____ Permit # _____ Inspection Date _____ Time _____

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

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

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

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

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

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

Pre Construction/installation of erosion/sediment controls	☐	Clearing/Demo/Grading	☐	Infrastructure/storm/roads	☐
Concrete pours	☐	Vertical Construction/buildings	☐	Utilities	☐
Offsite improvements	☐	Site temporary stabilized	☐	Final stabilization	☐

C. Questions:

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

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

_____

_____

_____

_____

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

Sampling Results: Date: _____

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

Construction Stormwater Site Inspection Form

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

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

Construction Stormwater Site Inspection Form

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

Construction Stormwater Site Inspection Form

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

E. Check all areas that have been inspected. ✔

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

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

Element #	Description and Location	Action Required	Completion Date	Initials

Attach additional page if needed

Sign the following certification:

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

Inspected by: (print) _____ (Signature) _____ Date: _____

Title/Qualification of Inspector: _____

burying and smothering vegetation.

- Vegetative buffer zones for streams, lakes or other waterways shall be established by the local permitting authority or other state or federal permits or approvals.

Maintenance Standards

Inspect the area frequently to make sure flagging remains in place and the area remains undisturbed. Replace all damaged flagging immediately. Remove all materials located in the buffer area that may impede the ability of the vegetation to act as a filter.

BMP C103: High-Visibility Fence

Purpose

High-visibility fencing is intended to:

- Restrict clearing to approved limits.
- Prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed.
- Limit construction traffic to designated construction entrances, exits, or internal roads.
- Protect areas where marking with survey tape may not provide adequate protection.

Conditions of Use

To establish clearing limits plastic, fabric, or metal fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left uncleared.
- As necessary to control vehicle access to and on the site.

Design and Installation Specifications

High-visibility plastic fence shall be composed of a high-density polyethylene material and shall be at least four feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every six inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stringer to prevent sagging between posts. The fence color shall be high-visibility orange. The fence tensile strength shall be 360 lbs/ft using the ASTM D4595 testing method.

If appropriate install fabric silt fence in accordance with BMP C233: Silt Fence to act as high-visibility fence. Silt fence shall be at least 3 feet high and must be highly visible to meet the requirements of this BMP.

Metal fences shall be designed and installed according to the manufacturer's specifications.

Metal fences shall be at least 3 feet high and must be highly visible.

Fences shall not be wired or stapled to trees.

Maintenance Standards

If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

BMP C105: Stabilized Construction Access

Purpose

Stabilized construction accesses are established to reduce the amount of sediment transported onto paved roads outside the project site by vehicles or equipment. This is done by constructing a stabilized pad of quarry spalls at entrances and exits for project sites.

Conditions of Use

Construction accesses shall be stabilized wherever traffic will be entering or leaving a construction site if paved roads or other paved areas are within 1,000 feet of the site.

For residential subdivision construction sites, provide a stabilized construction access for each residence, rather than only at the main subdivision entrance. Stabilized surfaces shall be of sufficient length/width to provide vehicle access/parking, based on lot size and configuration.

On large commercial, highway, and road projects, the designer should include enough extra materials in the contract to allow for additional stabilized accesses not shown in the initial Construction SWPPP. It is difficult to determine exactly where access to these projects will take place; additional materials will enable the contractor to install them where needed.

Design and Installation Specifications

See Figure II-3.1: Stabilized Construction Access for details. Note: the 100' minimum length of the access shall be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length (100').

Construct stabilized construction accesses with a 12-inch thick pad of 4-inch to 8-inch quarry spalls, a 4-inch course of asphalt treated base (ATB), or use existing pavement. Do not use crushed concrete, cement, or calcium chloride for construction access stabilization because these products raise pH levels in stormwater and concrete discharge to waters of the State is prohibited.

A separation geotextile shall be placed under the spalls to prevent fine sediment from pumping up into the rock pad. The geotextile shall meet the standards listed in Table II-3.2: Stabilized Construction Access Geotextile Standards.

Table II-3.2: Stabilized Construction Access Geotextile Standards

Geotextile Property	Required Value
Grab Tensile Strength (ASTM D4751)	200 psi min.

Table II-3.2: Stabilized Construction Access Geotextile Standards (continued)

Geotextile Property	Required Value
Grab Tensile Elongation (ASTM D4632)	30% max.
Mullen Burst Strength (ASTM D3786-80a)	400 psi min.
AOS (ASTM D4751)	20-45 (U.S. standard sieve size)

- Consider early installation of the first lift of asphalt in areas that will be paved; this can be used as a stabilized access. Also consider the installation of excess concrete as a stabilized access. During large concrete pours, excess concrete is often available for this purpose.
- Fencing (see BMP C103: High-Visibility Fence) shall be installed as necessary to restrict traffic to the construction access.
- Whenever possible, the access shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.
- Construction accesses should avoid crossing existing sidewalks and back of walk drains if at all possible. If a construction access must cross a sidewalk or back of walk drain, the full length of the sidewalk and back of walk drain must be covered and protected from sediment leaving the site.

Alternative Material Specification

WSDOT has raised safety concerns about the Quarry Spall rock specified above. WSDOT observes that the 4-inch to 8-inch rock sizes can become trapped between Dually truck tires, and then released off-site at highway speeds. WSDOT has chosen to use a modified specification for the rock while continuously verifying that the Stabilized Construction Access remains effective. To remain effective, the BMP must prevent sediment from migrating off site. To date, there has been no performance testing to verify operation of this new specification. Jurisdictions may use the alternative specification, but must perform increased off-site inspection if they use, or allow others to use, it.

Stabilized Construction Accesses may use material that meets the requirements of WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* Section 9-03.9(1) (WSDOT, 2016) for ballast except for the following special requirements.

The grading and quality requirements are listed in Table II-3.3: Stabilized Construction Access Alternative Material Requirements.

Table II-3.3: Stabilized Construction Access Alternative Material Requirements

Sieve Size	Percent Passing
2½"	99-100

Table II-3.3: Stabilized Construction Access Alternative Material Requirements (continued)

Sieve Size	Percent Passing
2″	65-100
¾″	40-80
No. 4	5 max.
No. 100	0-2
% Fracture	75 min.

- All percentages are by weight.
- The sand equivalent value and dust ratio requirements do not apply.
- The fracture requirement shall be at least one fractured face and will apply the combined aggregate retained on the No. 4 sieve in accordance with FOP for AASHTO T 335.

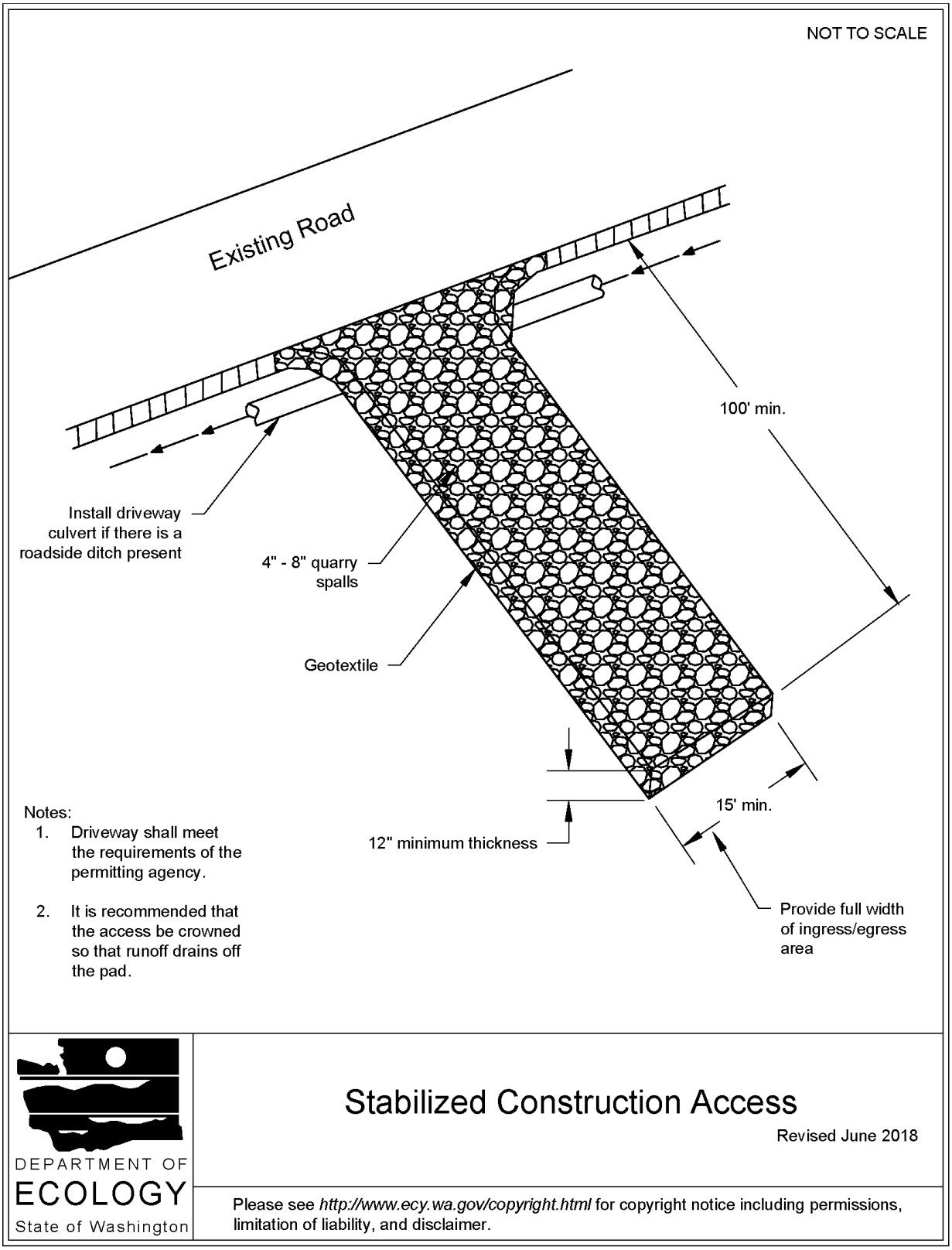
Maintenance Standards

Quarry spalls shall be added if the pad is no longer in accordance with the specifications.

- If the access is not preventing sediment from being tracked onto pavement, then alternative measures to keep the streets free of sediment shall be used. This may include replacement/cleaning of the existing quarry spalls, street sweeping, an increase in the dimensions of the access, or the installation of BMP C106: Wheel Wash.
- Any sediment that is tracked onto pavement shall be removed by shoveling or street sweeping. The sediment collected by sweeping shall be removed or stabilized on site. The pavement shall not be cleaned by washing down the street, except when high efficiency sweeping is ineffective and there is a threat to public safety. If it is necessary to wash the streets, the construction of a small sump to contain the wash water shall be considered. The sediment would then be washed into the sump where it can be controlled.
- Perform street sweeping by hand or with a high efficiency sweeper. Do not use a non-high efficiency mechanical sweeper because this creates dust and throws soils into storm systems or conveyance ditches.
- Any quarry spalls that are loosened from the pad, which end up on the roadway shall be removed immediately.
- If vehicles are entering or exiting the site at points other than the construction access(es), BMP C103: High-Visibility Fence shall be installed to control traffic.

- Upon project completion and site stabilization, all construction accesses intended as permanent access for maintenance shall be permanently stabilized.

Figure II-3.1: Stabilized Construction Access



Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

BMP C106: Wheel Wash

Purpose

Wheel washes reduce the amount of sediment transported onto paved roads by washing dirt from the wheels of motor vehicles prior to the motor vehicles leaving the construction site.

Conditions of Use

- Use a wheel wash when BMP C105: Stabilized Construction Access is not preventing sediment from being tracked off site.
- Wheel washing is generally an effective BMP when installed with careful attention to topography. For example, a wheel wash can be detrimental if installed at the top of a slope abutting a right-of-way where the water from the dripping truck can run unimpeded into the street.
- Pressure washing combined with an adequately sized and surfaced pad with direct drainage to a large 10-foot x 10-foot sump can be very effective.
- Wheel wash wastewater is not stormwater. It is commonly called process water, and must be discharged to a separate on-site treatment system that prevents discharge to waters of the State, or to the sanitary sewer with local sewer district approval.
- Wheel washes may use closed-loop recirculation systems to conserve water use.
- Wheel wash wastewater shall not include wastewater from concrete washout areas.
- When practical, the wheel wash should be placed in sequence with BMP C105: Stabilized Construction Access. Locate the wheel wash such that vehicles exiting the wheel wash will enter directly onto BMP C105: Stabilized Construction Access. In order to achieve this, BMP C105: Stabilized Construction Access may need to be extended beyond the standard installation to meet the exit of the wheel wash.

Design and Installation Specifications

Suggested details are shown in Figure II-3.2: Wheel Wash. The Local Permitting Authority may allow other designs. A minimum of 6 inches of asphalt treated base (ATB) over crushed base material or 8 inches over a good subgrade is recommended to pave the wheel wash.

Use a low clearance truck to test the wheel wash before paving. Either a belly dump or lowboy will work well to test clearance.

Keep the water level from 12 to 14 inches deep to avoid damage to truck hubs and filling the truck tongues with water.

Midpoint spray nozzles are only needed in extremely muddy conditions.

Wheel wash systems should be designed with a small grade change, 6- to 12-inches for a 10-foot-wide pond, to allow sediment to flow to the low side of pond to help prevent re-suspension of sediment. A drainpipe with a 2- to 3-foot riser should be installed on the low side of the pond to allow for easy cleaning and refilling. Polymers may be used to promote coagulation and flocculation in a closed-loop system. Polyacrylamide (PAM) added to the wheel wash water at a rate of 0.25 - 0.5 pounds per 1,000 gallons of water increases effectiveness and reduces cleanup time. If PAM is already being used for dust or erosion control and is being applied by a water truck, the same truck can be used to change the wash water.

Maintenance Standards

The wheel wash should start out each day with fresh water.

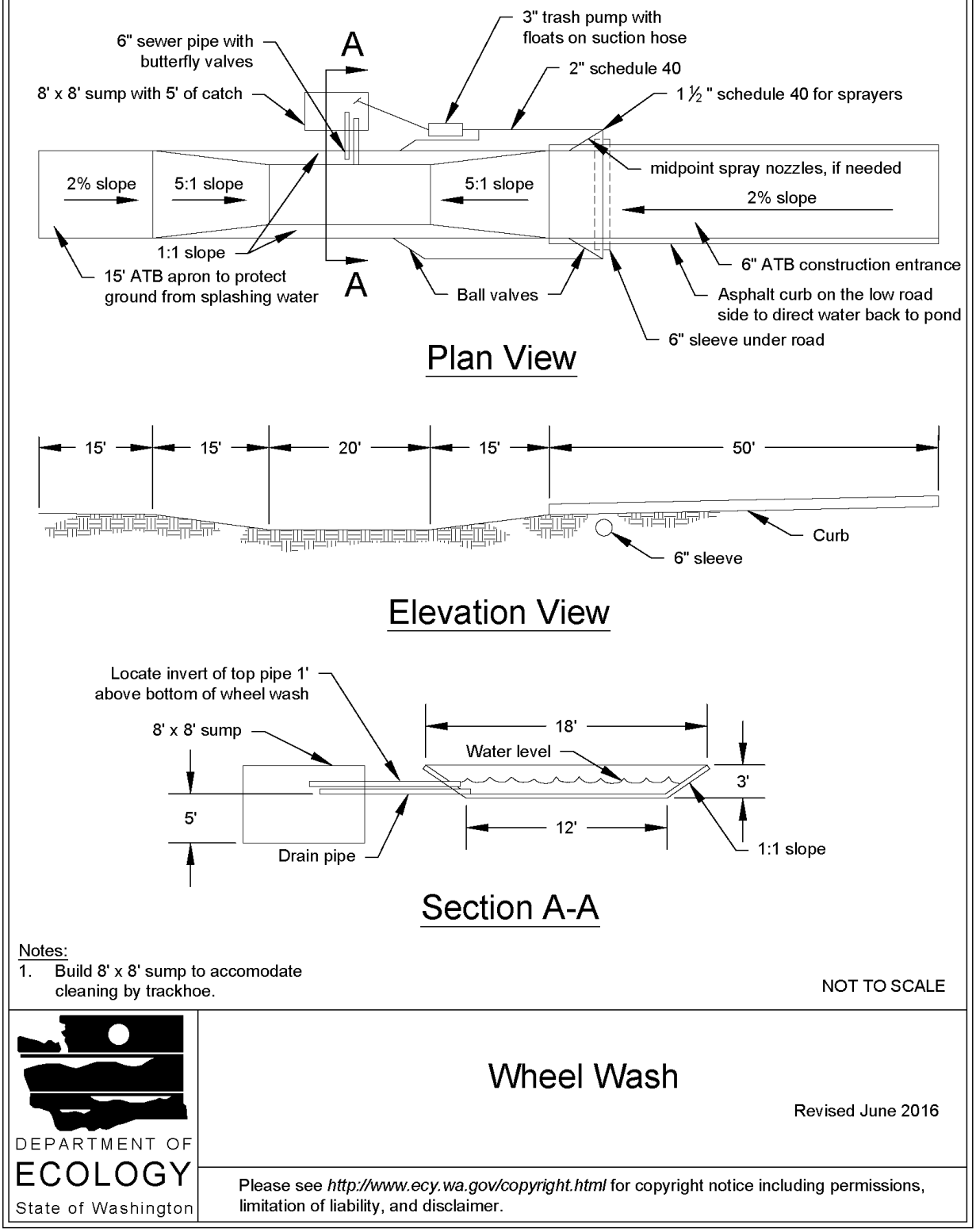
The wheel wash water should be changed a minimum of once per day. On large earthwork jobs where more than 10-20 trucks per hour are expected, the wheel wash water will need to be changed more often.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

Figure II-3.2: Wheel Wash



Notes:

1. Build 8' x 8' sump to accomodate cleaning by trackhoe.

NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Wheel Wash

Revised June 2016

BMP C107: Construction Road / Parking Area Stabilization

Purpose

Stabilizing roads, parking areas, and other on-site vehicle transportation routes immediately after grading reduces erosion caused by construction traffic or stormwater runoff.

Conditions of Use

Roads and parking areas shall be stabilized wherever they are constructed, whether permanent or temporary, for use by construction traffic.

BMP C103: High-Visibility Fence shall be installed, if necessary, to limit the access of vehicles to only those roads and parking areas that are stabilized.

Design and Installation Specifications

- On areas that will receive asphalt as part of the project, install the first lift as soon as possible.
- A 6-inch depth of 2- to 4-inch crushed rock, gravel base, or crushed surfacing base course shall be applied immediately after grading or utility installation. A 4-inch course of asphalt treated base (ATB) may also be used, or the road/parking area may be paved. It may also be possible to use cement or calcium chloride for soil stabilization. If cement or cement kiln dust is used for roadbase stabilization, pH monitoring and BMP C252: Treating and Disposing of High pH Water is necessary to evaluate and minimize the effects on stormwater. If the area will not be used for permanent roads, parking areas, or structures, a 6-inch depth of hog fuel may also be used, but this is likely to require more maintenance. Whenever possible, construction roads and parking areas shall be placed on a firm, compacted subgrade.
- Temporary road gradients shall not exceed 15 percent. Roadways shall be carefully graded to drain. Drainage ditches shall be provided on each side of the roadway in the case of a crowned section, or on one side in the case of a super-elevated section. Drainage ditches shall be directed to a sediment control BMP.
- Rather than relying on ditches, it may also be possible to grade the road so that runoff sheetflows into a heavily vegetated area with a well-developed topsoil. Landscaped areas are not adequate. If this area has at least 50 feet of vegetation that water can flow through, then it is generally preferable to use the vegetation to treat runoff, rather than a sediment pond or trap. The 50 feet shall not include wetlands or their buffers. If runoff is allowed to sheetflow through adjacent vegetated areas, it is vital to design the roadways and parking areas so that no concentrated runoff is created.
- Storm drain inlets shall be protected to prevent sediment-laden water entering the drainage system (see BMP C220: Inlet Protection).

Maintenance Standards

Inspect stabilized areas regularly, especially after large storm events.

Crushed rock, gravel base, etc., shall be added as required to maintain a stable driving surface and to stabilize any areas that have eroded.

Following construction, these areas shall be restored to pre-construction condition or better to prevent future erosion.

Perform street cleaning at the end of each day or more often if necessary.

BMP C120: Temporary and Permanent Seeding

Purpose

Seeding reduces erosion by stabilizing exposed soils. A well-established vegetative cover is one of the most effective methods of reducing erosion.

Conditions of Use

Use seeding throughout the project on disturbed areas that have reached final grade or that will remain unworked for more than 30 days.

The optimum seeding windows for western Washington are April 1 through June 30 and September 1 through October 1.

Between July 1 and August 30 seeding requires irrigation until 75 percent grass cover is established.

Between October 1 and March 30 seeding requires a cover of mulch or an erosion control blanket until 75 percent grass cover is established.

Review all disturbed areas in late August to early September and complete all seeding by the end of September. Otherwise, vegetation will not establish itself enough to provide more than average protection.

Mulch is required at all times for seeding because it protects seeds from heat, moisture loss, and transport due to runoff. Mulch can be applied on top of the seed or simultaneously by hydroseeding. See BMP C121: Mulching for specifications.

Seed and mulch all disturbed areas not otherwise vegetated at final site stabilization. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions, or geotextiles) which will prevent erosion. See BMP T5.13: Post-Construction Soil Quality and Depth.

Design and Installation Specifications

General

- Install channels intended for vegetation before starting major earthwork and hydroseed with a Bonded Fiber Matrix. For vegetated channels that will have high flows, install erosion control blankets over the top of hydroseed. Before allowing water to flow in vegetated channels, establish 75 percent vegetation cover. If vegetated channels cannot be established by seed

before water flow; install sod in the channel bottom — over top of hydromulch and erosion control blankets.

