



# Arlington Garden Apartments

Arlington, Washington

## Stormwater Drainage Report

September 2025 | Report





# Stormwater Drainage Report

September 2025

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# 1. Project Overview

This report describes required and proposed storm drainage measures for the Arlington Garden Apartments Development. The project is subject to the Department of Ecology (Ecology) 2024 Stormwater Management Manual for Western Washington (SWMMWW) as amended by the City of Arlington (City) 2010 Comprehensive Stormwater Plan.

The project site is located at 21117 59th Avenue Northeast, Arlington, Washington, 98223, parcel number 31051000402700. The property borders existing large residential lots and pasture to the east, pasture and a stream approximately 125-feet to the south, 59th Avenue Northeast to the west, and State Route 530 (SR530) to the north (Figure 1-1).

The project site is approximately 8.81 acres and is entirely vegetated with pasture with sparse trees on the perimeter. The project will be phased. Phase 1 proposes to construct 206 apartment homes across 5 three-story residential buildings and 3 mixed-use buildings surrounding a central clubhouse and outdoor pool/spa area. This proposal includes approximately 12,000 square feet of retail/commercial space across 3 mixed-use buildings, along with associated and requisite parking, open space and recreation space, road extensions and improvements, and utility extensions and services on a single parcel of 8.81 acres. Phase 2 proposes one building up to 3,300 square feet commercial space on Lot 1 along with requisite parking, open space, and utility connections. Phase 2 will likely be developed after Phase 1 is complete and occupied.

The site has less than 35 percent of hardscape coverage; therefore, the project is classified as “New Development” per the SWMMWW.



Figure 1-1: Site Vicinity Map

## 2. Existing Conditions

The project site is located at the northwest corner of the incorporated area of the City of Arlington. As previously noted, the parcel is currently undeveloped and consists of pasture lands with sparse trees and shrubs. The site is generally flat with a difference of only approximately 4 feet across the site with slopes generally southeast to northwest. The properties north and west of the site across public rights-of-way (ROW) are primarily rural farmland.

The flat site results in micro-low points scattered throughout the property with typical slopes of less than 2 percent. There are no existing drainage structures or facilities within the property boundaries. Given these numerous micro-low points, stormwater is generally assumed to infiltrate on-site, with potential sheet flow off-site during peak storm events.

The 59th Avenue Northeast ROW along the west edge of the site is improved with a rural, crowned, asphalt road section with roadside ditch. The SR530 ROW along the north edge of the site is improved with a rural, crowned, asphalt highway section with roadside ditches on both sides. Existing land-use areas are depicted in Appendix A.

As previously noted, a stream runs roughly parallel to the south property boundary 125 feet or more off-site. A large associated wetland complex partly extends onto the southeast corner of the site (Figure 2-1). See the Wetland and Fish and Wildlife Habitat Assessment Report by Soundview Consultants submitted concurrent with this report.



Figure 2-1: Wetland and Stream Map (Soundview Consultants, Wetland Report 2025)

According to the Geotechnical Feasibility Report by PanGEO dated July 25, 2024 (Appendix F), the site is generally weathered over Quaternary younger alluvium, Marysville sand member, and Vashon till. Groundwater was encountered on-site between 3 to 5 feet below ground level.

# 3. Off-Site Analysis Report

## DOWNSTREAM ANALYSIS

Based on the previously mentioned numerous micro-low points on-site, generally flat topography, observations of the soil conditions, discontinuous drainage ditches where they are present, and absence of wetlands on most of the site, we presume that rainfall readily infiltrates for most of the site. The geotechnical investigation by PanGeo noted soils with higher fine contents in the southeast corner of the site approaching the mapped wetland area, and we also note that this portion of the site does have two drainage ditches routing a portion of the site runoff down into the wetland area (Figure 3-1), and so we infer there is some shallow concentrated flow as well as potentially sheet flow off-site to the south.

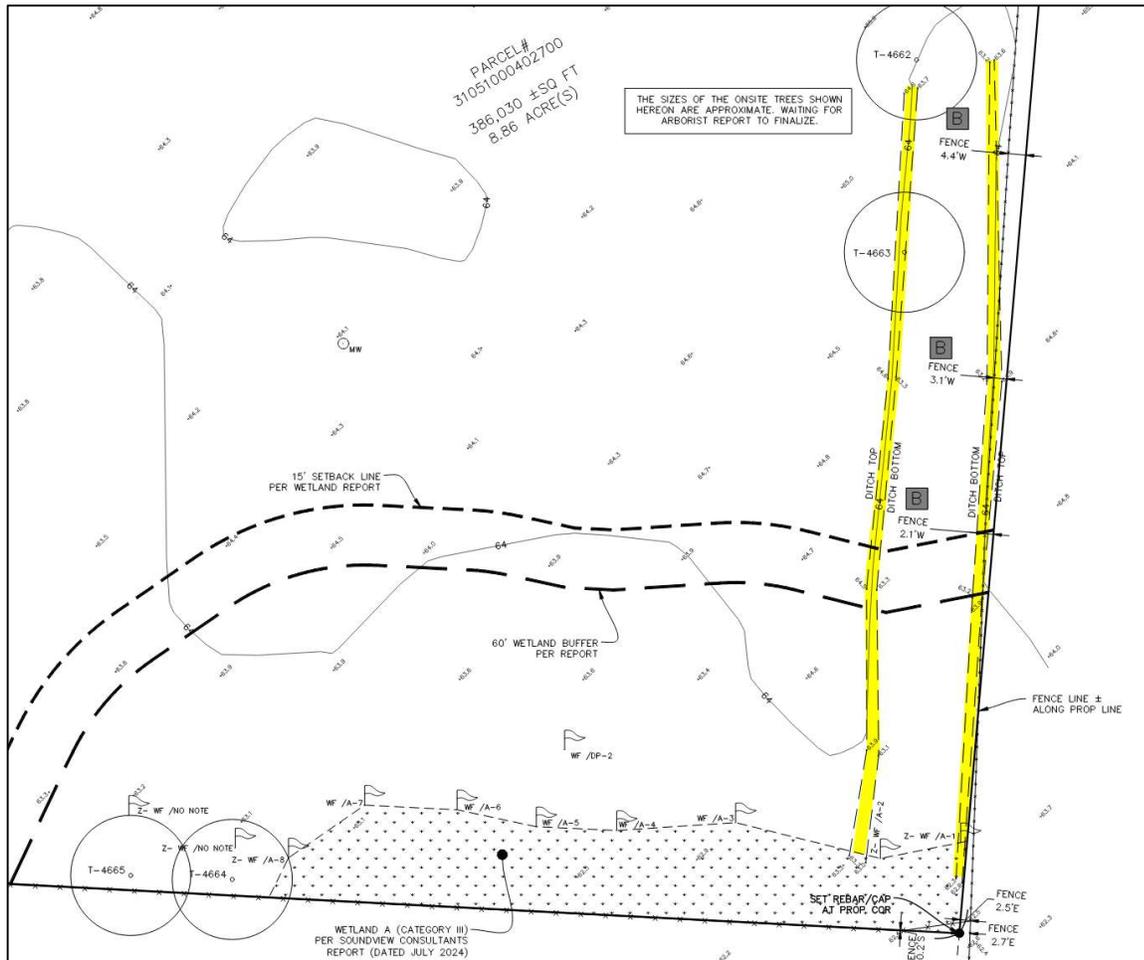


Figure 3-1: Surveyed Ditches in Southeast Area of Site (from ALTA by Terrane, 2024)

KPFF visited the site to observe the on-site and off-site drainage conditions on July 5, 2024, under dry weather conditions. The downstream flow path appears substantially overgrown with blackberry bramble and, except where it crosses 59th Avenue Northeast, is on private property. Therefore, except for what we could observe from 59th Avenue Northeast, we relied heavily on public information. From what we could observe from the ROW, the stream is generally silty and slow moving or standing water with no apparent scouring or clear channel (Figure 3-2). The stream is unnamed. The project biologist has categorized it as Type F-ESA.



**Figure 3-2: Portion of Stream Channel with Standing Water**

Based on a review of Snohomish County critical area GIS mapping, the downstream flow path is entirely within seismic, erosion, and lahar-hazard zones. The unnamed creek has associated wetlands intermittently along its route. At approximately 0.6 miles downstream the flow path enters mapped, 100-year FEMA floodplain, and at approximately 1.6 miles downstream the flow path enters Portage Creek (Figure 3-3). Portage Creek eventually joins the Stillaguamish River.

The intent of the project is to fully infiltrate on-site stormwater runoff, and we did not observe any downstream flooding, erosion, or other hazards that would be exacerbated by our project proposal.

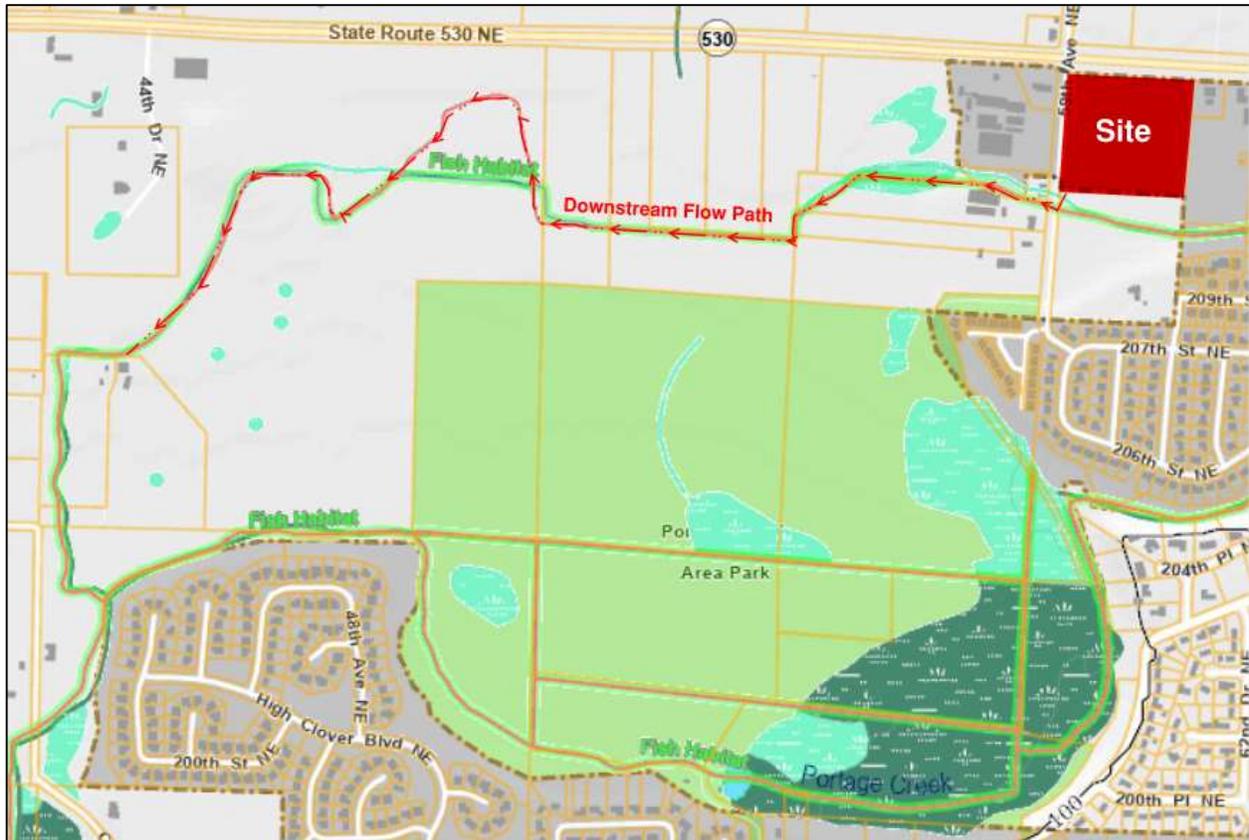


Figure 3-3: Downstream Flow Path

## UPSTREAM ANALYSIS

Portions of the adjacent property to the east appear to sheet flow to the previously mentioned ditch near the shared boundary in the southeast corner of the site (Figure 3-1). Development plans will construct a trench drain along this area that will collect and convey this off-site flow back to the portion of the ditch to remain at the edge of the wetland buffer.

Roadside ditches along the SR530 frontage and beyond collect off-site runoff and route it to a low point at approximately the mid-point on the north frontage of the site (Figure 3-4). This area is a closed contour or closed depression, and this runoff appears to infiltrate within the depression. The invert of the culvert does not allow for 3 feet of separation from groundwater, so the off-site runoff will be collected and routed to the stream to the south. This is described further in Section 7 below.

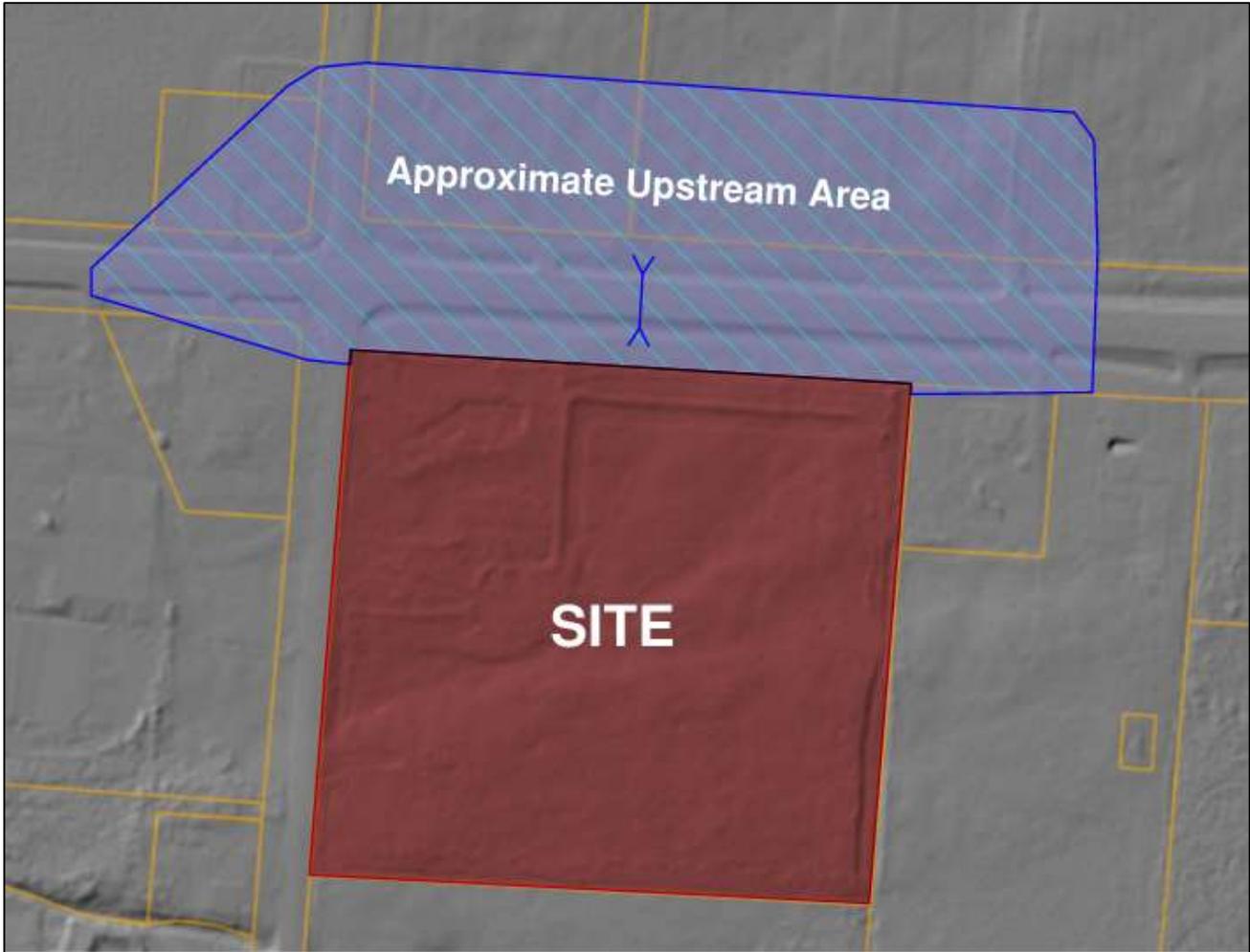


Figure 3-4:Upstream Contributing Area

## 4. Developed Conditions

### DEVELOPMENT

The project will be phased. Phase 1 proposes to construct 206 apartment homes across 5 three-story residential buildings and 3 mixed-use buildings surrounding a central clubhouse and outdoor pool/spa area. This proposal includes approximately 12,000 square feet of retail/commercial space across 3 mixed-use buildings, along with associated and requisite parking, open space and recreation space, road extensions and improvements, and utility extensions and services on a single parcel of 8.81 acres. Phase 2 proposes one building up to 3,300 square feet commercial space on Lot 1 along with requisite parking, open space, and utility connections. Phase 2 will likely be developed after Phase 1 is complete and occupied. Developed land-use areas are depicted in Appendix B.

As documented in the next section, the development is subject to all nine minimum requirements (MRs). The developed site is divided into nine sub-basins with separate facilities to meet MRs 5–7 for each sub-basin. These sub-basins are depicted in Figure 4-1 below and summarized in Table 4-1. The basin delineation exhibit is also shown in greater detail in Appendix C. Subsequent sections will describe how MRs are met for each sub-basin or the site as a whole.

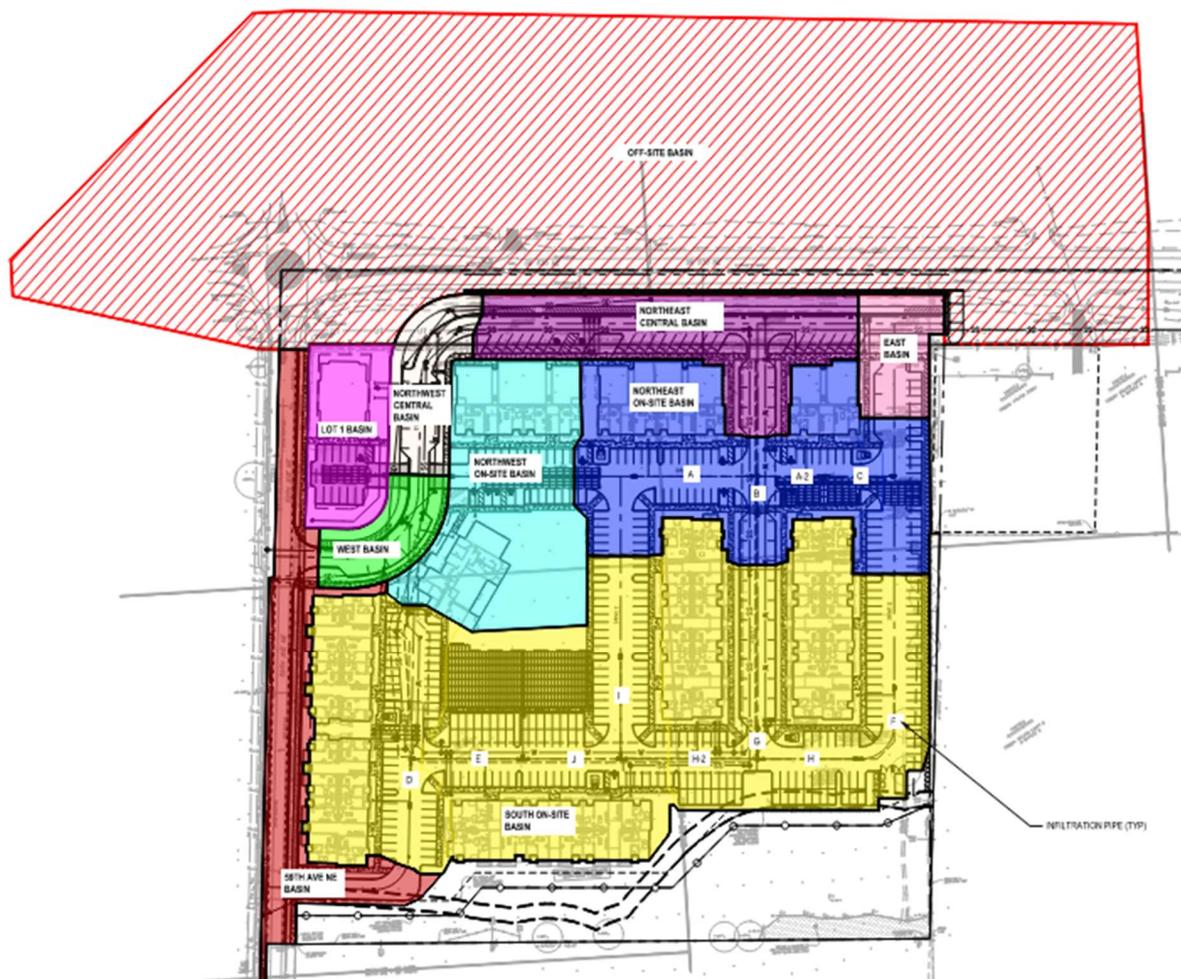


Figure 4-1: Infiltration Sub-Basins

**Table 4-1: Sub-Basin Area Summaries**

| Land Use  | Area (SF)      | Area (Ac)    |
|---|----------------|--------------|
| <b>Northeast On-Site Sub-Basin</b>              |                |              |
| Landscape                                       | 7,716          | 0.177        |
| Impervious                                      | 48,930         | 1.123        |
| <b>Subtotal</b>                                 | <b>56,646</b>  | <b>1.300</b> |
| <b>Northwest On-Site Sub-Basin</b>              |                |              |
| Landscape                                       | 6,528          | 0.150        |
| Impervious                                      | 32,136         | 0.738        |
| <b>Subtotal</b>                                 | <b>38,654</b>  | <b>0.887</b> |
| <b>South On-Site Sub-Basin</b>                  |                |              |
| Landscape                                       | 20,768         | 0.477        |
| Impervious                                      | 143,524        | 3.295        |
| <b>Subtotal</b>                                 | <b>164,291</b> | <b>3.772</b> |
| <b>West Bioretention Sub-Basin</b>              |                |              |
| Landscape                                       | 2,234          | 0.051        |
| Impervious                                      | 7,158          | 0.164        |
| <b>Subtotal</b>                                 | <b>9,392</b>   | <b>0.216</b> |
| <b>Northwest Central Bioretention Sub-Basin</b> |                |              |
| Landscape                                       | 2,530          | 0.058        |
| Impervious                                      | 9,285          | 0.213        |
| <b>Subtotal</b>                                 | <b>11,815</b>  | <b>0.271</b> |
| <b>Northeast Central Bioretention Sub-Basin</b> |                |              |
| Landscape                                       | 6,060          | 0.139        |
| Impervious                                      | 24,645         | 0.566        |
| <b>Subtotal</b>                                 | <b>30,705</b>  | <b>0.705</b> |
| <b>East Bioretention Sub-Basin</b>              |                |              |
| Landscape                                       | 2,714          | 0.062        |
| Impervious                                      | 6,841          | 0.157        |
| <b>Subtotal</b>                                 | <b>9,555</b>   | <b>0.219</b> |
| <b>59<sup>th</sup> Ave NE Sub-Basin</b>         |                |              |
| Landscape                                       | 6,299          | 0.145        |
| Impervious                                      | 13,637         | 0.313        |
| <b>Subtotal</b>                                 | <b>19,936</b>  | <b>0.458</b> |
| <b>Lot 1 Sub-Basin</b>                          |                |              |
| Landscape                                       | 7,107          | 0.163        |
| Impervious                                      | 7,851          | 0.180        |
| <b>Subtotal</b>                                 | <b>14,958</b>  | <b>0.343</b> |

# 5. Minimum Requirements

Minimum requirements for new development projects are outlined in Volume I, Chapter 3, Figure I-3.1 of the 2024 SWMMWW. Minimum requirement (MR) thresholds must be considered for each threshold discharge area (TDA). Stormwater either infiltrates on-site or runs off to the unnamed creek to the south; therefore the entire project is treated as a single TDA. As previously noted, the project meets the definition of “New Development.”