- Confirm the installation of all required surface water control measures to prevent seed from washing away.
- Hydroseed applications shall include a minimum of 1,500 pounds per acre of mulch with 3 percent tackifier. See BMP C121: Mulching for specifications.
- Areas that will have seeding only and not landscaping may need compost or meal-based mulch included in the hydroseed in order to establish vegetation. Re-install native topsoil on the disturbed soil surface before application. See BMP T5.13: Post-Construction Soil Quality and Depth.
- When installing seed via hydroseeding operations, only about 1/3 of the seed actually ends up in contact with the soil surface. This reduces the ability to establish a good stand of grass quickly. To overcome this, consider increasing seed quantities by up to 50 percent.
- Enhance vegetation establishment by dividing the hydromulch operation into two phases:
    - Phase 1- Install all seed and fertilizer with 25-30 percent mulch and tackifier onto soil in the first lift.
    - Phase 2- Install the rest of the mulch and tackifier over the first lift.

  Or, enhance vegetation by:
    - Installing the mulch, seed, fertilizer, and tackifier in one lift.
    - Spread or blow straw over the top of the hydromulch at a rate of 800-1000 pounds per acre.
    - Hold straw in place with a standard tackifier.

  Both of these approaches will increase cost moderately but will greatly improve and enhance vegetative establishment. The increased cost may be offset by the reduced need for:
    - Irrigation.
    - Reapplication of mulch.
    - Repair of failed slope surfaces.

  This technique works with standard hydromulch (1,500 pounds per acre minimum) and Bonded Fiber Matrix/ Mechanically Bonded Fiber Matrix (BFM/MBFMs) (3,000 pounds per acre minimum).
- Seed may be installed by hand if:
    - Temporary and covered by straw, mulch, or topsoil.
    - Permanent in small areas (usually less than 1 acre) and covered with mulch, topsoil, or erosion blankets.
- The seed mixes listed in Table II-3.4: Temporary and Permanent Seed Mixes include

recommended mixes for both temporary and permanent seeding.

- Apply these mixes, with the exception of the wet area seed mix, at a rate of 120 pounds per acre. This rate can be reduced if soil amendments or slow-release fertilizers are used. Apply the wet area seed mix at a rate of 60 pounds per acre.
- Consult the local suppliers or the local conservation district for their recommendations. The appropriate mix depends on a variety of factors, including location, exposure, soil type, slope, and expected foot traffic. Alternative seed mixes approved by the local authority may be used, depending on the soil type and hydrology of the area.

Table II-3.4: Temporary and Permanent Seed Mixes

Common Name	Latin Name	% Weight	% Purity	% Germination
Temporary Erosion Control Seed Mix A standard mix for areas requiring a temporary vegetative cover.				
Chewings or annual blue grass	*Festuca rubra var. commutata* or *Poa anna*	40	98	90
Perennial rye	*Lolium perenne*	50	98	90
Redtop or colonial bentgrass	*Agrostis alba* or *Agrostis tenuis*	5	92	85
White dutch clover	*Trifolium repens*	5	98	90
Landscaping Seed Mix A recommended mix for landscaping seed.				
Perennial rye blend	*Lolium perenne*	70	98	90
Chewings and red fescue blend	*Festuca rubra var. commutata* or *Festuca rubra*	30	98	90
Low-Growing Turf Seed Mix A turf seed mix for dry situations where there is no need for watering. This mix requires very little maintenance.				
Dwarf tall fescue (several varieties)	*Festuca arundinacea var.*	45	98	90
Dwarf perennial rye (Barclay)	*Lolium perenne var. barclay*	30	98	90
Red fescue	*Festuca rubra*	20	98	90
Colonial bentgrass	*Agrostis tenuis*	5	98	90
Bioswale Seed Mix A seed mix for bioswales and other intermittently wet areas.				
Tall or meadow fes-	*Festuca arundin-*	75-80	98	90

Table II-3.4: Temporary and Permanent Seed Mixes (continued)

Common Name	Latin Name	% Weight	% Purity	% Germination
cue	*acea* or *Festuca elatior*			
Seaside/Creeping bentgrass	*Agrostis palustris*	10-15	92	85
Redtop bentgrass	*Agrostis alba* or *Agrostis gigantea*	5-10	90	80
Wet Area Seed Mix A low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Consult Hydraulic Permit Authority (HPA) for seed mixes if applicable.				
Tall or meadow fescue	*Festuca arundinacea* or *Festuca elatior*	60-70	98	90
Seaside/Creeping bentgrass	*Agrostis palustris*	10-15	98	85
Meadow foxtail	*Alepocurus pratensis*	10-15	90	80
Alsike clover	*Trifolium hybridum*	1-6	98	90
Redtop bentgrass	*Agrostis alba*	1-6	92	85
Meadow Seed Mix A recommended meadow seed mix for infrequently maintained areas or non-maintained areas where colonization by native plants is desirable. Likely applications include rural road and utility right-of-way. Seeding should take place in September or very early October in order to obtain adequate establishment prior to the winter months. Consider the appropriateness of clover, a fairly invasive species, in the mix. Amending the soil can reduce the need for clover.				
Redtop or Oregon bentgrass	*Agrostis alba* or *Agrostis oregonensis*	20	92	85
Red fescue	*Festuca rubra*	70	98	90
White dutch clover	*Trifolium repens*	10	98	90

Roughening and Rototilling

- The seedbed should be firm and rough. Roughen all soil no matter what the slope. Track walk slopes before seeding if engineering purposes require compaction. Backblading or smoothing of slopes greater than 4H:1V is not allowed if they are to be seeded.
- Restoration-based landscape practices require deeper incorporation than that provided by a simple single-pass rototilling treatment. Wherever practical, initially rip the subgrade to improve long-term permeability, infiltration, and water inflow qualities. At a minimum,

permanent areas shall use soil amendments to achieve organic matter and permeability performance defined in engineered soil/landscape systems. For systems that are deeper than 8 inches complete the rototilling process in multiple lifts, or prepare the engineered soil system per specifications and place to achieve the specified depth.

Fertilizers

- Conducting soil tests to determine the exact type and quantity of fertilizer is recommended. This will prevent the over-application of fertilizer.
- Organic matter is the most appropriate form of fertilizer because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form.
- In general, use 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer at a rate of 90 pounds per acre. Always use slow-release fertilizers because they are more efficient and have fewer environmental impacts. Do not add fertilizer to the hydromulch machine, or agitate, more than 20 minutes before use. Too much agitation destroys the slow-release coating.
- There are numerous products available that take the place of chemical fertilizers. These include several with seaweed extracts that are beneficial to soil microbes and organisms. If 100 percent cottonseed meal is used as the mulch in hydroseed, chemical fertilizer may not be necessary. Cottonseed meal provides a good source of long-term, slow-release, available nitrogen.

Bonded Fiber Matrix and Mechanically Bonded Fiber Matrix

- On steep slopes use Bonded Fiber Matrix (BFM) or Mechanically Bonded Fiber Matrix (MBFM) products. Apply BFM/MBFM products at a minimum rate of 3,000 pounds per acre with approximately 10 percent tackifier. Achieve a minimum of 95 percent soil coverage during application. Numerous products are available commercially. Most products require 24-36 hours to cure before rainfall and cannot be installed on wet or saturated soils. Generally, products come in 40-50 pound bags and include all necessary ingredients except for seed and fertilizer.
- Install products per manufacturer's instructions.
- BFMs and MBFMs provide good alternatives to blankets in most areas requiring vegetation establishment. Advantages over blankets include:
    - BFM and MBFMs do not require surface preparation.
    - Helicopters can assist in installing BFM and MBFMs in remote areas.
    - On slopes steeper than 2.5H:1V, blanket installers may require ropes and harnesses for safety.
    - Installing BFM and MBFMs can save at least $1,000 per acre compared to blankets.

Maintenance Standards

Reseed any seeded areas that fail to establish at least 75 percent cover (100 percent cover for areas that receive sheet or concentrated flows). If reseeding is ineffective, use an alternate method such as sodding, mulching, nets, or blankets.

- Reseed and protect by mulch any areas that experience erosion after achieving adequate cover. Reseed and protect by mulch any eroded area.
- Supply seeded areas with adequate moisture, but do not water to the extent that it causes run-off.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

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BMP C121: Mulching

Purpose

Mulching soils provides immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture, holding fertilizer, seed, and topsoil in place, and moderating soil temperatures. There are a variety of mulches that can be used. This section discusses only the most common types of mulch.

Conditions of Use

As a temporary cover measure, mulch should be used:

- For less than 30 days on disturbed areas that require cover.
- At all times for seeded areas, especially during the wet season and during the hot summer months.
- During the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.

Mulch may be applied at any time of the year and must be refreshed periodically.

For seeded areas, mulch may be made up of 100 percent:

- cottonseed meal;
- fibers made of wood, recycled cellulose, hemp, or kenaf;

- compost;
- or blends of these.

Tackifier shall be plant-based, such as guar or alpha plantago, or chemical-based such as polyacrylamide or polymers.

Generally, mulches come in 40-50 pound bags. Seed and fertilizer are added at time of application.

Recycled cellulose may contain polychlorinated biphenyl (PCBs). Ecology recommends that products should be evaluated for PCBs prior to use.

Refer to BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection for conditions of use. PAM shall not be directly applied to water or allowed to enter a water body.

Any mulch or tackifier product used shall be installed per the manufacturer's instructions.

Design and Installation Specifications

For mulch materials, application rates, and specifications, see Table II-3.6: Mulch Standards and Guidelines. Consult with the local supplier or the local conservation district for their recommendations. Increase the application rate until the ground is 95% covered (i.e. not visible under the mulch layer). Note: Thickness may be increased for disturbed areas in or near sensitive areas or other areas highly susceptible to erosion.

Where the option of "Compost" is selected, it should be a coarse compost that meets the size gradations listed in Table II-3.5: Size Gradations of Compost as Mulch Material when tested in accordance with Test Method 02.02-B found in *Test Methods for the Examination of Composting and Compost* (Thompson, 2001).

Table II-3.5: Size Gradations of Compost as Mulch Material

Sieve Size	Percent Passing
3"	100%
1"	90% - 100%
3/4"	70% - 100%
1/4"	40% - 100%

Mulch used within the ordinary high-water mark of surface waters should be selected to minimize potential flotation of organic matter. Composted organic materials have higher specific gravities (densities) than straw, wood, or chipped material. Consult the Hydraulic Permit Authority (HPA) for mulch mixes if applicable.

Maintenance Standards

The thickness of the mulch cover must be maintained.

Any areas that experience erosion shall be remulched and/or protected with a net or blanket. If the erosion problem is drainage related, then the problem shall be fixed and the eroded area remulched.

Table II-3.6: Mulch Standards and Guidelines

Mulch Material	Guideline	Description
Straw	**Quality Standards**	Air-dried; free from undesirable seed and coarse material.
	Application Rates	2"-3" thick; 5 bales per 1,000 sf or 2-3 tons per acre
	Remarks	Cost-effective protection when applied with adequate thickness. Hand-application generally requires greater thickness than blown straw. The thickness of straw may be reduced by half when used in conjunction with seeding. In windy areas straw must be held in place by crimping, using a tackifier, or covering with netting. Blown straw always has to be held in place with a tackifier as even light winds will blow it away. Straw, however, has several deficiencies that should be considered when selecting mulch materials. It often introduces and/or encourages the propagation of weed species and it has no significant long-term benefits It should also not be used within the ordinary high-water elevation of surface waters (due to flotation).
Hydromulch	**Quality Standards**	No growth inhibiting factors.
	Application Rates	Approx. 35-45 lbs per 1,000 sf or 1,500 - 2,000 lbs per acre
	Remarks	Shall be applied with hydromulcher. Shall not be used without seed and tackifier unless the application rate is at least doubled. Fibers longer than about 3/4 - 1 inch clog hydromulch equipment. Fibers should be kept to less than 3/4 inch.
Compost	**Quality Standards**	No visible water or dust during handling. Must be produced per WAC 173-350, Solid Waste Handling Standards, but may have up to 35% biosolids.
	Application Rates	2" thick min.; approx. 100 tons per acre (approx. 750 lbs per cubic yard)
	Remarks	More effective control can be obtained by increasing thickness to 3". Excellent mulch for protecting final grades until landscaping because it can be directly seeded or tilled into soil as an amendment. Compost used for mulch has a coarser size gradation than compost used for BMP C125: Topsoiling / Composting or BMP T5.13: Post-Construction Soil Quality and Depth. It is more stable and practical to use in wet areas and during rainy weather conditions. Do not use near wetlands or near phosphorous impaired water bodies.
Chipped Site Vegetation	**Quality Standards**	Gradations from fines to 6 inches in length for texture, variation, and interlocking properties. Include a mix of various sizes so that the average size is between 2- and 4- inches.
	Application Rates	2" thick min.;

Table II-3.6: Mulch Standards and Guidelines (continued)

Mulch Material	Guideline	Description
	Remarks	This is a cost-effective way to dispose of debris from clearing and grubbing, and it eliminates the problems associated with burning. Generally, it should not be used on slopes above approx. 10% because of its tendency to be transported by runoff. It is not recommended within 200 feet of surface waters. If permanent seeding or planting is expected shortly after mulch, the decomposition of the chipped vegetation may tie up nutrients important to grass establishment. Note: thick application of this material over existing grass, herbaceous species, and some groundcovers could smother and kill vegetation.
Wood-Based Mulch	**Quality Standards**	No visible water or dust during handling. Must be purchased from a supplier with a Solid Waste Handling Permit or one exempt from solid waste regulations.
	Application Rates	2" thick min.; approx. 100 tons per acre (approx. 750 lbs. per cubic yard)
	Remarks	This material is often called "wood straw" or "hog fuel". The use of mulch ultimately improves the organic matter in the soil. Special caution is advised regarding the source and composition of wood-based mulches. Its preparation typically does not provide any weed seed control, so evidence of residual vegetation in its composition or known inclusion of weed plants or seeds should be monitored and prevented (or minimized).
Wood Strand Mulch	**Quality Standards**	A blend of loose, long, thin wood pieces derived from native conifer or deciduous trees with high length-to-width ratio.
	Application Rates	2" thick min.
	Remarks	Cost-effective protection when applied with adequate thickness. A minimum of 95-percent of the wood strand shall have lengths between 2 and 10-inches, with a width and thickness between 1/16 and 1/2-inches. The mulch shall not contain resin, tannin, or other compounds in quantities that would be detrimental to plant life. Sawdust or wood shavings shall not be used as mulch. [Specification 9-14.4(4) from the *Standard Specifications for Road, Bridge, and Municipal Construction* (WSDOT, 2016)

BMP C122: Nets and Blankets

Purpose

Erosion control nets and blankets are intended to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become well established. In addition, some nets and blankets can be used to permanently reinforce turf to protect drainage ways during high flows.

Nets (commonly called matting) are strands of material woven into an open, but high-tensile strength net (for example, coconut fiber matting). Blankets are strands of material that are not tightly woven, but instead form a layer of interlocking fibers, typically held together by a biodegradable or photodegradable netting (for example, excelsior or straw blankets). They generally have lower tensile strength than nets, but cover the ground more completely. Coir (coconut fiber) fabric comes as both nets and blankets.

Conditions of Use

Erosion control netting and blankets shall be made of natural plant fibers unaltered by synthetic materials.

Erosion control nets and blankets should be used:

- To aid permanent vegetated stabilization of slopes 2H:1V or greater and with more than 10 feet of vertical relief.
- For drainage ditches and swales (highly recommended). The application of appropriate netting or blanket to drainage ditches and swales can protect bare soil from channelized runoff while vegetation is established. Nets and blankets also can capture a great deal of sediment due to their open, porous structure. Nets and blankets can be used to permanently stabilize channels and may provide a cost-effective, environmentally preferable alternative to riprap.

Disadvantages of nets and blankets include:

- Surface preparation is required.
- On slopes steeper than 2.5H:1V, net and blanket installers may need to be roped and harnessed for safety.
- They cost at least $4,000-6,000 per acre installed.

Advantages of nets and blankets include:

- Installation without mobilizing special equipment.
- Installation by anyone with minimal training
- Installation in stages or phases as the project progresses.
- Installers can hand place seed and fertilizer as they progress down the slope.
- Installation in any weather.
- There are numerous types of nets and blankets that can be designed with various parameters in mind. Those parameters include: fiber blend, mesh strength, longevity, biodegradability, cost, and availability.

An alternative to nets and blankets in some limited conditions is BMP C202: Riprap Channel Lining. Ensure that BMP C202: Riprap Channel Lining is appropriate before using it as a substitute for nets and blankets.

Design and Installation Specifications

- See Figure II-3.3: Channel Installation (Clackamas County et al., 2008) and Figure II-3.4: Slope Installation for typical orientation and installation of nets and blankets used in channels and as slope protection. Note: these are typical only; all nets and blankets must be installed per manufacturer's installation instructions.
- Installation is critical to the effectiveness of these products. If good ground contact is not achieved, runoff can concentrate under the product, resulting in significant erosion.
- Installation of nets and blankets on slopes:
    1. Complete final grade and track walk up and down the slope.
    2. Install hydromulch with seed and fertilizer.
    3. Dig a small trench, approximately 12 inches wide by 6 inches deep along the top of the slope.
    4. Install the leading edge of the net/blanket into the small trench and staple approximately every 18 inches. NOTE: Staples are metal, "U"-shaped, and a minimum of 6 inches long. Longer staples are used in sandy soils. Biodegradable stakes are also available.
    5. Roll the net/blanket slowly down the slope as the installer walks backward. NOTE: The net/blanket rests against the installer's legs. Staples are installed as the net/blanket is unrolled. It is critical that the proper staple pattern is used for the net/blanket being installed. The net/blanket is not to be allowed to roll down the slope on its own as this stretches the net/blanket, making it impossible to maintain soil contact. In addition, no one is allowed to walk on the net/blanket after it is in place.
    6. If the net/blanket is not long enough to cover the entire slope length, the trailing edge of the upper net/blanket should overlap the leading edge of the lower net/blanket and be stapled. On steeper slopes, this overlap should be installed in a small trench, stapled, and covered with soil.
- With the variety of products available, it is impossible to cover all the details of appropriate use and installation. Therefore, it is critical that the designer consult the manufacturer's information and that a site visit takes place in order to ensure that the product specified is appropriate. Information is also available in WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* Division 8-01 and Division 9-14 (WSDOT, 2016).
- Use jute matting in conjunction with mulch (BMP C121: Mulching). Excelsior, woven straw blankets and coir (coconut fiber) blankets may be installed without mulch. There are many other types of erosion control nets and blankets on the market that may be appropriate in certain circumstances.
- In general, most nets (e.g., jute matting) require mulch in order to prevent erosion because they have a fairly open structure. Blankets typically do not require mulch because they usually provide complete protection of the surface.
- Extremely steep, unstable, wet, or rocky slopes are often appropriate candidates for use of synthetic blankets, as are riverbanks, beaches and other high-energy environments. If

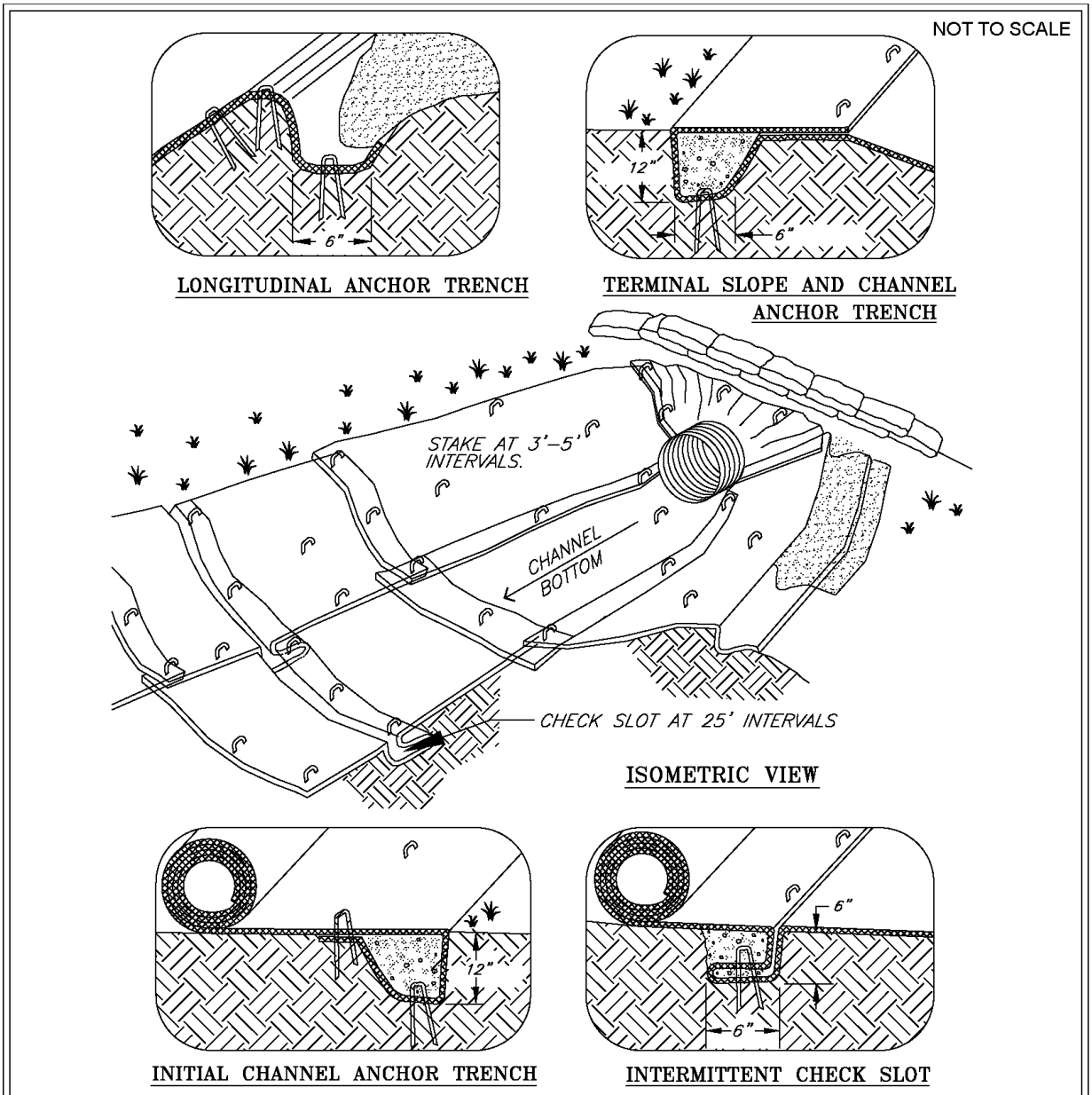
synthetic blankets are used, the soil should be hydromulched first.

- 100-percent biodegradable blankets are available for use in sensitive areas. These organic blankets are usually held together with a paper or fiber mesh and stitching which may last up to a year.
- Most netting used with blankets is photodegradable, meaning it breaks down under sunlight (not UV stabilized). However, this process can take months or years even under bright sun. Once vegetation is established, sunlight does not reach the mesh. It is not uncommon to find non-degraded netting still in place several years after installation. This can be a problem if maintenance requires the use of mowers or ditch cleaning equipment. In addition, birds and small animals can become trapped in the netting.

Maintenance Standards

- Maintain good contact with the ground. Erosion must not occur beneath the net or blanket.
- Repair and staple any areas of the net or blanket that are damaged or not in close contact with the ground.
- Fix and protect eroded areas if erosion occurs due to poorly controlled drainage.

Figure II-3.3: Channel Installation



Notes:
1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.

(Clackamas County et al., 2008)

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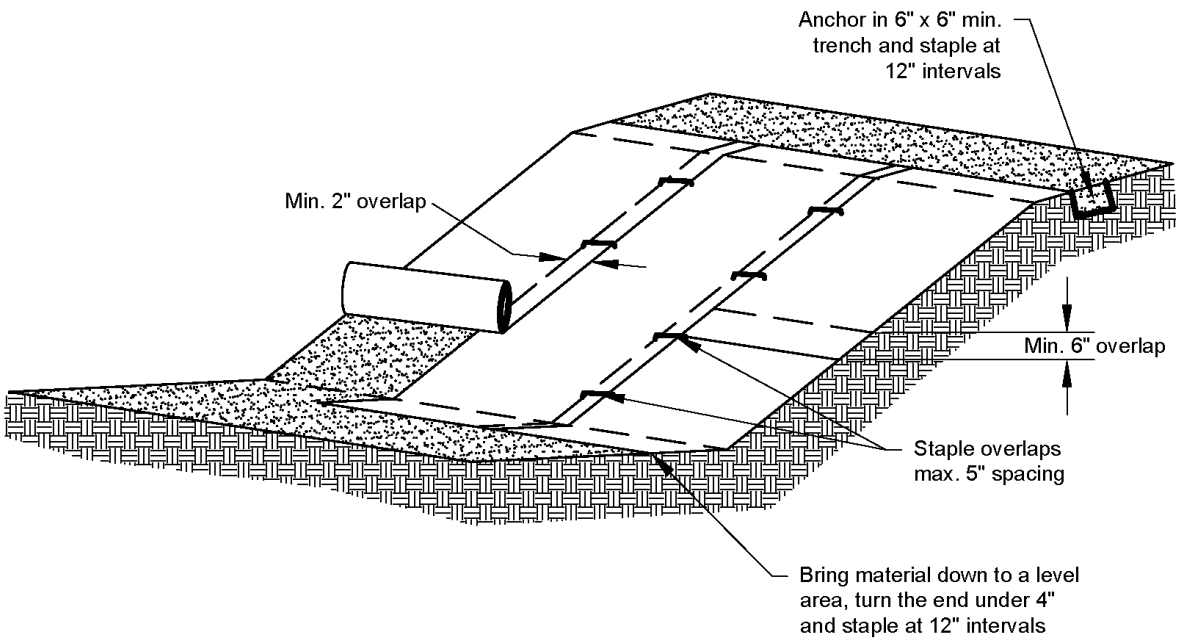
State of Washington

Channel Installation

Revised July 2016

Figure II-3.4: Slope Installation



Notes:

1. Slope surface shall be smooth before placement for proper soil contact.
2. Stapling pattern as per manufacturer's recommendations.
3. Do not stretch blankets/mattings tight - allow the rolls to mold to any irregularities.
4. For slopes less than 3H:1V, rolls may be placed in horizontal strips.
5. If there is a berm at the top of the slope, anchor upslope of the berm.
6. Lime, fertilize, and seed before installation. Planting of shrubs, trees, etc. should occur after installation.

NOT TO SCALE

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State of Washington

Slope Installation

Revised June 2016

BMP C123: Plastic Covering

Purpose

Plastic covering provides immediate, short-term erosion protection to slopes and disturbed areas.

Conditions of Use

Plastic covering may be used on disturbed areas that require cover measures for less than 30 days, except as stated below.

- Plastic is particularly useful for protecting cut and fill slopes and stockpiles. However, the relatively rapid breakdown of most polyethylene sheeting makes it unsuitable for applications greater than six months.
- Due to rapid runoff caused by plastic covering, do not use this method upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- Plastic sheeting may result in increased runoff volumes and velocities, requiring additional on-site measures to counteract the increases. Creating a trough with wattles or other material can convey clean water away from these areas.
- To prevent undercutting, trench and backfill rolled plastic covering products.
- Although the plastic material is inexpensive to purchase, the cost of installation, maintenance, removal, and disposal add to the total costs of this BMP.
- Whenever plastic is used to protect slopes, install water collection measures at the base of the slope. These measures include plastic-covered berms, channels, and pipes used to convey clean rainwater away from bare soil and disturbed areas. Do not mix clean runoff from a plastic covered slope with dirty runoff from a project.
- Other uses for plastic include:
    - Temporary ditch liner.
    - Pond liner in temporary sediment pond.
    - Liner for bermed temporary fuel storage area if plastic is not reactive to the type of fuel being stored.
    - Emergency slope protection during heavy rains.
    - Temporary drainpipe (“elephant trunk”) used to direct water.

Design and Installation Specifications

- Plastic slope cover must be installed as follows:
    1. Run plastic up and down the slope, not across the slope.
    2. Plastic may be installed perpendicular to a slope if the slope length is less than 10 feet.

3. Provide a minimum of 8-inch overlap at the seams.
4. On long or wide slopes, or slopes subject to wind, tape all seams.
5. Place plastic into a small (12-inch wide by 6-inch deep) slot trench at the top of the slope and backfill with soil to keep water from flowing underneath.
6. Place sand filled burlap or geotextile bags every 3 to 6 feet along seams and tie them together with twine to hold them in place.
7. Inspect plastic for rips, tears, and open seams regularly and repair immediately. This prevents high velocity runoff from contacting bare soil, which causes extreme erosion.
8. Sandbags may be lowered into place tied to ropes. However, all sandbags must be staked in place.

- Plastic sheeting shall have a minimum thickness of 0.06 millimeters.
- If erosion at the toe of a slope is likely, a gravel berm, riprap, or other suitable protection shall be installed at the toe of the slope in order to reduce the velocity of runoff.

Maintenance Standards

- Torn sheets must be replaced and open seams repaired.
- Completely remove and replace the plastic if it begins to deteriorate due to ultraviolet radiation.
- Completely remove plastic when no longer needed.
- Dispose of old tires used to weight down plastic sheeting appropriately.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

BMP C124: Sodding

Purpose

The purpose of sodding is to establish turf for immediate erosion protection and to stabilize drainage paths where concentrated overland flow will occur.

Conditions of Use

Sodding may be used in the following areas:

- Disturbed areas that require short-term or long-term cover.
- Disturbed areas that require immediate vegetative cover.
- All waterways that require vegetative lining. Waterways may also be seeded rather than sodded, and protected with a net or blanket.

Design and Installation Specifications

Sod shall be free of weeds, of uniform thickness (approximately 1-inch thick), and shall have a dense root mat for mechanical strength.

The following steps are recommended for sod installation:

1. Shape and smooth the surface to final grade in accordance with the approved grading plan. Consider any areas (such as swales) that need to be overexcavated below design elevation to allow room for placing soil amendment and sod.
2. Amend 4 inches (minimum) of compost into the top 8 inches of the soil if the organic content of the soil is less than ten percent or the permeability is less than 0.6 inches per hour. See https://ecology.wa.gov/Waste-Toxics/Reducing-recycling-waste/Organic-materials/Managing-organics-compost for further information.
3. Fertilize according to the sod supplier's recommendations.
4. Work lime and fertilizer 1 to 2 inches into the soil, and smooth the surface.
5. Lay strips of sod beginning at the lowest area to be sodded and perpendicular to the direction of water flow. Wedge strips securely into place. Square the ends of each strip to provide for a close, tight fit. Stagger joints at least 12 inches. Staple on slopes steeper than 3H:1V. Staple the upstream edge of each sod strip.
6. Roll the sodded area and irrigate.
7. When sodding is carried out in alternating strips or other patterns, seed the areas between the sod immediately after sodding.

Maintenance Standards

If the grass is unhealthy, the cause shall be determined and appropriate action taken to reestablish a healthy groundcover. If it is impossible to establish a healthy groundcover due to frequent saturation, instability, or some other cause, the sod shall be removed, the area seeded with an appropriate mix, and protected with a net or blanket.

BMP C125: Topsoiling / Composting

Purpose

Topsoiling and composting provide a suitable growth medium for final site stabilization with vegetation. While not a permanent cover practice in itself, topsoiling and composting are an integral component of providing permanent cover in those areas where there is an unsuitable soil surface for plant growth. Use this BMP in conjunction with other BMPs such as BMP C120: Temporary and Permanent Seeding, BMP C121: Mulching, or BMP C124: Sodding. Implementation of this BMP may meet the post-construction requirements of BMP T5.13: Post-Construction Soil Quality and Depth.

Native soils and disturbed soils that have been organically amended not only retain much more stormwater, but also serve as effective biofilters for urban pollutants and, by supporting more vigorous plant growth, reduce the water, fertilizer and pesticides needed to support installed landscapes. Topsoil does not include any subsoils but only the material from the top several inches including organic debris.

Conditions of Use

- Permanent landscaped areas shall contain healthy topsoil that reduces the need for fertilizers, improves overall topsoil quality, provides for better vegetative health and vitality, improves hydrologic characteristics, and reduces the need for irrigation.
- Leave native soils and the duff layer undisturbed to the maximum extent practicable. Stripping of existing, properly functioning soil system and vegetation for the purpose of topsoiling during construction is not acceptable. Preserve existing soil systems in undisturbed and uncompacted conditions if functioning properly.
- Areas that already have good topsoil, such as undisturbed areas, do not require soil amendments.
- Restore, to the maximum extent practical, native soils disturbed during clearing and grading to a condition equal to or better than the original site condition's moisture-holding capacity. Use on-site native topsoil, incorporate amendments into on-site soil, or import blended topsoil to meet this requirement.
- Topsoiling is a required procedure when establishing vegetation on shallow soils, and soils of critically low pH (high acid) levels.
- Beware of where the topsoil comes from, and what vegetation was on site before disturbance. Invasive plant seeds may be included and could cause problems for establishing native plants, landscaped areas, or grasses.
- Topsoil from the site will contain mycorrhizal bacteria that are necessary for healthy root growth and nutrient transfer. These native mycorrhiza are acclimated to the site and will provide optimum conditions for establishing grasses. Use commercially available mycorrhiza products when using off-site topsoil.

Design and Installation Specifications

Meet the following requirements for disturbed areas that will be developed as lawn or landscaped areas at the completed project site:

- Maximize the depth of the topsoil wherever possible to provide the maximum possible infiltration capacity and beneficial growth medium. Topsoil shall have:
    - A minimum depth of 8-inches. Scarify subsoils below the topsoil layer at least 4-inches with some incorporation of the upper material to avoid stratified layers, where feasible. Ripping or re-structuring the subgrade may also provide additional benefits regarding the overall infiltration and interflow dynamics of the soil system.
    - A minimum organic content of 10% dry weight in planting beds, and 5% organic matter content in turf areas. Incorporate organic amendments to a minimum 8-inch depth except where tree roots or other natural features limit the depth of incorporation.
    - A pH between 6.0 and 8.0 or matching the pH of the undisturbed soil.
    - If blended topsoil is imported, then fines should be limited to 25 percent passing through a 200 sieve.
- Mulch planting beds with 2 inches of organic material
- Accomplish the required organic content, depth, and pH by returning native topsoil to the site, importing topsoil of sufficient organic content, and/or incorporating organic amendments. When using the option of incorporating amendments to meet the organic content requirement, use compost that meets the compost specification for Bioretention (See BMP T7.30: Bioretention), with the exception that the compost may have up to 35% biosolids or manure.
- Sections 3 through 7 of *Building Soil: Guidelines and Resources for Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington* (Stenn et al., 2016), provides useful guidance for implementing whichever option is chosen. It includes guidance for pre-approved default strategies and guidance for custom strategies. Check with your local jurisdiction concerning its acceptance of this guidance.
- The final composition and construction of the soil system will result in a natural selection or favoring of certain plant species over time. For example, incorporation of topsoil may favor grasses, while layering with mildly acidic, high-carbon amendments may favor more woody vegetation.
- Allow sufficient time in scheduling for topsoil spreading prior to seeding, sodding, or planting.
- Take care when applying top soil to subsoils with contrasting textures. Sandy topsoil over clayey subsoil is a particularly poor combination, as water creeps along the junction between the soil layers and causes the topsoil to slough. If topsoil and subsoil are not properly bonded, water will not infiltrate the soil profile evenly and it will be difficult to establish vegetation. The best method to promote bonding is to actually work the topsoil into the layer below for a depth of at least 6 inches.
- Field exploration of the site shall be made to determine if there is surface soil of sufficient quantity and quality to justify stripping. Topsoil shall be friable and loamy (loam, sandy loam,

silt loam, sandy clay loam, and clay loam). Avoid areas of natural ground water recharge.

- Stripping shall be confined to the immediate construction area. A 4-inch to 6-inch stripping depth is common, but depth may vary depending on the particular soil. All surface runoff control structures shall be in place prior to stripping.
- Do not place topsoil while in a frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed sodding or seeding.
- In any areas requiring grading, remove and stockpile the duff layer and topsoil on site in a designated, controlled area, not adjacent to public resources and critical areas. Reapply stockpiled topsoil to other portions of the site where feasible.
- Locate the topsoil stockpile so that it meets specifications and does not interfere with work on the site. It may be possible to locate more than one pile in proximity to areas where topsoil will be used.
- Stockpiling of topsoil shall occur in the following manner:
    - Side slopes of the stockpile shall not exceed 2H:1V.
    - Between October 1 and April 30:
        - An interceptor dike with gravel outlet and silt fence shall surround all topsoil.
        - Within 2 days complete erosion control seeding, or covering stockpiles with clear plastic, or other mulching materials.
    - Between May 1 and September 30:
        - An interceptor dike with gravel outlet and silt fence shall surround all topsoil if the stockpile will remain in place for a longer period of time than active construction grading.
        - Within 7 days complete erosion control seeding, or covering stockpiles with clear plastic, or other mulching materials.
- When native topsoil is to be stockpiled and reused the following should apply to ensure that the mycorrhizal bacterial, earthworms, and other beneficial organisms will not be destroyed:
    - Re-install topsoil within 4 to 6 weeks.
    - Do not allow the saturation of topsoil with water.
    - Do not use plastic covering.

Maintenance Standards

- Inspect stockpiles regularly, especially after large storm events. Stabilize any areas that have eroded.
- Establish soil quality and depth toward the end of construction and once established, protect from compaction, such as from large machinery use, and from erosion.

- Plant and mulch soil after installation.
- Leave plant debris or its equivalent on the soil surface to replenish organic matter.
- Reduce and adjust, where possible, the use of irrigation, fertilizers, herbicides and pesticides, rather than continuing to implement formerly established practices.

BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection

Purpose

Polyacrylamide (PAM) is used on construction sites to prevent soil erosion.

Applying PAM to bare soil in advance of a rain event significantly reduces erosion and controls sediment in two ways. First, PAM increases the soil's available pore volume, thus increasing infiltration and reducing the quantity of stormwater runoff. Second, it increases flocculation of suspended particles and aids in their deposition, thus reducing stormwater runoff turbidity and improving water quality.

Conditions of Use

PAM shall not be directly applied to water or allowed to enter a water body. Stormwater runoff shall pass through a sediment pond prior to discharging to surface waters.

PAM can be applied to bare soil under the following conditions:

- During rough grading operations.
- In Staging areas.
- Balanced cut and fill earthwork.
- Haul roads prior to placement of crushed rock surfacing.
- Compacted soil roadbase.
- Stockpiles.
- After final grade and before paving or final seeding and planting.
- Pit sites.
- Sites having a winter shut down. In the case of winter shut down, or where soil will remain unworked for several months, PAM should be used together with mulch.

Design and Installation Specifications

- Do not use PAM on a slope that flows directly into a stream or wetland.
- Do not add PAM to water discharging from the site.

- When the total drainage area is greater than or equal to 5 acres, PAM treated areas shall drain to a sediment pond.
- Areas less than 5 acres shall drain to sediment control BMPs, such as sediment trap. The total number of sediment traps used shall be maximized to achieve the greatest amount of settlement of sediment prior to discharging from the site. Check dams may be used in a drainage channel to form the sediment trap.
- Maximize the use of silt fence to limit the discharge of sediment from the site.
- All areas not being actively worked shall be covered and protected from rainfall. PAM shall not be the only cover BMP used.
- PAM can be applied to wet soil, but dry soil is preferred due to less sediment loss.
- PAM will work when applied to saturated soil but is not as effective as applications to dry or damp soil.

The Preferred Application Method

PAM may be applied with water in dissolved form. The preferred application method is the dissolved form.

PAM is to be applied at a maximum rate of 2/3 pound PAM per 1,000 gallons water (80 mg/L) per 1 acre of bare soil. See Table II-3.7: PAM and Water Application Rates to determine the PAM and water application rate for a disturbed soil area. Higher concentrations of PAM **do not** provide any additional effectiveness.

Table II-3.7: PAM and Water Application Rates

Disturbed Area (ac)	PAM (lbs)	Water (gal)
0.50	0.33	500
1.00	0.66	1,000
1.50	1.00	1,500
2.00	1.32	2,000
2.50	1.65	2,500
3.00	2.00	3,000
3.50	2.33	3,500
4.00	2.65	4,000
4.50	3.00	4,500
5.00	3.33	5,000

Follow the steps below to apply PAM using the preferred method:

1. Pre-measure the area where PAM is to be applied and calculate the amount of product and water necessary to provide coverage at the specified application rate (2/3 pound PAM/1000 gallons/acre).
2. PAM has infinite solubility in water, but dissolves very slowly. Dissolve pre-measured dry granular PAM with a known quantity of clean water in a bucket several hours or overnight. Mechanical mixing will help dissolve the PAM. Always add PAM to water - not water to PAM.
3. Pre-fill the water truck about 1/8 full with water. The water does not have to be potable, but it must have relatively low turbidity – in the range of 20 NTU or less.
4. Add the PAM/Water mixture to the truck.
5. Completely fill the water truck to the specified volume.
6. Spray the PAM/Water mixture onto dry soil, until the soil surface is uniformly and completely wetted.

An Alternate Application Method

PAM may also be applied as a powder at the rate of 5 lbs per acre. This must be applied on a day that is dry. For areas less than 10 acres, a hand-held “organ grinder” fertilizer spreader set to the smallest setting will work. For efficiency, tractor-mounted spreaders will work for larger areas.

The following shall be used for application of powdered PAM:

- Powdered PAM shall be used in conjunction with other BMPs and not in place of other BMPs.
- Keep the granular PAM supply out of the sun. Granular PAM loses its effectiveness in three months after exposure to sunlight and air.
- Proper application and re-application plans are necessary to ensure total effectiveness of PAM usage.

Safety and Toxicity

PAM, combined with water, is very slippery and can be a safety hazard. Care must be taken to prevent spills of PAM powder onto paved surfaces. During an application of PAM, prevent over-spray from reaching pavement to avoid the pavement becoming slippery. If PAM powder gets on skin or clothing, wipe it off with a rough towel rather than washing with water. Washing with water will make cleanup messier and take longer.

Some PAMs are more toxic and carcinogenic than others. Only the most environmentally safe PAM products should be used.

The specific PAM copolymer formulation must be anionic. **Cationic PAM shall not be used in any application because of known aquatic toxicity problems.** Use only the highest drinking water grade PAM, certified for compliance with NSF International (NSF)/American National Standards Institute (ANSI) Standard 60 for drinking water treatment, for soil applications. Recent media attention and high interest in PAM has resulted in some entrepreneurial exploitation of the term "polymer." All PAM are polymers, but not all polymers are PAM, and not all PAM products comply with ANSI/NSF Standard 60. PAM use shall be reviewed and approved by the local permitting authority.

- PAM designated for these uses should be "water soluble" or "linear" or "non-crosslinked". Cross-linked or water absorbent PAM, polymerized in highly acidic (pH<2) conditions, are used to maintain soil moisture content.
- The PAM anionic charge density may vary from 2-30 percent; a value of 18 percent is typical. Studies conducted by the United States Department of Agriculture (USDA)/ARS demonstrated that soil stabilization was optimized by using very high molecular weight (12-15 mg/-mole), highly anionic (>20% hydrolysis) PAM.
- PAM tackifiers are available and being used in place of guar and alpha plantago. Typically, PAM tackifiers should be used at a mixing rate of no more than 0.5-1 lb. per 1000 gallons of water in a hydromulch machine. Some tackifier product instructions say to use at an application rate of 3 – 5 lbs per acre, which can be too much. In addition, pump problems can occur at higher application rates due to increased viscosity.

Maintenance Standards

- PAM may be reapplied on actively worked areas after a 48-hour period.
- Reapplication is not required unless PAM treated soil is disturbed or unless turbidity levels show the need for an additional application. If PAM treated soil is left undisturbed, a reapplication may be necessary after two months. More PAM applications may be required for steep slopes, silty and clayey soils (USDA Classification Type "C" and "D" soils), long grades, and high precipitation areas. When PAM is applied first to bare soil and then covered with straw, a reapplication may not be necessary for several months.
- Loss of sediment and PAM may be a basis for penalties per RCW 90.48.080.
- PAM may affect the treatment efficiency of chitosan flocculent systems.

BMP C130: Surface Roughening

Purpose

Surface roughening aids in the establishment of vegetative cover, reduces runoff velocity, increases infiltration, and provides for sediment trapping through the provision of a rough soil surface. Horizontal depressions are created by operating a tiller or other suitable equipment on the contour or by leaving slopes in a roughened condition by not fine grading them.