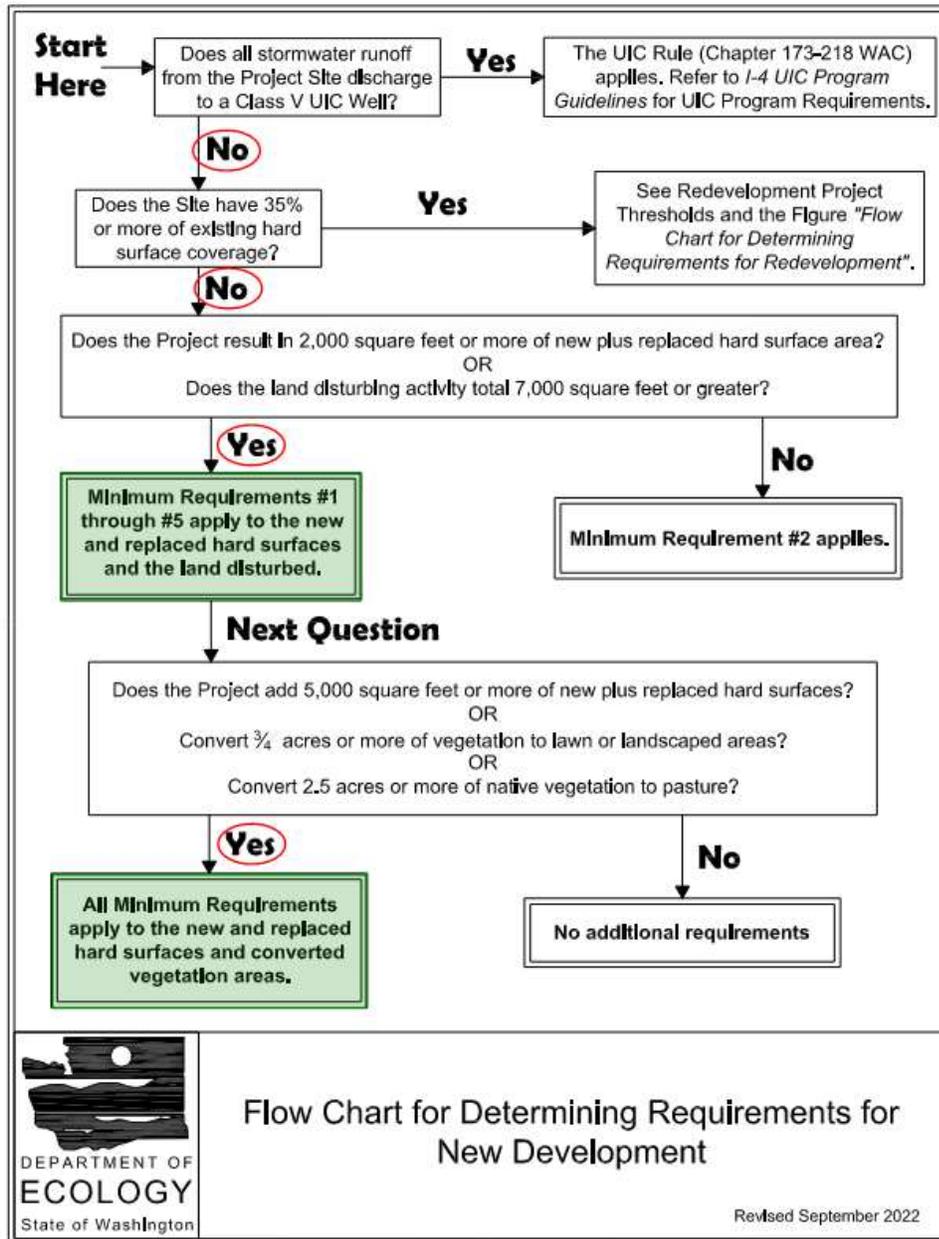


Figure 5-1: SWMMWW Figure I-3.1, Annotated for Project Scope

## MINIMUM REQUIREMENT #1 – PREPARATION OF STORMWATER SITE PLANS

This report and the associated Binding Site Plan (BSP) together constitute the preliminary stormwater site plan as defined by Volume I, Chapter 1-3.1 of the SWMMWW.

## **MINIMUM REQUIREMENT #2 – CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN (SWPPP)**

The project is required to have an approved Construction Stormwater Pollution Prevention Plan (SWPPP) and Temporary Erosion and Sediment Control (TESC) plans prior to construction. Refer to Section 10 of this report for the description of project compliance with this MR. A completed SWPPP is included in Appendix H and TESC plans and calculations are included in Appendix G.

## **MINIMUM REQUIREMENT #3 – SOURCE CONTROL OF POLLUTION**

All applicable and recommended source control best management practices (BMPs), as described in Volume 6 of the SWMMWW, are required. Source control BMPs are addressed through the final construction documents, including an Operation and Maintenance Manual. See Section 10 and 13 of this report for additional information.

## **MINIMUM REQUIREMENT #4 – PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND OUTFALLS**

The project proposes to infiltrate all stormwater drainage up to the 100-year storm on-site and install a 4.5-ft detention tank facility within the ROW. In the event of overflow above the 100-year storm, the project will discharge to the existing wetland and creek to the south. The detention tank will discharge to the creek. Therefore, the existing drainage pattern of the property will be preserved. See Section 3 for additional information.

## **MINIMUM REQUIREMENT #5 – ON-SITE STORMWATER MANAGEMENT**

The project is electing to meet the low-impact development (LID) performance standard, which is to demonstrate that the discharge flow duration will match pre-developed conditions for 8 percent to 50 percent of the 2-year recurrence interval storm. This will be achieved through full infiltration of all runoff from rooftop, other hard surfaces, and landscape areas on-site up to the 100-year recurrence interval storm. See Section 7 of this report for additional information. The project will also provide Post-Construction Soil Quality and Depth per BMP T5.13.

## **MINIMUM REQUIREMENT #6 – RUNOFF TREATMENT**

The project does not discharge to a phosphorous sensitive basin or to stream, and only basic treatment is required. This will be accomplished through proprietary filter vaults preceding each infiltration facility. See Section 6 of this report for additional information.

## **MINIMUM REQUIREMENT #7 – FLOW CONTROL**

The project is subject to the Flow Control Performance standard, which is that stormwater discharge shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50 percent of the 2-year recurrence interval storm up to the 50-year recurrence interval storm. This will be accomplished by three different approaches. Runoff collected on-site will be collected in water quality treatment basins before being partially infiltrated through perforated pipe infiltration trench. The perforated pipes will convey any runoff that is not fully infiltrated by the infiltration trenches to downstream infiltration chamber facilities. Runoff collected along the 211<sup>th</sup> Place Northeast will be routed to infiltration bioretention planters along the north of the roadway, which have been sized for 100% infiltration. Runoff that is collected along 59<sup>th</sup> Avenue Northeast will be routed to a detention tank facility. Sizing and calculations for the infiltration and detention facilities are discussed in Section 7 of this report.

## MINIMUM REQUIREMENT #8 – WETLANDS PROTECTION

The on-site wetland is considered a Category II wetland with a Habitat Score of 6 per the Soundview Consultants report dated June 2025. The project is required to provide General Protection, Protection from Pollutants, and Wetland Hydroperiod Protection (Method 2) as described in SWMMWW I-C.2 and C.3 (Figure 5-2). See Section 8 for additional information.

**Figure I-3.5: Flow Chart for Determining Wetland Protection Level Requirements**

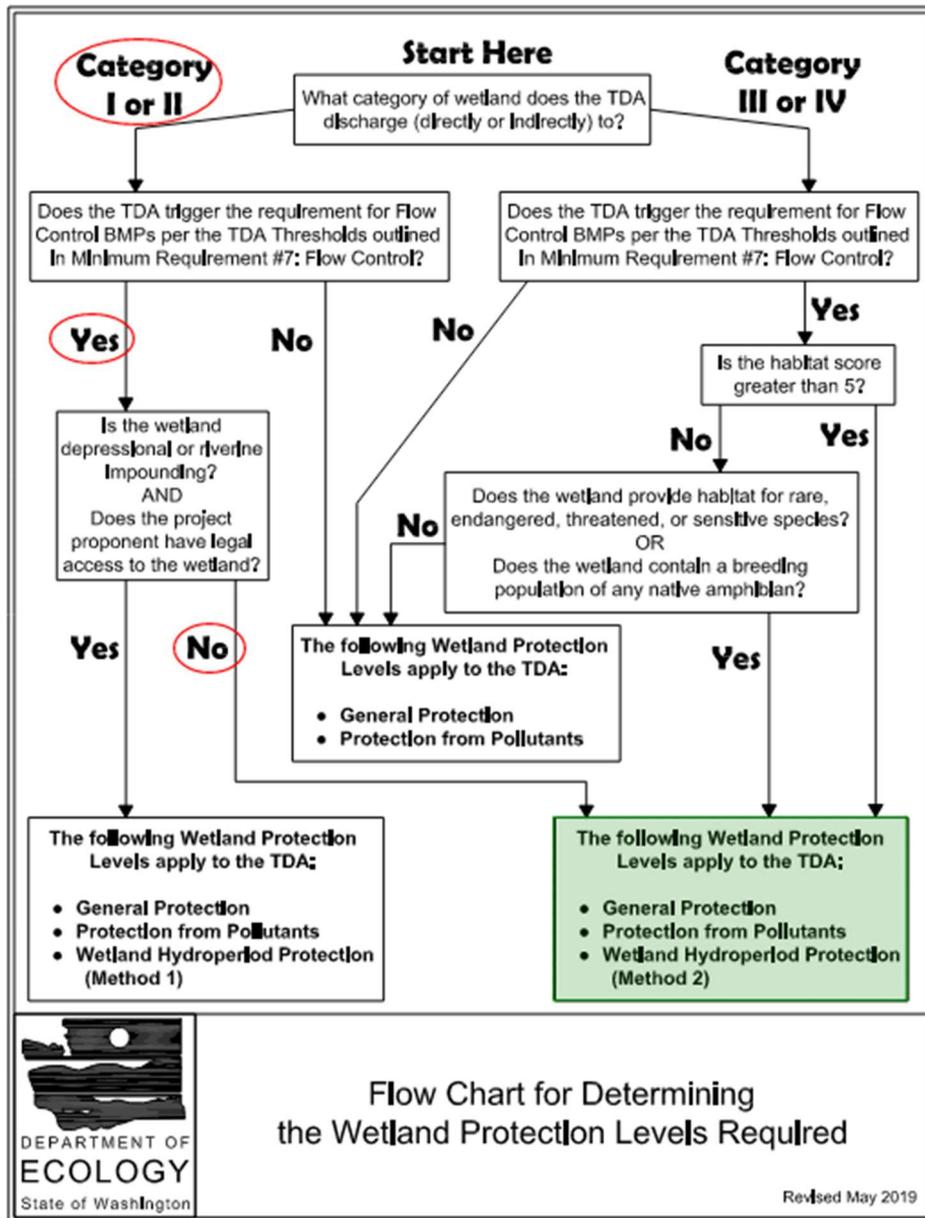


Figure 5-2: SWMMWW Figure I-3.5, Annotated for Project Scope

## MINIMUM REQUIREMENT #9 – OPERATION AND MAINTENANCE MANUAL

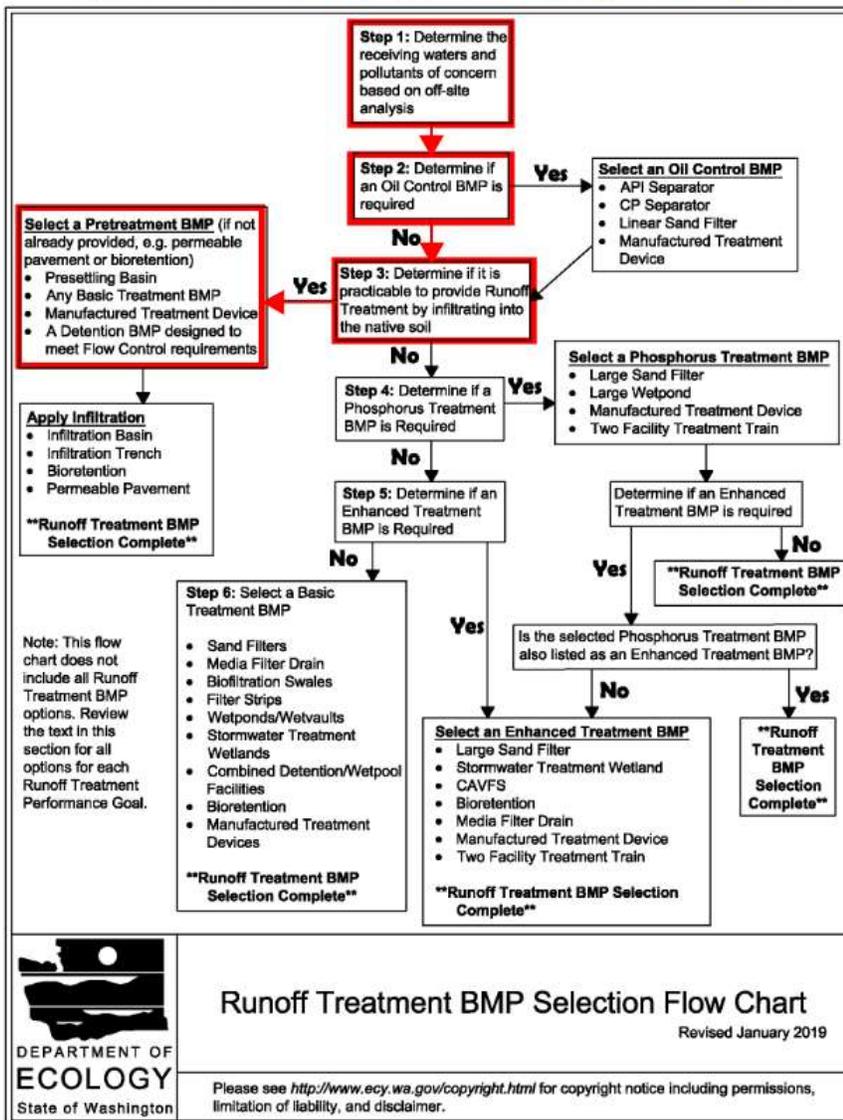
An Operation and Maintenance Manual for public and private stormwater infrastructure will be required. See Section 13 of this report for additional information.

# 6. Runoff Treatment Systems

The proposed project will result in more than 5,000 square feet of pollution-generating hard surface. The project proposes to provide basic runoff treatment through use of infiltration into engineered fill soils and water quality structures., which will meet the Volume V, Chapter 5.6, Site Suitability Criteria per the SWMMWW.

As previously described, stormwater runoff will be collected and conveyed to proprietary filter vaults upstream of each infiltration facility to provide basic water quality treatment. The proprietary wetlands will use Contech Concrete Catch Basin Stormfilter underground vaults. These systems are approved by the Department of Ecology for basic treatment. Each vault is sized to treat 2.1 gallons per minute (gpm) per square foot for basic treatment. The water quality flow rate for the sizing of the proprietary wetlands has been determined using MGSFlood methodology. Vaults were selected with treatment flow rate capacity greater than the water quality flow rate for the contributing area. Further sizing details will be provided as part of the construction document.

**Figure III-1.1: Runoff Treatment BMP Selection Flow Chart**



**Figure 6-1: SWMMWW Figure III-1.1 – Runoff Treatment BMP Selection Flow Chart, Annotated for Project Scope**

## 7. Flow Control Systems

Flow control is accomplished through infiltration trenches and 16-inch-tall ADS chambers onsite, infiltrating bioretention planters along 211<sup>th</sup> Place Northeast, and a detention tank facility along 59<sup>th</sup> Avenue Northeast. A flow control structure will be used to restrict flows from the detention tank facility. The stormwater facilities have been sized using MGSFlood methodology to meet the Flow Control Performance Standard.

Infiltration facilities were modeled with an infiltration rate of 3- to 4.9-inches per hour, per the results of the PITs conducted by the geotechnical engineer. According to the geotechnical engineer’s investigation, seasonal high groundwater is typically 3 to 4 feet below existing grade. The SWMMWW requires a minimum of 5 feet of vertical separation from the bottom of infiltration facilities to the seasonal high groundwater elevation. This separation may be reduced to 3 feet based on the results of a mounding analysis. Refer to the Preliminary Infiltration Evaluation Report prepared by PanGEO dated October 2024 in Appendix F. In order to achieve this minimum separation, even with a shallow infiltration system, the site must be raised 5 to 6 feet on average. Fill material below the infiltration systems and above infiltrative native soils is specified by the geotechnical engineer to facilitate transmission from the facility to the native soils.

Pre-developed conditions must be modeled as forested conditions. Grind and overlay within the ROW were modeled as impervious in pre-developed and developed conditions. The project proposes buffer averaging and enhancement mitigation with densely planted assortment of native trees and shrubs; therefore, the stormwater runoff dispersed and within the stream and wetland buffer areas have been omitted from the flow control model.

Refer to the Pre-Developed Conditions Exhibit in Appendix A, Developed Conditions Exhibit in Appendix B, and Appendix C for MGSFlood model output. The infiltration system for each sub-basin is summarized in Table 7-1 below.

**Table 7-1: Flow Control Facility Summary**

| Sub-Basin                                      | Infiltration System   | Storage Required     | Storage Provided     |
|--|---|----------------------|----------------------|
| Northeast On-Site                              | ADS 16 in. chambers in 6 in. stone bedding                        | 2,372 CF             | 2,372 CF             |
| Northwest On-Site                              | ADS 16 in. chambers in 6 in. stone bedding                        | 2,254 CF             | 2,254 CF             |
| South On-Site                                  | ADS 16 in. chambers in 6 in. stone bedding                        | 6,476 CF             | 6,476 CF             |
| West Bioretention - 211 <sup>th</sup> Place NE | Infiltration bioretention, 1’ wide bottom width, 3:1 sloped sides | 150 SF (Bottom Area) | 150 SF (Bottom Area) |
| Northwest Central - 211 <sup>th</sup> Place NE | Infiltration bioretention, 1’ wide bottom width, 3:1 sloped sides | 50 SF (Bottom Area)  | 50 SF (Bottom Area)  |
| Northeast Central - 211 <sup>th</sup> Place NE | Infiltration bioretention, 1’ wide bottom width, 3:1 sloped sides | 160 SF (Bottom Area) | 160 SF (Bottom Area) |
| E - 211 <sup>th</sup> Place NE                 | Infiltration bioretention, 1’ wide bottom width, 3:1 sloped sides | 35 SF (Bottom Area)  | 35 SF (Bottom Area)  |
| 59 <sup>th</sup> Avenue Northeast              | Detention tank  | 4015 CF              | 4015 CF              |
| Lot 1  | ADS 16 in. chambers in 6 in. stone bedding                        | 930 CF               | 930 CF               |

## 8. Wetland Protection

As previously noted, the site is required to provide General Protection, Protection from Pollutants, Wetland Hydroperiod Protection (Method 2) for the downstream wetland. These requirements are summarized in Table 8-1 below along with the project proposal to achieve these protections.

**Table 8-1: Wetland Protection Requirements per SWMMWW Appendix I**

| Protection Measure   | Method   |
|--|--|
| <b>General Protection</b>  |  |
| Consult regulations  | Compliance with all applicable stormwater regulations is described above in Section 5.   |
| Maintain wetland buffer required by local and/or state regulations                 | The project is maintaining the 60 ft. buffer required by AMC.  |
| Retain native vegetation   | Project limits are confined to the wetland buffer. No work is proposed within the wetland or buffer.   |
| Avoid physical impact  | Project limits are confined to the wetland buffer. No work is proposed within the wetland or buffer.   |
| Stormwater management practices to be done outside of wetland buffer boundary      | The site is designed to fully infiltrate the 100-year recurrence interval storm. An emergency overflow will be provided to the edge of the wetland buffer.           |
| Discharge from project site should be dispersed using a method to diffuse the flow | See response above.  |
| Consider fences to restrict human access   | A split rail fence and signage will be provided along the wetland buffer edge to restrict access.  |
| <b>Protection from Pollutants</b>  |  |
| Provide Construction Stormwater BMPs   | Satisfied through MR2 compliance. See Section 11 below.  |
| Provide Source Control BMPs  | Satisfied through MR3 compliance. See Section 5 above.   |
| Provide On-Site Stormwater Management  | Satisfied through MR5 compliance. See Section 7 above.   |
| Provide Runoff Treatment BMPs  | Satisfied through MR6 compliance. See Section 6 above.   |
| <b>Wetland Hydroperiod Protection (Method 2)</b>                                   |  |
| Site Discharge Modeling  | Currently, the entire project site infiltrates to the underlying groundwater storage aquifer. In the proposed conditions, the project to maintain full infiltration. |

## 9. Conveyance System Analysis & Design

All runoff from project frontage improvements as well as on-site improvements will be collected and conveyed in a series of pipes and catch basins to one of eight sub-basin facilities, as previously described. All conveyance systems are designed to convey the 100-year recurrence interval storm without overtopping. An emergency overflow conveyance is provided to the on-site wetland buffer.

Conveyance calculations for the proposed on-site conveyance system will be provided with the construction permit submittal.

## 10. Construction Stormwater Pollution Prevention Plan

The project proposes to fully infiltrate stormwater within project limits, and therefore technically does not require coverage under the Ecology National Pollution Discharge Elimination System (NPDES) permit. However, in an abundance of caution, the project will voluntarily seek NPDES coverage. The notice of intent will be prepared and submitted to Ecology.

A TESC Plan and detail sheets are provided in Appendix G. A SWPPP is provided in Appendix F.

The design implements adequately sized BMPs to meet construction stormwater pollution prevention requirements. These BMPs include the following elements:

1. Preserve Vegetation/Mark Clearing Limits.
2. Establish Construction Access.
3. Control Flow Rates.
4. Install Sediment Controls.
5. Stabilize Soils.
6. Protect Slopes.
7. Protect Drain Inlets.
8. Stabilize Channels and Outlets.
9. Control Pollutants.
10. Control Dewatering, including flow rates and quality.
11. Maintain BMPs.
12. Manage the Project.
13. Protect Low-Impact Development (LID) BMPs.

## 11. Special Reports and Studies

The following reports are included under a separate cover as a part of this submittal:

- Geotechnical Feasibility Report by PanGEO, dated July 2024
- Wetland and Fish and Wildlife Assessment Report by Soundview Consultants, dated June 2025
- Phase 1 ESA Report by Farallon Consulting, dated July 2024
- Arborist Report by Soundview Consultants, dated October 18, 2024.

## 12. Other Permits

At this time, other permits associated with Arlington Apartments include:

- City of Arlington Conditional Use Permit
- City of Arlington Binding Site Plan (BSP)
- City of Arlington SEPA Determination
- City of Arlington Civil Construction Permit
- City of Arlington ROW Permit
- City of Arlington Building Permit
- WSDOT Channelization Plan Approval
- WA Ecology, NPDES Coverage

## 13. Operations and Maintenance Manual

An Operations and Maintenance Manual will be included as a separate document during construction permitting.