Use this BMP in conjunction with other BMPs such as BMP C120: Temporary and Permanent Seeding, BMP C121: Mulching, or BMP C124: Sodding.

Conditions for Use

- All slopes steeper than 3H:1V and greater than 5 vertical feet require surface roughening to a depth of 2 to 4 inches prior to seeding.
- Areas that will not be stabilized immediately may be roughened to reduce runoff velocity until seeding takes place.

BMP C140: Dust Control

Purpose

Dust control prevents wind transport of dust from disturbed soil surfaces onto roadways, drainage ways, and surface waters.

Conditions of Use

Use dust control in areas (including roadways) subject to surface and air movement of dust where on-site or off-site impacts to roadways, drainage ways, or surface waters are likely.

Design and Installation Specifications

- Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.
- Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition. Maintain the original ground cover as long as practical.
- Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.
- Sprinkle the site with water until the surface is wet. Repeat as needed. To prevent carryout of mud onto the street, refer to BMP C105: Stabilized Construction Access and BMP C106: Wheel Wash.
- Irrigation water can be used for dust control. Irrigation systems should be installed as a first step on sites where dust control is a concern.
- Spray exposed soil areas with a dust palliative, following the manufacturer's instructions and cautions regarding handling and application. Used oil is prohibited from use as a dust suppressant. Local governments may approve other dust palliatives such as calcium chloride or PAM.
- PAM (BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection) added to water at a rate of 0.5 pounds per 1,000 gallons of water per acre and applied from a water truck is more effective than water alone. This is due to increased infiltration of water into the soil and reduced evaporation. In addition, small soil particles are bonded together and are not as easily transported by wind. Adding PAM may reduce the quantity of water needed for dust control. Note that the application rate specified here applies to this BMP, and is not the same application rate that is specified in BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection, but the downstream protections still apply.

  Refer to BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection for conditions of use. PAM shall not be directly applied to water or allowed to enter a water body.
- Contact your local Air Pollution Control Authority for guidance and training on other dust control measures. Compliance with the local Air Pollution Control Authority constitutes

compliance with this BMP.

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

Maintenance Standards

Respray area as necessary to keep dust to a minimum.

BMP C150: Materials on Hand

Purpose

Keep quantities of erosion prevention and sediment control materials on the project site at all times to be used for regular maintenance and emergency situations such as unexpected heavy rains. Having these materials on-site reduces the time needed to replace existing or implement new BMPs when inspections indicate that existing BMPs are not meeting the Construction SWPPP requirements. In addition, contractors can save money by buying some materials in bulk and storing them at their office or yard.

Conditions of Use

- Construction projects of any size or type can benefit from having materials on hand. A small commercial development project could have a roll of plastic and some gravel available for immediate protection of bare soil and temporary berm construction. A large earthwork project, such as highway construction, might have several tons of straw, several rolls of plastic, flexible

pipe, sandbags, geotextile fabric and steel “T” posts.

- Materials should be stockpiled and readily available before any site clearing, grubbing, or earthwork begins. A large contractor or project proponent could keep a stockpile of materials that are available for use on several projects.
- If storage space at the project site is at a premium, the contractor could maintain the materials at their office or yard. The office or yard must be less than an hour from the project site.

Design and Installation Specifications

Depending on project type, size, complexity, and length, materials and quantities will vary. A good minimum list of items that will cover numerous situations includes:

- Clear Plastic, 6 mil
- Drainpipe, 6 or 8 inch diameter
- Sandbags, filled
- Straw Bales for mulching
- Quarry Spalls
- Washed Gravel
- Geotextile Fabric
- Catch Basin Inserts
- Steel "T" Posts
- Silt fence material
- Straw Wattles

Maintenance Standards

- All materials with the exception of the quarry spalls, steel “T” posts, and gravel should be kept covered and out of both sun and rain.
- Re-stock materials as needed.

BMP C151: Concrete Handling

Purpose

Concrete work can generate process water and slurry that contain fine particles and high pH, both of which can violate water quality standards in the receiving water. Concrete spillage or concrete discharge to waters of the State is prohibited. Use this BMP to minimize and eliminate concrete, concrete process water, and concrete slurry from entering waters of the State.

Conditions of Use

Any time concrete is used, utilize these management practices. Concrete construction project components include, but are not limited to:

- Curbs
- Sidewalks
- Roads
- Bridges
- Foundations
- Floors
- Runways

Disposal options for concrete, in order of preference are:

1. Off-site disposal
2. Concrete wash-out areas (see BMP C154: Concrete Washout Area)
3. De minimus washout to formed areas awaiting concrete

Design and Installation Specifications

- Wash concrete truck drums at an approved off-site location or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground (including formed areas awaiting concrete), or into storm drains, open ditches, streets, or streams. Refer to BMP C154: Concrete Washout Area for information on concrete washout areas.
    - Return unused concrete remaining in the truck and pump to the originating batch plant for recycling. Do not dump excess concrete on site, except in designated concrete washout areas as allowed in BMP C154: Concrete Washout Area.
- Wash small concrete handling equipment (e.g. hand tools, screeds, shovels, rakes, floats, trowels, and wheelbarrows) into designated concrete washout areas or into formed areas awaiting concrete pour.
- At no time shall concrete be washed off into the footprint of an area where an infiltration feature will be installed.
- Wash equipment difficult to move, such as concrete paving machines, in areas that do not directly drain to natural or constructed stormwater conveyance or potential infiltration areas.
- Do not allow washwater from areas, such as concrete aggregate driveways, to drain directly (without detention or treatment) to natural or constructed stormwater conveyances.
- Contain washwater and leftover product in a lined container when no designated concrete washout areas (or formed areas, allowed as described above) are available. Dispose of contained concrete and concrete washwater (process water) properly.

- Always use forms or solid barriers for concrete pours, such as pilings, within 15-feet of surface waters.
- Refer to BMP C252: Treating and Disposing of High pH Water for pH adjustment requirements.
- Refer to the Construction Stormwater General Permit (CSWGP) for pH monitoring requirements if the project involves one of the following activities:
    - Significant concrete work (as defined in the CSWGP).
    - The use of soils amended with (but not limited to) Portland cement-treated base, cement kiln dust or fly ash.
    - Discharging stormwater to segments of water bodies on the 303(d) list (Category 5) for high pH.

Maintenance Standards

Check containers for holes in the liner daily during concrete pours and repair the same day.

BMP C152: Sawcutting and Surfacing Pollution Prevention

Purpose

Sawcutting and surfacing operations generate slurry and process water that contains fine particles and high pH (concrete cutting), both of which can violate the water quality standards in the receiving water. Concrete spillage or concrete discharge to waters of the State is prohibited. Use this BMP to minimize and eliminate process water and slurry created through sawcutting or surfacing from entering waters of the State.

Conditions of Use

Utilize these management practices anytime sawcutting or surfacing operations take place. Sawcutting and surfacing operations include, but are not limited to:

- Sawing
- Coring
- Grinding
- Roughening
- Hydro-demolition
- Bridge and road surfacing

Design and Installation Specifications

- Vacuum slurry and cuttings during cutting and surfacing operations.
- Slurry and cuttings shall not remain on permanent concrete or asphalt pavement overnight.
- Slurry and cuttings shall not drain to any natural or constructed drainage conveyance including stormwater systems. This may require temporarily blocking catch basins.
- Dispose of collected slurry and cuttings in a manner that does not violate ground water or surface water quality standards.
- Do not allow process water generated during hydro-demolition, surface roughening or similar operations to drain to any natural or constructed drainage conveyance including stormwater systems. Dispose of process water in a manner that does not violate ground water or surface water quality standards.
- Handle and dispose of cleaning waste material and demolition debris in a manner that does not cause contamination of water. Dispose of sweeping material from a pick-up sweeper at an appropriate disposal site.

Maintenance Standards

Continually monitor operations to determine whether slurry, cuttings, or process water could enter waters of the state. If inspections show that a violation of water quality standards could occur, stop operations and immediately implement preventive measures such as berms, barriers, secondary containment, and/or vacuum trucks.

BMP C153: Material Delivery, Storage, and Containment

Purpose

Prevent, reduce, or eliminate the discharge of pollutants to the stormwater system or watercourses from material delivery and storage. Minimize the storage of hazardous materials on-site, store materials in a designated area, and install secondary containment.

Conditions of Use

Use at construction sites with delivery and storage of the following materials:

- Petroleum products such as fuel, oil and grease
- Soil stabilizers and binders (e.g., Polyacrylamide)
- Fertilizers, pesticides and herbicides
- Detergents
- Asphalt and concrete compounds

- Hazardous chemicals such as acids, lime, adhesives, paints, solvents, and curing compounds
- Any other material that may be detrimental if released to the environment

Design and Installation Specifications

- The temporary storage area should be located away from vehicular traffic, near the construction entrance(s), and away from waterways or storm drains.
- Safety Data Sheets (SDS) should be supplied for all materials stored. Chemicals should be kept in their original labeled containers.
- Hazardous material storage on-site should be minimized.
- Hazardous materials should be handled as infrequently as possible.
- During the wet weather season (Oct 1 – April 30), consider storing materials in a covered area.
- Materials should be stored in secondary containments, such as an earthen dike, horse trough, or even a children's wading pool for non-reactive materials such as detergents, oil, grease, and paints. Small amounts of material may be secondarily contained in "bus boy" trays or concrete mixing trays.
- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items on a pallet and, when possible, within secondary containment.
- If drums must be kept uncovered, store them at a slight angle to reduce ponding of rainwater on the lids to reduce corrosion. Domed plastic covers are inexpensive and snap to the top of drums, preventing water from collecting.
- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 shall be stored in approved containers and drums and shall not be overfilled. Containers and drums shall be stored in temporary secondary containment facilities.
- Temporary secondary containment facilities shall provide for a spill containment volume able to contain 10% of the total enclosed container volume of all containers, or 110% of the capacity of the largest container within its boundary, whichever is greater.
- Secondary containment facilities shall be impervious to the materials stored therein for a minimum contact time of 72 hours.
- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.
- During the wet weather season (Oct 1 – April 30), each secondary containment facility shall be covered during non-working days, prior to and during rain events.
- Keep material storage areas clean, organized and equipped with an ample supply of appropriate spill clean-up material (spill kit).
- The spill kit should include, at a minimum:

- 1-Water Resistant Nylon Bag
- 3-Oil Absorbent Socks 3”x 4’
- 2-Oil Absorbent Socks 3”x 10’
- 12-Oil Absorbent Pads 17”x19”
- 1-Pair Splash Resistant Goggles
- 3-Pair Nitrile Gloves
- 10-Disposable Bags with Ties
- Instructions

Maintenance Standards

- Secondary containment facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills shall be collected and placed into drums. These liquids shall be handled as hazardous waste unless testing determines them to be non-hazardous.
- Re-stock spill kit materials as needed.

BMP C154: Concrete Washout Area

Purpose

Prevent or reduce the discharge of pollutants from concrete waste to stormwater by conducting washout off-site, or performing on-site washout in a designated area.

Conditions of Use

Concrete washout areas are implemented on construction projects where:

- Concrete is used as a construction material
- It is not possible to dispose of all concrete wastewater and washout off-site (ready mix plant, etc.).
- Concrete truck drums are washed on-site.

  Note that auxiliary concrete truck components (e.g. chutes and hoses) and small concrete handling equipment (e.g. hand tools, screeds, shovels, rakes, floats, trowels, and wheel-barrows) may be washed into formed areas awaiting concrete pour.

At no time shall concrete be washed off into the footprint of an area where an infiltration feature will be installed.

Design and Installation Specifications

Implementation

- Perform washout of concrete truck drums at an approved off-site location or in designated concrete washout areas only.
- Do not wash out concrete onto non-formed areas, or into storm drains, open ditches, streets, or streams.
- Wash equipment difficult to move, such as concrete paving machines, in areas that do not directly drain to natural or constructed stormwater conveyance or potential infiltration areas.
- Do not allow excess concrete to be dumped on-site, except in designated concrete washout areas as allowed above.
- Concrete washout areas may be prefabricated concrete washout containers, or self-installed structures (above-grade or below-grade).
- Prefabricated containers are most resistant to damage and protect against spills and leaks. Companies may offer delivery service and provide regular maintenance and disposal of solid and liquid waste.
- If self-installed concrete washout areas are used, below-grade structures are preferred over above-grade structures because they are less prone to spills and leaks.
- Self-installed above-grade structures should only be used if excavation is not practical.
- Concrete washout areas shall be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

Education

- Discuss the concrete management techniques described in this BMP with the ready-mix concrete supplier before any deliveries are made.
- Educate employees and subcontractors on the concrete waste management techniques described in this BMP.
- Arrange for the contractor's superintendent or Certified Erosion and Sediment Control Lead (CESCL) to oversee and enforce concrete waste management procedures.
- A sign should be installed adjacent to each concrete washout area to inform concrete equipment operators to utilize the proper facilities.

Contracts

Incorporate requirements for concrete waste management into concrete supplier and subcontractor agreements.

Location and Placement

- Locate concrete washout areas at least 50 feet from sensitive areas such as storm drains, open ditches, water bodies, or wetlands.
- Allow convenient access to the concrete washout area for concrete trucks, preferably near the area where the concrete is being poured.
- If trucks need to leave a paved area to access the concrete washout area, prevent track-out with a pad of rock or quarry spalls (see BMP C105: Stabilized Construction Access). These areas should be far enough away from other construction traffic to reduce the likelihood of accidental damage and spills.
- The number of concrete washout areas you install should depend on the expected demand for storage capacity.
- On large sites with extensive concrete work, concrete washout areas should be placed in multiple locations for ease of use by concrete truck drivers.

Concrete Truck Washout Procedures

- Washout of concrete truck drums shall be performed in designated concrete washout areas only.
- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated concrete washout areas or properly disposed of off-site.

Concrete Washout Area Installation

- Concrete washout areas should be constructed as shown in the figures below, with a recommended minimum length and minimum width of 10 ft, but with sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations.
- Plastic lining material should be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.
- Lath and flagging should be commercial type.
- Liner seams shall be installed in accordance with manufacturers' recommendations.
- Soil base shall be prepared free of rocks or other debris that may cause tears or holes in the plastic lining material.

Maintenance Standards

Inspection and Maintenance

- Inspect and verify that concrete washout areas are in place prior to the commencement of concrete work.
- Once concrete wastes are washed into the designated washout area and allowed to harden,

the concrete should be broken up, removed, and disposed of per applicable solid waste regulations. Dispose of hardened concrete on a regular basis.

- During periods of concrete work, inspect the concrete washout areas daily to verify continued performance.
    - Check overall condition and performance.
    - Check remaining capacity (% full).
    - If using self-installed concrete washout areas, verify plastic liners are intact and sidewalls are not damaged.
    - If using prefabricated containers, check for leaks.
- Maintain the concrete washout areas to provide adequate holding capacity with a minimum freeboard of 12 inches.
- Concrete washout areas must be cleaned, or new concrete washout areas must be constructed and ready for use once the concrete washout area is 75% full.
- If the concrete washout area is nearing capacity, vacuum and dispose of the waste material in an approved manner.
    - Do not discharge liquid or slurry to waterways, storm drains or directly onto ground.
    - Do not discharge to the sanitary sewer without local approval.
    - Place a secure, non-collapsing, non-water collecting cover over the concrete washout area prior to predicted wet weather to prevent accumulation and overflow of precipitation.
    - Remove and dispose of hardened concrete and return the structure to a functional condition. Concrete may be reused on-site or hauled away for disposal or recycling.
- When you remove materials from a self-installed concrete washout area, build a new structure; or, if the previous structure is still intact, inspect for signs of weakening or damage, and make any necessary repairs. Re-line the structure with new plastic after each cleaning.

Removal of Concrete Washout Areas

- When concrete washout areas are no longer required for the work, the hardened concrete, slurries and liquids shall be removed and properly disposed of.
- Materials used to construct concrete washout areas shall be removed from the site of the work and disposed of or recycled.
- Holes, depressions or other ground disturbance caused by the removal of the concrete washout areas shall be backfilled, repaired, and stabilized to prevent erosion.

Figure II-3.7: Concrete Washout Area with Wood Planks

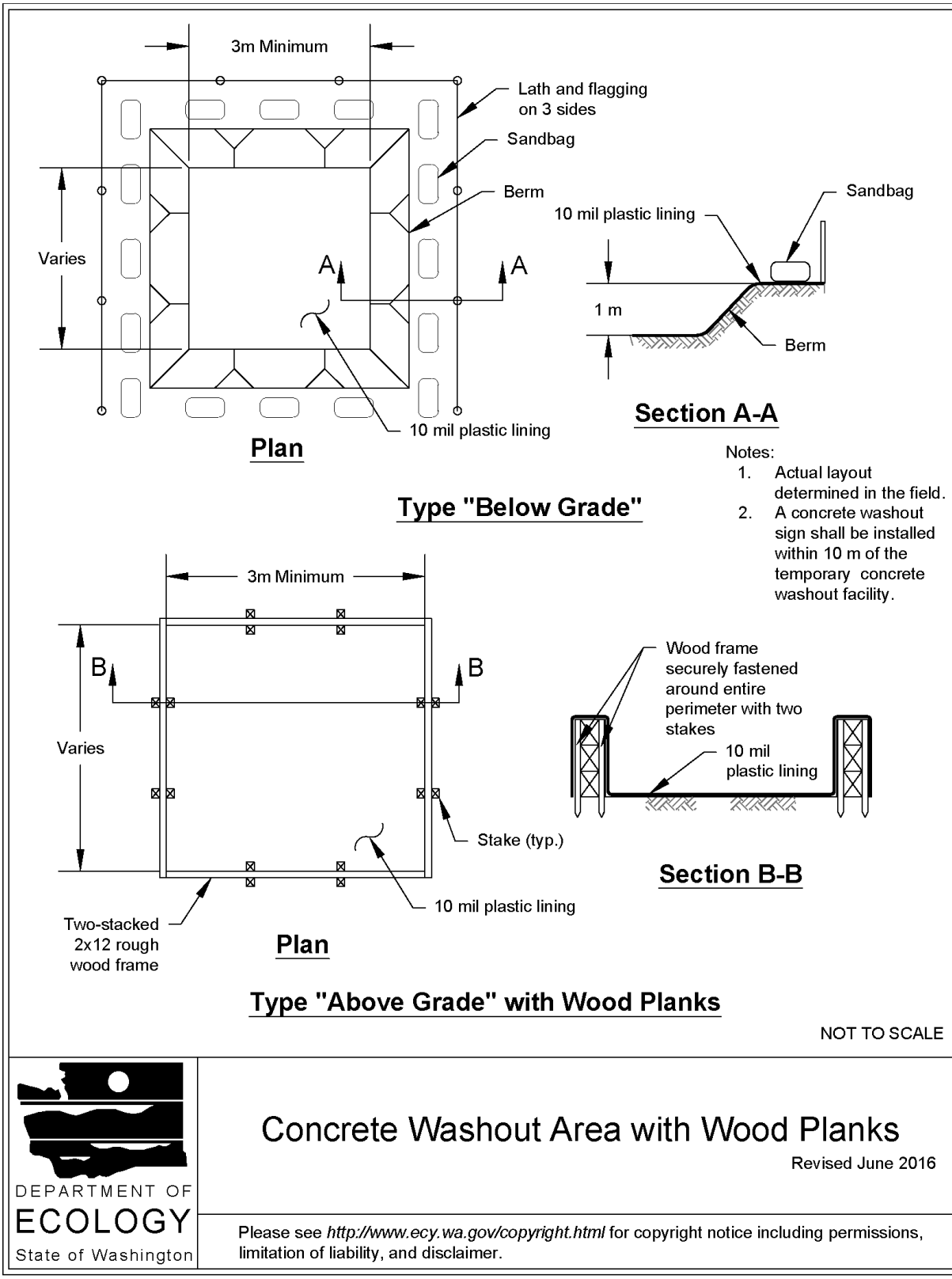


Figure II-3.8: Concrete Washout Area with Straw Bales

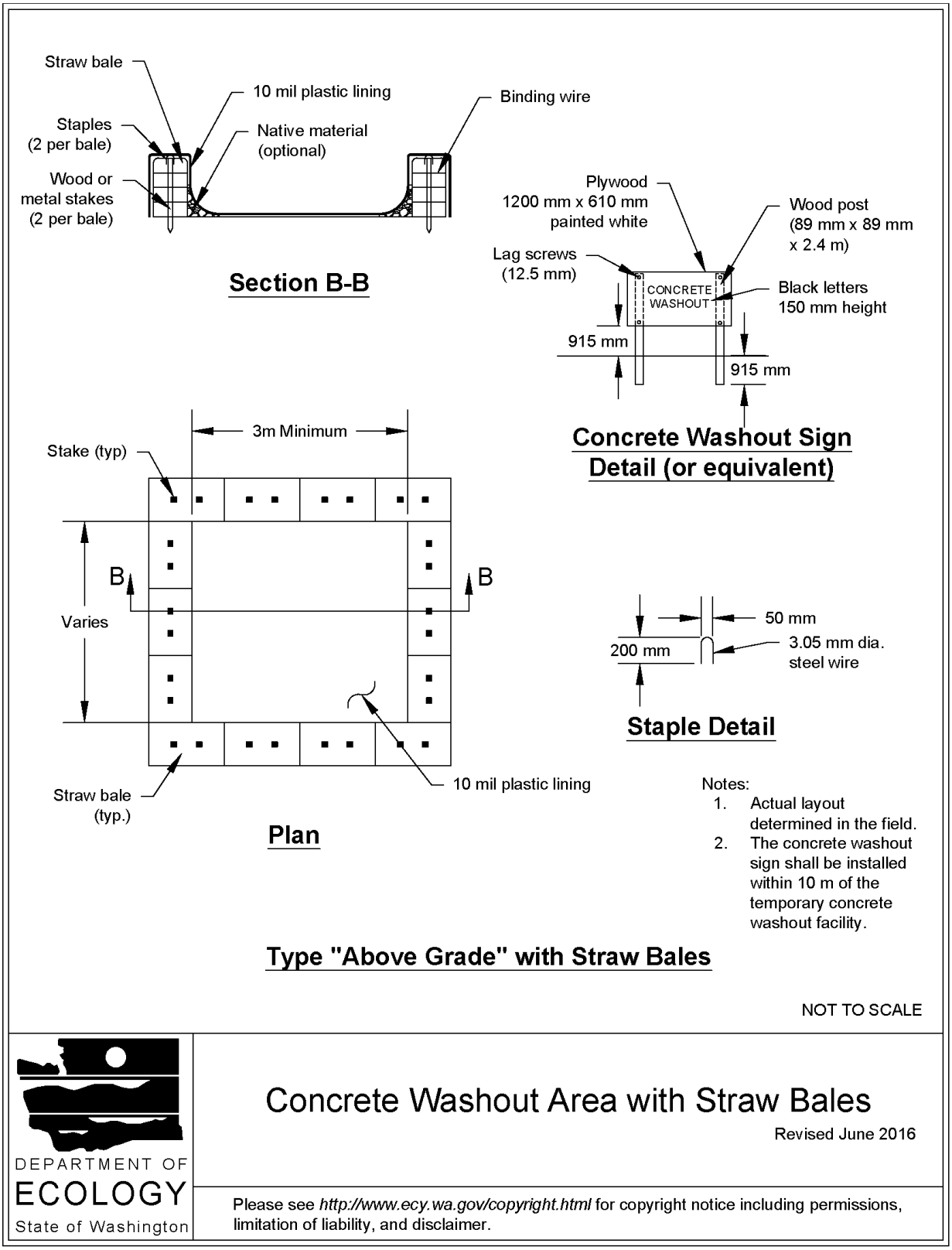
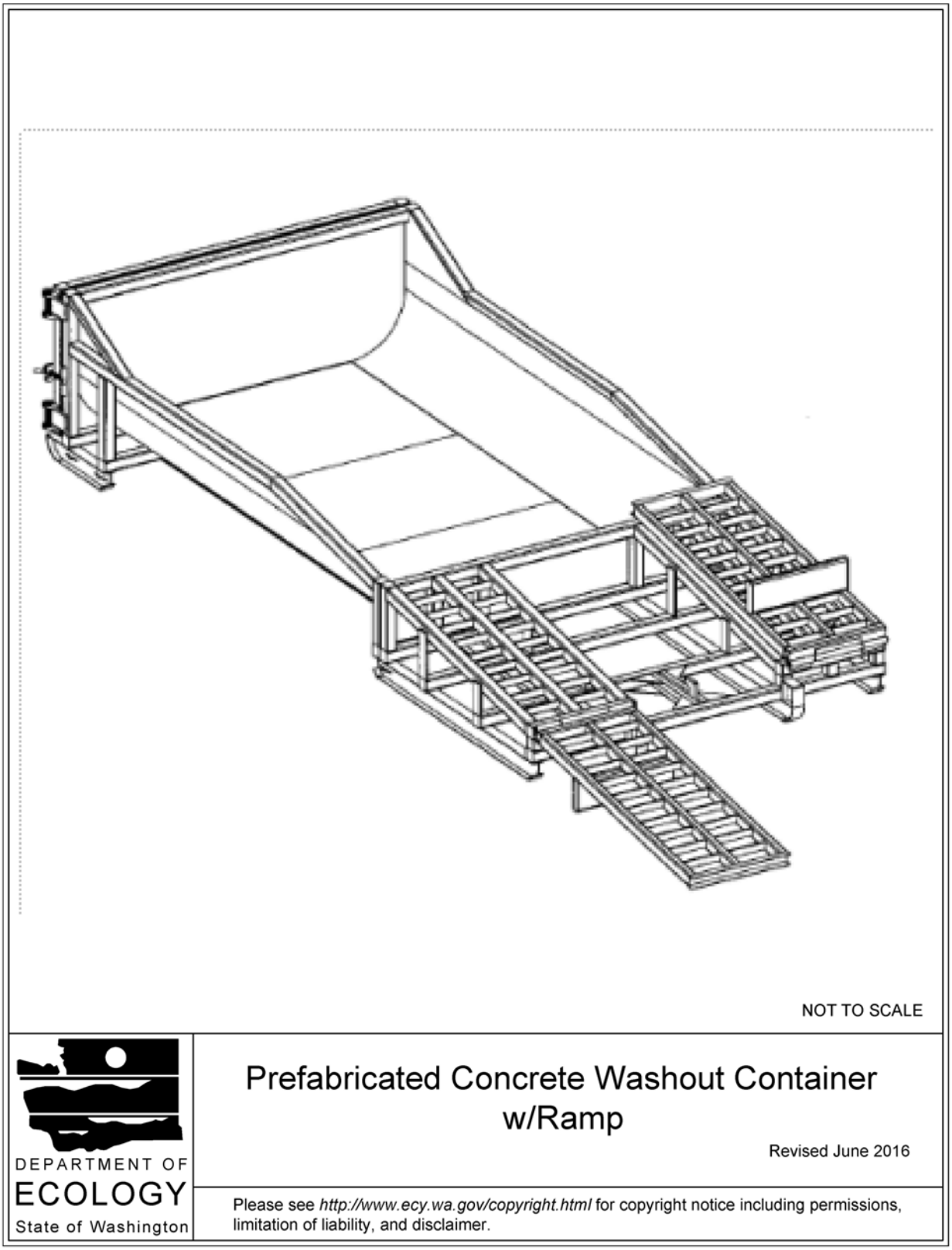


Figure II-3.9: Prefabricated Concrete Washout Container w/Ramp



BMP C160: Certified Erosion and Sediment Control Lead

Purpose

The project proponent designates at least one person as the responsible representative in charge of erosion and sediment control (ESC), and water quality protection. The designated person shall be responsible for ensuring compliance with all local, state, and federal erosion and sediment control and water quality requirements. Construction sites one acre or larger that discharge to waters of the State must designate a Certified Erosion and Sediment Control Lead (CESCL) as the responsible representative.

Conditions of Use

A CESCL shall be made available on projects one acre or larger that discharge stormwater to surface waters of the state. Sites less than one acre may have a person without CESCL certification conduct inspections.

The CESCL shall:

- Have a current certificate proving attendance in an erosion and sediment control training course that meets the minimum ESC training and certification requirements established by Ecology.

  Ecology has provided the minimum requirements for CESCL course training, as well as a list of ESC training and certification providers at:

  https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Certified-erosion-sediment-control

  OR

- Be a Certified Professional in Erosion and Sediment Control (CPESC). For additional information go to:

  http://www.envirocertintl.org/cpesc/

Specifications

- CESCL certification shall remain valid for three years.
- The CESCL shall have authority to act on behalf of the contractor or project proponent and shall be available, or on-call, 24 hours per day throughout the period of construction.
- The Construction SWPPP shall include the name, telephone number, fax number, and address of the designated CESCL. See II-2 Construction Stormwater Pollution Prevention Plans (Construction SWPPPs).
- A CESCL may provide inspection and compliance services for multiple construction projects in the same geographic region, but must be on site whenever earthwork activities are

occurring that could generate release of turbid water.

- Duties and responsibilities of the CESCL shall include, but are not limited to the following:
    - Maintaining a permit file on site at all times which includes the Construction SWPPP and any associated permits and plans.
    - Directing BMP installation, inspection, maintenance, modification, and removal.
    - Updating all project drawings and the Construction SWPPP with changes made.
    - Completing any sampling requirements including reporting results using electronic Discharge Monitoring Reports (WebDMR).
    - Facilitate, participate in, and take corrective actions resulting from inspections performed by outside agencies or the owner.
    - Keeping daily logs, and inspection reports. Inspection reports should include:
        - Inspection date/time.
        - Weather information; general conditions during inspection and approximate amount of precipitation since the last inspection.
        - Visual monitoring results, including a description of discharged stormwater. The presence of suspended sediment, turbid water, discoloration, and oil sheen shall be noted, as applicable.
        - Any water quality monitoring performed during inspection.
        - General comments and notes, including a brief description of any BMP repairs, maintenance or installations made as a result of the inspection.
        - A summary or list of all BMPs implemented, including observations of all erosion/sediment control structures or practices. The following shall be noted:
            1. Locations of BMPs inspected.
            2. Locations of BMPs that need maintenance.
            3. Locations of BMPs that failed to operate as designed or intended.
            4. Locations of where additional or different BMPs are required.

BMP C162: Scheduling

Purpose

Sequencing a construction project reduces the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking.

Conditions of Use

The construction sequence schedule is an orderly listing of all major land-disturbing activities together with the necessary erosion and sedimentation control measures planned for the project. This type of schedule guides the contractor on work to be done before other work is started so that serious erosion and sedimentation problems can be avoided.

Following a specified work schedule that coordinates the timing of land-disturbing activities and the installation of control measures is perhaps the most cost-effective way of controlling erosion during construction. The removal of ground cover leaves a site vulnerable to erosion. Construction sequencing that limits land clearing, provides timely installation of erosion and sedimentation controls, and restores protective cover quickly can significantly reduce the erosion potential of a site.

Design Considerations

- Minimize construction during rainy periods.
- Schedule projects to disturb only small portions of the site at any one time. Complete grading as soon as possible. Immediately stabilize the disturbed portion before grading the next portion. Practice staged seeding in order to revegetate cut and fill slopes as the work progresses.

II-3.3 Construction Runoff BMPs

BMP C200: Interceptor Dike and Swale

Purpose

Provide a dike of compacted soil or a swale at the top or base of a disturbed slope or along the perimeter of a disturbed construction area to convey stormwater. Use the dike and/or swale to intercept the runoff from unprotected areas and direct it to areas where erosion can be controlled. This can prevent storm runoff from entering the work area or sediment-laden runoff from leaving the construction site.

Conditions of Use

Use an interceptor dike or swale where runoff from an exposed site or disturbed slope must be conveyed to an erosion control BMP which can safely convey the stormwater.

- Locate upslope of a construction site to prevent runoff from entering the disturbed area.
- When placed horizontally across a disturbed slope, it reduces the amount and velocity of runoff flowing down the slope.
- Locate downslope to collect runoff from a disturbed area and direct it to a sediment BMP (e.g. BMP C240: Sediment Trap or BMP C241: Sediment Pond (Temporary)).

thickness is 2 feet.

- For outlets at the base of steep slope pipes (pipe slope greater than 10 percent), use an engineered energy dissipator.
- Filter fabric or erosion control blankets should always be used under riprap to prevent scour and channel erosion. See BMP C122: Nets and Blankets.

- Bank stabilization, bioengineering, and habitat features may be required for disturbed areas. This work may require a Hydraulic Project Approval (HPA) from the Washington State Department of Fish and Wildlife. See I-2.11 Hydraulic Project Approvals.

Maintenance Standards

- Inspect and repair as needed.
- Add rock as needed to maintain the intended function.
- Clean energy dissipator if sediment builds up.

BMP C220: Inlet Protection

Purpose

Inlet protection prevents coarse sediment from entering drainage systems prior to permanent stabilization of the disturbed area.

Conditions of Use

Use inlet protection at inlets that are operational before permanent stabilization of the disturbed areas that contribute runoff to the inlet. Provide protection for all storm drain inlets downslope and within 500 feet of a disturbed or construction area, unless those inlets are preceded by a sediment trapping BMP.

Also consider inlet protection for lawn and yard drains on new home construction. These small and numerous drains coupled with lack of gutters can add significant amounts of sediment into the roof drain system. If possible, delay installing lawn and yard drains until just before landscaping, or cap these drains to prevent sediment from entering the system until completion of landscaping. Provide 18-inches of sod around each finished lawn and yard drain.

Table II-3.10: Storm Drain Inlet Protection lists several options for inlet protection. All of the methods for inlet protection tend to plug and require a high frequency of maintenance. Limit contributing drainage areas for an individual inlet to one acre or less. If possible, provide emergency overflows with additional end-of-pipe treatment where stormwater ponding would cause a hazard.

Table II-3.10: Storm Drain Inlet Protection

Type of Inlet Protection	Emergency Overflow	Applicable for Paved/ Earthen Surfaces	Conditions of Use
Drop Inlet Protection			
Excavated drop inlet protection	Yes, temporary flooding may occur	Earthen	Applicable for heavy flows. Easy to maintain. Large area requirement: 30'x30'/acre
Block and gravel drop inlet protection	Yes	Paved or Earthen	Applicable for heavy concentrated flows. Will not pond.
Gravel and wire drop inlet protection	No	Paved or Earthen	Applicable for heavy concentrated flows. Will pond. Can withstand traffic.
Catch basin filters	Yes	Paved or Earthen	Frequent maintenance required.
Curb Inlet Protection			
Curb inlet protection with wooden weir	Small capacity overflow	Paved	Used for sturdy, more compact installation.
Block and gravel curb inlet protection	Yes	Paved	Sturdy, but limited filtration.
Culvert Inlet Protection			
Culvert inlet sediment trap	N/A	N/A	18 month expected life.

Design and Installation Specifications

Excavated Drop Inlet Protection

Excavated drop inlet protection consists of an excavated impoundment around the storm drain inlet. Sediment settles out of the stormwater prior to entering the storm drain. Design and installation specifications for excavated drop inlet protection include:

- Provide a depth of 1-2 ft as measured from the crest of the inlet structure.
- Slope sides of excavation should be no steeper than 2H:1V.
- Minimum volume of excavation is 35 cubic yards.
- Shape the excavation to fit the site, with the longest dimension oriented toward the longest inflow area.
- Install provisions for draining to prevent standing water.
- Clear the area of all debris.

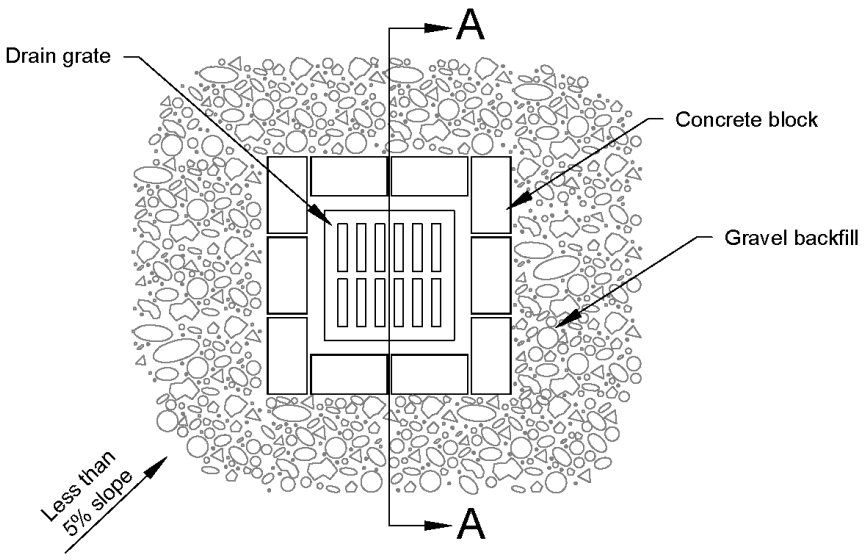
- Grade the approach to the inlet uniformly.
- Drill weep holes into the side of the inlet.
- Protect weep holes with screen wire and washed aggregate.
- Seal weep holes when removing structure and stabilizing area.
- Build a temporary dike, if necessary, to the down slope side of the structure to prevent bypass flow.

Block and Gravel Filter

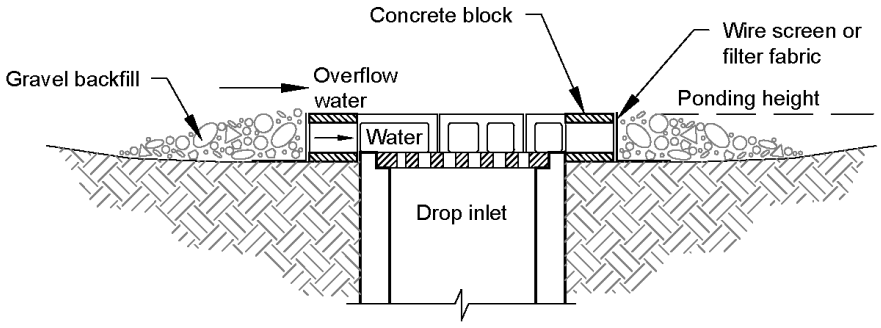
A block and gravel filter is a barrier formed around the inlet with standard concrete blocks and gravel. See Figure II-3.17: Block and Gravel Filter. Design and installation specifications for block gravel filters include:

- Provide a height of 1 to 2 feet above the inlet.
- Recess the first row of blocks 2-inches into the ground for stability.
- Support subsequent courses by placing a pressure treated wood 2x4 through the block opening.
- Do not use mortar.
- Lay some blocks in the bottom row on their side to allow for dewatering the pool.
- Place hardware cloth or comparable wire mesh with ½-inch openings over all block openings.
- Place gravel to just below the top of blocks on slopes of 2H:1V or flatter.
- An alternative design is a gravel berm surrounding the inlet, as follows:
    - Provide a slope of 3H:1V on the upstream side of the berm.
    - Provide a slope of 2H:1V on the downstream side of the berm.
    - Provide a 1-foot wide level stone area between the gravel berm and the inlet.
    - Use stones 3 inches in diameter or larger on the upstream slope of the berm.
    - Use gravel ½- to ¾-inch at a minimum thickness of 1-foot on the downstream slope of the berm.

Figure II-3.17: Block and Gravel Filter



Plan View



Section A-A

Notes:

1. Drop inlet sediment barriers are to be used for small, nearly level drainage areas. (less than 5%)
2. Excavate a basin of sufficient size adjacent to the drop inlet.
3. The top of the structure (ponding height) must be well below the ground elevation downslope to prevent runoff from bypassing the inlet. A temporary dike may be necessary on the downslope side of the structure.

NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Block and Gravel Filter

Revised June 2016

Gravel and Wire Mesh Filter

Gravel and wire mesh filters are gravel barriers placed over the top of the inlet. This method does not provide an overflow. Design and installation specifications for gravel and wire mesh filters include:

- Use a hardware cloth or comparable wire mesh with ½-inch openings.
    - Place wire mesh over the drop inlet so that the wire extends a minimum of 1-foot beyond each side of the inlet structure.
    - Overlap the strips if more than one strip of mesh is necessary.
- Place coarse aggregate over the wire mesh.
    - Provide at least a 12-inch depth of aggregate over the entire inlet opening and extend at least 18-inches on all sides.

Catch Basin Filters

Catch basin filters are designed by manufacturers for construction sites. The limited sediment storage capacity increases the amount of inspection and maintenance required, which may be daily for heavy sediment loads. To reduce maintenance requirements, combine a catch basin filter with another type of inlet protection. This type of inlet protection provides flow bypass without overflow and therefore may be a better method for inlets located along active rights-of-way. Design and installation specifications for catch basin filters include:

- Provides 5 cubic feet of storage.
- Requires dewatering provisions.
- Provides a high-flow bypass that will not clog under normal use at a construction site.
- Insert the catch basin filter in the catch basin just below the grating.

Curb Inlet Protection with Wooden Weir

Curb inlet protection with wooden weir is an option that consists of a barrier formed around a curb inlet with a wooden frame and gravel. Design and installation specifications for curb inlet protection with wooden weirs include:

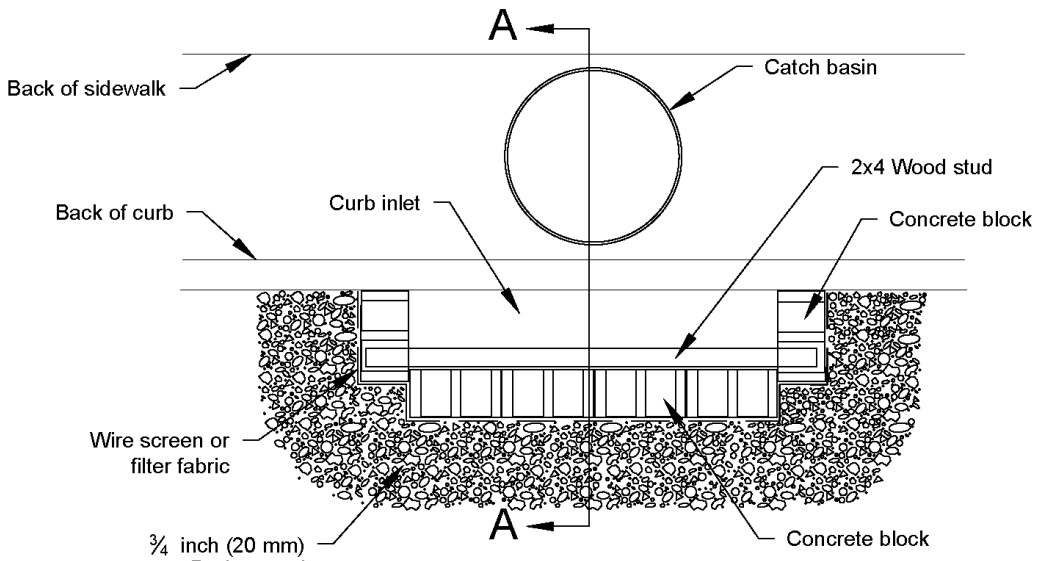
- Use wire mesh with ½-inch openings.
- Use extra strength filter cloth.
- Construct a frame.
- Attach the wire and filter fabric to the frame.
- Pile coarse washed aggregate against the wire and fabric.
- Place weight on the frame anchors.

Block and Gravel Curb Inlet Protection

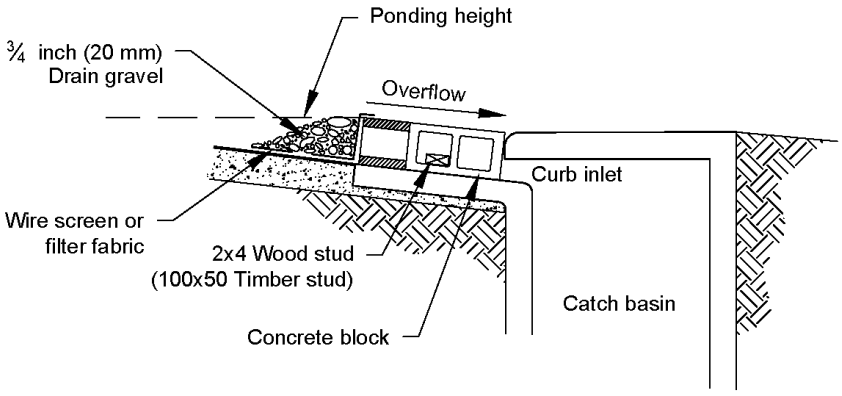
Block and gravel curb inlet protection is a barrier formed around a curb inlet with concrete blocks and gravel. See Figure II-3.18: Block and Gravel Curb Inlet Protection. Design and installation specifications for block and gravel curb inlet protection include:

- Use wire mesh with ½-inch openings.
- Place two concrete blocks on their sides abutting the curb at either side of the inlet opening. These are spacer blocks.
- Place a 2x4 stud through the outer holes of each spacer block to align the front blocks.
- Place blocks on their sides across the front of the inlet and abutting the spacer blocks.
- Place wire mesh over the outside vertical face.
- Pile coarse aggregate against the wire to the top of the barrier.