# Appendix A

Existing Conditions Exhibit





| LOT 2 - ON-SITE             |           |           |
|-----------------------------|-----------|-----------|
| SURFACE TYPE                | AREA (SF) | AREA (AC) |
| IMPERVIOUS                  | 0         | 0.00      |
| PERVIOUS                    | 296,581   | 6.81      |
| WETLAND BOUNDARY - PERVIOUS | 44,559    | 1.02      |
| TOTAL                       | 341,140   | 7.83      |

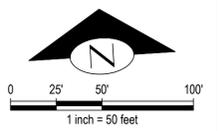
| FUTURE COA ROW                  |           |           |
|---------------------------------|-----------|-----------|
| SURFACE TYPE                    | AREA (SF) | AREA (AC) |
| IMPERVIOUS                      | 0         | 0.00      |
| PERVIOUS                        | 25,620    | 0.59      |
| EXISTING TO REMAIN - IMPERVIOUS | 0         | 0.00      |
| TOTAL                           | 25,620    | 0.59      |

| LOT 1 - FUTURE COMMERCIAL       |           |           |
|---------------------------------|-----------|-----------|
| SURFACE TYPE                    | AREA (SF) | AREA (AC) |
| IMPERVIOUS                      | 0         | 0.00      |
| PERVIOUS                        | 14,958    | 0.34      |
| EXISTING TO REMAIN - IMPERVIOUS | 0         | 0.00      |
| TOTAL                           | 14,958    | 0.34      |

| WSDOT RIGHT OF WAY (FUTURE COA ROW) |           |           |
|-------------------------------------|-----------|-----------|
| SURFACE TYPE                        | AREA (SF) | AREA (AC) |
| IMPERVIOUS                          | 0         | 0.00      |
| PERVIOUS                            | 27,130    | 0.62      |
| EXISTING TO REMAIN - IMPERVIOUS     | 0         | 0.00      |
| TOTAL                               | 27,130    | 0.62      |

| RIGHT OF WAY - 59TH AVE NE      |           |           |
|---------------------------------|-----------|-----------|
| SURFACE TYPE                    | AREA (SF) | AREA (AC) |
| IMPERVIOUS                      | 10,561    | 0.24      |
| PERVIOUS                        | 9,375     | 0.22      |
| EXISTING TO REMAIN - IMPERVIOUS | 9,653     | 0.22      |
| TOTAL                           | 29,589    | 0.68      |

| FUTURE TRACT                    |           |           |
|---------------------------------|-----------|-----------|
| SURFACE TYPE                    | AREA (SF) | AREA (AC) |
| IMPERVIOUS                      | 0         | 0.00      |
| PERVIOUS                        | 1,986     | 0.05      |
| EXISTING TO REMAIN - IMPERVIOUS | 0         | 0.00      |
| TOTAL                           | 1,986     | 0.05      |



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Sep 17, 2025 - 4:25pm

| NO. | DATE      | BY  | CHD. | APPR. | REVISION                    |
|-----|-----------|-----|------|-------|-----------------------------|
| 3   | 9/17/2025 | MMM | MNF  | JSF   | CUP / BSP CYCLE 2 SUBMITTAL |
| 2   | 6/13/2025 | MMM | MNF  | JSF   | CUP / BSP CYCLE 1 SUBMITTAL |

|                   |                    |
|-------------------|--------------------|
| DRAWN BY<br>CEP   | DESIGNED BY<br>MMM |
| CHECKED BY<br>MNF | APPROVED BY<br>JSF |
| DATE<br>9/17/2025 |                    |
| JOB No.: 2400346  |                    |

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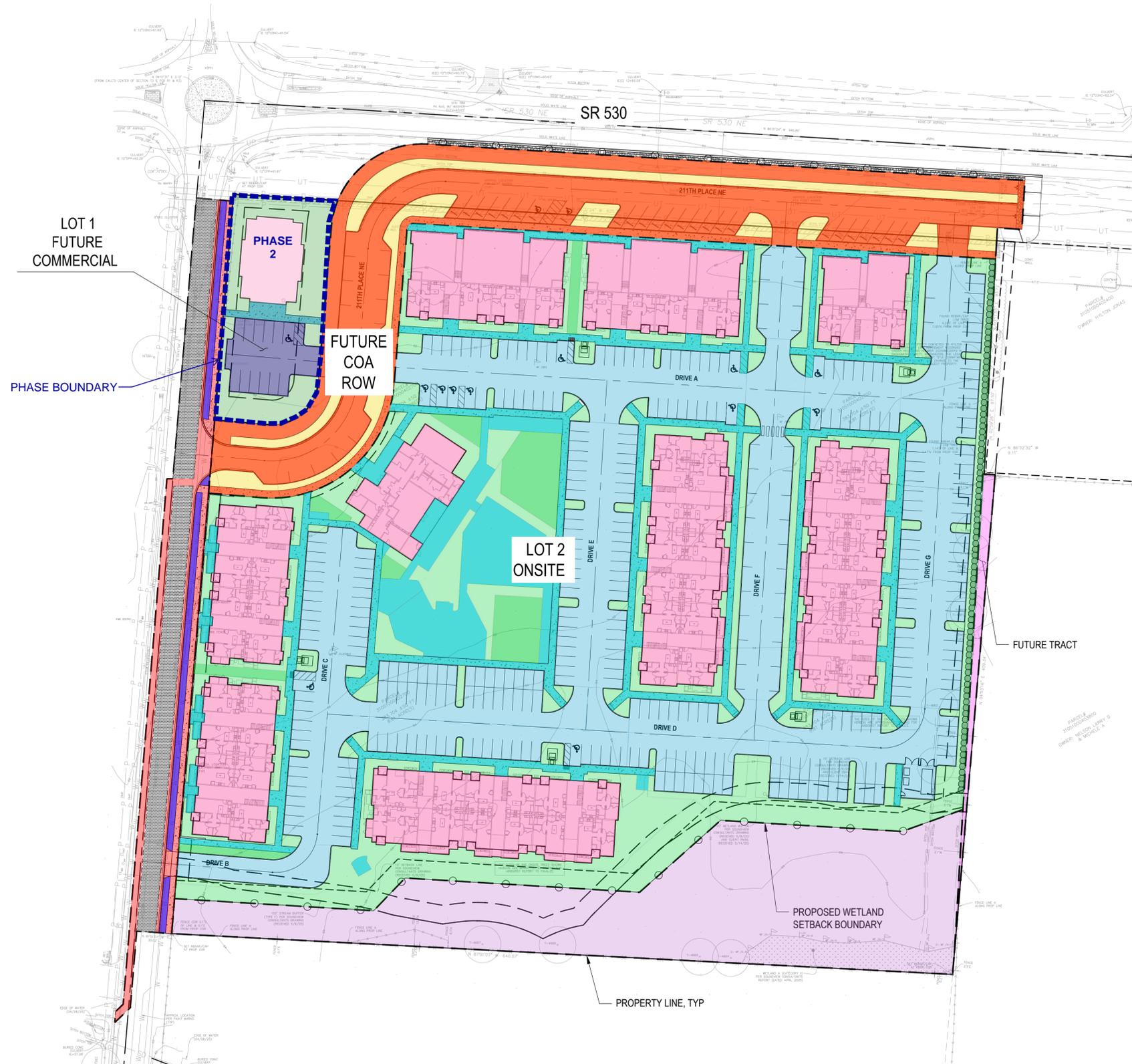
**PRE-DEVELOPED CONDITIONS EXHIBIT**

SHEET

# Appendix B

Proposed Conditions Exhibit





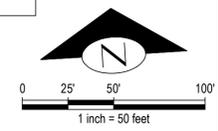
| LOT 2 - ON-SITE  |                |             |
|--|----------------|-------------|
| SURFACE TYPE   | AREA (SF)      | AREA (AC)   |
| ROADWAY - POLLUTANT GENERATING IMPERVIOUS SURFACE      | 107,293        | 2.46        |
| SIDEWALK - NON POLLUTANT GENERATING IMPERVIOUS SURFACE | 26,612         | 0.61        |
| ROOF - NON POLLUTANT GENERATING IMPERVIOUS SURFACE     | 83,285         | 1.91        |
| PERVIOUS   | 79,391         | 1.82        |
| WETLAND BOUNDARY - PERVIOUS                            | 44,559         | 1.02        |
| <b>TOTAL</b>   | <b>341,140</b> | <b>7.83</b> |

| RIGHT OF WAY - 211TH PL NE      |               |             |
|---------------------------------|---------------|-------------|
| SURFACE TYPE                    | AREA (SF)     | AREA (AC)   |
| IMPERVIOUS                      | 42,100        | 0.97        |
| PERVIOUS                        | 10,650        | 0.24        |
| EXISTING TO REMAIN - IMPERVIOUS | 0             | 0.00        |
| <b>TOTAL</b>                    | <b>52,750</b> | <b>1.21</b> |

| RIGHT OF WAY - 59TH AVE NE      |               |             |
|---------------------------------|---------------|-------------|
| SURFACE TYPE                    | AREA (SF)     | AREA (AC)   |
| IMPERVIOUS                      | 13,637        | 0.31        |
| PERVIOUS                        | 6,299         | 0.14        |
| EXISTING TO REMAIN - IMPERVIOUS | 9,653         | 0.22        |
| <b>TOTAL</b>                    | <b>29,589</b> | <b>0.68</b> |

| LOT 1 - FUTURE COMMERCIAL                              |               |             |
|--|---------------|-------------|
| SURFACE TYPE   | AREA (SF)     | AREA (AC)   |
| ROADWAY - POLLUTANT GENERATING IMPERVIOUS SURFACE      | 3,867         | 0.09        |
| SIDEWALK - NON POLLUTANT GENERATING IMPERVIOUS SURFACE | 694           | 0.02        |
| ROOF - NON POLLUTANT GENERATING IMPERVIOUS SURFACE     | 3,290         | 0.08        |
| PERVIOUS   | 7,107         | 0.16        |
| <b>TOTAL</b>   | <b>14,958</b> | <b>0.34</b> |

| FUTURE TRACT                    |              |             |
|---------------------------------|--------------|-------------|
| SURFACE TYPE                    | AREA (SF)    | AREA (AC)   |
| IMPERVIOUS                      | 0            | 0.00        |
| PERVIOUS                        | 1,986        | 0.05        |
| EXISTING TO REMAIN - IMPERVIOUS | 0            | 0.00        |
| <b>TOTAL</b>                    | <b>1,986</b> | <b>0.05</b> |



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Sep 17, 2025 - 4:39pm

| NO. | DATE      | BY  | CHD. | APPR. | REVISION                    |
|-----|-----------|-----|------|-------|-----------------------------|
| 3   | 9/17/2025 | MMM | MNF  | JSF   | CUP / BSP CYCLE 2 SUBMITTAL |
| 2   | 6/13/2025 | MMM | MNF  | JSF   | CUP / BSP CYCLE 1 SUBMITTAL |

|                   |                    |
|-------------------|--------------------|
| DRAWN BY<br>CEP   | DESIGNED BY<br>MMM |
| CHECKED BY<br>MNF | APPROVED BY<br>JSF |
| DATE<br>9/17/2025 |                    |
| JOB No.: 2400346  |                    |

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**POST-DEVELOPED CONDITIONS EXHIBIT**

SHEET

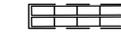
**B-1**

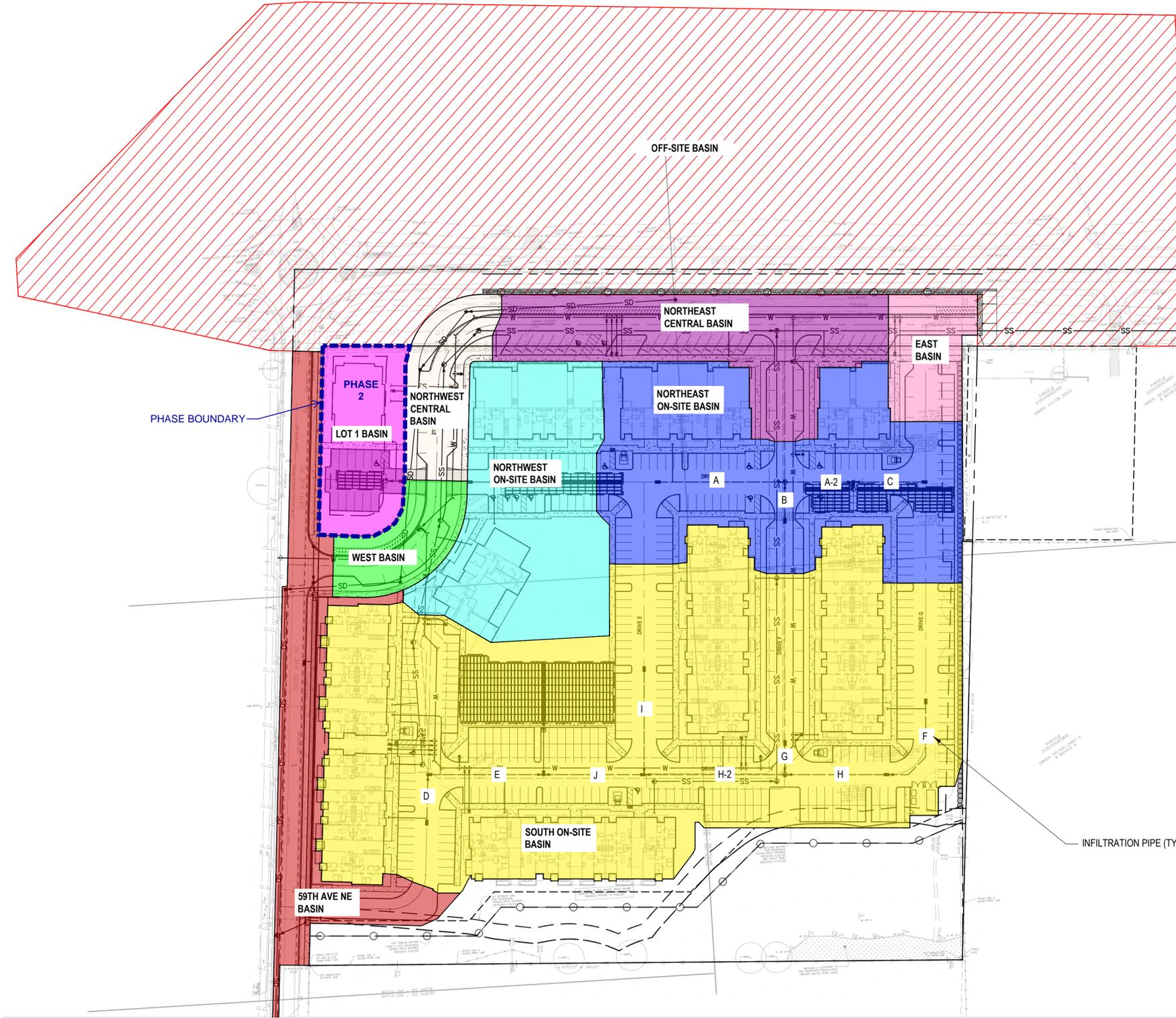
# Appendix C

Basin Delineation Exhibit



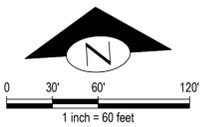
**STORMWATER MANAGEMENT LEGEND:**

-  STORMWATER BASIN BOUNDARY
-  CONTRIBUTING DRAINAGE AREA
-  INFILTRATION CHAMBER



| STORMWATER MANAGEMENT FACILITIES      |                           |                            |   |                                  |                              |
|---------------------------------------|---------------------------|----------------------------|---|----------------------------------|------------------------------|
| STORMTECH INFILTRATION CHAMBER SIZING |                           |                            |   |                                  |                              |
| BASIN                                 | INFILTRATION RATE (IN/HR) | MIN REQUIRED # OF CHAMBERS | PROVIDED # OF CHAMBERS                    | TOTAL PROVIDED CHAMBER AREA (SF) | PROVIDED STORAGE VOLUME (CF) |
| NORTHEAST ON-SITE BASIN               | 3                         | 120                        | 124                                       | 3496                             | 3,844                        |
| NORTHWEST ON-SITE BASIN               | 3                         | 95                         | 97  | 2593                             | 3,007                        |
| SOUTH ON-SITE BASIN                   | 3                         | 365                        | 368                                       | 9314                             | 11,407                       |
| LOT 1 BASIN                           | 4.90                      | 30                         | 30  | 712                              | 930                          |
| DETENTION PIPE                        |                           |                            |   |                                  |                              |
| BASIN                                 | LENGTH (FT)               | DIAMETER (FT)              | NOTES                                     |                                  |                              |
| 59TH AVE NE BASIN                     | 310                       | 4                          | SEE SHEET C4.47 FOR DETENTION PIPE DETAIL |                                  |                              |
| INFILTRATING BIORETENTION PLANTER     |                           |                            |   |                                  |                              |
| BASIN                                 | INFILTRATION RATE (IN/HR) | MIN BOTTOM AREA REQUIRED   | MIN BOTTOM AREA PROVIDED                  |                                  |                              |
| WEST BASIN                            | 4.50                      | 150                        | 150                                       |                                  |                              |
| NORTHWEST CENTRAL BASIN               | 4.50                      | 50                         | 50  |                                  |                              |
| NORTHEAST CENTRAL BASIN               | 4.50                      | 160                        | 160                                       |                                  |                              |
| EAST BASIN                            | 4.50                      | 35                         | 35  |                                  |                              |

NOTE: NAMING CONVENTION FOR INFILTRATION PIPES ARE SHOWN FOR MODELING PURPOSES ONLY. SEE MODELING CALCULATION IN APPENDIX E.



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Sep 17, 2025 - 4:44pm

| NO. | DATE      | BY  | CHD. | APPR. | REVISION                    |
|-----|-----------|-----|------|-------|-----------------------------|
| 3   | 9/17/2025 | MMM | MNF  | JSF   | CUP / BSP CYCLE 2 SUBMITTAL |
| 2   | 6/13/2025 | MMM | MNF  | JSF   | CUP / BSP CYCLE 1 SUBMITTAL |

|                   |                    |
|-------------------|--------------------|
| DRAWN BY<br>CEP   | DESIGNED BY<br>MMM |
| CHECKED BY<br>MNF | APPROVED BY<br>JSF |
| DATE<br>9/17/2025 |                    |
| JOB No.: 2400346  |                    |

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**STORMWATER MANAGEMENT PLAN EXHIBIT**

SHEET

**EXBT-1**

# Appendix D

Water Quality Calculations

To Be Provided as Part of the Construction Documents



# Appendix E

## Infiltration Calculations



# 59TH AVE NE BASIN

SEE APPENDIX C FOR BASIN  
DELINEATION EXHIBIT.

---

## MGS FLOOD PROJECT REPORT

Program Version: MGSFlood 4.64  
Program License Number: 200410007  
Project Simulation Performed on: 06/23/2025 9:17 AM  
Report Generation Date: 06/23/2025 9:18 AM

---

Input File Name: JBL\_59th Modeling.fld  
Project Name: Arlington Apartments  
Analysis Title: Combined Onsite and 59th ROW  
Comments: detention for 59th ROW basin

---

**PRECIPITATION INPUT**

---

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected

Full Period of Record Available used for Routing

Climatic Region Number: 17  
Precipitation Station : 96004805 Puget East 48 in\_5min 10/01/1939-10/01/2097  
Evaporation Station : 961048 Puget East 48 in MAP

Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1  
HSPF Parameter Region Name : Ecology Default

\*\*\*\*\* Default HSPF Parameters Used (Not Modified by User) \*\*\*\*\*

\*\*\*\*\* **WATERSHED DEFINITION** \*\*\*\*\*

**Predevelopment/Post Development Tributary Area Summary**

|  | Predeveloped | Post Developed |
|--|--------------|----------------|
| Total Subbasin Area (acres)                    | 0.680        | 0.679          |
| Area of Links that Include Precip/Evap (acres) | 0.000        | 0.000          |
| Total (acres)                                  | 0.680        | 0.679          |

-----**SCENARIO: PREDEVELOPED**

Number of Subbasins: 2

----- Subbasin : Existing to remain -----

-----Area (Acres) -----  
ROADS/FLAT 0.222

---

Subbasin Total 0.222

----- Subbasin : Improvements -----  
-----Area (Acres) -----  
A/B, Forest, Flat 0.458  
-----  
Subbasin Total 0.458

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 2

----- Subbasin : 59TH ST BASIN -----  
-----Area (Acres) -----  
C, Lawn, Flat 0.145  
ROADS/FLAT 0.313  
-----  
Subbasin Total 0.458

----- Subbasin : Existing to Remain -----  
-----Area (Acres) -----  
ROADS/FLAT 0.222  
-----  
Subbasin Total 0.222

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Links: 1

-----  
**Link Name: New Copy Lnk1**

Link Type: Copy  
Downstream Link: None

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: POSTDEVELOPED

Number of Links: 2

-----  
**Link Name: New Copy Lnk15**

Link Type: Copy  
Downstream Link: None

-----  
**Link Name: 4' - DETENTION PIPE**

Link Type: Structure

Downstream Link Name: New Copy Lnk15

User Specified Elevation Volume Table Used

| Elevation (ft) | Pond Volume (cu-ft) |
|----------------|---------------------|
| 100.00         | 0.                  |
| 100.10         | 37.                 |
| 100.20         | 79.                 |
| 100.30         | 155.                |
| 100.40         | 216.                |
| 100.50         | 314.                |
| 100.60         | 386.                |
| 100.70         | 500.                |
| 100.80         | 582.                |
| 100.90         | 708.                |
| 101.00         | 796.                |
| 101.10         | 931.                |
| 101.20         | 1025.               |
| 101.30         | 1167.               |
| 101.40         | 1264.               |
| 101.50         | 1411.               |
| 101.60         | 1512.               |
| 101.70         | 1661.               |
| 101.80         | 1763.               |
| 101.90         | 1915.               |
| 102.00         | 2017.               |
| 102.10         | 2168.               |
| 102.20         | 2269.               |
| 102.30         | 2419.               |
| 102.40         | 2519.               |
| 102.50         | 2667.               |
| 102.60         | 2765.               |
| 102.70         | 2907.               |
| 102.80         | 3002.               |
| 102.90         | 3139.               |
| 103.00         | 3228.               |
| 103.10         | 3357.               |
| 103.20         | 3440.               |
| 103.30         | 3558.               |
| 103.40         | 3633.               |
| 103.50         | 3738.               |
| 103.60         | 3802.               |
| 103.70         | 3887.               |
| 103.80         | 3937.               |
| 103.90         | 3994.               |
| 104.00         | 4015.               |

Hydraulic Conductivity (in/hr) : 0.00  
Massmann Regression Used to Estimate Hydralic Gradient  
Depth to Water Table (ft) : 100.00  
Bio-Fouling Potential : Low  
Maintenance : Average or Better

Riser Geometry  
Riser Structure Type : Circular  
Riser Diameter (in) : 12.00  
Common Length (ft) : 0.000

Riser Crest Elevation : 104.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---  
Device Type : Circular Orifice  
Control Elevation (ft) : 100.00  
Diameter (in) : 1.13  
Orientation : Horizontal  
Elbow : No

--- Device Number 2 ---  
Device Type : Rectangular Weir that Intersects the Riser Top  
Invert Elevation (ft) : 102.45  
Length (ft) : 0.020

\*\*\*\*\*FLOOD FREQUENCY AND DURATION STATISTICS\*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Subbasins: 2  
Number of Links: 1

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 2  
Number of Links: 2

\*\*\*\*\*Groundwater Recharge Summary \*\*\*\*\*

Recharge is computed as input to PerInd Groundwater Plus Infiltration in Structures

| Total Predeveloped Recharge During Simulation |                         |
|---|-------------------------|
| Model Element                                 | Recharge Amount (ac-ft) |
| Subbasin: Existing to remain                  | 0.000                   |
| Subbasin: Improvements                        | 165.311                 |
| Link: New Copy Lnk1                           | 0.000                   |
| <b>Total:</b>                                 | <b>165.311</b>          |

| Total Post Developed Recharge During Simulation |                         |
|---|-------------------------|
| Model Element                                   | Recharge Amount (ac-ft) |
| Subbasin: 59TH ST BASIN                         | 19.384                  |
| Subbasin: Existing to Remain                    | 0.000                   |
| Link: New Copy Lnk15                            | 0.000                   |
| Link: 4' - DETENTION PIPE                       | Not Computed            |
| <b>Total:</b>                                   | <b>19.384</b>           |

**Total Predevelopment Recharge is Greater than Post Developed Average Recharge Per Year, (Number of Years= 158)**  
**Predeveloped: 1.046 ac-ft/year, Post Developed: 0.123 ac-ft/year**

\*\*\*\*\*Water Quality Facility Data\*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Links: 1

\*\*\*\*\* Link: New Copy Lnk1\*\*\*\*\*

2-Year Discharge Rate : 0.095 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge

On-line Design Discharge Rate (91% Exceedance): 0.04 cfs

Off-line Design Discharge Rate (91% Exceedance): 0.02 cfs

Infiltration/Filtration Statistics-----

Inflow Volume (ac-ft): 123.22

Inflow Volume Including PPT-Evap (ac-ft): 123.22

Total Runoff Infiltrated (ac-ft): 0.00, 0.00%

Total Runoff Filtered (ac-ft): 0.00, 0.00%

Primary Outflow To Downstream System (ac-ft): 123.22

Secondary Outflow To Downstream System (ac-ft): 0.00

Volume Lost to ET (ac-ft): 0.00

Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 0.00%

-----SCENARIO: POSTDEVELOPED

Number of Links: 2

\*\*\*\*\* Link: New Copy Lnk15\*\*\*\*\*

2-Year Discharge Rate : 0.046 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge

On-line Design Discharge Rate (91% Exceedance): 0.04 cfs

Off-line Design Discharge Rate (91% Exceedance): 0.02 cfs

Infiltration/Filtration Statistics-----

Inflow Volume (ac-ft): 340.48

Inflow Volume Including PPT-Evap (ac-ft): 340.48

Total Runoff Infiltrated (ac-ft): 0.00, 0.00%

Total Runoff Filtered (ac-ft): 0.00, 0.00%

Primary Outflow To Downstream System (ac-ft): 340.48

Secondary Outflow To Downstream System (ac-ft): 0.00

Volume Lost to ET (ac-ft): 0.00

Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 0.00%

\*\*\*\*\*Compliance Point Results\*\*\*\*\*

Scenario Predeveloped Compliance Link: New Copy Lnk1

Scenario Postdeveloped Compliance Link: New Copy Lnk15

**\*\*\* Point of Compliance Flow Frequency Data \*\*\***

Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff |                 | Postdevelopment Runoff |                 |
|-----------------------|-----------------|------------------------|-----------------|
| Tr (Years)            | Discharge (cfs) | Tr (Years)             | Discharge (cfs) |
| 2-Year                | 9.455E-02       | 2-Year                 | 4.598E-02       |
| 5-Year                | 0.119           | 5-Year                 | 5.622E-02       |
| 10-Year               | 0.145           | 10-Year                | 7.732E-02       |
| 25-Year               | 0.177           | 25-Year                | 0.119           |
| 50-Year               | 0.214           | 50-Year                | 0.154           |
| 100-Year              | 0.247           | 100-Year               | 0.161           |
| 200-Year              | 0.266           | 200-Year               | 0.167           |
| 500-Year              | 0.291           | 500-Year               | 0.175           |

**MODEL MEETS  
PRE-DEVELOPED FOREST  
STANDARD PER 2024 DOE  
STORMWATER MANUAL**

\*\* Record too Short to Compute Peak Discharge for These Recurrence Intervals

**\*\*\*\* Flow Duration Performance \*\*\*\***

|  |       |      |
|--|-------|------|
| Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):    | -1.2% | PASS |
| Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%): | -1.2% | PASS |
| Maximum Excursion from Q2 to Q50 (Must be less than 10%):              | 5.6%  | PASS |
| Percent Excursion from Q2 to Q50 (Must be less than 50%):              | 8.0%  | PASS |

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

**\*\*\*\* LID Duration Performance \*\*\*\***

|  |        |      |
|--|--------|------|
| Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):       | 194.8% | FAIL |
| Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): | 424.5% | FAIL |

LID DURATION DESIGN CRITERIA: FAIL

# LOT 1 BASIN

SEE APPENDIX C FOR BASIN  
DELINEATION EXHIBIT.