Figure II-3.18: Block and Gravel Curb Inlet Protection



Plan View



Section A-A

Notes:

1. Use block and gravel type sediment barrier when curb inlet is located in gently sloping street segment, where water can pond and allow sediment to separate from runoff.
2. Barrier shall allow for overflow from severe storm event.
3. Inspect barriers and remove sediment after each storm event. Sediment and gravel must be removed from the traveled way immediately.

NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Block and Gravel Curb Inlet Protection

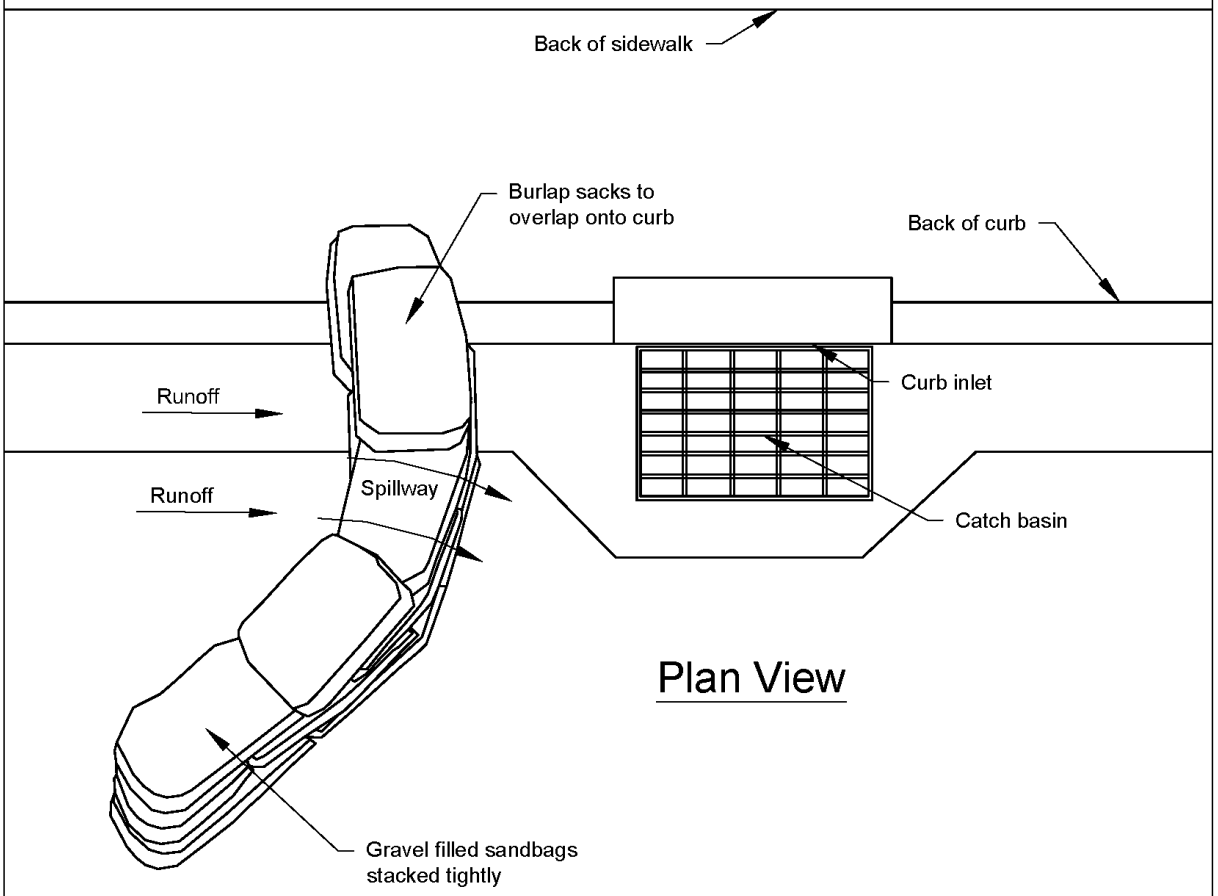
Revised June 2016

Curb and Gutter Sediment Barrier

Curb and gutter sediment barrier is a sandbag or rock berm (riprap and aggregate) 3 feet high and 3 feet wide in a horseshoe shape. See Figure II-3.19: Curb and Gutter Barrier. Design and installation specifications for curb and gutter sediment barrier include:

- Construct a horseshoe shaped berm, faced with coarse aggregate if using riprap, 3 feet high and 3 feet wide, at least 2 feet from the inlet.
- Construct a horseshoe shaped sedimentation trap on the upstream side of the berm. Size the trap to sediment trap standards for protecting a culvert inlet.

Figure II-3.19: Curb and Gutter Barrier



Notes:

1. Place curb type sediment barriers on gently sloping street segments, where water can pond and allow sediment to separate from runoff.
2. Sandbags of either burlap or woven 'geotextile' fabric, are filled with gravel, layered and packed tightly.
3. Leave a one sandbag gap in the top row to provide a spillway for overflow.
4. Inspect barriers and remove sediment after each storm event. Sediment and gravel must be removed from the traveled way immediately.

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DEPARTMENT OF ECOLOGY
State of Washington

Curb and Gutter Barrier

Revised June 2016

Maintenance Standards

- Inspect all forms of inlet protection frequently, especially after storm events. Clean and replace clogged catch basin filters. For rock and gravel filters, pull away the rocks from the inlet and clean or replace. An alternative approach would be to use the clogged rock as fill and put fresh rock around the inlet.
- Do not wash sediment into storm drains while cleaning. Spread all excavated material evenly over the surrounding land area or stockpile and stabilize as appropriate.

Approved as Functionally Equivalent

Ecology has approved products as able to meet the requirements of this BMP. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Local jurisdictions may choose not to accept these products, or may require additional testing prior to consideration for local use. Products that Ecology has approved as functionally equivalent are available for review on Ecology's website at:

https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

BMP C231: Brush Barrier

Purpose

The purpose of brush barriers is to reduce the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

Conditions of Use

- Brush barriers may be used downslope of disturbed areas that are less than one-quarter acre.
- Brush barriers are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be directed to a sediment trapping BMP. The only circumstance in which overland flow can be treated solely by a brush barrier, rather than by a sediment trapping BMP, is when the area draining to the barrier is small.
- Brush barriers should only be installed on contours.

Design and Installation Specifications

- Height: 2 feet (minimum) to 5 feet (maximum).
- Width: 5 feet at base (minimum) to 15 feet (maximum).
- Filter fabric (geotextile) may be anchored over the brush berm to enhance the filtration ability of the barrier. Ten-ounce burlap is an adequate alternative to filter fabric.

BMP C233: Silt Fence

Purpose

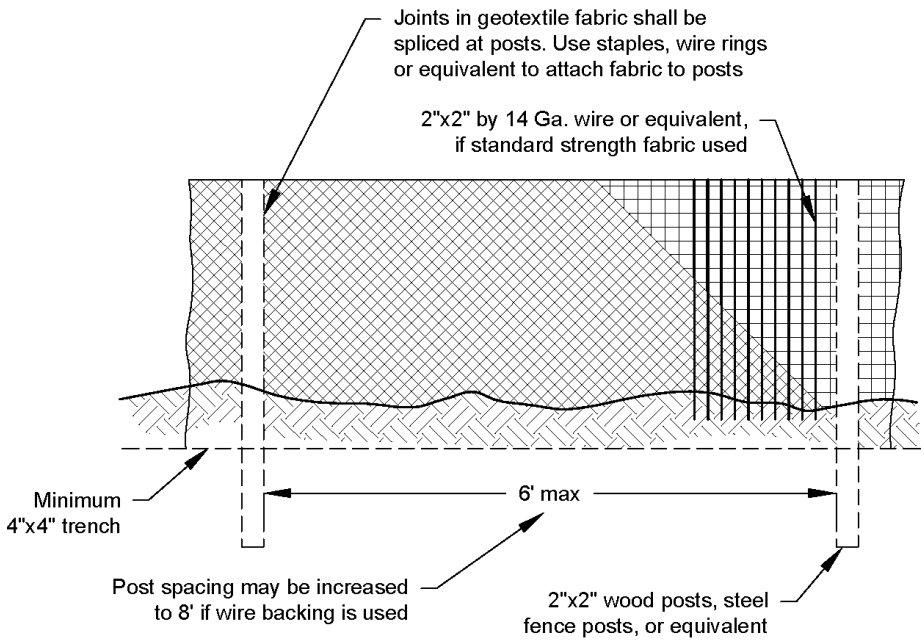
Silt fence reduces the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

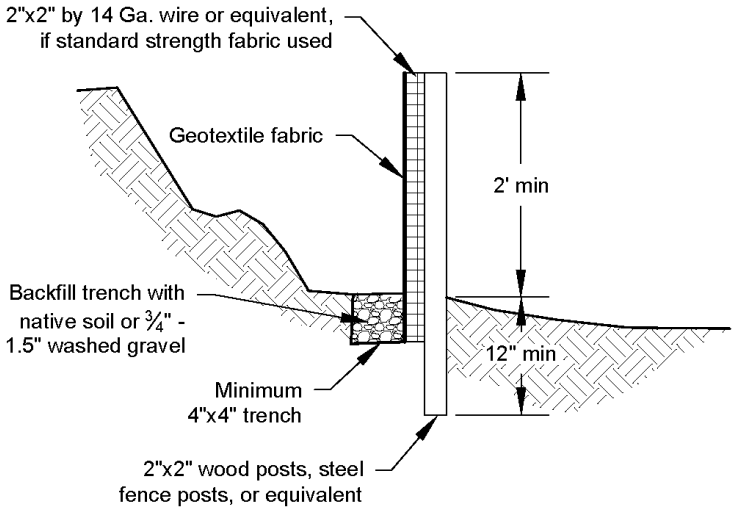
Conditions of Use

Silt fence may be used downslope of all disturbed areas.

- Silt fence shall prevent sediment carried by runoff from going beneath, through, or over the top of the silt fence, but shall allow the water to pass through the fence.
- Silt fence is not intended to treat concentrated flows, nor is it intended to treat substantial amounts of overland flow. Convey any concentrated flows through the drainage system to a sediment trapping BMP.
- Do not construct silt fences in streams or use in V-shaped ditches. Silt fences do not provide an adequate method of silt control for anything deeper than sheet or overland flow.

Figure II-3.22: Silt Fence





NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Silt Fence

Revised July 2017

Design and Installation Specifications

- Use in combination with other construction stormwater BMPs.
- Maximum slope steepness (perpendicular to the silt fence line) 1H:1V.
- Maximum sheet or overland flow path length to the silt fence of 100 feet.
- Do not allow flows greater than 0.5 cfs.
- Use geotextile fabric that meets the following standards. All geotextile properties listed below are minimum average roll values (i.e., the test result for any sampled roll in a lot shall meet or exceed the values shown in Table II-3.11: Geotextile Fabric Standards for Silt Fence):

Table II-3.11: Geotextile Fabric Standards for Silt Fence

Geotextile Property	Minimum Average Roll Value
Polymeric Mesh AOS (ASTM D4751)	0.60 mm maximum for slit film woven (#30 sieve). 0.30 mm maximum for all other geotextile types (#50 sieve). 0.15 mm minimum for all fabric types (#100 sieve).
Water Permittivity (ASTM D4491)	0.02 sec^{-1} minimum
Grab Tensile Strength (ASTM D4632)	180 lbs. Minimum for extra strength fabric. 100 lbs minimum for standard strength fabric.
Grab Tensile Strength (ASTM D4632)	30% maximum
Ultraviolet Resistance (ASTM D4355)	70% minimum

- Support standard strength geotextiles with wire mesh, chicken wire, 2-inch x 2-inch wire, safety fence, or jute mesh to increase the strength of the geotextile. Silt fence materials are available that have synthetic mesh backing attached.
- Silt fence material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0°F to 120°F.
- One-hundred percent biodegradable silt fence is available that is strong, long lasting, and can be left in place after the project is completed, if permitted by the local jurisdiction.
- Refer to Figure II-3.22: Silt Fence for standard silt fence details. Include the following Standard Notes for silt fence on construction plans and specifications:

    1. The Contractor shall install and maintain temporary silt fences at the locations shown in the Plans.
    2. Construct silt fences in areas of clearing, grading, or drainage prior to starting those activities.

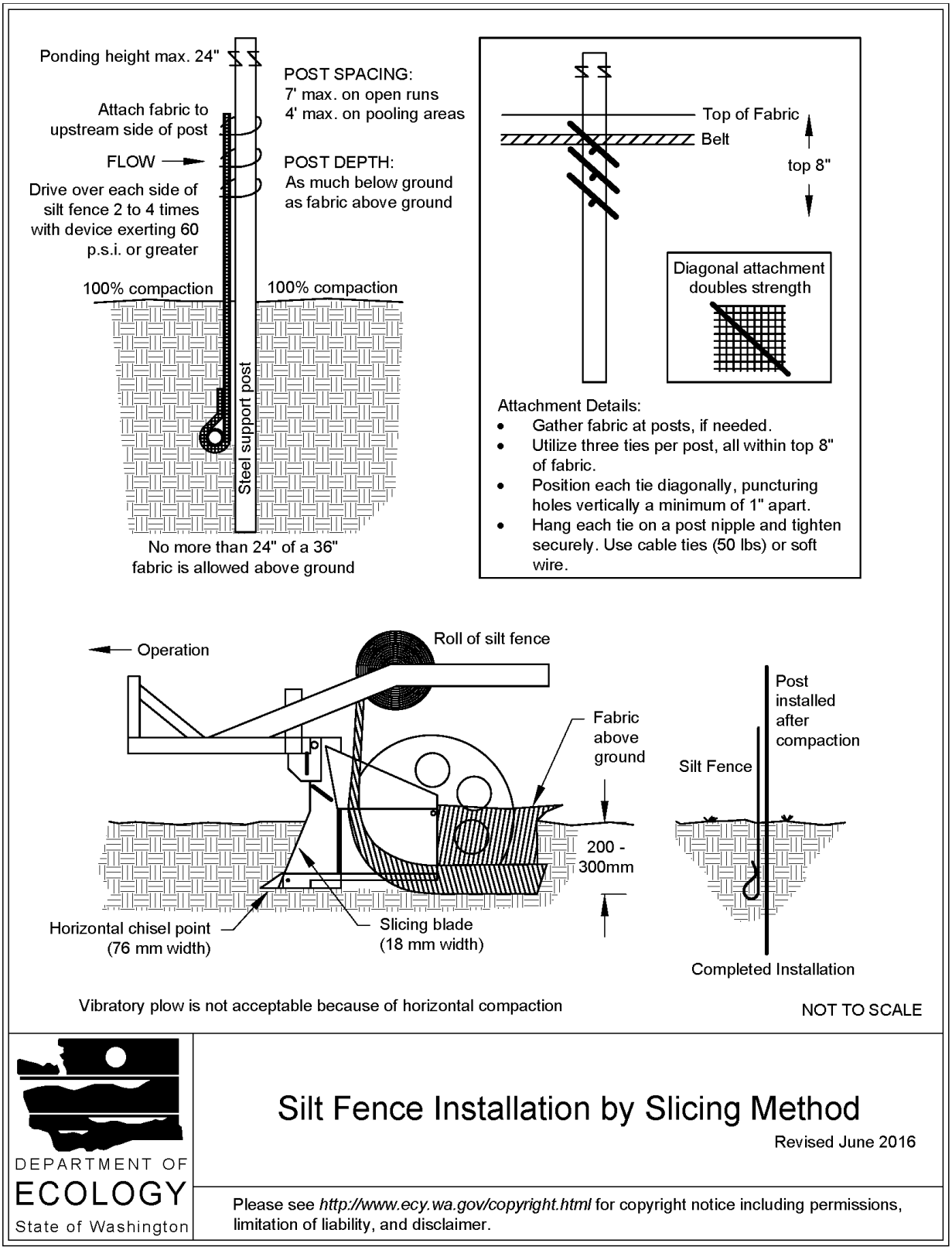
3. The silt fence shall have a 2-feet min. and a 2½-feet max. height above the original ground surface.
4. The geotextile fabric shall be sewn together at the point of manufacture to form fabric lengths as required. Locate all sewn seams at support posts. Alternatively, two sections of silt fence can be overlapped, provided that the overlap is long enough and that the adjacent silt fence sections are close enough together to prevent silt laden water from escaping through the fence at the overlap.
5. Attach the geotextile fabric on the up-slope side of the posts and secure with staples, wire, or in accordance with the manufacturer's recommendations. Attach the geotextile fabric to the posts in a manner that reduces the potential for tearing.
6. Support the geotextile fabric with wire or plastic mesh, dependent on the properties of the geotextile selected for use. If wire or plastic mesh is used, fasten the mesh securely to the up-slope side of the posts with the geotextile fabric up-slope of the mesh.
7. Mesh support, if used, shall consist of steel wire with a maximum mesh spacing of 2-inches, or a prefabricated polymeric mesh. The strength of the wire or polymeric mesh shall be equivalent to or greater than 180 lbs. grab tensile strength. The polymeric mesh must be as resistant to the same level of ultraviolet radiation as the geotextile fabric it supports.
8. Bury the bottom of the geotextile fabric 4-inches min. below the ground surface. Backfill and tamp soil in place over the buried portion of the geotextile fabric, so that no flow can pass beneath the silt fence and scouring cannot occur. When wire or polymeric back-up support mesh is used, the wire or polymeric mesh shall extend into the ground 3-inches min.
9. Drive or place the silt fence posts into the ground 18-inches min. A 12–inch min. depth is allowed if topsoil or other soft subgrade soil is not present and 18-inches cannot be reached. Increase fence post min. depths by 6 inches if the fence is located on slopes of 3H:1V or steeper and the slope is perpendicular to the fence. If required post depths cannot be obtained, the posts shall be adequately secured by bracing or guying to prevent overturning of the fence due to sediment loading.
10. Use wood, steel or equivalent posts. The spacing of the support posts shall be a maximum of 6-feet. Posts shall consist of either:
    - Wood with minimum dimensions of 2 inches by 2 inches by 3 feet. Wood shall be free of defects such as knots, splits, or gouges.
    - No. 6 steel rebar or larger.
    - ASTM A 120 steel pipe with a minimum diameter of 1-inch.
    - U, T, L, or C shape steel posts with a minimum weight of 1.35 lbs./ft.
    - Other steel posts having equivalent strength and bending resistance to the post sizes listed above.
11. Locate silt fences on contour as much as possible, except at the ends of the fence,

where the fence shall be turned uphill such that the silt fence captures the runoff water and prevents water from flowing around the end of the fence.

12. If the fence must cross contours, with the exception of the ends of the fence, place check dams perpendicular to the back of the fence to minimize concentrated flow and erosion. The slope of the fence line where contours must be crossed shall not be steeper than 3H:1V.
    - Check dams shall be approximately 1-foot deep at the back of the fence. Check dams shall be continued perpendicular to the fence at the same elevation until the top of the check dam intercepts the ground surface behind the fence.
    - Check dams shall consist of crushed surfacing base course, gravel backfill for walls, or shoulder ballast. Check dams shall be located every 10 feet along the fence where the fence must cross contours.

- Refer to Figure II-3.23: Silt Fence Installation by Slicing Method for slicing method details. The following are specifications for silt fence installation using the slicing method:
    1. The base of both end posts must be at least 2- to 4-inches above the top of the geotextile fabric on the middle posts for ditch checks to drain properly. Use a hand level or string level, if necessary, to mark base points before installation.
    2. Install posts 3- to 4-feet apart in critical retention areas and 6- to 7-feet apart in standard applications.
    3. Install posts 24-inches deep on the downstream side of the silt fence, and as close as possible to the geotextile fabric, enabling posts to support the geotextile fabric from upstream water pressure.
    4. Install posts with the nipples facing away from the geotextile fabric.
    5. Attach the geotextile fabric to each post with three ties, all spaced within the top 8-inches of the fabric. Attach each tie diagonally 45 degrees through the fabric, with each puncture at least 1-inch vertically apart. Each tie should be positioned to hang on a post nipple when tightening to prevent sagging.
    6. Wrap approximately 6-inches of the geotextile fabric around the end posts and secure with 3 ties.
    7. No more than 24-inches of a 36-inch geotextile fabric is allowed above ground level.
    8. Compact the soil immediately next to the geotextile fabric with the front wheel of the tractor, skid steer, or roller exerting at least 60 pounds per square inch. Compact the upstream side first and then each side twice for a total of four trips. Check and correct the silt fence installation for any deviation before compaction. Use a flat-bladed shovel to tuck the fabric deeper into the ground if necessary.

Figure II-3.23: Silt Fence Installation by Slicing Method



Maintenance Standards

- Repair any damage immediately.
- Intercept and convey all evident concentrated flows uphill of the silt fence to a sediment trapping BMP.
- Check the uphill side of the silt fence for signs of the fence clogging and acting as a barrier to flow and then causing channelization of flows parallel to the fence. If this occurs, replace the fence and remove the trapped sediment.
- Remove sediment deposits when the deposit reaches approximately one-third the height of the silt fence, or install a second silt fence.
- Replace geotextile fabric that has deteriorated due to ultraviolet breakdown.

BMP C234: Vegetated Strip

Purpose

Vegetated strips reduce the transport of coarse sediment from a construction site by providing a physical barrier to sediment and reducing the runoff velocities of overland flow.