---

## MGS FLOOD PROJECT REPORT

Program Version: MGSFlood 4.64  
Program License Number: 200410007  
Project Simulation Performed on: 09/16/2025 3:47 PM  
Report Generation Date: 09/16/2025 3:47 PM

---

Input File Name: MMM - Lot 1.fld  
Project Name: Arlington Apartments  
Analysis Title: Drainage Analysis  
Comments:

---

### PRECIPITATION INPUT

---

Computational Time Step (Minutes): 5

Extended Precipitation Time Series Selected

Full Period of Record Available used for Routing

Climatic Region Number: 17  
Precipitation Station : 96004805 Puget East 48 in\_5min 10/01/1939-10/01/2097  
Evaporation Station : 961048 Puget East 48 in MAP

Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1  
HSPF Parameter Region Name : Ecology Default

\*\*\*\*\* Default HSPF Parameters Used (Not Modified by User) \*\*\*\*\*

### \*\*\*\*\* WATERSHED DEFINITION \*\*\*\*\*

#### Predevelopment/Post Development Tributary Area Summary

|  | Predeveloped | Post Developed |
|--|--------------|----------------|
| Total Subbasin Area (acres)                    | 0.343        | 0.343          |
| Area of Links that Include Precip/Evap (acres) | 0.000        | 0.000          |
| Total (acres)                                  | 0.343        | 0.343          |

#### -----SCENARIO: PREDEVELOPED

Number of Subbasins: 1

----- Subbasin : Subbasin 1 -----  
-----Area (Acres) -----  
A/B, Forest, Flat 0.343  
-----

Subbasin Total 0.343

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 1

----- Subbasin : Subbasin 1 -----

|                | -----Area (Acres) ----- |
|----------------|-------------------------|
| C, Lawn, Flat  | 0.163                   |
| ROADS/FLAT     | 0.089                   |
| ROOF TOPS/FLAT | 0.076                   |
| SIDEWALKS/MOD  | 0.016                   |
| -----          |                         |
| Subbasin Total | 0.343                   |

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Links: 0

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: POSTDEVELOPED

Number of Links: 1

-----  
**Link Name: Infiltration Chamber**

Link Type: Structure

Downstream Link: None

User Specified Elevation Volume Table Used

| Elevation (ft) | Pond Volume (cu-ft) |
|----------------|---------------------|
| 100.00         | 0.                  |
| 100.08         | 24.                 |
| 100.17         | 48.                 |
| 100.25         | 71.                 |
| 100.33         | 95.                 |
| 100.42         | 119.                |
| 100.50         | 142.                |
| 100.58         | 192.                |
| 100.67         | 241.                |
| 100.75         | 289.                |
| 100.83         | 337.                |
| 100.92         | 384.                |
| 101.00         | 429.                |
| 101.08         | 474.                |
| 101.17         | 517.                |
| 101.25         | 559.                |
| 101.33         | 600.                |
| 101.42         | 638.                |
| 101.50         | 675.                |
| 101.58         | 708.                |

|        |      |
|--------|------|
| 101.67 | 737. |
| 101.75 | 763. |
| 101.83 | 788. |
| 101.92 | 812. |
| 102.00 | 835. |
| 102.08 | 859. |
| 102.17 | 883. |
| 102.25 | 907. |
| 102.33 | 930. |

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 4.90

Riser Geometry  
Riser Structure Type : Circular  
Riser Diameter (in) : 12.00  
Common Length (ft) : 0.000  
Riser Crest Elevation : 101.83 ft

Hydraulic Structure Geometry

Number of Devices: 0

\*\*\*\*\*FLOOD FREQUENCY AND DURATION STATISTICS\*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Subbasins: 1  
Number of Links: 0

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 1  
Number of Links: 1

\*\*\*\*\* Link: Infiltration Chamber

\*\*\*\*\* Link WSEL Stats

WSEL Frequency Data(ft)  
(Recurrence Interval Computed Using Gringorten Plotting Position)  
Tr (yrs) WSEL Peak (ft)

| Tr (yrs)  | WSEL Peak (ft) |
|-----------|----------------|
| 1.05-Year | 100.063        |
| 1.11-Year | 100.073        |
| 1.25-Year | 100.086        |
| 2.00-Year | 100.187        |
| 3.33-Year | 100.277        |
| 5-Year    | 100.369        |
| 10-Year   | 100.545        |
| 25-Year   | 100.900        |
| 50-Year   | 101.159        |
| 100-Year  | 101.231        |

\*\*\*\*\*Groundwater Recharge Summary\*\*\*\*\*

Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

| Total Predeveloped Recharge During Simulation |                         |
|---|-------------------------|
| Model Element                                 | Recharge Amount (ac-ft) |
| Subbasin: Subbasin 1                          | 123.674                 |
| <b>Total:</b>                                 | <b>123.674</b>          |

| Total Post Developed Recharge During Simulation |                         |
|---|-------------------------|
| Model Element                                   | Recharge Amount (ac-ft) |
| Subbasin: Subbasin 1                            | 21.865                  |
| Link: Infiltration Chamber                      | 147.791                 |
| <b>Total:</b>                                   | <b>169.656</b>          |

**Total Predevelopment Recharge is Less than Post Developed Average Recharge Per Year, (Number of Years= 158)**  
**Predeveloped: 0.783 ac-ft/year, Post Developed: 1.074 ac-ft/year**

\*\*\*\*\*Water Quality Facility Data \*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Links: 0

-----SCENARIO: POSTDEVELOPED

Number of Links: 1

\*\*\*\*\* Link: Infiltration Chamber \*\*\*\*\*

Basic Wet Pond Volume (91% Exceedance): 1172. cu-ft  
 Computed Large Wet Pond Volume, 1.5\*Basic Volume: 1757. cu-ft

2-Year Discharge Rate : 0.000 cfs

Time to Infiltrate 91% Treatment Volume, (Hours): 4.21

Infiltration/Filtration Statistics-----

Inflow Volume (ac-ft): 147.79  
 Inflow Volume Including PPT-Evap (ac-ft): 147.79  
 Total Runoff Infiltrated (ac-ft): 147.79, 100.00%  
 Total Runoff Filtered (ac-ft): 0.00, 0.00%  
 Primary Outflow To Downstream System (ac-ft): 0.00  
 Secondary Outflow To Downstream System (ac-ft): 0.00  
 Volume Lost to ET (ac-ft): 0.00  
 Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 100.00%

\*\*\*\*\*Compliance Point Results \*\*\*\*\*

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: Infiltration Chamber

**\*\*\* Point of Compliance Flow Frequency Data \*\*\***

Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff |                 | Postdevelopment Runoff |                 |
|-----------------------|-----------------|------------------------|-----------------|
| Tr (Years)            | Discharge (cfs) | Tr (Years)             | Discharge (cfs) |
| 2-Year                | 8.010E-04       | 2-Year                 | 0.000           |
| 5-Year                | 8.279E-04       | 5-Year                 | 0.000           |
| 10-Year               | 1.737E-03       | 10-Year                | 0.000           |
| 25-Year               | 5.346E-03       | 25-Year                | 0.000           |
| 50-Year               | 6.156E-03       | 50-Year                | 0.000           |
| 100-Year              | 9.184E-03       | 100-Year               | 0.000           |
| 200-Year              | 1.233E-02       | 200-Year               | 0.000           |
| 500-Year              | 1.645E-02       | 500-Year               | 0.000           |

100% INFILTRATION  
SHOWN BY 0 CFS  
FOR 100-YEAR  
POSTDEVELOPED  
DISCHARGE

\*\* Record too Short to Compute Peak Discharge for These Recurrence Intervals

**\*\*\*\* Flow Duration Performance \*\*\*\***

|  |      |      |
|--|------|------|
| Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):    | 0.0% | PASS |
| Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%): | 0.0% | PASS |
| Maximum Excursion from Q2 to Q50 (Must be less than 10%):              | 0.0% | PASS |
| Percent Excursion from Q2 to Q50 (Must be less than 50%):              | 0.0% | PASS |

-----  
MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS  
-----

**\*\*\*\* LID Duration Performance \*\*\*\***

|  |      |      |
|--|------|------|
| Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):       | 0.0% | PASS |
| Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): | 0.0% | PASS |

-----  
MEETS ALL LID DURATION DESIGN CRITERIA: PASS  
-----

# NORTHEAST ON-SITE BASIN

SEE APPENDIX C FOR BASIN  
DELINEATION EXHIBIT.

---

## MGS FLOOD PROJECT REPORT

Program Version: MGSFlood 4.64  
Program License Number: 200410007  
Project Simulation Performed on: 06/23/2025 9:21 AM  
Report Generation Date: 06/23/2025 9:21 AM

---

Input File Name: JBL\_Trench-NORTHEAST.fld  
Project Name: Arlington Apartments - Northeast Basin  
Analysis Title: Prelim infiltration sizing  
Comments:

---

### PRECIPITATION INPUT

---

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected

Full Period of Record Available used for Routing

Climatic Region Number: 17  
Precipitation Station : 96004805 Puget East 48 in\_5min 10/01/1939-10/01/2097  
Evaporation Station : 961048 Puget East 48 in MAP

Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1  
HSPF Parameter Region Name : Ecology Default

\*\*\*\*\* Default HSPF Parameters Used (Not Modified by User) \*\*\*\*\*

### \*\*\*\*\* WATERSHED DEFINITION \*\*\*\*\*

#### Predevelopment/Post Development Tributary Area Summary

|  | Predeveloped | Post Developed |
|--|--------------|----------------|
| Total Subbasin Area (acres)                    | 1.300        | 1.301          |
| Area of Links that Include Precip/Evap (acres) | 0.000        | 0.000          |
| Total (acres)                                  | 1.300        | 1.301          |

#### -----SCENARIO: PREDEVELOPED

Number of Subbasins: 1

----- Subbasin : Subbasin 1 -----  
-----Area (Acres) -----  
A/B, Forest, Flat 1.300  
-----

Subbasin Total 1.300

-----SCENARIO: POSTDEVELOPED  
Number of Subbasins: 4

IN POSTDEVELOPED  
SCENARIO, INFILTRATION  
PIPES ARE MODELED AS  
INFILTRATION PIPES.

----- Subbasin : PIPE A -----  
-----Area (Acres) -----  
ROADS/FLAT 0.200  
-----  
Subbasin Total 0.200

----- Subbasin : PIPE B -----  
-----Area (Acres) -----  
ROADS/FLAT 0.089  
-----  
Subbasin Total 0.089

----- Subbasin : PIPE D -----  
-----Area (Acres) -----  
ROADS/FLAT 0.221  
-----  
Subbasin Total 0.221

----- Subbasin : AREA NOT ROUTED TO INFIL PIPE -----  
-----Area (Acres) -----  
ROADS/FLAT 0.791  
-----  
Subbasin Total 0.791

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: PREDEVELOPED  
Number of Links: 0

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: POSTDEVELOPED  
Number of Links: 5

-----  
**Link Name: INFIL PIPE A**  
Link Type: Infiltration Trench  
Downstream Link Name: INFIL PIPE A-2

Trench Type : Trench at Toe of Embankment  
Trench Length (ft) : 122.00  
Trench Width (ft) : 2.00  
Trench Depth (ft) : 1.50

Trench Bottom Elev (ft) : 100.34  
Trench Rockfill Porosity (%) : 40.00

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 3.00

-----  
**Link Name: INFIL PIPE B**

Link Type: Infiltration Trench  
Downstream Link Name: INFIL PIPE A-2

Trench Type : Trench at Toe of Embankment  
Trench Length (ft) : 35.00  
Trench Width (ft) : 2.00  
Trench Depth (ft) : 1.50  
Trench Bottom Elev (ft) : 100.34  
Trench Rockfill Porosity (%) : 40.00

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 3.00

-----  
**Link Name: INFIL PIPE D**

Link Type: Infiltration Trench  
Downstream Link Name: STORMSHED CHAMBERS

Trench Type : Trench at Toe of Embankment  
Trench Length (ft) : 67.00  
Trench Width (ft) : 2.00  
Trench Depth (ft) : 1.50  
Trench Bottom Elev (ft) : 100.00  
Trench Rockfill Porosity (%) : 40.00

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 3.00

-----  
**Link Name: INFIL PIPE A-2**

Link Type: Infiltration Trench  
Downstream Link Name: STORMSHED CHAMBERS

Trench Type : Trench at Toe of Embankment  
Trench Length (ft) : 67.00  
Trench Width (ft) : 2.00  
Trench Depth (ft) : 1.50  
Trench Bottom Elev (ft) : 100.00  
Trench Rockfill Porosity (%) : 40.00

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 3.00  
-----

**Link Name: STORMSHED CHAMBERS**

Link Type: Structure

Downstream Link: None

User Specified Elevation Volume Table Used

| Elevation (ft) | Pond Volume (cu-ft) |
|----------------|---------------------|
| 100.08         | 0.                  |
| 100.17         | 190.                |
| 100.25         | 285.                |
| 100.33         | 380.                |
| 100.42         | 475.                |
| 100.50         | 569.                |
| 100.58         | 768.                |
| 100.67         | 964.                |
| 100.75         | 1157.               |
| 100.83         | 1347.               |
| 100.92         | 1534.               |
| 101.00         | 1716.               |
| 101.08         | 1894.               |
| 101.17         | 2068.               |
| 101.25         | 2236.               |
| 101.33         | 2397.               |
| 101.42         | 2552.               |
| 101.50         | 2697.               |
| 101.58         | 2831.               |
| 101.67         | 2945.               |
| 101.75         | 3051.               |
| 101.83         | 3151.               |
| 101.92         | 3245.               |
| 102.00         | 3340.               |
| 102.08         | 3435.               |
| 102.17         | 3530.               |
| 102.25         | 3625.               |
| 102.33         | 3720.               |

Constant Infiltration Option Used

Infiltration Rate (in/hr): 3.00

Riser Geometry

Riser Structure Type : Circular  
Riser Diameter (in) : 12.00  
Common Length (ft) : 0.000  
Riser Crest Elevation : 102.33 ft

Hydraulic Structure Geometry

Number of Devices: 0

\*\*\*\*\*FLOOD FREQUENCY AND DURATION STATISTICS\*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Subbasins: 1  
Number of Links: 0

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 4  
 Number of Links: 5

\*\*\*\*\* Link: STORMSHED CHAMBERS

\*\*\*\*\* Link

WSEL Stats

WSEL Frequency Data(ft)  
 (Recurrence Interval Computed Using Gringorten Plotting Position)

| Tr (yrs)  | WSEL Peak (ft) |
|-----------|----------------|
| 1.05-Year | 100.118        |
| 1.11-Year | 100.152        |
| 1.25-Year | 100.201        |
| 2.00-Year | 100.451        |
| 3.33-Year | 100.576        |
| 5-Year    | 100.712        |
| 10-Year   | 100.992        |
| 25-Year   | 101.548        |
| 50-Year   | 101.712        |
| 100-Year  | 102.093        |

\*\*\*\*\*Groundwater Recharge Summary \*\*\*\*\*

Recharge is computed as input to PerInd Groundwater Plus Infiltration in Structures

| Total Predeveloped Recharge During Simulation |                         |
|---|-------------------------|
| Model Element                                 | Recharge Amount (ac-ft) |
| Subbasin: Subbasin 1                          | 468.959                 |
| <b>Total:</b>                                 | <b>468.959</b>          |

| Total Post Developed Recharge During Simulation |                         |
|---|-------------------------|
| Model Element                                   | Recharge Amount (ac-ft) |
| Subbasin: PIPE A                                | 0.000                   |
| Subbasin: PIPE B                                | 0.000                   |
| Subbasin: PIPE D                                | 0.000                   |
| Subbasin: AREA NOT ROUTED TO I                  | 0.000                   |
| Link: INFIL PIPE A                              | Not Computed            |
| Link: INFIL PIPE B                              | Not Computed            |
| Link: INFIL PIPE D                              | Not Computed            |
| Link: INFIL PIPE A-2                            | Not Computed            |
| Link: STORMSHED CHAMBERS                        | 445.486                 |
| <b>Total:</b>                                   | <b>445.486</b>          |

**Total Predevelopment Recharge is Greater than Post Developed Average Recharge Per Year, (Number of Years= 158)**  
**Predeveloped: 2.968 ac-ft/year, Post Developed: 2.820 ac-ft/year**

\*\*\*\*\*Water Quality Facility Data \*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Links: 0

-----SCENARIO: POSTDEVELOPED

Number of Links: 5

\*\*\*\*\* Link: STORMSHED CHAMBERS

\*\*\*\*\*

Basic Wet Pond Volume (91% Exceedance): 4374. cu-ft  
Computed Large Wet Pond Volume, 1.5\*Basic Volume: 6562. cu-ft

2-Year Discharge Rate : 0.000 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge  
On-line Design Discharge Rate (91% Exceedance): 0.15 cfs  
Off-line Design Discharge Rate (91% Exceedance): 0.08 cfs

Time to Infiltrate 91% Treatment Volume, (Hours): 6.16

Infiltration/Filtration Statistics-----

Inflow Volume (ac-ft): 445.49  
Inflow Volume Including PPT-Evap (ac-ft): 445.49  
Total Runoff Infiltrated (ac-ft): 445.49, 100.00%  
Total Runoff Filtered (ac-ft): 0.00, 0.00%  
Primary Outflow To Downstream System (ac-ft): 0.01  
Secondary Outflow To Downstream System (ac-ft): 0.00  
Volume Lost to ET (ac-ft): 0.00  
Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 100.00%

\*\*\*\*\*Compliance Point Results \*\*\*\*\*

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: STORMSHED CHAMBERS

\*\*\* Point of Compliance Flow Frequency Data \*\*\*

Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff |                 | Postdevelopment Runoff |                 |
|-----------------------|-----------------|------------------------|-----------------|
| Tr (Years)            | Discharge (cfs) | Tr (Years)             | Discharge (cfs) |
| 2-Year                | 1.023E-03       | 2-Year                 | 0.000           |
| 5-Year                | 1.047E-03       | 5-Year                 | 0.000           |
| 10-Year               | 1.997E-03       | 10-Year                | 0.000           |
| 25-Year               | 8.507E-03       | 25-Year                | 0.000           |
| 50-Year               | 1.728E-02       | 50-Year                | 0.000           |
| 100-Year              | 2.289E-02       | 100-Year               | 0.000           |
| 200-Year              | 3.094E-02       | 200-Year               | 9.975E-02       |
| 500-Year              | 4.162E-02       | 500-Year               | 0.234           |

\*\* Record too Short to Compute Peak Discharge for These Recurrence Intervals

100% INFILTRATION  
SHOWN BY 0 CFS  
FOR 100-YEAR  
POSTDEVELOPED  
DISCHARGE

**\*\*\*\* Flow Duration Performance \*\*\*\***

|  |        |      |
|--|--------|------|
| Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):    | -99.9% | PASS |
| Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%): | -99.6% | PASS |
| Maximum Excursion from Q2 to Q50 (Must be less than 10%):              | 0.0%   | PASS |
| Percent Excursion from Q2 to Q50 (Must be less than 50%):              | 1.1%   | PASS |

-----  
MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS  
-----

**\*\*\*\* LID Duration Performance \*\*\*\***

|  |         |      |
|--|---------|------|
| Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):       | -100.0% | PASS |
| Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): | -99.9%  | PASS |

-----  
MEETS ALL LID DURATION DESIGN CRITERIA: PASS  
-----

# NORTHWEST ON-SITE BASIN

SEE APPENDIX C FOR BASIN  
DELINEATION EXHIBIT.

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## MGS FLOOD PROJECT REPORT

Program Version: MGSFlood 4.64  
Program License Number: 200410007  
Project Simulation Performed on: 06/23/2025 10:58 AM  
Report Generation Date: 06/23/2025 10:59 AM

---

Input File Name: JBL\_Infiltration Modeling-NORTHWEST.fld  
Project Name: Arlington Apartments  
Analysis Title: Prelim infiltration sizing  
Comments:

---

### PRECIPITATION INPUT

---

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected

Full Period of Record Available used for Routing

Climatic Region Number: 17  
Precipitation Station : 96004805 Puget East 48 in\_5min 10/01/1939-10/01/2097  
Evaporation Station : 961048 Puget East 48 in MAP

Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1  
HSPF Parameter Region Name : Ecology Default

\*\*\*\*\* Default HSPF Parameters Used (Not Modified by User) \*\*\*\*\*

### \*\*\*\*\* WATERSHED DEFINITION \*\*\*\*\*

#### Predevelopment/Post Development Tributary Area Summary

|  | Predeveloped | Post Developed |
|--|--------------|----------------|
| Total Subbasin Area (acres)                    | 0.888        | 0.887          |
| Area of Links that Include Precip/Evap (acres) | 0.000        | 0.000          |
| Total (acres)                                  | 0.888        | 0.887          |

#### -----SCENARIO: PREDEVELOPED

Number of Subbasins: 1

----- Subbasin : Subbasin 1 -----  
-----Area (Acres) -----  
A/B, Forest, Flat 0.888  
-----

Subbasin Total 0.888

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 1

----- Subbasin : Subbasin 1 -----

|                | -----Area (Acres) ----- |
|----------------|-------------------------|
| C, Lawn, Flat  | 0.150                   |
| ROADS/FLAT     | 0.738                   |
| -----          |                         |
| Subbasin Total | 0.887                   |

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Links: 0

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: POSTDEVELOPED

Number of Links: 1

-----  
**Link Name: PRELIM INFILTRATION VAULT**

Link Type: Structure

Downstream Link: None

User Specified Elevation Volume Table Used

| Elevation (ft) | Pond Volume (cu-ft) |
|----------------|---------------------|
| 100.08         | 0.                  |
| 100.17         | 150.                |
| 100.25         | 225.                |
| 100.33         | 301.                |
| 100.42         | 376.                |
| 100.50         | 451.                |
| 100.58         | 608.                |
| 100.67         | 763.                |
| 100.75         | 916.                |
| 100.83         | 1067.               |
| 100.92         | 1214.               |
| 101.00         | 1359.               |
| 101.08         | 1500.               |
| 101.17         | 1637.               |
| 101.25         | 1770.               |
| 101.33         | 1898.               |
| 101.42         | 2020.               |
| 101.50         | 2135.               |
| 101.58         | 2242.               |
| 101.67         | 2332.               |
| 101.75         | 2416.               |
| 101.83         | 2494.               |

|        |       |
|--------|-------|
| 101.92 | 2569. |
| 102.00 | 2645. |
| 102.08 | 2720. |
| 102.17 | 2795. |
| 102.25 | 2870. |
| 102.33 | 2945. |

Constant Infiltration Option Used  
 Infiltration Rate (in/hr): 3.00

Riser Geometry  
 Riser Structure Type : Circular  
 Riser Diameter (in) : 12.00  
 Common Length (ft) : 0.000  
 Riser Crest Elevation : 102.33 ft

Hydraulic Structure Geometry

Number of Devices: 0

\*\*\*\*\*FLOOD FREQUENCY AND DURATION STATISTICS\*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Subbasins: 1  
 Number of Links: 0

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 1  
 Number of Links: 1

\*\*\*\*\* Link: PRELIM INFILTRATION VAULT

\*\*\*\*\* Link

WSEL Stats

WSEL Frequency Data(ft)  
 (Recurrence Interval Computed Using Gringorten Plotting Position)

| Tr (yrs)  | WSEL Peak (ft) |
|-----------|----------------|
| 1.05-Year | 100.139        |
| 1.11-Year | 100.177        |
| 1.25-Year | 100.246        |
| 2.00-Year | 100.510        |
| 3.33-Year | 100.631        |
| 5-Year    | 100.714        |
| 10-Year   | 101.033        |
| 25-Year   | 101.481        |
| 50-Year   | 101.724        |
| 100-Year  | 101.950        |

\*\*\*\*\*Groundwater Recharge Summary \*\*\*\*\*

Recharge is computed as input to Perind Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

| Model Element        | Recharge Amount (ac-ft) |
|----------------------|-------------------------|
| Subbasin: Subbasin 1 | 320.093                 |
| <b>Total:</b>        | <b>320.093</b>          |

| Total Post Developed Recharge During Simulation |                         |
|---|-------------------------|
| Model Element                                   | Recharge Amount (ac-ft) |
| Subbasin: Subbasin 1                            | 20.095                  |
| Link: PRELIM INFILTRATION                       | 453.215                 |
| <b>Total:</b>                                   | <b>473.310</b>          |

**Total Predevelopment Recharge is Less than Post Developed Average Recharge Per Year, (Number of Years= 158)**  
**Predeveloped: 2.026 ac-ft/year, Post Developed: 2.996 ac-ft/year**

\*\*\*\*\*Water Quality Facility Data \*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Links: 0

-----SCENARIO: POSTDEVELOPED

Number of Links: 1

\*\*\*\*\* Link: PRELIM INFILTRATION VAULT \*\*\*\*\*

Basic Wet Pond Volume (91% Exceedance): 3997. cu-ft  
 Computed Large Wet Pond Volume, 1.5\*Basic Volume: 5995. cu-ft

2-Year Discharge Rate : 0.000 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge  
 On-line Design Discharge Rate (91% Exceedance): 0.13 cfs  
 Off-line Design Discharge Rate (91% Exceedance): 0.07 cfs

Time to Infiltrate 91% Treatment Volume, (Hours): 7.10

Infiltration/Filtration Statistics-----

Inflow Volume (ac-ft): 453.22  
 Inflow Volume Including PPT-Evap (ac-ft): 453.22  
 Total Runoff Infiltrated (ac-ft): 453.22, 100.00%  
 Total Runoff Filtered (ac-ft): 0.00, 0.00%  
 Primary Outflow To Downstream System (ac-ft): 0.01  
 Secondary Outflow To Downstream System (ac-ft): 0.00  
 Volume Lost to ET (ac-ft): 0.00  
 Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 100.00%

\*\*\*\*\*Compliance Point Results \*\*\*\*\*

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: PRELIM INFILTRATION VAULT

**\*\*\* Point of Compliance Flow Frequency Data \*\*\***

Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff |                 | Postdevelopment Runoff |                 |
|-----------------------|-----------------|------------------------|-----------------|
| Tr (Years)            | Discharge (cfs) | Tr (Years)             | Discharge (cfs) |
| 2-Year                | 6.984E-04       | 2-Year                 | 0.000           |
| 5-Year                | 7.146E-04       | 5-Year                 | 0.000           |
| 10-Year               | 1.363E-03       | 10-Year                | 0.000           |
| 25-Year               | 5.806E-03       | 25-Year                | 0.000           |
| 50-Year               | 1.179E-02       | 50-Year                | 0.000           |
| 100-Year              | 1.562E-02       | 100-Year               | 0.000           |
| 200-Year              | 2.112E-02       | 200-Year               | 8.199E-02       |
| 500-Year              | 2.841E-02       | 500-Year               | 0.193           |

\*\* Record too Short to Compute Peak Discharge for These Recurrence Intervals

100% INFILTRATION  
SHOWN BY 0 CFS  
FOR 100-YEAR  
POSTDEVELOPED  
DISCHARGE

**\*\*\*\* Flow Duration Performance \*\*\*\***

|  |        |      |
|--|--------|------|
| Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):    | -99.9% | PASS |
| Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%): | -99.6% | PASS |
| Maximum Excursion from Q2 to Q50 (Must be less than 10%):              | 0.0%   | PASS |
| Percent Excursion from Q2 to Q50 (Must be less than 50%):              | 1.1%   | PASS |

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

**\*\*\*\* LID Duration Performance \*\*\*\***

|  |         |      |
|--|---------|------|
| Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):       | -100.0% | PASS |
| Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): | -99.9%  | PASS |

MEETS ALL LID DURATION DESIGN CRITERIA: PASS

# SOUTH ON-SITE BASIN

SEE APPENDIX C FOR BASIN  
DELINEATION EXHIBIT.

---

## MGS FLOOD PROJECT REPORT

Program Version: MGSFlood 4.64  
Program License Number: 200410007  
Project Simulation Performed on: 06/23/2025 9:22 AM  
Report Generation Date: 06/23/2025 9:23 AM

---

Input File Name: JBL\_Trench-SOUTH.fld  
Project Name: Arlington Apartments  
Analysis Title: Prelim infiltration sizing  
Comments:

---

### PRECIPITATION INPUT

---

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected

Full Period of Record Available used for Routing

Climatic Region Number: 17  
Precipitation Station : 96004805 Puget East 48 in\_5min 10/01/1939-10/01/2097  
Evaporation Station : 961048 Puget East 48 in MAP

Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1  
HSPF Parameter Region Name : Ecology Default

\*\*\*\*\* Default HSPF Parameters Used (Not Modified by User) \*\*\*\*\*

### \*\*\*\*\* WATERSHED DEFINITION \*\*\*\*\*

#### Predevelopment/Post Development Tributary Area Summary

|  | Predeveloped | Post Developed |
|--|--------------|----------------|
| Total Subbasin Area (acres)                    | 3.772        | 3.772          |
| Area of Links that Include Precip/Evap (acres) | 0.000        | 0.000          |
| Total (acres)                                  | 3.772        | 3.772          |

#### -----SCENARIO: PREDEVELOPED

Number of Subbasins: 1

----- Subbasin : Subbasin 1 -----  
-----Area (Acres) -----  
A/B, Forest, Flat 3.772  
-----

Subbasin Total 3.772

-----**SCENARIO: POSTDEVELOPED**  
Number of Subbasins: 8

IN POSTDEVELOPED  
SCENARIO, INFILTRATION  
PIPES ARE MODELED AS  
INFILTRATION PIPES.

----- Subbasin : PIPE D -----  
-----Area (Acres) -----  
ROADS/FLAT 0.277  
-----  
Subbasin Total 0.277

----- Subbasin : AREA NOT ROUTED TO INFIL PIPE -----  
-----Area (Acres) -----  
ROADS/FLAT 1.074  
-----  
Subbasin Total 1.074

----- Subbasin : PIPE E -----  
-----Area (Acres) -----  
ROADS/FLAT 0.563  
-----  
Subbasin Total 0.563

----- Subbasin : PIPE F -----  
-----Area (Acres) -----  
ROADS/FLAT 0.182  
-----  
Subbasin Total 0.182

----- Subbasin : PIPE H -----  
-----Area (Acres) -----  
ROADS/FLAT 0.461  
-----  
Subbasin Total 0.461

----- Subbasin : PIPE G -----  
-----Area (Acres) -----  
ROADS/FLAT 0.253  
-----  
Subbasin Total 0.253

----- Subbasin : PIPE J -----  
-----Area (Acres) -----  
ROADS/FLAT 0.808  
-----  
Subbasin Total 0.808

----- Subbasin : PIPE I -----

|                |                        |
|----------------|------------------------|
|                | -----Area (Acres)----- |
| ROADS/FLAT     | 0.155                  |
| -----          |                        |
| Subbasin Total | 0.155                  |

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: PREDEVELOPED  
Number of Links: 0

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: POSTDEVELOPED  
Number of Links: 9

-----  
**Link Name: INFIL PIPE D**

Link Type: Infiltration Trench  
Downstream Link Name: INFIL PIPE E

Trench Type : Trench at Toe of Embankment  
Trench Length (ft) : 43.00  
Trench Width (ft) : 2.00  
Trench Depth (ft) : 1.50  
Trench Bottom Elev (ft) : 100.54  
Trench Rockfill Porosity (%) : 40.00

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 3.00

-----  
**Link Name: STORMSHED CHAMBERS**

Link Type: Structure  
Downstream Link: None

User Specified Elevation Volume Table Used

| Elevation (ft) | Pond Volume (cu-ft) |
|----------------|---------------------|
| 100.08         | 0.                  |
| 100.17         | 577.                |
| 100.25         | 866.                |
| 100.33         | 1155.               |
| 100.42         | 1443.               |
| 100.50         | 1732.               |
| 100.58         | 2335.               |
| 100.67         | 2931.               |
| 100.75         | 3519.               |
| 100.83         | 4097.               |
| 100.92         | 4665.               |
| 101.00         | 5220.               |
| 101.08         | 5761.               |
| 101.17         | 6290.               |

|        |        |
|--------|--------|
| 101.25 | 6800.  |
| 101.33 | 7292.  |
| 101.42 | 7761.  |
| 101.50 | 8204.  |
| 101.58 | 8612.  |
| 101.67 | 8958.  |
| 101.75 | 9281.  |
| 101.83 | 9582.  |
| 101.92 | 9871.  |
| 102.00 | 10160. |
| 102.08 | 10448. |
| 102.17 | 10737. |
| 102.25 | 11026. |
| 102.33 | 11314. |

Constant Infiltration Option Used  
 Infiltration Rate (in/hr): 3.00

Riser Geometry  
 Riser Structure Type : Circular  
 Riser Diameter (in) : 12.00  
 Common Length (ft) : 0.000  
 Riser Crest Elevation : 102.33 ft

Hydraulic Structure Geometry

Number of Devices: 0

-----  
**Link Name: INFIL PIPE E**

Link Type: Infiltration Trench  
 Downstream Link Name: STORMSHED CHAMBERS

Trench Type : Trench at Toe of Embankment  
 Trench Length (ft) : 108.00  
 Trench Width (ft) : 2.00  
 Trench Depth (ft) : 1.50  
 Trench Bottom Elev (ft) : 100.00  
 Trench Rockfill Porosity (%) : 40.00

Constant Infiltration Option Used  
 Infiltration Rate (in/hr): 3.00

-----  
**Link Name: INFIL PIPE F**

Link Type: Infiltration Trench  
 Downstream Link Name: INFIL PIPE H

Trench Type : Trench at Toe of Embankment  
 Trench Length (ft) : 95.00  
 Trench Width (ft) : 2.00  
 Trench Depth (ft) : 1.50  
 Trench Bottom Elev (ft) : 101.65  
 Trench Rockfill Porosity (%) : 40.00

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 3.00

---

**Link Name: INFIL PIPE H**

Link Type: Infiltration Trench  
Downstream Link Name: INFIL PIPE H-2

Trench Type : Trench at Toe of Embankment  
Trench Length (ft) : 97.00  
Trench Width (ft) : 2.00  
Trench Depth (ft) : 1.50  
Trench Bottom Elev (ft) : 101.16  
Trench Rockfill Porosity (%) : 40.00

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 3.00

---

**Link Name: INFIL PIPE G**

Link Type: Infiltration Trench  
Downstream Link Name: INFIL PIPE H-2

Trench Type : Trench at Toe of Embankment  
Trench Length (ft) : 28.00  
Trench Width (ft) : 2.00  
Trench Depth (ft) : 1.50  
Trench Bottom Elev (ft) : 101.16  
Trench Rockfill Porosity (%) : 40.00

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 3.00

---

**Link Name: INFIL PIPE H-2**

Link Type: Infiltration Trench  
Downstream Link Name: INFIL PIPE J

Trench Type : Trench at Toe of Embankment  
Trench Length (ft) : 137.00  
Trench Width (ft) : 2.00  
Trench Depth (ft) : 1.50  
Trench Bottom Elev (ft) : 100.47  
Trench Rockfill Porosity (%) : 40.00

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 3.00

---

**Link Name: INFIL PIPE J**

Link Type: Infiltration Trench

Downstream Link Name: STORMSHED CHAMBERS

Trench Type : Trench at Toe of Embankment  
Trench Length (ft) : 93.00  
Trench Width (ft) : 2.00  
Trench Depth (ft) : 1.50  
Trench Bottom Elev (ft) : 100.00  
Trench Rockfill Porosity (%) : 40.00

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 3.00

-----  
**Link Name: INFIL PIPE I**

Link Type: Infiltration Trench  
Downstream Link Name: INFIL PIPE J

Trench Type : Trench at Toe of Embankment  
Trench Length (ft) : 99.00  
Trench Width (ft) : 2.00  
Trench Depth (ft) : 1.50  
Trench Bottom Elev (ft) : 100.47  
Trench Rockfill Porosity (%) : 40.00

Constant Infiltration Option Used  
Infiltration Rate (in/hr): 3.00

\*\*\*\*\***FLOOD FREQUENCY AND DURATION STATISTICS**\*\*\*\*\*

-----**SCENARIO: PREDEVELOPED**

Number of Subbasins: 1  
Number of Links: 0

-----**SCENARIO: POSTDEVELOPED**

Number of Subbasins: 8  
Number of Links: 9

\*\*\*\*\* Link: STORMSHED CHAMBERS

\*\*\*\*\* Link

WSEL Stats

WSEL Frequency Data(ft)  
(Recurrence Interval Computed Using Gringorten Plotting Position)

| Tr (yrs)  | WSEL Peak (ft) |
|-----------|----------------|
| 1.05-Year | 100.109        |
| 1.11-Year | 100.137        |
| 1.25-Year | 100.196        |
| 2.00-Year | 100.475        |
| 3.33-Year | 100.610        |
| 5-Year    | 100.740        |
| 10-Year   | 100.999        |
| 25-Year   | 101.559        |
| 50-Year   | 101.735        |

100-Year 102.042

\*\*\*\*\*Groundwater Recharge Summary\*\*\*\*\*

Recharge is computed as input to PerInd Groundwater Plus Infiltration in Structures

| Model Element        | Total Predeveloped Recharge During Simulation<br>Recharge Amount (ac-ft) |
|----------------------|--|
| Subbasin: Subbasin 1 | 1360.141   |
| Total:               | 1360.141   |

| Model Element                  | Total Post Developed Recharge During Simulation<br>Recharge Amount (ac-ft) |
|--------------------------------|--|
| Subbasin: PIPE D               | 0.000  |
| Subbasin: AREA NOT ROUTED TO I | 0.000  |
| Subbasin: PIPE E               | 0.000  |
| Subbasin: PIPE F               | 0.000  |
| Subbasin: PIPE H               | 0.000  |
| Subbasin: PIPE G               | 0.000  |
| Subbasin: PIPE J               | 0.000  |
| Subbasin: PIPE I               | 0.000  |
| Link: INFIL PIPE D             | Not Computed   |
| Link: STORMSHED CHAMBERS       | 810.418  |
| Link: INFIL PIPE E             | Not Computed   |
| Link: INFIL PIPE F             | Not Computed   |
| Link: INFIL PIPE H             | Not Computed   |
| Link: INFIL PIPE G             | Not Computed   |
| Link: INFIL PIPE H-2           | Not Computed   |
| Link: INFIL PIPE J             | Not Computed   |
| Link: INFIL PIPE I             | Not Computed   |
| Total:                         | 810.418  |

**Total Predevelopment Recharge is Greater than Post Developed  
Average Recharge Per Year, (Number of Years= 158)  
Predeveloped: 8.608 ac-ft/year, Post Developed: 5.129 ac-ft/year**

\*\*\*\*\*Water Quality Facility Data\*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Links: 0

-----SCENARIO: POSTDEVELOPED

Number of Links: 9

\*\*\*\*\* Link: STORMSHED CHAMBERS

\*\*\*\*\*

Basic Wet Pond Volume (91% Exceedance): 11618. cu-ft

Computed Large Wet Pond Volume, 1.5\*Basic Volume: 17427. cu-ft

2-Year Discharge Rate : 0.000 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge

On-line Design Discharge Rate (91% Exceedance): 0.53 cfs

Off-line Design Discharge Rate (91% Exceedance): 0.29 cfs

Time to Infiltrate 91% Treatment Volume, (Hours): 5.39

Infiltration/Filtration Statistics-----

Inflow Volume (ac-ft): 810.44

Inflow Volume Including PPT-Evap (ac-ft): 810.44

Total Runoff Infiltrated (ac-ft): 810.42, 100.00%

Total Runoff Filtered (ac-ft): 0.00, 0.00%

Primary Outflow To Downstream System (ac-ft): 0.02

Secondary Outflow To Downstream System (ac-ft): 0.00

Volume Lost to ET (ac-ft): 0.00

Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 100.00%

\*\*\*\*\*Compliance Point Results \*\*\*\*\*

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: STORMSHED CHAMBERS

\*\*\* Point of Compliance Flow Frequency Data \*\*\*

Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff |                 | Postdevelopment Runoff |                 |
|-----------------------|-----------------|------------------------|-----------------|
| Tr (Years)            | Discharge (cfs) | Tr (Years)             | Discharge (cfs) |
| 2-Year                | 2.968E-03       | 2-Year                 | 0.000           |
| 5-Year                | 3.037E-03       | 5-Year                 | 0.000           |
| 10-Year               | 5.792E-03       | 10-Year                | 0.000           |
| 25-Year               | 2.467E-02       | 25-Year                | 0.000           |
| 50-Year               | 5.011E-02       | 50-Year                | 0.000           |
| 100-Year              | 6.639E-02       | 100-Year               | 0.000           |
| 200-Year              | 8.974E-02       | 200-Year               | 0.183           |
| 500-Year              | 0.121           | 500-Year               | 0.430           |

100% INFILTRATION SHOWN BY 0 CFS FOR 100-YEAR POSTDEVELOPED DISCHARGE

\*\* Record too Short to Compute Peak Discharge for These Recurrence Intervals

\*\*\*\* Flow Duration Performance \*\*\*\*

|  |        |      |
|--|--------|------|
| Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):    | -99.9% | PASS |
| Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%): | -99.5% | PASS |
| Maximum Excursion from Q2 to Q50 (Must be less than 10%):              | 0.0%   | PASS |
| Percent Excursion from Q2 to Q50 (Must be less than 50%):              | 1.1%   | PASS |

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

**\*\*\*\* LID Duration Performance \*\*\*\***

|  |         |      |
|--|---------|------|
| Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):       | -100.0% | PASS |
| Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): | -99.9%  | PASS |

-----  
MEETS ALL LID DURATION DESIGN CRITERIA:      PASS  
-----

**WWHM2012  
PROJECT REPORT**

---

**Project Name:** Bioretention E  
**Site Name:** Arlington Apartments  
**Site Address:**  
**City :**  
**Report Date:** 5/20/2025  
**Gage :** Everett  
**Data Start :** 1948/10/01  
**Data End :** 2009/09/30  
**Precip Scale:** 1.20  
**Version Date:** 2016/02/25  
**Version :** 4.2.12

---

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

---

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

---

**PREDEVELOPED LAND USE**

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

**GroundWater:** No

|                            |               |
|----------------------------|---------------|
| <u>Pervious Land Use</u>   | <u>acre</u>   |
| C, Forest, Flat            | .2194         |
| <b>Pervious Total</b>      | <b>0.2194</b> |
| <u>Impervious Land Use</u> | <u>acre</u>   |
| <b>Impervious Total</b>    | <b>0</b>      |
| <b>Basin Total</b>         | <b>0.2194</b> |

---

**Element Flows To:**

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

---

**MITIGATED LAND USE**

**Name :** Proposed  
**Bypass:** No

**GroundWater:** No

|                            |               |
|----------------------------|---------------|
| <u>Pervious Land Use</u>   | <u>acre</u>   |
| C, Lawn, Flat              | .0623         |
| <b>Pervious Total</b>      | <b>0.0623</b> |
| <u>Impervious Land Use</u> | <u>acre</u>   |
| ROADS FLAT                 | 0.157         |
| <b>Impervious Total</b>    | <b>0.157</b>  |
| <b>Basin Total</b>         | <b>0.2193</b> |

**Element Flows To:**

|                     |                     |                    |
|---------------------|---------------------|--------------------|
| <b>Surface</b>      | <b>Interflow</b>    | <b>Groundwater</b> |
| Surface retention 1 | Surface retention 1 |                    |

**Name** : Bioretention 1  
**Bottom Length:** 35.00 ft.  
**Bottom Width:** 1.00 ft.  
**Material thickness of first layer:** 0.25  
**Material type for first layer:** ASTM 100  
**Material thickness of second layer:** 1.5  
**Material type for second layer:** SMMWW 12 in/hr  
**Material thickness of third layer:** 1.5  
**Material type for third layer:** GRAVEL  
**Infiltration On**  
**Infiltration rate:** 4.5  
**Infiltration safety factor:** 1  
**Wetted surface area On**  
**Total Volume Infiltrated (ac-ft.):** 39.368  
**Total Volume Through Riser (ac-ft.):** 0  
**Total Volume Through Facility (ac-ft.):** 39.368  
**Percent Infiltrated:** 100  
**Total Precip Applied to Facility:** 3.087  
**Total Evap From Facility:** 0.86  
**Underdrain not used**  
**Discharge Structure**  
**Riser Height:** 0.25 ft.  
**Riser Diameter:** 0 in.

**Element Flows To:**

|                 |                 |
|-----------------|-----------------|
| <b>Outlet 1</b> | <b>Outlet 2</b> |
|-----------------|-----------------|

**Bioretention 1 Hydraulic Table**

| <u>Stage(feet)</u> | <u>Area(ac.)</u> | <u>Volume(ac-ft.)</u> | <u>Discharge(cfs)</u> | <u>Infilt(cfs)</u> |
|--------------------|------------------|-----------------------|-----------------------|--------------------|
| 0.0000             | 0.0256           | 0.0000                | 0.0000                | 0.0000             |
| 0.0440             | 0.0252           | 0.0000                | 0.0000                | 0.0000             |
| 0.0879             | 0.0248           | 0.0000                | 0.0000                | 0.0000             |

|        |        |        |        |        |
|--------|--------|--------|--------|--------|
| 0.1319 | 0.0243 | 0.0001 | 0.0000 | 0.0000 |
| 0.1758 | 0.0239 | 0.0001 | 0.0000 | 0.0000 |
| 0.2198 | 0.0234 | 0.0002 | 0.0000 | 0.0000 |
| 0.2637 | 0.0230 | 0.0002 | 0.0000 | 0.0000 |
| 0.3077 | 0.0226 | 0.0002 | 0.0000 | 0.0000 |
| 0.3516 | 0.0221 | 0.0003 | 0.0000 | 0.0001 |
| 0.3956 | 0.0217 | 0.0003 | 0.0000 | 0.0001 |
| 0.4396 | 0.0213 | 0.0004 | 0.0000 | 0.0002 |
| 0.4835 | 0.0209 | 0.0005 | 0.0000 | 0.0003 |
| 0.5275 | 0.0205 | 0.0005 | 0.0000 | 0.0004 |
| 0.5714 | 0.0200 | 0.0006 | 0.0000 | 0.0006 |
| 0.6154 | 0.0196 | 0.0007 | 0.0000 | 0.0007 |
| 0.6593 | 0.0192 | 0.0008 | 0.0000 | 0.0008 |
| 0.7033 | 0.0188 | 0.0009 | 0.0000 | 0.0011 |
| 0.7473 | 0.0184 | 0.0010 | 0.0000 | 0.0014 |
| 0.7912 | 0.0180 | 0.0011 | 0.0000 | 0.0017 |
| 0.8352 | 0.0176 | 0.0012 | 0.0000 | 0.0022 |
| 0.8791 | 0.0172 | 0.0013 | 0.0000 | 0.0023 |
| 0.9231 | 0.0168 | 0.0014 | 0.0000 | 0.0026 |
| 0.9670 | 0.0165 | 0.0015 | 0.0000 | 0.0029 |
| 1.0110 | 0.0161 | 0.0017 | 0.0000 | 0.0036 |
| 1.0549 | 0.0157 | 0.0018 | 0.0000 | 0.0043 |
| 1.0989 | 0.0153 | 0.0020 | 0.0000 | 0.0051 |
| 1.1429 | 0.0149 | 0.0021 | 0.0000 | 0.0057 |
| 1.1868 | 0.0146 | 0.0023 | 0.0000 | 0.0063 |
| 1.2308 | 0.0142 | 0.0024 | 0.0000 | 0.0074 |
| 1.2747 | 0.0138 | 0.0026 | 0.0000 | 0.0086 |
| 1.3187 | 0.0135 | 0.0028 | 0.0000 | 0.0100 |
| 1.3626 | 0.0131 | 0.0029 | 0.0000 | 0.0115 |
| 1.4066 | 0.0128 | 0.0031 | 0.0000 | 0.0119 |
| 1.4505 | 0.0124 | 0.0033 | 0.0000 | 0.0136 |
| 1.4945 | 0.0121 | 0.0035 | 0.0000 | 0.0155 |
| 1.5385 | 0.0117 | 0.0037 | 0.0000 | 0.0176 |
| 1.5824 | 0.0114 | 0.0039 | 0.0000 | 0.0198 |
| 1.6264 | 0.0111 | 0.0042 | 0.0000 | 0.0212 |
| 1.6703 | 0.0107 | 0.0044 | 0.0000 | 0.0230 |
| 1.7143 | 0.0104 | 0.0046 | 0.0000 | 0.0240 |
| 1.7582 | 0.0101 | 0.0048 | 0.0000 | 0.0265 |
| 1.8022 | 0.0097 | 0.0051 | 0.0000 | 0.0296 |
| 1.8462 | 0.0094 | 0.0053 | 0.0000 | 0.0330 |
| 1.8901 | 0.0091 | 0.0055 | 0.0000 | 0.0362 |
| 1.9341 | 0.0088 | 0.0058 | 0.0000 | 0.0376 |
| 1.9780 | 0.0085 | 0.0060 | 0.0000 | 0.0415 |
| 2.0220 | 0.0082 | 0.0063 | 0.0000 | 0.0430 |
| 2.0659 | 0.0079 | 0.0065 | 0.0000 | 0.0441 |
| 2.1099 | 0.0075 | 0.0068 | 0.0000 | 0.0452 |
| 2.1538 | 0.0073 | 0.0071 | 0.0000 | 0.0463 |
| 2.1978 | 0.0070 | 0.0074 | 0.0000 | 0.0475 |
| 2.2418 | 0.0067 | 0.0076 | 0.0000 | 0.0486 |
| 2.2857 | 0.0064 | 0.0079 | 0.0000 | 0.0498 |
| 2.3297 | 0.0061 | 0.0082 | 0.0000 | 0.0509 |
| 2.3736 | 0.0058 | 0.0086 | 0.0000 | 0.0521 |
| 2.4176 | 0.0055 | 0.0089 | 0.0000 | 0.0533 |
| 2.4615 | 0.0052 | 0.0092 | 0.0000 | 0.0545 |
| 2.5055 | 0.0050 | 0.0095 | 0.0000 | 0.0557 |
| 2.5495 | 0.0047 | 0.0099 | 0.0000 | 0.0569 |
| 2.5934 | 0.0044 | 0.0102 | 0.0000 | 0.0581 |

|        |        |        |        |        |
|--------|--------|--------|--------|--------|
| 2.6374 | 0.0042 | 0.0106 | 0.0000 | 0.0594 |
| 2.6813 | 0.0039 | 0.0109 | 0.0000 | 0.0606 |
| 2.7253 | 0.0036 | 0.0113 | 0.0000 | 0.0619 |
| 2.7692 | 0.0034 | 0.0117 | 0.0000 | 0.0631 |
| 2.8132 | 0.0031 | 0.0121 | 0.0000 | 0.0644 |
| 2.8571 | 0.0029 | 0.0125 | 0.0000 | 0.0657 |
| 2.9011 | 0.0026 | 0.0129 | 0.0000 | 0.0670 |
| 2.9451 | 0.0024 | 0.0133 | 0.0000 | 0.0683 |
| 2.9890 | 0.0022 | 0.0137 | 0.0000 | 0.0696 |
| 3.0330 | 0.0019 | 0.0141 | 0.0000 | 0.0709 |
| 3.0769 | 0.0017 | 0.0145 | 0.0000 | 0.0723 |
| 3.1209 | 0.0015 | 0.0150 | 0.0000 | 0.0736 |
| 3.1648 | 0.0012 | 0.0154 | 0.0000 | 0.0749 |
| 3.2088 | 0.0010 | 0.0159 | 0.0000 | 0.0763 |
| 3.2500 | 0.0008 | 0.0163 | 0.0000 | 0.0776 |