Conditions of Use

- Vegetated strips may be used downslope of all disturbed areas.
- Vegetated strips are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to BMP C241: Sediment Pond (Temporary) or other sediment trapping BMP. The only circumstance in which overland flow can be treated solely by a vegetated strip, rather than by a sediment trapping BMP, is when the following criteria are met (see Table II-3.12: Contributing Drainage Area for Vegetated Strips):

Table II-3.12: Contributing Drainage Area for Vegetated Strips

Average Contributing Area Slope	Average Contributing Area Percent Slope	Max Contributing area Flowpath Length
1.5H : 1V or flatter	67% or flatter	100 feet
2H : 1V or flatter	50% or flatter	115 feet
4H : 1V or flatter	25% or flatter	150 feet
6H : 1V or flatter	16.7% or flatter	200 feet
10H : 1V or flatter	10% or flatter	250 feet

system) will be directed into the permanent Flow Control BMP. If site constraints make locating the untreated stormwater storage pond difficult, the permanent Flow Control BMP may be divided to serve as the untreated stormwater storage pond and the post-treatment temporary flow control pond. A berm or barrier must be used in this case so the untreated water does not mix with the treated water. Both untreated stormwater storage requirements, and adequate post-treatment flow control must be achieved. The designer must document in the Construction SWPPP how the permanent Flow Control BMP is able to attenuate the discharge from the site to meet the requirements of Element 3: Control Flow Rates. If the design of the permanent Flow Control BMP was modified for temporary construction flow control purposes, the construction of the permanent Flow Control BMP must be finalized, as designed for its permanent function, at project completion.

Maintenance Standards

- Rapid sand filters typically have automatic backwash systems that are triggered by a pre-set pressure drop across the filter. If the backwash water volume is not large or substantially more turbid than the untreated stormwater stored in the holding pond or tank, backwash return to the untreated stormwater pond or tank may be appropriate. However, other means of treatment and disposal may be necessary.
- Screen, bag, and fiber filters must be cleaned and/or replaced when they become clogged.
- Sediment shall be removed from the storage and/or treatment ponds as necessary. Typically, sediment removal is required once or twice during a wet season and at the decommissioning of the ponds.
- Disposal of filtration equipment must comply with applicable local, state, and federal regulations.

BMP C252: Treating and Disposing of High pH Water

Purpose

When pH levels in stormwater rise above 8.5, it is necessary to lower the pH levels to the acceptable range of 6.5 to 8.5 prior to discharge to surface or ground water. A pH level range of 6.5 to 8.5 is typical for most natural watercourses, and this neutral pH range is required for the survival of aquatic organisms. Should the pH rise or drop out of this range, fish and other aquatic organisms may become stressed and may die.

Conditions of Use

- The water quality standard for pH in Washington State is in the range of 6.5 to 8.5. Stormwater with pH levels exceeding water quality standards may be either neutralized on site or disposed of to a sanitary sewer or concrete batch plant with pH neutralization capabilities.
- Neutralized stormwater may be discharged to surface waters under the Construction Stormwater General permit.
- Neutralized process water such as concrete truck wash-out, hydro-demolition, or saw-cutting slurry must be managed to prevent discharge to surface waters. Any stormwater

contaminated during concrete work is considered process wastewater and must not be discharged to waters of the State or stormwater collection systems.

- The process used for neutralizing and/or disposing of high pH stormwater from the site must be documented in the Construction Stormwater Pollution Prevention Plan.

Causes of High pH

High pH at construction sites is most commonly caused by the contact of stormwater with poured or recycled concrete, cement, mortars, and other Portland cement or lime containing construction materials. (See BMP C151: Concrete Handling for more information on concrete handling procedures). The principal caustic agent in cement is calcium hydroxide (free lime).

Calcium hardness can contribute to high pH values and cause toxicity that is associated with high pH conditions. A high level of calcium hardness in waters of the state is not allowed. Ground water standard for calcium and other dissolved solids in Washington State is less than 500 mg/l.

Treating High pH Stormwater by Carbon Dioxide Sparging

Advantages of Carbon Dioxide Sparging

- Rapidly neutralizes high pH water.
- Cost effective and safer to handle than acid compounds.
- CO_2 is self-buffering. It is difficult to overdose and create harmfully low pH levels.
- Material is readily available.

The Chemical Process of Carbon Dioxide Sparging

When carbon dioxide (CO_2) is added to water (H_2O), carbonic acid (H_2CO_3) is formed which can further dissociate into a proton (H+) and a bicarbonate anion (HCO_3-) as shown below:

$$CO_2 + H_2O \leftrightarrow H_2CO_3 \leftrightarrow H+ + HCO_3-$$

The free proton is a weak acid that can lower the pH. Water temperature has an effect on the reaction as well. The colder the water temperature is, the slower the reaction occurs. The warmer the water temperature is, the quicker the reaction occurs. Most construction applications in Washington State have water temperatures in the 50°F or higher range so the reaction is almost simultaneous.

The Treatment Process of Carbon Dioxide Sparging

High pH water may be treated using continuous treatment, continuous discharge systems. These manufactured systems continuously monitor influent and effluent pH to ensure that pH values are within an acceptable range before being discharged. All systems must have fail safe automatic shut off switches in the event that pH is not within the acceptable discharge range. Only trained operators may operate manufactured systems. System manufacturers often provide trained operators or training on their devices.

The following procedure may be used when not using a continuous discharge system:

1. Prior to treatment, the appropriate jurisdiction should be notified in accordance with the regulations set by the jurisdiction.
2. Every effort should be made to isolate the potential high pH water in order to treat it separately from other stormwater on-site.
3. Water should be stored in an acceptable storage facility, detention pond, or containment cell prior to pH treatment.
4. Transfer water to be treated for pH to the pH treatment structure. Ensure that the pH treatment structure size is sufficient to hold the amount of water that is to be treated. Do not fill the pH treatment structure completely, allow at least 2 feet of freeboard.
5. The operator samples the water within the pH treatment structure for pH and notes the clarity of the water. As a rule of thumb, less CO_2 is necessary for clearer water. The results of the samples and water clarity observations should be recorded.
6. In the pH treatment structure, add CO_2 until the pH falls into the range of 6.9-7.1. Adjusting pH to within 0.2 pH units of receiving water (background pH) is recommended. It is unlikely that pH can be adjusted to within 0.2 pH units using dry ice. Compressed carbon dioxide gas should be introduced to the water using a carbon dioxide diffuser located near the bottom of the pH treatment structure, this will allow carbon dioxide to bubble up through the water and diffuse more evenly.
7. Slowly discharge the water, making sure water does not get stirred up in the process. Release about 80% of the water from the pH treatment structure leaving any sludge behind. If turbidity remains above the maximum allowable, consider adding filtration to the treatment train. See BMP C251: Construction Stormwater Filtration.
8. Discharge treated water through a pond or drainage system.
9. Excess sludge needs to be disposed of properly as concrete waste. If several batches of water are undergoing pH treatment, sludge can be left in the treatment structure for the next batch treatment. Dispose of sludge when it fills 50% of the treatment structure volume.
10. Disposal must comply with applicable local, state, and federal regulations.

Treating High pH Stormwater by Food Grade Vinegar

Food grade vinegar that meets FDA standards may be used to neutralize high pH water. Food grade vinegar is only 4% to 18% acetic acid with the remainder being water. Food grade vinegar may be used if dosed just enough to lower pH sufficiently. Use a treatment process as described above for CO_2 sparging, but add food grade vinegar instead of CO_2.

This treatment option for high pH stormwater does not apply to anything but food grade vinegar. Acetic acid does not equal vinegar. Any other product or waste containing acetic acid must go through the evaluation process in Appendix G of *Whole Effluent Toxicity Testing Guidance and Test Review Criteria* (Marshall, 2016).

Disposal of High pH Stormwater

Sanitary Sewer Disposal

Local sewer authority approval is required prior to disposal via the sanitary sewer.

Concrete Batch Plant Disposal

- Only permitted facilities may accept high pH water.
- Contact the facility to ensure they can accept the high pH water.

Maintenance Standards

Safety and materials handling:

- All equipment should be handled in accordance with OSHA rules and regulations.
- Follow manufacturer guidelines for materials handling.

Each operator should provide:

- A diagram of the monitoring and treatment equipment.
- A description of the pumping rates and capacity the treatment equipment is capable of treating.

Each operator should keep a written record of the following:

- Client name and phone number.
- Date of treatment.
- Weather conditions.
- Project name and location.
- Volume of water treated.
- pH of untreated water.
- Amount of CO_2 or food grade vinegar needed to adjust water to a pH range of 6.9-7.1.
- pH of treated water.
- Discharge point location and description.

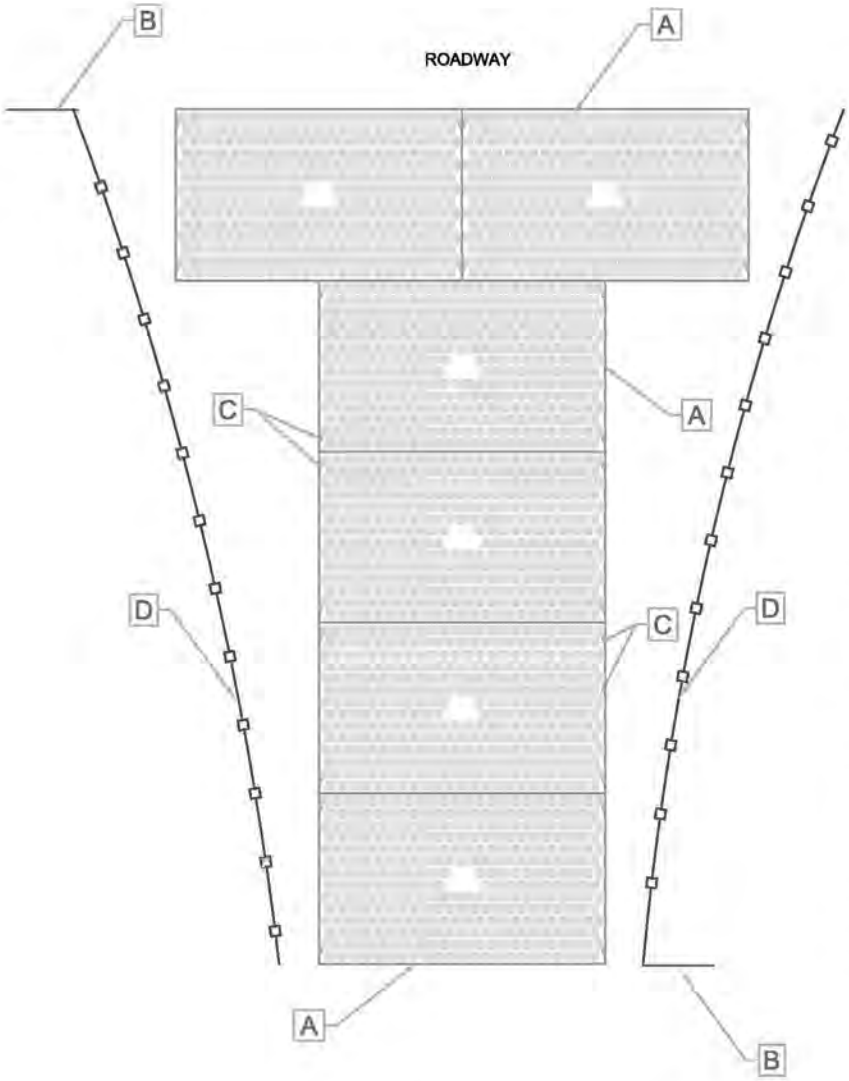
A copy of this record should be given to the client/contractor who should retain the record for three years.

FODS TRACKOUT CONTROL SYSTEM INSTALLATION GUIDE

THE PURPOSE AND DESIGN OF THE FODS TRACKOUT CONTROL SYSTEM IS TO EFFECTIVELY REMOVE MOST SEDIMENT FROM VEHICLE TIRES AS THEY EXIT A DISTURBED LAND AREA ONTO A PAVED STREET. THIS MANUAL IS A PLATFORM FROM WHICH TO INSTALL A FODS TRACKOUT CONTROL SYSTEM. (NOTE: THIS IS NOT A ONE SIZE FITS ALL GUIDE.) THE INSTALLATION MAY NEED TO BE MODIFIED TO MEET THE EXISTING CONDITIONS, EXPECTATIONS, OR DEMANDS OF A PARTICULAR SITE. THIS IS A GUIDELINE. ULTIMATELY THE FODS TRACKOUT CONTROL SYSTEM SHOULD BE INSTALLED SAFELY WITH PROPER ANCHORING AND SIGNS PLACED AT THE ENTRANCE AND EXIT TO CAUTION USERS AND OTHERS.

KEY NOTES:

A. FODS TRACKOUT CONTROL SYSTEM MAT.
B. FODS SAFETY SIGN.
C. ANCHOR POINT.
D. SILT OR ORANGE CONSTRUCTION FENCE.



TYPICAL ONE-LANE LAYOUT

INSTALLATION:

1. THE SITE WHERE THE FODS TRACKOUT CONTROL SYSTEM IS TO BE PLACED SHOULD CORRESPOND TO BEST MANAGEMENT PRACTICES AS MUCH AS POSSIBLE. THE SITE WHERE FODS TRACKOUT CONTROL SYSTEM IS PLACED SHOULD ALSO MEET OR EXCEED THE LOCAL JURISDICTION OR STORM WATER POLLUTION PREVENTION PLAN (SWPPP) REQUIREMENTS.
2. CALL FOR UTILITY LOCATES 3 BUSINESS DAYS IN ADVANCE OF THE OF FODS TRACKOUT CONTROL SYSTEM INSTALLATION FOR THE MARKING OF UNDERGROUND UTILITIES. CALL THE UTILITY NOTIFICATION CENTER AT 811.
3. ONCE THE SITE IS ESTABLISHED WHERE FODS TRACKOUT CONTROL SYSTEM IS TO BE PLACED, ANY EXCESSIVE UNEVEN TERRAIN SHOULD BE LEVELED OUT OR REMOVED SUCH AS LARGE ROCKS, LANDSCAPING MATERIALS, OR SUDDEN ABRUPT CHANGES IN ELEVATION.
4. THE INDIVIDUAL MATS CAN START TO BE PLACED INTO POSITION. THE FIRST MAT SHOULD BE PLACED NEXT TO THE CLOSEST POINT OF EGRESS. THIS WILL ENSURE THAT THE VEHICLE WILL EXIT STRAIGHT FROM THE SITE ONTO THE PAVED SURFACE.
8. AFTER THE FIRST MAT IS PLACED DOWN IN THE PROPER LOCATION, MATS SHOULD BE ANCHORED TO PREVENT THE POTENTIAL MOVEMENT WHILE THE ADJOINING MATS ARE INSTALLED. ANCHORS SHOULD BE PLACED AT EVERY ANCHOR POINT (IF FEASIBLE) TO HELP MAINTAIN THE MAT IN ITS CURRENT POSITION.
9. AFTER THE FIRST MAT IS ANCHORED IN ITS PROPER PLACE, AN H BRACKET SHOULD BE PLACED AT THE END OF THE FIRST MAT BEFORE ANOTHER MAT IS PLACED ADJACENT TO THE FIRST MAT.
10. ONCE THE SECOND MAT IS PLACED ADJACENT TO THE FIRST MAT, MAKE SURE THE H BRACKET IS CORRECTLY SITUATED BETWEEN THE TWO MATS, AND SLIDE MATS TOGETHER.
11. NEXT THE CONNECTOR STRAPS SHOULD BE INSTALLED TO CONNECT THE TWO MATS TOGETHER.
12. UPON PLACEMENT OF EACH NEW MAT IN THE SYSTEM, THAT MAT SHOULD BE ANCHORED AT EVERY ANCHOR POINT TO HELP STABILIZE THE MAT AND ENSURE THE SYSTEM IS CONTINUOUS WITH NO GAPS IN BETWEEN THE MATS.
13. SUCCESSIVE MATS CAN THEN BE PLACED TO CREATE THE FODS TRACKOUT CONTROL SYSTEM REPEATING THE ABOVE STEPS.

USE AND MAINTENANCE

1. VEHICLES SHOULD TRAVEL DOWN THE LENGTH OF THE TRACKOUT CONTROL SYSTEM AND NOT CUT ACROSS THE MATS.
2. DRIVERS SHOULD TURN THE WHEEL OF THEIR VEHICLES SUCH THAT THE VEHICLE WILL MAKE A SHALLOW S-TURN ROUTE DOWN THE LENGTH OF THE FODS TRACKOUT CONTROL SYSTEM.
3. MATS SHOULD BE CLEANED ONCE THE VOIDS BETWEEN THE PYRAMIDS BECOME FULL OF SEDIMENT. TYPICALLY THIS WILL NEED TO BE PERFORMED WITHIN TWO WEEKS AFTER A STORM EVENT. BRUSHING IS THE PREFERRED METHOD OF CLEANING, EITHER MANUALLY OR MECHANICALLY.
4. THE USE OF ICE MELT, ROCK SALT, SNOW MELT, DE-ICER, ETC. SHOULD BE UTILIZED AS NECESSARY DURING THE WINTER MONTHS AND AFTER A SNOW EVENT TO PREVENT ICE BUILDUP.

REMOVAL

1. REMOVAL OF FODS TRACKOUT CONTROL SYSTEM IS REVERSE ORDER OF INSTALLATION.
2. STARTING WITH THE LAST MAT, THE MAT THAT IS PLACED AT THE INNERMOST POINT OF THE SITE OR THE MAT FURTHEST FROM THE EXIT OR PAVED SURFACE SHOULD BE REMOVED FIRST.
3. THE ANCHORS SHOULD BE REMOVED.
4. THE CONNECTOR STRAPS SHOULD BE UNBOLTED AT ALL LOCATIONS IN THE FODS TRACKOUT CONTROL SYSTEM.
5. STARTING WITH THE LAST MAT IN THE SYSTEM, EACH SUCCESSIVE MAT SHOULD THEN BE MOVED AND STACKED FOR LOADING BY FORKLIFT OR EXCAVATOR ONTO A TRUCK FOR REMOVAL FROM THE SITE.

APPENDIX E

BMP T5.30 – Full Dispersion

BMP T5.30: Full Dispersion

Purpose and Definition

This BMP allows for "fully dispersing" runoff from impervious surfaces and cleared areas of Project Sites into areas preserved as forest, native vegetation, or cleared area.

Ecology accepts Full Dispersion as meeting I-3.4.5 MR5: On-Site Stormwater Management, I-3.4.6 MR6: Runoff Treatment, and I-3.4.7 MR7: Flow Control. Sites that can fully disperse are not required to provide additional Runoff Treatment or Flow Control BMPs. Hard surfaces that are not fully dispersed should be partially dispersed to the maximum extent practicable.

The project will use Full Dispersion for the north portion of the improvements designated as TDA 1 within the report. By meeting the requirements of this BMP, MR #5, #6, & #7 will be considered to have been met with no additional measures required.

Applications and Limitations

The site (or area of the site) that is applying full dispersion per this BMP must be laid out to allow the runoff from the impervious (or cleared) surface to fully disperse into the preserved dispersion area. (i.e. Have full access to and not be intercepted by pipe(s), ditch(es), stream(s), river(s), pond(s), lake (s), or wetland(s)).

The runoff from the north portion of the improvements will disperse to the north which slopes away from the improvements with no pipes, ditches, streams, rivers, ponds, lakes, or wetlands within the preserved dispersion area.

Projects that successfully apply this BMP on all or a portion of their site will decrease effective imper- vious surfaces, and may avoid triggering the TDA Thresholds in I-3.4.7 MR7: Flow Control.

The use of this BMP will completely eliminate the effective impervious areas and disturbed areas with respect to MR#7, Flow Control.

A site (or an area of a site) that applies full dispersion per this BMP consists of the following ele- ments:

- **An impervious (or cleared) area**. The impervious (or cleared) area is the area that the design is mitigating for by using this BMP.
    - TDA 1 consists of 15,854 sf of hard surface and 8,314 sf of additional cleared area to be landscaped as the areas to be mitigated by the use of this BMP.
- **A flow spreader.** Runoff from the impervious (or cleared) area may need to be routed through a flow spreader (see V-1.4.2 Flow Spreaders), depending on the site layout and type of impervious surface, as further described below.
    - A dispersion trench per the Pierce County detail will be used as a flow spreader for flows from the majority of the TDA. 3,253 sf of lawn/landscaped area will have sheet flow dispersion to the preserved

dispersion area.

- **A dispersion area.** This area defines the limits of the Full Dispersion BMP. The impervious (or cleared) area must disperse into the preserved dispersion area.
    - The dispersion area must be forest, native vegetation, or a cleared area depending on the site type. Details are provided below for what amount of vegetation the dispersion area must contain based on site type.
        - The north portion of the project site will be preserved as the dispersion area and is in a forested/native condition.
    - If the dispersion area must be preserved as forest or native vegetation, it may be a pre- viously cleared area that has been replanted in accordance with Native Vegetation Landscape Specifications (below).
        - The dispersion area has not been cleared and there is no need for replating.
    - The dispersion area should be situated to minimize the clearing of existing forest cover, to maximize the preservation of wetlands (though the wetland area and any streams and lakes do not count as part of the dispersion area), and to buffer stream corridors.
        - The dispersion area is downstream of the proposed improvements and there is no need for any clearing of existing forest cover within the dispersion area.
    - The dispersion area should be placed in a separate tract or protected through recorded easements for individual lots.
        - An easement will be placed over the required dispersion area.
    - The dispersion area should be shown on all property maps and should be clearly marked during clearing and construction on the site.
        - The dispersion area is shown on the construction drawings. Silt fence as required for erosion control will be placed on the edge of the dispersion area to function as marking the edge of the dispersion area for protection from clearing and construction activities.
    - All trees within the dispersion area at the time of permit application shall be retained, aside from:
        - dangerous or diseased trees, and
        - approved timber harvest activities regulated under WAC Title 222. Class IV Gen- eral Forest Practices that are conversions from timberland to other uses are not acceptable for the preserved area.
            - No trees or other disturbance of the dispersion area is proposed.
    - The dispersion area may be used for passive recreation and related facilities, including pedestrian and bicycle trails, nature viewing areas, fishing and

camping areas, and other similar activities that do not require permanent structures. Cleared areas and areas of compacted soil associated with these areas and facilities must not exceed eight percent of the dispersion area.

- No passive recreation facilities area proposed at this time.

- The dispersion area may contain utilities and utility easements, but not septic systems. For the purpose of this BMP, utilities are defined as potable and wastewater under- ground piping, underground wiring, and power and telephone poles.