**Surface retention 1 Hydraulic Table**

| <u>Stage(feet)</u> | <u>Area(ac.)</u> | <u>Volume(ac-ft.)</u> | <u>Discharge(cfs)</u> | <u>To Amended(cfs)</u> | <u>Wetted Surface</u> |
|--------------------|------------------|-----------------------|-----------------------|------------------------|-----------------------|
| 3.2500             | 0.0256           | 0.0163                | 0.0000                | 0.0100                 | 0.0021                |
| 3.2940             | 0.0261           | 0.0175                | 0.0000                | 0.0100                 | 0.0041                |
| 3.3379             | 0.0266           | 0.0186                | 0.0000                | 0.0102                 | 0.0062                |
| 3.3819             | 0.0270           | 0.0198                | 0.0000                | 0.0105                 | 0.0084                |
| 3.4258             | 0.0275           | 0.0210                | 0.0000                | 0.0107                 | 0.0105                |
| 3.4698             | 0.0280           | 0.0222                | 0.0000                | 0.0109                 | 0.0126                |
| 3.5137             | 0.0284           | 0.0234                | 0.0000                | 0.0112                 | 0.0148                |
| 3.5577             | 0.0289           | 0.0247                | 0.0000                | 0.0114                 | 0.0169                |
| 3.6016             | 0.0294           | 0.0260                | 0.0000                | 0.0117                 | 0.0191                |
| 3.6456             | 0.0299           | 0.0273                | 0.0000                | 0.0119                 | 0.0213                |
| 3.6896             | 0.0303           | 0.0286                | 0.0000                | 0.0122                 | 0.0235                |
| 3.7335             | 0.0308           | 0.0300                | 0.0000                | 0.0124                 | 0.0258                |
| 3.7775             | 0.0313           | 0.0313                | 0.0000                | 0.0127                 | 0.0280                |
| 3.8214             | 0.0318           | 0.0327                | 0.0000                | 0.0129                 | 0.0303                |
| 3.8654             | 0.0323           | 0.0341                | 0.0000                | 0.0131                 | 0.0325                |
| 3.9093             | 0.0328           | 0.0356                | 0.0000                | 0.0134                 | 0.0348                |
| 3.9533             | 0.0333           | 0.0370                | 0.0000                | 0.0136                 | 0.0371                |
| 3.9973             | 0.0338           | 0.0385                | 0.0000                | 0.0139                 | 0.0373                |
| 4.0000             | 0.0339           | 0.0386                | 0.0000                | 0.0139                 | 0.0000                |

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**Name** : Surface retention 1

**Element Flows To:**

**Outlet 1**                      **Outlet 2**  
Bioretention 1

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**ANALYSIS RESULTS**

**POC #1 was not reported because POC must exist in both scenarios and both scenarios must have been run. Perlnd and Implnd Changes**

No changes have been made.

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**WWHM2012  
PROJECT REPORT**

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**Project Name:** Bioretention NE  
**Site Name:** Arlington Apartments  
**Site Address:**  
**City :**  
**Report Date:** 5/20/2025  
**Gage :** Everett  
**Data Start :** 1948/10/01  
**Data End :** 2009/09/30  
**Precip Scale:** 1.20  
**Version Date:** 2016/02/25  
**Version :** 4.2.12

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

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

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**PREDEVELOPED LAND USE**

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

**GroundWater:** No

|                            |               |
|----------------------------|---------------|
| <u>Pervious Land Use</u>   | <u>acre</u>   |
| C, Forest, Flat            | .7049         |
| <b>Pervious Total</b>      | <b>0.7049</b> |
| <u>Impervious Land Use</u> | <u>acre</u>   |
| <b>Impervious Total</b>    | <b>0</b>      |
| <b>Basin Total</b>         | <b>0.7049</b> |

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**Element Flows To:**

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

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**MITIGATED LAND USE**

**Name :** Proposed  
**Bypass:** No

**GroundWater:** No

|                            |               |
|----------------------------|---------------|
| <u>Pervious Land Use</u>   | <u>acre</u>   |
| C, Lawn, Flat              | .1391         |
| <b>Pervious Total</b>      | <b>0.1391</b> |
| <u>Impervious Land Use</u> | <u>acre</u>   |
| ROADS FLAT                 | 0.5658        |
| <b>Impervious Total</b>    | <b>0.5658</b> |
| <b>Basin Total</b>         | <b>0.7049</b> |

**Element Flows To:**

|                     |                     |                    |
|---------------------|---------------------|--------------------|
| <b>Surface</b>      | <b>Interflow</b>    | <b>Groundwater</b> |
| Surface retention 1 | Surface retention 1 |                    |

**Name** : Bioretention 1  
**Bottom Length:** 160.00 ft.  
**Bottom Width:** 1.00 ft.  
**Material thickness of first layer:** 0.25  
**Material type for first layer:** ASTM 100  
**Material thickness of second layer:** 1.5  
**Material type for second layer:** SMMWW 12 in/hr  
**Material thickness of third layer:** 1.5  
**Material type for third layer:** GRAVEL  
**Infiltration On**  
**Infiltration rate:** 4.5  
**Infiltration safety factor:** 1  
**Wetted surface area On**  
**Total Volume Infiltrated (ac-ft.):** 131.292  
**Total Volume Through Riser (ac-ft.):** 0  
**Total Volume Through Facility (ac-ft.):** 131.292  
**Percent Infiltrated:** 100  
**Total Precip Applied to Facility:** 9.945  
**Total Evap From Facility:** 3.279  
**Underdrain not used**  
**Discharge Structure**  
**Riser Height:** 0.25 ft.  
**Riser Diameter:** 0 in.

**Element Flows To:**

|                 |                 |
|-----------------|-----------------|
| <b>Outlet 1</b> | <b>Outlet 2</b> |
|-----------------|-----------------|

**Bioretention 1 Hydraulic Table**

| <u>Stage(feet)</u> | <u>Area(ac.)</u> | <u>Volume(ac-ft.)</u> | <u>Discharge(cfs)</u> | <u>Infilt(cfs)</u> |
|--------------------|------------------|-----------------------|-----------------------|--------------------|
| 0.0000             | 0.0845           | 0.0000                | 0.0000                | 0.0000             |
| 0.0440             | 0.0833           | 0.0001                | 0.0000                | 0.0000             |
| 0.0879             | 0.0821           | 0.0002                | 0.0000                | 0.0000             |

|        |        |        |        |        |
|--------|--------|--------|--------|--------|
| 0.1319 | 0.0809 | 0.0003 | 0.0000 | 0.0000 |
| 0.1758 | 0.0797 | 0.0005 | 0.0000 | 0.0000 |
| 0.2198 | 0.0785 | 0.0007 | 0.0000 | 0.0000 |
| 0.2637 | 0.0773 | 0.0009 | 0.0000 | 0.0001 |
| 0.3077 | 0.0762 | 0.0011 | 0.0000 | 0.0002 |
| 0.3516 | 0.0750 | 0.0013 | 0.0000 | 0.0003 |
| 0.3956 | 0.0738 | 0.0015 | 0.0000 | 0.0005 |
| 0.4396 | 0.0726 | 0.0018 | 0.0000 | 0.0008 |
| 0.4835 | 0.0714 | 0.0021 | 0.0000 | 0.0012 |
| 0.5275 | 0.0702 | 0.0024 | 0.0000 | 0.0017 |
| 0.5714 | 0.0691 | 0.0027 | 0.0000 | 0.0024 |
| 0.6154 | 0.0679 | 0.0030 | 0.0000 | 0.0030 |
| 0.6593 | 0.0667 | 0.0034 | 0.0000 | 0.0034 |
| 0.7033 | 0.0656 | 0.0038 | 0.0000 | 0.0044 |
| 0.7473 | 0.0644 | 0.0042 | 0.0000 | 0.0057 |
| 0.7912 | 0.0633 | 0.0046 | 0.0000 | 0.0072 |
| 0.8352 | 0.0621 | 0.0051 | 0.0000 | 0.0089 |
| 0.8791 | 0.0610 | 0.0055 | 0.0000 | 0.0096 |
| 0.9231 | 0.0598 | 0.0060 | 0.0000 | 0.0106 |
| 0.9670 | 0.0587 | 0.0065 | 0.0000 | 0.0119 |
| 1.0110 | 0.0575 | 0.0071 | 0.0000 | 0.0144 |
| 1.0549 | 0.0564 | 0.0076 | 0.0000 | 0.0172 |
| 1.0989 | 0.0553 | 0.0082 | 0.0000 | 0.0205 |
| 1.1429 | 0.0541 | 0.0088 | 0.0000 | 0.0229 |
| 1.1868 | 0.0530 | 0.0094 | 0.0000 | 0.0249 |
| 1.2308 | 0.0519 | 0.0100 | 0.0000 | 0.0291 |
| 1.2747 | 0.0508 | 0.0107 | 0.0000 | 0.0338 |
| 1.3187 | 0.0497 | 0.0114 | 0.0000 | 0.0389 |
| 1.3626 | 0.0485 | 0.0121 | 0.0000 | 0.0446 |
| 1.4066 | 0.0474 | 0.0128 | 0.0000 | 0.0461 |
| 1.4505 | 0.0463 | 0.0136 | 0.0000 | 0.0524 |
| 1.4945 | 0.0452 | 0.0143 | 0.0000 | 0.0595 |
| 1.5385 | 0.0441 | 0.0151 | 0.0000 | 0.0672 |
| 1.5824 | 0.0430 | 0.0159 | 0.0000 | 0.0755 |
| 1.6264 | 0.0419 | 0.0168 | 0.0000 | 0.0806 |
| 1.6703 | 0.0408 | 0.0176 | 0.0000 | 0.0869 |
| 1.7143 | 0.0397 | 0.0185 | 0.0000 | 0.0903 |
| 1.7582 | 0.0387 | 0.0193 | 0.0000 | 0.0993 |
| 1.8022 | 0.0376 | 0.0201 | 0.0000 | 0.1104 |
| 1.8462 | 0.0365 | 0.0210 | 0.0000 | 0.1224 |
| 1.8901 | 0.0354 | 0.0219 | 0.0000 | 0.1337 |
| 1.9341 | 0.0344 | 0.0228 | 0.0000 | 0.1383 |
| 1.9780 | 0.0333 | 0.0237 | 0.0000 | 0.1523 |
| 2.0220 | 0.0322 | 0.0246 | 0.0000 | 0.1570 |
| 2.0659 | 0.0312 | 0.0256 | 0.0000 | 0.1604 |
| 2.1099 | 0.0301 | 0.0265 | 0.0000 | 0.1638 |
| 2.1538 | 0.0290 | 0.0275 | 0.0000 | 0.1672 |
| 2.1978 | 0.0280 | 0.0286 | 0.0000 | 0.1706 |
| 2.2418 | 0.0269 | 0.0296 | 0.0000 | 0.1741 |
| 2.2857 | 0.0259 | 0.0307 | 0.0000 | 0.1775 |
| 2.3297 | 0.0248 | 0.0317 | 0.0000 | 0.1810 |
| 2.3736 | 0.0238 | 0.0328 | 0.0000 | 0.1844 |
| 2.4176 | 0.0228 | 0.0340 | 0.0000 | 0.1879 |
| 2.4615 | 0.0217 | 0.0351 | 0.0000 | 0.1914 |
| 2.5055 | 0.0207 | 0.0363 | 0.0000 | 0.1949 |
| 2.5495 | 0.0197 | 0.0375 | 0.0000 | 0.1984 |
| 2.5934 | 0.0187 | 0.0387 | 0.0000 | 0.2019 |

|        |        |        |        |        |
|--------|--------|--------|--------|--------|
| 2.6374 | 0.0176 | 0.0399 | 0.0000 | 0.2054 |
| 2.6813 | 0.0166 | 0.0411 | 0.0000 | 0.2090 |
| 2.7253 | 0.0156 | 0.0424 | 0.0000 | 0.2125 |
| 2.7692 | 0.0146 | 0.0437 | 0.0000 | 0.2161 |
| 2.8132 | 0.0136 | 0.0450 | 0.0000 | 0.2196 |
| 2.8571 | 0.0126 | 0.0464 | 0.0000 | 0.2232 |
| 2.9011 | 0.0116 | 0.0477 | 0.0000 | 0.2268 |
| 2.9451 | 0.0106 | 0.0491 | 0.0000 | 0.2304 |
| 2.9890 | 0.0096 | 0.0505 | 0.0000 | 0.2340 |
| 3.0330 | 0.0086 | 0.0519 | 0.0000 | 0.2376 |
| 3.0769 | 0.0076 | 0.0534 | 0.0000 | 0.2412 |
| 3.1209 | 0.0066 | 0.0548 | 0.0000 | 0.2448 |
| 3.1648 | 0.0056 | 0.0563 | 0.0000 | 0.2485 |
| 3.2088 | 0.0046 | 0.0578 | 0.0000 | 0.2521 |
| 3.2500 | 0.0037 | 0.0593 | 0.0000 | 0.2555 |

**Surface retention 1 Hydraulic Table**

| <u>Stage(feet)</u> | <u>Area(ac.)</u> | <u>Volume(ac-ft.)</u> | <u>Discharge(cfs)</u> | <u>To Amended(cfs)</u> | <u>Wetted Surface</u> |
|--------------------|------------------|-----------------------|-----------------------|------------------------|-----------------------|
| 3.2500             | 0.0845           | 0.0593                | 0.0000                | 0.0456                 | 0.0055                |
| 3.2940             | 0.0857           | 0.0630                | 0.0000                | 0.0456                 | 0.0110                |
| 3.3379             | 0.0869           | 0.0668                | 0.0000                | 0.0467                 | 0.0165                |
| 3.3819             | 0.0881           | 0.0706                | 0.0000                | 0.0478                 | 0.0221                |
| 3.4258             | 0.0893           | 0.0745                | 0.0000                | 0.0489                 | 0.0277                |
| 3.4698             | 0.0906           | 0.0785                | 0.0000                | 0.0500                 | 0.0332                |
| 3.5137             | 0.0918           | 0.0825                | 0.0000                | 0.0511                 | 0.0388                |
| 3.5577             | 0.0930           | 0.0866                | 0.0000                | 0.0523                 | 0.0444                |
| 3.6016             | 0.0943           | 0.0907                | 0.0000                | 0.0534                 | 0.0500                |
| 3.6456             | 0.0955           | 0.0948                | 0.0000                | 0.0545                 | 0.0557                |
| 3.6896             | 0.0967           | 0.0991                | 0.0000                | 0.0556                 | 0.0613                |
| 3.7335             | 0.0980           | 0.1033                | 0.0000                | 0.0567                 | 0.0670                |
| 3.7775             | 0.0992           | 0.1077                | 0.0000                | 0.0578                 | 0.0727                |
| 3.8214             | 0.1005           | 0.1121                | 0.0000                | 0.0590                 | 0.0783                |
| 3.8654             | 0.1017           | 0.1165                | 0.0000                | 0.0601                 | 0.0840                |
| 3.9093             | 0.1030           | 0.1210                | 0.0000                | 0.0612                 | 0.0898                |
| 3.9533             | 0.1043           | 0.1256                | 0.0000                | 0.0623                 | 0.0955                |
| 3.9973             | 0.1055           | 0.1302                | 0.0000                | 0.0634                 | 0.0959                |
| 4.0000             | 0.1056           | 0.1305                | 0.0000                | 0.0635                 | 0.0000                |

**Name** : Surface retention 1

**Element Flows To:**

**Outlet 1**                      **Outlet 2**  
 Bioretention 1

**ANALYSIS RESULTS**

**POC #1 was not reported because POC must exist in both scenarios and both scenarios must have been run. Perlnd and Implnd Changes**

No changes have been made.

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WWHM2012  
PROJECT REPORT

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**Project Name:** Bioretention  
**Site Name:** Arlington Apartments  
**Site Address:**  
**City :**  
**Report Date:** 5/20/2025  
**Gage :** Everett  
**Data Start :** 1948/10/01  
**Data End :** 2009/09/30  
**Precip Scale:** 1.20  
**Version Date:** 2016/02/25  
**Version :** 4.2.12

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

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

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**PREDEVELOPED LAND USE**

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

**GroundWater:** No

|                            |               |
|----------------------------|---------------|
| <u>Pervious Land Use</u>   | <u>acre</u>   |
| C, Forest, Flat            | .2712         |
| <b>Pervious Total</b>      | <b>0.2712</b> |
| <u>Impervious Land Use</u> | <u>acre</u>   |
| <b>Impervious Total</b>    | <b>0</b>      |
| <b>Basin Total</b>         | <b>0.2712</b> |

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**Element Flows To:**

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

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**MITIGATED LAND USE**

**Name :** Proposed  
**Bypass:** No

**GroundWater:** No

|                            |               |
|----------------------------|---------------|
| <u>Pervious Land Use</u>   | <u>acre</u>   |
| C, Lawn, Flat              | .0581         |
| <b>Pervious Total</b>      | <b>0.0581</b> |
| <u>Impervious Land Use</u> | <u>acre</u>   |
| ROADS FLAT                 | 0.2132        |
| <b>Impervious Total</b>    | <b>0.2132</b> |
| <b>Basin Total</b>         | <b>0.2713</b> |

**Element Flows To:**

|                     |                     |                    |
|---------------------|---------------------|--------------------|
| <b>Surface</b>      | <b>Interflow</b>    | <b>Groundwater</b> |
| Surface retention 1 | Surface retention 1 |                    |

**Name** : Bioretention 1  
**Bottom Length:** 50.00 ft.  
**Bottom Width:** 1.00 ft.  
**Material thickness of first layer:** 0.25  
**Material type for first layer:** ASTM 100  
**Material thickness of second layer:** 1.5  
**Material type for second layer:** SMMWW 12 in/hr  
**Material thickness of third layer:** 1.5  
**Material type for third layer:** GRAVEL  
**Infiltration On**  
**Infiltration rate:** 4.5  
**Infiltration safety factor:** 1  
**Wetted surface area On**  
**Total Volume Infiltrated (ac-ft.):** 50.358  
**Total Volume Through Riser (ac-ft.):** 0  
**Total Volume Through Facility (ac-ft.):** 50.358  
**Percent Infiltrated:** 100  
**Total Precip Applied to Facility:** 3.94  
**Total Evap From Facility:** 1.157  
**Underdrain not used**  
**Discharge Structure**  
**Riser Height:** 0.25 ft.  
**Riser Diameter:** 0 in.

**Element Flows To:**

|                 |                 |
|-----------------|-----------------|
| <b>Outlet 1</b> | <b>Outlet 2</b> |
|-----------------|-----------------|

**Bioretention 1 Hydraulic Table**

| <u>Stage(feet)</u> | <u>Area(ac.)</u> | <u>Volume(ac-ft.)</u> | <u>Discharge(cfs)</u> | <u>Infilt(cfs)</u> |
|--------------------|------------------|-----------------------|-----------------------|--------------------|
| 0.0000             | 0.0327           | 0.0000                | 0.0000                | 0.0000             |
| 0.0440             | 0.0322           | 0.0000                | 0.0000                | 0.0000             |
| 0.0879             | 0.0317           | 0.0001                | 0.0000                | 0.0000             |

|        |        |        |        |        |
|--------|--------|--------|--------|--------|
| 0.1319 | 0.0311 | 0.0001 | 0.0000 | 0.0000 |
| 0.1758 | 0.0306 | 0.0002 | 0.0000 | 0.0000 |
| 0.2198 | 0.0301 | 0.0002 | 0.0000 | 0.0000 |
| 0.2637 | 0.0295 | 0.0003 | 0.0000 | 0.0000 |
| 0.3077 | 0.0290 | 0.0003 | 0.0000 | 0.0001 |
| 0.3516 | 0.0285 | 0.0004 | 0.0000 | 0.0001 |
| 0.3956 | 0.0280 | 0.0005 | 0.0000 | 0.0002 |
| 0.4396 | 0.0275 | 0.0006 | 0.0000 | 0.0003 |
| 0.4835 | 0.0269 | 0.0007 | 0.0000 | 0.0004 |
| 0.5275 | 0.0264 | 0.0008 | 0.0000 | 0.0006 |
| 0.5714 | 0.0259 | 0.0009 | 0.0000 | 0.0008 |
| 0.6154 | 0.0254 | 0.0010 | 0.0000 | 0.0010 |
| 0.6593 | 0.0249 | 0.0011 | 0.0000 | 0.0011 |
| 0.7033 | 0.0244 | 0.0012 | 0.0000 | 0.0015 |
| 0.7473 | 0.0239 | 0.0014 | 0.0000 | 0.0019 |
| 0.7912 | 0.0234 | 0.0015 | 0.0000 | 0.0024 |
| 0.8352 | 0.0230 | 0.0017 | 0.0000 | 0.0030 |
| 0.8791 | 0.0225 | 0.0018 | 0.0000 | 0.0032 |
| 0.9231 | 0.0220 | 0.0020 | 0.0000 | 0.0035 |
| 0.9670 | 0.0215 | 0.0021 | 0.0000 | 0.0040 |
| 1.0110 | 0.0210 | 0.0023 | 0.0000 | 0.0049 |
| 1.0549 | 0.0206 | 0.0025 | 0.0000 | 0.0058 |
| 1.0989 | 0.0201 | 0.0027 | 0.0000 | 0.0070 |
| 1.1429 | 0.0196 | 0.0029 | 0.0000 | 0.0078 |
| 1.1868 | 0.0192 | 0.0031 | 0.0000 | 0.0085 |
| 1.2308 | 0.0187 | 0.0033 | 0.0000 | 0.0100 |
| 1.2747 | 0.0183 | 0.0036 | 0.0000 | 0.0116 |
| 1.3187 | 0.0178 | 0.0038 | 0.0000 | 0.0134 |
| 1.3626 | 0.0174 | 0.0040 | 0.0000 | 0.0154 |
| 1.4066 | 0.0169 | 0.0043 | 0.0000 | 0.0160 |
| 1.4505 | 0.0165 | 0.0045 | 0.0000 | 0.0182 |
| 1.4945 | 0.0161 | 0.0048 | 0.0000 | 0.0208 |
| 1.5385 | 0.0156 | 0.0051 | 0.0000 | 0.0235 |
| 1.5824 | 0.0152 | 0.0054 | 0.0000 | 0.0265 |
| 1.6264 | 0.0148 | 0.0057 | 0.0000 | 0.0284 |
| 1.6703 | 0.0143 | 0.0060 | 0.0000 | 0.0307 |
| 1.7143 | 0.0139 | 0.0063 | 0.0000 | 0.0320 |
| 1.7582 | 0.0135 | 0.0066 | 0.0000 | 0.0353 |
| 1.8022 | 0.0131 | 0.0069 | 0.0000 | 0.0393 |
| 1.8462 | 0.0127 | 0.0072 | 0.0000 | 0.0437 |
| 1.8901 | 0.0123 | 0.0075 | 0.0000 | 0.0479 |
| 1.9341 | 0.0118 | 0.0078 | 0.0000 | 0.0496 |
| 1.9780 | 0.0114 | 0.0081 | 0.0000 | 0.0548 |
| 2.0220 | 0.0110 | 0.0085 | 0.0000 | 0.0567 |
| 2.0659 | 0.0106 | 0.0088 | 0.0000 | 0.0580 |
| 2.1099 | 0.0103 | 0.0092 | 0.0000 | 0.0594 |
| 2.1538 | 0.0099 | 0.0095 | 0.0000 | 0.0608 |
| 2.1978 | 0.0095 | 0.0099 | 0.0000 | 0.0623 |
| 2.2418 | 0.0091 | 0.0103 | 0.0000 | 0.0637 |
| 2.2857 | 0.0087 | 0.0107 | 0.0000 | 0.0651 |
| 2.3297 | 0.0083 | 0.0111 | 0.0000 | 0.0665 |
| 2.3736 | 0.0080 | 0.0115 | 0.0000 | 0.0680 |
| 2.4176 | 0.0076 | 0.0119 | 0.0000 | 0.0695 |
| 2.4615 | 0.0072 | 0.0123 | 0.0000 | 0.0709 |
| 2.5055 | 0.0069 | 0.0127 | 0.0000 | 0.0724 |
| 2.5495 | 0.0065 | 0.0132 | 0.0000 | 0.0739 |
| 2.5934 | 0.0061 | 0.0136 | 0.0000 | 0.0754 |

|        |        |        |        |        |
|--------|--------|--------|--------|--------|
| 2.6374 | 0.0058 | 0.0141 | 0.0000 | 0.0769 |
| 2.6813 | 0.0054 | 0.0146 | 0.0000 | 0.0784 |
| 2.7253 | 0.0051 | 0.0150 | 0.0000 | 0.0800 |
| 2.7692 | 0.0047 | 0.0155 | 0.0000 | 0.0815 |
| 2.8132 | 0.0044 | 0.0160 | 0.0000 | 0.0830 |
| 2.8571 | 0.0041 | 0.0165 | 0.0000 | 0.0846 |
| 2.9011 | 0.0037 | 0.0170 | 0.0000 | 0.0862 |
| 2.9451 | 0.0034 | 0.0176 | 0.0000 | 0.0877 |
| 2.9890 | 0.0031 | 0.0181 | 0.0000 | 0.0893 |
| 3.0330 | 0.0027 | 0.0186 | 0.0000 | 0.0909 |
| 3.0769 | 0.0024 | 0.0192 | 0.0000 | 0.0925 |
| 3.1209 | 0.0021 | 0.0198 | 0.0000 | 0.0941 |
| 3.1648 | 0.0018 | 0.0203 | 0.0000 | 0.0958 |
| 3.2088 | 0.0015 | 0.0209 | 0.0000 | 0.0974 |
| 3.2500 | 0.0011 | 0.0215 | 0.0000 | 0.0989 |