  - There are no existing or proposed utilities within the dispersion area.

- The dispersion area is not allowed in critical area buffers or on slopes steeper than 20%. Dispersion areas proposed on slopes steeper than 15% or within 50 feet of a geo- logically hazardous area (RCW 36.70A.030(5)) must be approved by a geotechnical engineer or engineering geologist.

  - There are small areas at the south end of the dispersion area that are between 15 and 20% slopes. The geotechnical engineer for the project has approved these slopes within the dispersion area. See letter at end of this appendix.

- For sites with on-site sewage disposal systems, the discharge of runoff from the dis- persion area must be located downslope of the primary and reserve drainfield areas. This requirement may be waived by the permitting jurisdiction if site topography clearly prevents discharged flows from intersecting the drainfield.

  - The site does not have on-site sewage disposal.

- **A flow path through the dispersion area.** The length of the flow path from the impervious (or cleared) area through the dispersion area varies based on the site layout and type of imper- vious surface, as further described below. Regardless of the site layout and type of impervious surface, the flow path must meet the following criteria:

  - The slope of the flow path must be no steeper than 15% for any 20-foot reach of the flow path. Slopes up to 20% are allowed where flow spreaders are located upstream of the dispersion area and at sites where vegetation can be established.

    - There area small areas of greater than 15% slope on the sheet flow flowpath, but they are less than 20 feet long.

  - The flow paths from adjacent flow spreaders must be sufficiently spaced to prevent overlap of flows in the flow path areas.

    - Only a single flow spreader is proposed so no overlapping flowpaths.

The dispersion of runoff must not create flooding or erosion impacts.

The length of the flowpath through the dispersion area, and the calculated flow rates are such that no flooding or erosion impacts will occur. The area is well vegetated, the slopes are relatively flat, and the dispersion area itself is within a 100-year floodplain created by the Puyallup River so that drainage from the site could not exacerbate the flood condition.

Minimum Design Requirements for Residential Projects

THESE REQUIREMENTS WILL BE APPLIED TO THIS PROJECT

Rural single family residential developments should use this BMP wherever possible to minimize effective impervious surfaces.

Full Dispersion from Impervious Surfaces in Residential Projects

Impervious surfaces within residential projects may be "fully dispersed" if they are within a TDA that is less than 10% impervious. If the TDA has more than 10% impervious area, the design may still fully disperse up to 10% of the TDA's area. The impervious areas that are beyond the 10% cannot drain to the dispersion area, and are subject to the thresholds in I-3.4.6 MR6: Runoff Treatment and I-3.4.7 MR7: Flow Control.

The area of the TDA owned by the applicant totals 159,332 sf. The total impervious proposed in TDA 1 is 15,854 sf. The proposed impervious is 9.95% of the TDA, meeting the requirement.

The lawn and landscaping areas associated with the impervious area being mitigated may be dis- persed into the dispersion area. The lawn and landscaped area must comply with BMP T5.13: Post- Construction Soil Quality and Depth.

Internal parking lot landscaping will be collected in the conveyance system and routed to the dispersion trench. A small area will sheet flow directly into the dispersion area.

The dispersion area must be preserved as forest or native vegetation.

The dispersion area is forest/native vegetation and will be undisturbed.

The dispersion area shall have a minimum area 6.5 times the area of the impervious surface draining to it.

6.5 times the impervious area of 15,854 is 103,051 sf. 103,095 sf will be set aside as the dispersion area within an easement.

The flow path from the impervious surface through the area preserved as forest or native vegetation must be at least 100 feet in length, or 25 feet for sheet flow from lawn and landscaping areas asso- ciated with the impervious area being mitigated.

The available flowpath length is over 400 feet.

The following additional guidelines must be followed for the following types of impervious surfaces within residential projects:

- **Full dispersion from roof surfaces:** Runoff from roof surfaces must either:
    - Provide dispersion BMPs as described in BMP T5.10B: Downspout Dispersion Sys- tems prior to the runoff entering the dispersion area. The dispersion area and flow path must meet the criteria described in this BMP.

or

    - Combine the roof runoff with the road runoff, and follow the guidance for full

dispersion from roadway surfaces (below).

- Runoff will be collected and dispersed as explained below.

- **Full dispersion from driveway surfaces:** Runoff from driveway surfaces must either:
  - Provide dispersion BMPs as described in BMP T5.11: Concentrated Flow Dispersion and BMP T5.12: Sheet Flow Dispersion prior to the runoff entering the dispersion area. The dispersion area and flow path must meet the criteria described in this BMP.

or

  - Combine the driveway runoff with the road runoff, and follow the guidance for full dis- persion from roadway surfaces (below).
    - Runoff will be collected and dispersed as explained below.

- **Full Dispersion from Roadway Surfaces:** Runoff from roadway surfaces comply with all of the following requirements:
  - The road section shall be designed to minimize collection and concentration of roadway runoff. Sheet flow over roadway fill slopes (i.e., where roadway subgrade is above adja- cent right-of-way) should be used wherever possible to avoid concentration.
    - Not applicable
  - When it is necessary to collect and concentrate runoff from the roadway and adjacent upstream areas (e.g., in a ditch on a cut slope), concentrated flows shall be incre- mentally discharged from the ditch via cross culverts or at the ends of cut sections. These incremental discharges of newly concentrated flows shall not exceed 0.5 cfs at any one discharge point from a ditch for the 100-year runoff event. Where flows at a par- ticular ditch discharge point were already concentrated under existing site conditions (e.g., in a natural channel that crosses the roadway alignment), the 0.5-cfs limit would be in addition to the existing concentrated peak flows.
    - The 100-year peak flow is approximately 0.38 cfs, meeting the 0.5 cfs limit.
  - Ditch discharge points with up to 0.2 cfs discharge for the peak 100-year flow shall use rock pads or dispersion trenches to disperse flows into the dispersion area. Ditch dis- charge points with between 0.2 and 0.5 cfs discharge for the 100-year peak flow shall use dispersion trenches to disperse flows into the dispersion area. See V-1.4.3 Outfall Systems for details on rock pads and dispersion trenches.
    - A dispersion trench will be used for the approximately 0.38 cfs 100-year flow from the project.
    - Dispersion trenches shall be designed to accept surface flows (free discharge) from a pipe, culvert, or ditch end, shall be aligned perpendicular to the flowpath, and shall have a minimum 2 feet by 2

cross section, 50 feet in length, filled with 3/4-inch to 1 1/2-inch washed rock, and provided with a level notched grade board. Manifolds may be used to split flows up to 2 cfs discharge for the 100-year peak flow between up to 4 trenches. Dispersion trenches shall have a minimum spacing of 50 feet between centerlines.

- The Pierce County dispersion trench detail will be used. The trench will be 50 feet long, width will be 2 feet plus pipe diameter. Rock and grade board meeting above conditions will be used.

- Where the Local Plan Approval Authority determines there is a potential for significant adverse impacts downstream (e.g., erosive steep slopes or existing downstream drain- age problems), dispersion of runoff from roadway surfaces may not be allowed, or other measures may be required.
  - We do not feel the conditions warrant any additional measures.

Full Dispersion from Cleared Areas in Residential Projects

The runoff from cleared areas of residential projects that are comprised of bare soil, non-native land- scaping, lawn, and/or pasture is "fully dispersed" if it meets all of the following criteria:

- Cleared areas must comply with BMP T5.13: Post-Construction Soil Quality and Depth.
  - All disturbed areas will meet this requirement as required by City of Puyallup.
- The dispersion area must be preserved as forest or native vegetation.
  - The dispersion area is forest/native and will not be disturbed.
- The flow path through the cleared area (and leading to the dispersion area) must not be greater than 25 feet.
  - The flow path through the cleared area is less than 25 feet.
- If the cleared area has a width of up to 25 feet:
  - The minimum flow path length from the cleared area through the dispersion area must be at least 25 feet.
    - The dispersion area has an available flowpath length of over 400 feet.
- If the cleared area has a width of 25 to 250 feet:
  - The minimum flow path length from the cleared area through the dispersion area must be 25 feet, plus an additional 1 foot for every 3 feet of width of the cleared area (beyond the initial 25 feet) up to a maximum width of 250 feet.
    - Not applicable.
- The topography of the cleared area must be such that runoff will not concentrate prior to dis- charge to the dispersion area.

- The cleared area is an even slope.

- The width of the dispersion area must equal the width of the cleared area.
  - The available dispersion area is much wider than the cleared area.

Minimum Design Requirements for Public Road Projects

NOT APPLICABLE. SECTION DELETED.

Native Vegetation Landscape Specifications

These specifications may be used in situations where an applicant wishes to convert a previously developed surface to a native vegetation landscape for purposes of meeting full dispersion require- ments or code requirements for forest retention. Native vegetation landscape is intended to have the soil, vegetation, and runoff characteristics approaching that of natural forestland.

NO CONVERSION PROPOSED, THEREFORE THIS SECTION IS NOT APPLICABLE AND HAS BEEN DELETED.

Runoff Model Representation

Areas that are fully dispersed do not have to use approved runoff models to demonstrate compliance. They are presumed to fully meet the Runoff Treatment and Flow Control requirements in I-3.4.6 MR6: Runoff Treatment and I-3.4.7 MR7: Flow Control.

Since all disturbed areas within TDA 1 will be fully dispersed, no hydrologic analysis of TDA 1 is required.

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November 1, 2024

Taco Time Northwest
3401 Lind Avenue SW
Renton, Washington 98057

Attn: Robby Tonkin
(206) 499-1360
rtonkin@tacotimenw.com

Geotechnical Analysis Letter
Stormwater Dispersion
1115 & 1129 East Main
Puyallup, Washington
PN: 7845100032 & 0420271171
Doc ID: TacoTimeNorthwest.EMainSt.SR.doc

This *Geotechnical Analysis Letter* provides recommendations for stormwater dispersion on slopes steeper than 15 percent for the proposed restaurant and parking area to be constructed at 1115 & 1129 East Main in Puyallup, Washington. We previously prepared an *Updated Soils Report* dated February 3, 2023. Based on our correspondence with Azure Green Consultants and our review of the updated site plan prepared by Azure Green Consultants dated November 1, 2024, we understand that the project is currently proposing to utilize full dispersion. This will include dispersing stormwater via a 50-foot dispersion trench on slopes between 15 and 20 percent. As such, we have been requested to provide our opinion on the feasibility of dispersing stormwater on these slopes.

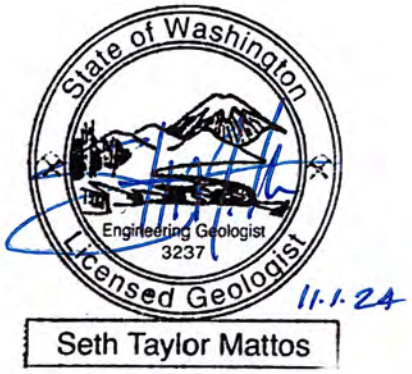
Based on the findings in our 2023 *Soils Report*, the infiltration of stormwater at the site is limited because of the variability in fines content of the soil. As such, we understand full dispersion is being proposed in the northern portion of the parcel on slopes between 15 and 20 percent. During our previous site visits, the central and northern portions of the property were vegetated with a moderately dense understory of native and invasive plants and shrubs with a moderately dense stand of coniferous and deciduous trees. Provided the dispersion trenches are appropriately designed, and construction is completed in accordance with the 2019 Stormwater Management Manual for Western Washington, It is our opinion that the overall impact to the stability of the slope should be minimal. Provided the appropriate temporary and permanent erosion control Best Management Practices (BMPs) are implemented into the design, there should be no significant impact to the slope from erosion. If conditions are altered or if soils should become exposed, it may be necessary to provide additional BMPs to mitigate the potential for erosion. These BMPs include, but are not limited to, BMP's C120 through C130 in Volume II of the 2019 Stormwater Management Manual for Western Washington.

Our review of the above mentioned plans focused on geotechnical aspects of the proposed development, and we trust that this letter is sufficient for your current needs.

◆ ◆ ◆

We have appreciated the opportunity to be of service to you on this project. If you have any questions or comments, please do not hesitate to call at your earliest convenience.

Respectfully submitted,
GeoResources, LLC



Kyle Billingsley, PE
Senior Geotechnical Engineer

Seth T. Mattos, LEG
Associate

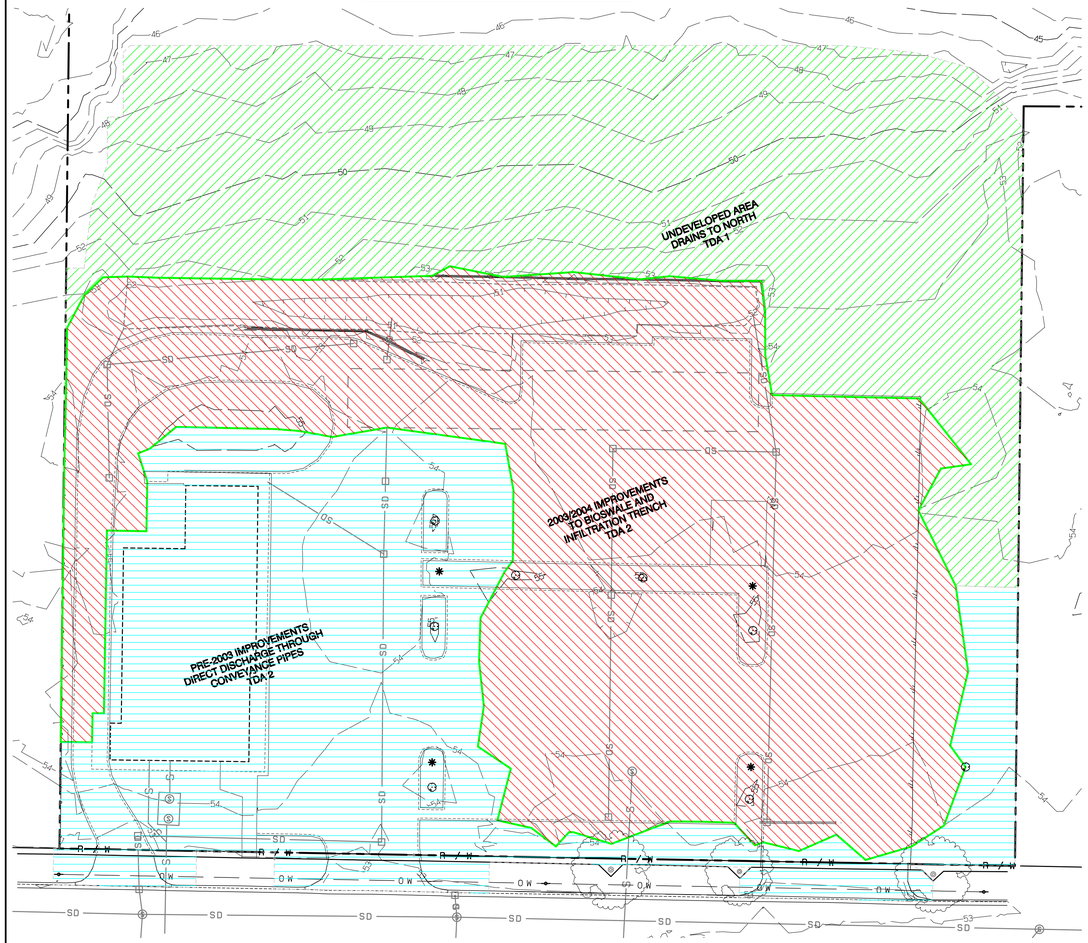
KEB:STM/keb
DocID: TacoTimeNorthwest.EMainSt.SRa

GEORESOURCES

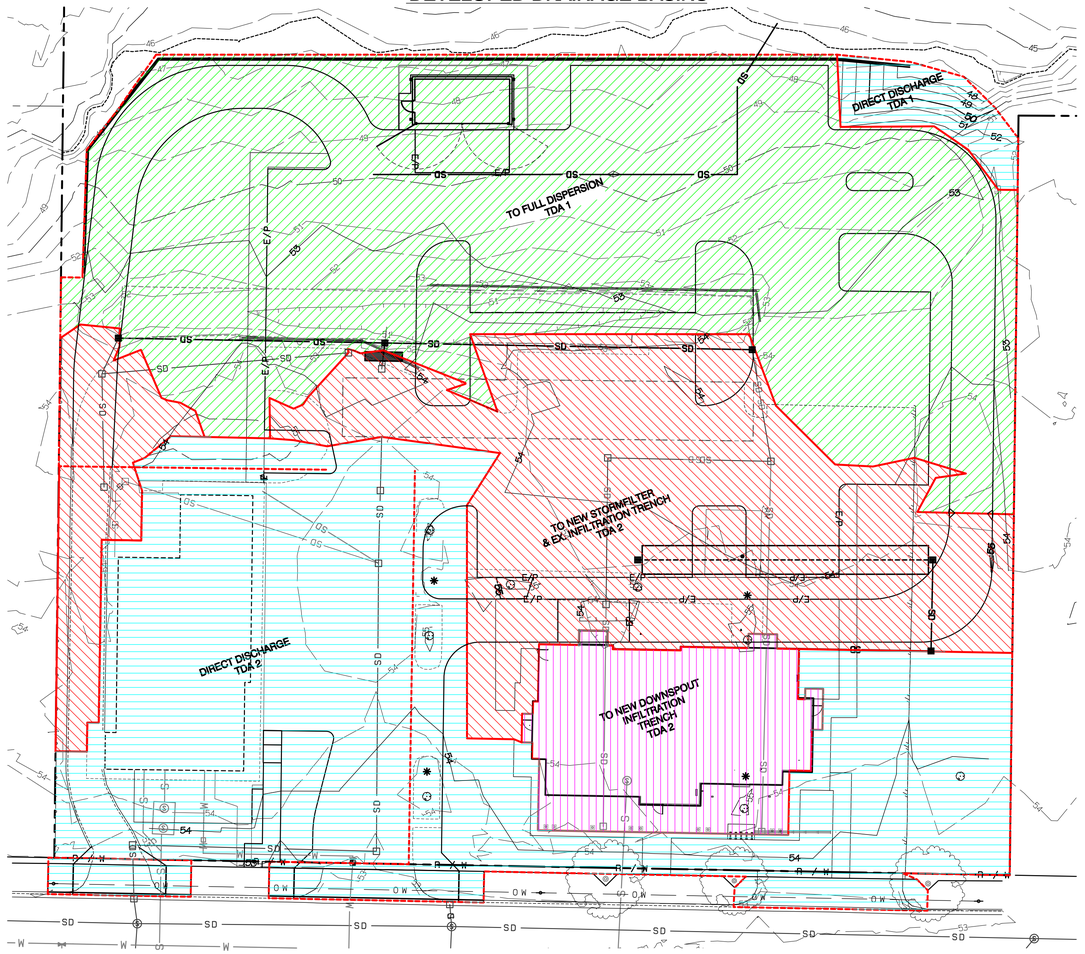
Taco Time

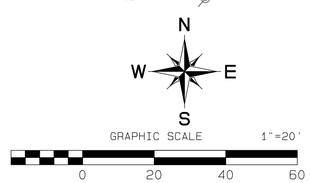
Section 27, Township 20 N, Range 4 E, Willamette Meridian, Pierce County, Washington

EXISTING DRAINAGE BASINS



DEVELOPED DRAINAGE BASINS





EXISTING		
EX. TO NORTH/TDA 1-POC 1	sf	acre
C, Forest, Flat	3662	0.0841
C, Forest, Mod	15745	0.3615
C, Lawn, Flat	586	0.0135
Total	19993	0.4590

PRE-2003 IMPROVEMENTS		
DIRECT DISCHARGE TO SOUTH/TDA 2-POC 2		
Existing	Area (sf)	acre
C, Lawn, Flat	4401	0.1010
Roof	3625	0.0832
Paving	8532	0.1959
Walk	197	0.0045
Total impervious	12354	0.2836
Total	16755	0.3846

2003/2C04 IMPROVEMENTS		
TO BIOSWALE AND INFIL./TDA 2-POC 2		
Existing	Area (sf)	acre
C, Lawn, Flat	5278	0.1212
Paving	19303	0.4431
Total	24581	0.5643

DEVELOPED		
TO FULL DISPERSION/TDA 1 - POC 1	sf	acre
C, Lawn, Flat	8314	0.1909
New Roof	648	0.0149
Walk, Flat	720	0.0165
Paving, Flat	14486	0.3326
Total Impervious	15854	0.3640
Total Hard Surface	15854	0.3640
Total	24168	0.5548

TO ROOF D.S. INFIL.		
TRENCH/TDA 2-POC 2	sf	acre
Roof	3941	0.0905
DIRECT DISCHARGE/TDA 2-POC 2		
	sf	acre
C, Lawn, Flat	4731	0.1086
Roof	3625	0.0832
Paving	6039	0.1386
Walk	3256	0.0747
Total Impervious	12920	0.2966
Total	17651	0.4052

TO STORMFILTER & EX.		
INFIL./TDA 2-POC 2	sf	acre
C, Lawn, Flat	3353	0.0770
Paving, Flat	9564	0.2196
Walk, Flat	589	0.0135
Total Impervious	10153	0.2331
Total	13506	0.3101

11/4/2024
ROBERT A. TRIVITT
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER
20745

REVISION	DATE
1 Revised per City review.	4/17/23
2 Revised per City review/permeable pavement.	6/17/24
3 Revised for full dispersion.	11/3/24
4	
5	
6	
7	
8	
9	
10	

JOB NO. 2935 2023
DESIGNED BY: Paul Green
DRAWN BY: Rob Trivitt
CHECKED BY: JIA Job
APPROVED BY: Paul Green

AZURE GREEN CONSULTANTS
409 East Pioneer, Suite A • Puyallup, WA 98372 phone: 253.770.3144 fax: 253.770.3142
+feasibility +planning +engineering +surveying

Drainage Basin Map

Taco Time

Puyallup TT, LLC
3401 Lind Ave SW
Renton, WA. 98057
Phone 206.255.3633
Fax rtonkin@tacotimenw.com

DRAWING
D-1
SHEET 1
OF 1

Project Desc: Taco Time Path: F:\Jobs\2935 - Taco Time\Tech\Taco 2024 1104.pro Plot Date/Time: 11/4/2024 8:37:03AM