**Surface retention 1 Hydraulic Table**

| <u>Stage(feet)</u> | <u>Area(ac.)</u> | <u>Volume(ac-ft.)</u> | <u>Discharge(cfs)</u> | <u>To Amended(cfs)</u> | <u>Wetted Surface</u> |
|--------------------|------------------|-----------------------|-----------------------|------------------------|-----------------------|
| 3.2500             | 0.0327           | 0.0215                | 0.0000                | 0.0142                 | 0.0025                |
| 3.2940             | 0.0333           | 0.0229                | 0.0000                | 0.0142                 | 0.0050                |
| 3.3379             | 0.0338           | 0.0244                | 0.0000                | 0.0146                 | 0.0075                |
| 3.3819             | 0.0344           | 0.0259                | 0.0000                | 0.0149                 | 0.0100                |
| 3.4258             | 0.0349           | 0.0274                | 0.0000                | 0.0153                 | 0.0125                |
| 3.4698             | 0.0355           | 0.0290                | 0.0000                | 0.0156                 | 0.0151                |
| 3.5137             | 0.0360           | 0.0305                | 0.0000                | 0.0160                 | 0.0177                |
| 3.5577             | 0.0366           | 0.0321                | 0.0000                | 0.0163                 | 0.0202                |
| 3.6016             | 0.0372           | 0.0337                | 0.0000                | 0.0167                 | 0.0228                |
| 3.6456             | 0.0377           | 0.0354                | 0.0000                | 0.0170                 | 0.0254                |
| 3.6896             | 0.0383           | 0.0371                | 0.0000                | 0.0174                 | 0.0281                |
| 3.7335             | 0.0389           | 0.0388                | 0.0000                | 0.0177                 | 0.0307                |
| 3.7775             | 0.0395           | 0.0405                | 0.0000                | 0.0181                 | 0.0334                |
| 3.8214             | 0.0401           | 0.0422                | 0.0000                | 0.0184                 | 0.0360                |
| 3.8654             | 0.0406           | 0.0440                | 0.0000                | 0.0188                 | 0.0387                |
| 3.9093             | 0.0412           | 0.0458                | 0.0000                | 0.0191                 | 0.0414                |
| 3.9533             | 0.0418           | 0.0476                | 0.0000                | 0.0195                 | 0.0441                |
| 3.9973             | 0.0424           | 0.0495                | 0.0000                | 0.0198                 | 0.0443                |
| 4.0000             | 0.0425           | 0.0496                | 0.0000                | 0.0198                 | 0.0000                |

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**Name** : Surface retention 1

**Element Flows To:**

**Outlet 1**                      **Outlet 2**  
 Bioretention 1

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**ANALYSIS RESULTS**

**POC #1 was not reported because POC must exist in both scenarios and both scenarios must have been run.Perlnd and Implnd Changes**

No changes have been made.

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**WWHM2012  
PROJECT REPORT**

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**Project Name:** Bioretention  
**Site Name:** Arlington  
**Site Address:** 21117 59th Ave NE  
**City** : Arlington  
**Report Date:** 6/17/2025  
**Gage** : Everett  
**Data Start** : 1948/10/01  
**Data End** : 2009/09/30  
**Precip Scale:** 1.40  
**Version Date:** 2016/02/25  
**Version** : 4.2.12

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

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

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**PREDEVELOPED LAND USE**

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

**GroundWater:** No

|                            |               |
|----------------------------|---------------|
| <u>Pervious Land Use</u>   | <u>acre</u>   |
| C, Forest, Flat            | .2156         |
| <b>Pervious Total</b>      | <b>0.2156</b> |
| <u>Impervious Land Use</u> | <u>acre</u>   |
| <b>Impervious Total</b>    | <b>0</b>      |
| <b>Basin Total</b>         | <b>0.2156</b> |

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**Element Flows To:**

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

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**MITIGATED LAND USE**

**Name** : Proposed  
**Bypass:** No

**GroundWater:** No

|                            |               |
|----------------------------|---------------|
| <u>Pervious Land Use</u>   | <u>acre</u>   |
| C, Lawn, Flat              | .0513         |
| <b>Pervious Total</b>      | <b>0.0513</b> |
| <u>Impervious Land Use</u> | <u>acre</u>   |
| ROADS FLAT                 | 0.1643        |
| <b>Impervious Total</b>    | <b>0.1643</b> |
| <b>Basin Total</b>         | <b>0.2156</b> |

**Element Flows To:**

|                     |                     |                     |
|---------------------|---------------------|---------------------|
| <b>Surface</b>      | <b>Interflow</b>    | <b>Groundwater</b>  |
| Surface retention 1 | Surface retention 1 | Surface retention 1 |

**Name** : Bioretention 1  
**Bottom Length:** 150.00 ft.  
**Bottom Width:** 1.00 ft.  
**Material thickness of first layer:** 0.25  
**Material type for first layer:** ASTM 100  
**Material thickness of second layer:** 1.5  
**Material type for second layer:** SMMWW 12 in/hr  
**Material thickness of third layer:** 1.5  
**Material type for third layer:** GRAVEL  
**Infiltration On**  
**Infiltration rate:** 4.5  
**Infiltration safety factor:** 1  
**Wetted surface area On**  
**Total Volume Infiltrated (ac-ft.):** 51.023  
**Total Volume Through Riser (ac-ft.):** 0.011  
**Total Volume Through Facility (ac-ft.):** 51.034  
**Percent Infiltrated:** 99.98  
**Total Precip Applied to Facility:** 5.686  
**Total Evap From Facility:** 2.293  
**Underdrain not used**  
**Discharge Structure**  
**Riser Height:** 0.25 ft.  
**Riser Diameter:** 6 in.

**Element Flows To:**

|                 |                 |
|-----------------|-----------------|
| <b>Outlet 1</b> | <b>Outlet 2</b> |
|-----------------|-----------------|

**Bioretention 1 Hydraulic Table**

| <u>Stage(feet)</u> | <u>Area(ac.)</u> | <u>Volume(ac-ft.)</u> | <u>Discharge(cfs)</u> | <u>Infilt(cfs)</u> |
|--------------------|------------------|-----------------------|-----------------------|--------------------|
| 0.0000             | 0.0658           | 0.0000                | 0.0000                | 0.0000             |
| 0.0440             | 0.0650           | 0.0001                | 0.0000                | 0.0000             |
| 0.0879             | 0.0640           | 0.0002                | 0.0000                | 0.0000             |

|        |        |        |        |        |
|--------|--------|--------|--------|--------|
| 0.1319 | 0.0631 | 0.0003 | 0.0000 | 0.0000 |
| 0.1758 | 0.0622 | 0.0004 | 0.0000 | 0.0000 |
| 0.2198 | 0.0613 | 0.0006 | 0.0000 | 0.0000 |
| 0.2637 | 0.0604 | 0.0007 | 0.0000 | 0.0001 |
| 0.3077 | 0.0595 | 0.0009 | 0.0000 | 0.0001 |
| 0.3516 | 0.0586 | 0.0011 | 0.0000 | 0.0003 |
| 0.3956 | 0.0576 | 0.0013 | 0.0000 | 0.0004 |
| 0.4396 | 0.0567 | 0.0015 | 0.0000 | 0.0007 |
| 0.4835 | 0.0558 | 0.0018 | 0.0000 | 0.0010 |
| 0.5275 | 0.0549 | 0.0020 | 0.0000 | 0.0014 |
| 0.5714 | 0.0540 | 0.0023 | 0.0000 | 0.0019 |
| 0.6154 | 0.0531 | 0.0025 | 0.0000 | 0.0024 |
| 0.6593 | 0.0523 | 0.0028 | 0.0000 | 0.0027 |
| 0.7033 | 0.0514 | 0.0032 | 0.0000 | 0.0036 |
| 0.7473 | 0.0505 | 0.0035 | 0.0000 | 0.0046 |
| 0.7912 | 0.0496 | 0.0038 | 0.0000 | 0.0058 |
| 0.8352 | 0.0487 | 0.0042 | 0.0000 | 0.0072 |
| 0.8791 | 0.0478 | 0.0046 | 0.0000 | 0.0077 |
| 0.9231 | 0.0469 | 0.0050 | 0.0000 | 0.0085 |
| 0.9670 | 0.0461 | 0.0054 | 0.0000 | 0.0095 |
| 1.0110 | 0.0452 | 0.0058 | 0.0000 | 0.0115 |
| 1.0549 | 0.0443 | 0.0062 | 0.0000 | 0.0138 |
| 1.0989 | 0.0434 | 0.0067 | 0.0000 | 0.0163 |
| 1.1429 | 0.0426 | 0.0072 | 0.0000 | 0.0183 |
| 1.1868 | 0.0417 | 0.0077 | 0.0000 | 0.0199 |
| 1.2308 | 0.0408 | 0.0082 | 0.0000 | 0.0232 |
| 1.2747 | 0.0400 | 0.0087 | 0.0000 | 0.0269 |
| 1.3187 | 0.0391 | 0.0092 | 0.0000 | 0.0309 |
| 1.3626 | 0.0383 | 0.0098 | 0.0000 | 0.0354 |
| 1.4066 | 0.0374 | 0.0104 | 0.0000 | 0.0365 |
| 1.4505 | 0.0365 | 0.0109 | 0.0000 | 0.0416 |
| 1.4945 | 0.0357 | 0.0116 | 0.0000 | 0.0471 |
| 1.5385 | 0.0348 | 0.0122 | 0.0000 | 0.0532 |
| 1.5824 | 0.0340 | 0.0128 | 0.0000 | 0.0598 |
| 1.6264 | 0.0332 | 0.0135 | 0.0000 | 0.0637 |
| 1.6703 | 0.0323 | 0.0142 | 0.0000 | 0.0686 |
| 1.7143 | 0.0315 | 0.0148 | 0.0000 | 0.0713 |
| 1.7582 | 0.0306 | 0.0155 | 0.0000 | 0.0784 |
| 1.8022 | 0.0298 | 0.0161 | 0.0000 | 0.0871 |
| 1.8462 | 0.0290 | 0.0168 | 0.0000 | 0.0965 |
| 1.8901 | 0.0281 | 0.0175 | 0.0000 | 0.1054 |
| 1.9341 | 0.0273 | 0.0182 | 0.0000 | 0.1089 |
| 1.9780 | 0.0265 | 0.0189 | 0.0000 | 0.1199 |
| 2.0220 | 0.0256 | 0.0197 | 0.0000 | 0.1235 |
| 2.0659 | 0.0248 | 0.0204 | 0.0000 | 0.1261 |
| 2.1099 | 0.0240 | 0.0212 | 0.0000 | 0.1288 |
| 2.1538 | 0.0232 | 0.0220 | 0.0000 | 0.1314 |
| 2.1978 | 0.0224 | 0.0228 | 0.0000 | 0.1340 |
| 2.2418 | 0.0216 | 0.0236 | 0.0000 | 0.1367 |
| 2.2857 | 0.0207 | 0.0244 | 0.0000 | 0.1393 |
| 2.3297 | 0.0199 | 0.0253 | 0.0000 | 0.1420 |
| 2.3736 | 0.0191 | 0.0261 | 0.0000 | 0.1446 |
| 2.4176 | 0.0183 | 0.0270 | 0.0000 | 0.1473 |
| 2.4615 | 0.0175 | 0.0279 | 0.0000 | 0.1500 |
| 2.5055 | 0.0167 | 0.0288 | 0.0000 | 0.1527 |
| 2.5495 | 0.0159 | 0.0298 | 0.0000 | 0.1554 |
| 2.5934 | 0.0151 | 0.0307 | 0.0000 | 0.1581 |

|        |        |        |        |        |
|--------|--------|--------|--------|--------|
| 2.6374 | 0.0143 | 0.0317 | 0.0000 | 0.1608 |
| 2.6813 | 0.0135 | 0.0326 | 0.0000 | 0.1635 |
| 2.7253 | 0.0127 | 0.0336 | 0.0000 | 0.1662 |
| 2.7692 | 0.0120 | 0.0346 | 0.0000 | 0.1689 |
| 2.8132 | 0.0112 | 0.0357 | 0.0000 | 0.1717 |
| 2.8571 | 0.0104 | 0.0367 | 0.0000 | 0.1744 |
| 2.9011 | 0.0096 | 0.0378 | 0.0000 | 0.1771 |
| 2.9451 | 0.0088 | 0.0389 | 0.0000 | 0.1799 |
| 2.9890 | 0.0081 | 0.0399 | 0.0000 | 0.1826 |
| 3.0330 | 0.0073 | 0.0411 | 0.0000 | 0.1854 |
| 3.0769 | 0.0065 | 0.0422 | 0.0000 | 0.1882 |
| 3.1209 | 0.0057 | 0.0433 | 0.0000 | 0.1910 |
| 3.1648 | 0.0050 | 0.0445 | 0.0000 | 0.1937 |
| 3.2088 | 0.0042 | 0.0457 | 0.0000 | 0.1965 |
| 3.2500 | 0.0034 | 0.0468 | 0.0000 | 0.1992 |

**Surface retention 1 Hydraulic Table**

| <u>Stage(feet)</u> | <u>Area(ac.)</u> | <u>Volume(ac-ft.)</u> | <u>Discharge(cfs)</u> | <u>To Amended(cfs)</u> | <u>Wetted Surface</u> |
|--------------------|------------------|-----------------------|-----------------------|------------------------|-----------------------|
| 3.2500             | 0.0658           | 0.0468                | 0.0000                | 0.0427                 | 0.0042                |
| 3.2940             | 0.0668           | 0.0497                | 0.0000                | 0.0427                 | 0.0084                |
| 3.3379             | 0.0677           | 0.0527                | 0.0000                | 0.0438                 | 0.0126                |
| 3.3819             | 0.0686           | 0.0556                | 0.0000                | 0.0448                 | 0.0169                |
| 3.4258             | 0.0696           | 0.0587                | 0.0000                | 0.0459                 | 0.0211                |
| 3.4698             | 0.0705           | 0.0618                | 0.0000                | 0.0469                 | 0.0254                |
| 3.5137             | 0.0714           | 0.0649                | 0.0085                | 0.0479                 | 0.0297                |
| 3.5577             | 0.0724           | 0.0680                | 0.0729                | 0.0490                 | 0.0339                |
| 3.6016             | 0.0733           | 0.0712                | 0.1641                | 0.0500                 | 0.0382                |
| 3.6456             | 0.0743           | 0.0745                | 0.2582                | 0.0511                 | 0.0425                |
| 3.6896             | 0.0752           | 0.0778                | 0.3331                | 0.0521                 | 0.0468                |
| 3.7335             | 0.0762           | 0.0811                | 0.3781                | 0.0532                 | 0.0511                |
| 3.7775             | 0.0771           | 0.0845                | 0.4148                | 0.0542                 | 0.0555                |
| 3.8214             | 0.0781           | 0.0879                | 0.4464                | 0.0553                 | 0.0598                |
| 3.8654             | 0.0790           | 0.0913                | 0.4760                | 0.0563                 | 0.0641                |
| 3.9093             | 0.0800           | 0.0948                | 0.5038                | 0.0574                 | 0.0685                |
| 3.9533             | 0.0809           | 0.0984                | 0.5301                | 0.0584                 | 0.0729                |
| 3.9973             | 0.0819           | 0.1019                | 0.5552                | 0.0595                 | 0.0731                |
| 4.0000             | 0.0820           | 0.1022                | 0.5793                | 0.0595                 | 0.0000                |

**Name** : Surface retention 1

**Element Flows To:**

**Outlet 1**                      **Outlet 2**  
 Bioretention 1

**ANALYSIS RESULTS**

**Stream Protection Duration**

**Predeveloped Landuse Totals for POC #1**

**Total Pervious Area:0.2156**

Total Impervious Area:0

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**Mitigated Landuse Totals for POC #1**

Total Pervious Area:0.0513

Total Impervious Area:0.1643

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

| <u>Return Period</u> | <u>Flow(cfs)</u> |
|----------------------|------------------|
| 2 year               | 0.011291         |
| 5 year               | 0.019411         |
| 10 year              | 0.0267           |
| 25 year              | 0.038576         |
| 50 year              | 0.049699         |
| 100 year             | 0.06309          |

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

| <u>Return Period</u> | <u>Flow(cfs)</u> |
|----------------------|------------------|
| 2 year               | 0                |
| 5 year               | 0                |
| 10 year              | 0                |
| 25 year              | 0                |
| 50 year              | 0                |
| 100 year             | 0                |

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**Stream Protection Duration**

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

| <u>Year</u> | <u>Predeveloped</u> | <u>Mitigated</u> |
|-------------|---------------------|------------------|
| 1949        | 0.017               | 0.000            |
| 1950        | 0.014               | 0.000            |
| 1951        | 0.010               | 0.000            |
| 1952        | 0.009               | 0.000            |
| 1953        | 0.011               | 0.000            |
| 1954        | 0.043               | 0.000            |
| 1955        | 0.015               | 0.001            |
| 1956        | 0.011               | 0.000            |
| 1957        | 0.016               | 0.000            |
| 1958        | 0.036               | 0.051            |
| 1959        | 0.010               | 0.000            |
| 1960        | 0.012               | 0.000            |
| 1961        | 0.088               | 0.031            |
| 1962        | 0.012               | 0.000            |
| 1963        | 0.023               | 0.000            |
| 1964        | 0.014               | 0.000            |
| 1965        | 0.008               | 0.000            |
| 1966        | 0.005               | 0.000            |
| 1967        | 0.009               | 0.007            |
| 1968        | 0.012               | 0.000            |
| 1969        | 0.053               | 0.000            |
| 1970        | 0.007               | 0.000            |
| 1971        | 0.013               | 0.000            |
| 1972        | 0.010               | 0.015            |
| 1973        | 0.008               | 0.000            |
| 1974        | 0.022               | 0.000            |
| 1975        | 0.010               | 0.000            |

|      |       |       |
|------|-------|-------|
| 1976 | 0.008 | 0.000 |
| 1977 | 0.007 | 0.000 |
| 1978 | 0.007 | 0.000 |
| 1979 | 0.028 | 0.005 |
| 1980 | 0.011 | 0.000 |
| 1981 | 0.007 | 0.000 |
| 1982 | 0.010 | 0.000 |
| 1983 | 0.019 | 0.000 |
| 1984 | 0.009 | 0.000 |
| 1985 | 0.012 | 0.000 |
| 1986 | 0.028 | 0.000 |
| 1987 | 0.012 | 0.000 |
| 1988 | 0.009 | 0.000 |
| 1989 | 0.009 | 0.000 |
| 1990 | 0.009 | 0.000 |
| 1991 | 0.009 | 0.000 |
| 1992 | 0.008 | 0.000 |
| 1993 | 0.007 | 0.000 |
| 1994 | 0.007 | 0.000 |
| 1995 | 0.009 | 0.000 |
| 1996 | 0.017 | 0.000 |
| 1997 | 0.035 | 0.014 |
| 1998 | 0.009 | 0.000 |
| 1999 | 0.007 | 0.000 |
| 2000 | 0.007 | 0.000 |
| 2001 | 0.003 | 0.000 |
| 2002 | 0.009 | 0.000 |
| 2003 | 0.007 | 0.000 |
| 2004 | 0.011 | 0.002 |
| 2005 | 0.008 | 0.000 |
| 2006 | 0.025 | 0.000 |
| 2007 | 0.020 | 0.000 |
| 2008 | 0.023 | 0.005 |
| 2009 | 0.007 | 0.000 |

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**Stream Protection Duration**

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

| <b>Rank</b> | <b>Predeveloped</b> | <b>Mitigated</b> |
|-------------|---------------------|------------------|
| 1           | 0.0882              | 0.0505           |
| 2           | 0.0529              | 0.0314           |
| 3           | 0.0433              | 0.0150           |
| 4           | 0.0356              | 0.0138           |
| 5           | 0.0355              | 0.0071           |
| 6           | 0.0284              | 0.0051           |
| 7           | 0.0279              | 0.0050           |
| 8           | 0.0247              | 0.0023           |
| 9           | 0.0229              | 0.0008           |
| 10          | 0.0226              | 0.0000           |
| 11          | 0.0222              | 0.0000           |
| 12          | 0.0195              | 0.0000           |
| 13          | 0.0193              | 0.0000           |
| 14          | 0.0173              | 0.0000           |
| 15          | 0.0171              | 0.0000           |
| 16          | 0.0157              | 0.0000           |
| 17          | 0.0147              | 0.0000           |
| 18          | 0.0141              | 0.0000           |

|    |        |        |
|----|--------|--------|
| 19 | 0.0139 | 0.0000 |
| 20 | 0.0127 | 0.0000 |
| 21 | 0.0124 | 0.0000 |
| 22 | 0.0124 | 0.0000 |
| 23 | 0.0121 | 0.0000 |
| 24 | 0.0119 | 0.0000 |
| 25 | 0.0117 | 0.0000 |
| 26 | 0.0115 | 0.0000 |
| 27 | 0.0114 | 0.0000 |
| 28 | 0.0107 | 0.0000 |
| 29 | 0.0106 | 0.0000 |
| 30 | 0.0103 | 0.0000 |
| 31 | 0.0103 | 0.0000 |
| 32 | 0.0102 | 0.0000 |
| 33 | 0.0099 | 0.0000 |
| 34 | 0.0097 | 0.0000 |
| 35 | 0.0095 | 0.0000 |
| 36 | 0.0094 | 0.0000 |
| 37 | 0.0094 | 0.0000 |
| 38 | 0.0091 | 0.0000 |
| 39 | 0.0089 | 0.0000 |
| 40 | 0.0089 | 0.0000 |
| 41 | 0.0089 | 0.0000 |
| 42 | 0.0086 | 0.0000 |
| 43 | 0.0086 | 0.0000 |
| 44 | 0.0085 | 0.0000 |
| 45 | 0.0082 | 0.0000 |
| 46 | 0.0081 | 0.0000 |
| 47 | 0.0080 | 0.0000 |
| 48 | 0.0080 | 0.0000 |
| 49 | 0.0076 | 0.0000 |
| 50 | 0.0074 | 0.0000 |
| 51 | 0.0073 | 0.0000 |
| 52 | 0.0072 | 0.0000 |
| 53 | 0.0070 | 0.0000 |
| 54 | 0.0069 | 0.0000 |
| 55 | 0.0068 | 0.0000 |
| 56 | 0.0067 | 0.0000 |
| 57 | 0.0067 | 0.0000 |
| 58 | 0.0067 | 0.0000 |
| 59 | 0.0065 | 0.0000 |
| 60 | 0.0050 | 0.0000 |
| 61 | 0.0030 | 0.0000 |

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**Stream Protection Duration  
POC #1**

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

| Flow(cfs) | Predev | Mit  | Percentage | Pass/Fail |
|-----------|--------|------|------------|-----------|
| 0.0056    | 80679  | 6885 | 8          | Pass      |
| 0.0061    | 73278  | 6722 | 9          | Pass      |
| 0.0065    | 66476  | 6558 | 9          | Pass      |
| 0.0070    | 60488  | 6400 | 10         | Pass      |
| 0.0074    | 54884  | 6239 | 11         | Pass      |
| 0.0079    | 49964  | 6104 | 12         | Pass      |

|        |       |      |     |      |
|--------|-------|------|-----|------|
| 0.0083 | 45601 | 5972 | 13  | Pass |
| 0.0088 | 41644 | 5811 | 13  | Pass |
| 0.0092 | 37987 | 5642 | 14  | Pass |
| 0.0097 | 34735 | 5495 | 15  | Pass |
| 0.0101 | 31891 | 5373 | 16  | Pass |
| 0.0105 | 29324 | 5257 | 17  | Pass |
| 0.0110 | 26971 | 5185 | 19  | Pass |
| 0.0114 | 24790 | 5114 | 20  | Pass |
| 0.0119 | 22800 | 5039 | 22  | Pass |
| 0.0123 | 20863 | 4966 | 23  | Pass |
| 0.0128 | 19045 | 4911 | 25  | Pass |
| 0.0132 | 17410 | 4857 | 27  | Pass |
| 0.0137 | 15924 | 4795 | 30  | Pass |
| 0.0141 | 14579 | 4729 | 32  | Pass |
| 0.0145 | 13332 | 4684 | 35  | Pass |
| 0.0150 | 12155 | 4622 | 38  | Pass |
| 0.0154 | 11090 | 4584 | 41  | Pass |
| 0.0159 | 10108 | 4526 | 44  | Pass |
| 0.0163 | 9178  | 4464 | 48  | Pass |
| 0.0168 | 8402  | 4400 | 52  | Pass |
| 0.0172 | 7713  | 4350 | 56  | Pass |
| 0.0177 | 7065  | 4297 | 60  | Pass |
| 0.0181 | 6415  | 4250 | 66  | Pass |
| 0.0186 | 5873  | 4196 | 71  | Pass |
| 0.0190 | 5347  | 4154 | 77  | Pass |
| 0.0194 | 4855  | 4107 | 84  | Pass |
| 0.0199 | 4449  | 4055 | 91  | Pass |
| 0.0203 | 4109  | 4010 | 97  | Pass |
| 0.0208 | 3811  | 3970 | 104 | Pass |
| 0.0212 | 3538  | 3912 | 110 | Pass |
| 0.0217 | 3281  | 3863 | 117 | Fail |
| 0.0221 | 3044  | 3814 | 125 | Fail |
| 0.0226 | 2808  | 3769 | 134 | Fail |
| 0.0230 | 2618  | 3724 | 142 | Fail |
| 0.0234 | 2436  | 3677 | 150 | Fail |
| 0.0239 | 2265  | 3632 | 160 | Fail |
| 0.0243 | 2110  | 3583 | 169 | Fail |
| 0.0248 | 1955  | 3544 | 181 | Fail |
| 0.0252 | 1823  | 3503 | 192 | Fail |
| 0.0257 | 1704  | 3465 | 203 | Fail |
| 0.0261 | 1610  | 3420 | 212 | Fail |
| 0.0266 | 1513  | 3379 | 223 | Fail |
| 0.0270 | 1440  | 3332 | 231 | Fail |
| 0.0274 | 1373  | 3287 | 239 | Fail |
| 0.0279 | 1313  | 3247 | 247 | Fail |
| 0.0283 | 1247  | 3206 | 257 | Fail |
| 0.0288 | 1181  | 3163 | 267 | Fail |
| 0.0292 | 1129  | 3125 | 276 | Fail |
| 0.0297 | 1069  | 3086 | 288 | Fail |
| 0.0301 | 1019  | 3050 | 299 | Fail |
| 0.0306 | 981   | 3018 | 307 | Fail |
| 0.0310 | 940   | 2979 | 316 | Fail |
| 0.0315 | 899   | 2937 | 326 | Fail |
| 0.0319 | 857   | 2900 | 338 | Fail |
| 0.0323 | 828   | 2849 | 344 | Fail |
| 0.0328 | 802   | 2808 | 350 | Fail |
| 0.0332 | 776   | 2781 | 358 | Fail |

|        |     |      |     |      |
|--------|-----|------|-----|------|
| 0.0337 | 739 | 2740 | 370 | Fail |
| 0.0341 | 713 | 2699 | 378 | Fail |
| 0.0346 | 693 | 2654 | 382 | Fail |
| 0.0350 | 669 | 2614 | 390 | Fail |
| 0.0355 | 653 | 2569 | 393 | Fail |
| 0.0359 | 637 | 2526 | 396 | Fail |
| 0.0363 | 621 | 2488 | 400 | Fail |
| 0.0368 | 606 | 2453 | 404 | Fail |
| 0.0372 | 588 | 2423 | 412 | Fail |
| 0.0377 | 572 | 2393 | 418 | Fail |
| 0.0381 | 558 | 2366 | 424 | Fail |
| 0.0386 | 548 | 2329 | 425 | Fail |
| 0.0390 | 535 | 2304 | 430 | Fail |
| 0.0395 | 521 | 2265 | 434 | Fail |
| 0.0399 | 513 | 2218 | 432 | Fail |
| 0.0404 | 502 | 2192 | 436 | Fail |
| 0.0408 | 493 | 2169 | 439 | Fail |
| 0.0412 | 487 | 2132 | 437 | Fail |
| 0.0417 | 474 | 2106 | 444 | Fail |
| 0.0421 | 463 | 2077 | 448 | Fail |
| 0.0426 | 454 | 2047 | 450 | Fail |
| 0.0430 | 439 | 2021 | 460 | Fail |
| 0.0435 | 430 | 1991 | 463 | Fail |
| 0.0439 | 422 | 1954 | 463 | Fail |
| 0.0444 | 410 | 1924 | 469 | Fail |
| 0.0448 | 397 | 1899 | 478 | Fail |
| 0.0452 | 390 | 1872 | 480 | Fail |
| 0.0457 | 381 | 1849 | 485 | Fail |
| 0.0461 | 372 | 1814 | 487 | Fail |
| 0.0466 | 367 | 1790 | 487 | Fail |
| 0.0470 | 363 | 1756 | 483 | Fail |
| 0.0475 | 356 | 1739 | 488 | Fail |
| 0.0479 | 353 | 1708 | 483 | Fail |
| 0.0484 | 350 | 1678 | 479 | Fail |
| 0.0488 | 345 | 1650 | 478 | Fail |
| 0.0493 | 339 | 1625 | 479 | Fail |
| 0.0497 | 328 | 1597 | 486 | 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 BMP Flow and Volume for POC #1**

On-line facility volume: 0 acre-feet

On-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

Off-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

---

**LID Report**

| LID Technique Percent | Water Quality | Used for Percent | Total Volumn Comment | Volumn | Infiltration | Cumulative |
|-----------------------|---------------|------------------|----------------------|--------|--------------|------------|
|-----------------------|---------------|------------------|----------------------|--------|--------------|------------|

| Volume                            | Treatment?<br>Water Quality | Needs<br>Treatment | Through<br>Facility | Volume<br>(ac-ft.) | Volume<br>Infiltration<br>Credit |
|-----------------------------------|-----------------------------|--------------------|---------------------|--------------------|----------------------------------|
| Infiltrated                       | Treated                     | (ac-ft)            | (ac-ft)             |                    |                                  |
| retention 1 POC                   | N                           | 46.44              |                     |                    | N                                |
| 99.98                             |                             |                    |                     |                    |                                  |
| Total Volume Infiltrated          |                             | 46.44              | 0.00                | 0.00               |                                  |
| 99.98                             | 0.00 0%                     | No Treat.          | Credit              |                    |                                  |
| Compliance with LID Standard 8    |                             |                    |                     |                    |                                  |
| Duration Analysis Result = Failed |                             |                    |                     |                    |                                  |

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**PerlnD and ImplnD Changes**

No changes have been made.

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**Detention System Volume Calculator**

Blue Indicates Data Entry Cells, the rest are calculated.

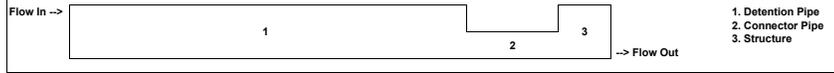


Computes stage-storage volumes for horizontal detention pipe systems

Note: To clear manual override

| System Design | Pipe                         |                       | System Components      |          | Structures               |          | Calculation Shortcuts        |                             |
|---------------|------------------------------|-----------------------|------------------------|----------|--------------------------|----------|------------------------------|-----------------------------|
|               | Detention Pipe Diameter      | Detention Pipe Length | Type                   | Quantity | Type                     | Quantity | Total Structure Surface Area | Total Connector Pipe Length |
|               | 4.0 ft                       | 310 ft total          | Type 204 (4 1/4" Dia)  | 2 total  | Type 204.5 (4.5/54" Dia) | 0 total  | 25.13                        | 6                           |
|               | 10% added to be conservative |                       | Type 205 (5/60" Dia)   | 0 total  | Type 206 (6/72" Dia)     | 0 total  |                              |                             |
|               | 2.0 ft                       |                       | Type 207 (7/84" Dia)   | 0 total  | Type 208 (8/96" Dia)     | 0 total  |                              |                             |
|               | 3.0 ft                       |                       | Type 209 (9/108" Dia)  | 0 total  | Type 210 (10/120" Dia)   | 0 total  |                              |                             |
|               | 2 total                      |                       | Type 211 (11/132" Dia) | 0 total  | Type 212 (12/144" Dia)   | 0 total  |                              |                             |
|               | 0.00 ft                      |                       |                        |          |                          |          |                              |                             |

|  |         |
|--|---------|
| Overflow Elevation:                    | 4.00 ft |
| Check Pond Volume at Overflow (cu ft): | 3994    |



Pond Volume Table - DO NOT MODIFY  
Circular Section Geometry Read from CircularSections Tab

| elev. ft | Det. y/d | Conn. y/d | Det Wet. Area s.f. | Con. Wet. Area s.f. | storage cu.ft. | storage (ac.ft.) |
|----------|----------|-----------|--------------------|---------------------|----------------|------------------|
| 0.00     | 0.000    | 0.000     | 0.000              | 0.000               | 0              | 0.00000          |
| 0.10     | 0.030    | 0.050     | 0.110              | 0.059               | 37             | 0.00085          |
| 0.20     | 0.050    | 0.100     | 0.235              | 0.164               | 79             | 0.00181          |
| 0.30     | 0.080    | 0.150     | 0.470              | 0.296               | 155            | 0.00356          |
| 0.40     | 0.100    | 0.200     | 0.654              | 0.447               | 216            | 0.00495          |
| 0.50     | 0.130    | 0.250     | 0.960              | 0.614               | 314            | 0.00721          |
| 0.60     | 0.150    | 0.300     | 1.182              | 0.793               | 386            | 0.00887          |
| 0.70     | 0.180    | 0.350     | 1.538              | 0.980               | 500            | 0.01148          |
| 0.80     | 0.200    | 0.400     | 1.789              | 1.174               | 582            | 0.01335          |
| 0.90     | 0.230    | 0.450     | 2.184              | 1.371               | 708            | 0.01625          |
| 1.00     | 0.250    | 0.500     | 2.456              | 1.571               | 796            | 0.01827          |
| 1.10     | 0.280    | 0.550     | 2.880              | 1.770               | 931            | 0.02137          |
| 1.20     | 0.300    | 0.600     | 3.171              | 1.968               | 1025           | 0.02353          |
| 1.30     | 0.330    | 0.650     | 3.616              | 2.162               | 1167           | 0.02678          |
| 1.40     | 0.350    | 0.700     | 3.920              | 2.349               | 1264           | 0.02903          |
| 1.50     | 0.380    | 0.750     | 4.382              | 2.527               | 1411           | 0.03240          |
| 1.60     | 0.400    | 0.800     | 4.694              | 2.694               | 1512           | 0.03470          |
| 1.70     | 0.430    | 0.850     | 5.166              | 2.846               | 1661           | 0.03814          |
| 1.80     | 0.450    | 0.900     | 5.485              | 2.978               | 1763           | 0.04048          |
| 1.90     | 0.480    | 0.950     | 5.963              | 3.083               | 1915           | 0.04396          |
| 2.00     | 0.500    | 1.000     | 6.283              | 3.142               | 2017           | 0.04630          |
| 2.10     | 0.530    | 1.050     | 6.763              | 3.142               | 2168           | 0.04978          |
| 2.20     | 0.550    | 1.100     | 7.082              | 3.142               | 2269           | 0.05210          |
| 2.30     | 0.580    | 1.150     | 7.557              | 3.142               | 2419           | 0.05554          |
| 2.40     | 0.600    | 1.200     | 7.872              | 3.142               | 2519           | 0.05784          |
| 2.50     | 0.630    | 1.250     | 8.339              | 3.142               | 2667           | 0.06122          |
| 2.60     | 0.650    | 1.300     | 8.646              | 3.142               | 2765           | 0.06347          |
| 2.70     | 0.680    | 1.350     | 9.099              | 3.142               | 2907           | 0.06675          |
| 2.80     | 0.700    | 1.400     | 9.395              | 3.142               | 3002           | 0.06891          |
| 2.90     | 0.730    | 1.450     | 9.829              | 3.142               | 3139           | 0.07205          |
| 3.00     | 0.750    | 1.500     | 10.109             | 3.142               | 3228           | 0.07410          |
| 3.10     | 0.780    | 1.550     | 10.517             | 3.142               | 3357           | 0.07707          |
| 3.20     | 0.800    | 1.600     | 10.778             | 3.142               | 3440           | 0.07898          |
| 3.30     | 0.830    | 1.650     | 11.150             | 3.142               | 3558           | 0.08169          |
| 3.40     | 0.850    | 1.700     | 11.384             | 3.142               | 3633           | 0.08341          |
| 3.50     | 0.880    | 1.750     | 11.712             | 3.142               | 3738           | 0.08580          |
| 3.60     | 0.900    | 1.800     | 11.912             | 3.142               | 3802           | 0.08728          |
| 3.70     | 0.930    | 1.850     | 12.179             | 3.142               | 3887           | 0.08924          |
| 3.80     | 0.950    | 1.900     | 12.331             | 3.142               | 3937           | 0.09038          |
| 3.90     | 0.980    | 1.950     | 12.506             | 3.142               | 3994           | 0.09168          |
| 4.00     | 1.000    | 2.000     | 12.566             | 3.142               | 4015           | 0.09217          |
| 4.10     | 1.030    | 2.050     | 12.566             | 3.142               | 4017           | 0.09223          |
| 4.20     | 1.050    | 2.100     | 12.566             | 3.142               | 4020           | 0.09229          |
| 4.30     | 1.080    | 2.150     | 12.566             | 3.142               | 4022           | 0.09234          |
| 4.40     | 1.100    | 2.200     | 12.566             | 3.142               | 4025           | 0.09240          |
| 4.50     | 1.130    | 2.250     | 12.566             | 3.142               | 4027           | 0.09246          |
| 4.60     | 1.150    | 2.300     | 12.566             | 3.142               | 4030           | 0.09252          |
| 4.70     | 1.180    | 2.350     | 12.566             | 3.142               | 4032           | 0.09257          |
| 4.80     | 1.200    | 2.400     | 12.566             | 3.142               | 4035           | 0.09263          |
| 4.90     | 1.230    | 2.450     | 12.566             | 3.142               | 4037           | 0.09269          |
| 5.00     | 1.250    | 2.500     | 12.566             | 3.142               | 4040           | 0.09274          |
| 5.10     | 1.280    | 2.550     | 12.566             | 3.142               | 4042           | 0.09280          |
| 5.20     | 1.300    | 2.600     | 12.566             | 3.142               | 4045           | 0.09286          |
| 5.30     | 1.330    | 2.650     | 12.566             | 3.142               | 4047           | 0.09292          |
| 5.40     | 1.350    | 2.700     | 12.566             | 3.142               | 4050           | 0.09297          |
| 5.50     | 1.380    | 2.750     | 12.566             | 3.142               | 4052           | 0.09303          |
| 5.60     | 1.400    | 2.800     | 12.566             | 3.142               | 4055           | 0.09309          |
| 5.70     | 1.430    | 2.850     | 12.566             | 3.142               | 4057           | 0.09315          |
| 5.80     | 1.450    | 2.900     | 12.566             | 3.142               | 4060           | 0.09320          |
| 5.90     | 1.480    | 2.950     | 12.566             | 3.142               | 4062           | 0.09326          |
| 6.00     | 1.500    | 3.000     | 12.566             | 3.142               | 4065           | 0.09332          |
| 6.10     | 1.530    | 3.050     | 12.566             | 3.142               | 4067           | 0.09338          |
| 6.20     | 1.550    | 3.100     | 12.566             | 3.142               | 4070           | 0.09343          |
| 6.30     | 1.580    | 3.150     | 12.566             | 3.142               | 4072           | 0.09349          |
| 6.40     | 1.600    | 3.200     | 12.566             | 3.142               | 4075           | 0.09355          |
| 6.50     | 1.630    | 3.250     | 12.566             | 3.142               | 4077           | 0.09361          |
| 6.60     | 1.650    | 3.300     | 12.566             | 3.142               | 4080           | 0.09366          |
| 6.70     | 1.680    | 3.350     | 12.566             | 3.142               | 4082           | 0.09372          |
| 6.80     | 1.700    | 3.400     | 12.566             | 3.142               | 4085           | 0.09378          |
| 6.90     | 1.730    | 3.450     | 12.566             | 3.142               | 4087           | 0.09384          |
| 7.00     | 1.750    | 3.500     | 12.566             | 3.142               | 4090           | 0.09389          |

\*\*\* Copy Table below to MGSFlood Program Elevation Volume Input Screen

| ELEV (FT) | Top Area (Dummy) | VOLUME (AC FT) | VOLUME (CF) |
|-----------|------------------|----------------|-------------|
| 100.00    | 0.0000           | 0.00000        | 0           |
| 100.10    | 0.1000           | 0.00085        | 37          |
| 100.20    | 0.2000           | 0.00181        | 79          |
| 100.30    | 0.3000           | 0.00356        | 155         |
| 100.40    | 0.4000           | 0.00495        | 216         |
| 100.50    | 0.5000           | 0.00721        | 314         |
| 100.60    | 0.6000           | 0.00887        | 386         |
| 100.70    | 0.7000           | 0.01148        | 500         |
| 100.80    | 0.8000           | 0.01335        | 582         |
| 100.90    | 0.9000           | 0.01625        | 708         |
| 101.00    | 1.0000           | 0.01827        | 796         |
| 101.10    | 1.1000           | 0.02137        | 931         |
| 101.20    | 1.2000           | 0.02353        | 1025        |
| 101.30    | 1.3000           | 0.02678        | 1167        |
| 101.40    | 1.4000           | 0.02903        | 1264        |
| 101.50    | 1.5000           | 0.03240        | 1411        |
| 101.60    | 1.6000           | 0.03470        | 1512        |
| 101.70    | 1.7000           | 0.03814        | 1661        |
| 101.80    | 1.8000           | 0.04048        | 1763        |
| 101.90    | 1.9000           | 0.04396        | 1915        |
| 102.00    | 2.0000           | 0.04630        | 2017        |
| 102.10    | 2.1000           | 0.04978        | 2168        |
| 102.20    | 2.2000           | 0.05210        | 2269        |
| 102.30    | 2.3000           | 0.05554        | 2419        |
| 102.40    | 2.4000           | 0.05784        | 2519        |
| 102.50    | 2.5000           | 0.06122        | 2667        |
| 102.60    | 2.6000           | 0.06347        | 2765        |
| 102.70    | 2.7000           | 0.06675        | 2907        |
| 102.80    | 2.8000           | 0.06891        | 3002        |
| 102.90    | 2.9000           | 0.07205        | 3139        |
| 103.00    | 3.0000           | 0.07410        | 3228        |
| 103.10    | 3.1000           | 0.07707        | 3357        |
| 103.20    | 3.2000           | 0.07898        | 3440        |
| 103.30    | 3.3000           | 0.08169        | 3558        |
| 103.40    | 3.4000           | 0.08341        | 3633        |
| 103.50    | 3.5000           | 0.08580        | 3738        |
| 103.60    | 3.6000           | 0.08728        | 3802        |
| 103.70    | 3.7000           | 0.08924        | 3887        |
| 103.80    | 3.8000           | 0.09038        | 3937        |
| 103.90    | 3.9000           | 0.09168        | 3994        |
| 104.00    | 4.0000           | 0.09217        | 4015        |
| 104.10    | 4.1000           | 0.09223        | 4017        |
| 104.20    | 4.2000           | 0.09229        | 4020        |
| 104.30    | 4.3000           | 0.09234        | 4022        |
| 104.40    | 4.4000           | 0.09240        | 4025        |
| 104.50    | 4.5000           | 0.09246        | 4027        |
| 104.60    | 4.6000           | 0.09252        | 4030        |
| 104.70    | 4.7000           | 0.09257        | 4032        |
| 104.80    | 4.8000           | 0.09263        | 4035        |
| 104.90    | 4.9000           | 0.09269        | 4037        |
| 105.00    | 5.0000           | 0.09274        | 4040        |

Note: Storage Volume is increased by 1 for Elevations Greater than Pipe Diameter to avoid MGSFlood error

# Appendix F

## Geotechnical Report

This Document Included Separately with this Submittal



# Appendix G

TESC Plans and Calculations



## TESC Calculations Summary

### Arlington Garden Apartments

Requirements: 2024 Department of Ecology (DOE) Stormwater Management Manual for Western Washington (SWMMWW)

### Sediment Pond

Sediment Pond sized per 2024 DOE SWMMWW, Volume 2, Chapter 4 BMP C241: Sediment Pond (Temporary)

Surface Area =  $2 \times Q_{10}/0.00096$

| Basin Name | Total Area (sf) | Total Area (acres) | Impervious Area (sf) | Impervious Area (acres) | Pervious Area (sf) | Pervious Area (acres) | Q10 <sub>-yr peak</sub> (cfs) | Surface Area | Depth (ft) | Side Slopes H:1'V |
|------------|-----------------|--------------------|----------------------|-------------------------|--------------------|-----------------------|-------------------------------|--------------|------------|-------------------|
| North      | 40571           | 0.93               | 31799                | 0.73                    | 8772               | 0.20                  | 0.525                         | <b>1094</b>  | 3.5        | 3                 |
| Northeast  | 57830           | 1.33               | 50094                | 1.15                    | 7736               | 0.18                  | 0.791                         | <b>1648</b>  | 3.5        | 3                 |
| Northwest  | 75127           | 1.72               | 48787                | 1.12                    | 26340              | 0.60                  | 0.846                         | <b>1763</b>  | 3.5        | 3                 |
| South      | 190762          | 4.38               | 153767               | 3.53                    | 36995              | 0.85                  | 2.499                         | <b>5206</b>  | 3.5        | 3                 |

### Infiltration Basin

Sizing provided in MGS Flood Report

| Basin Name | Total Area (sf) | Total Area (acres) | Impervious Area (sf) | Impervious Area (acres) | Pervious Area (sf) | Pervious Area (acres) | Volume (cf) | Surface Area (sf) | Bottom Area (sf) |
|------------|-----------------|--------------------|----------------------|-------------------------|--------------------|-----------------------|-------------|-------------------|------------------|
| North      | 40571           | 0.93               | 31799                | 0.73                    | 8772               | 0.20                  | 2719        | 1428              | <b>273</b>       |
| Northeast  | 57830           | 1.33               | 50094                | 1.15                    | 7736               | 0.18                  | 4345        | 2050              | <b>580</b>       |
| Northwest  | 75127           | 1.72               | 48787                | 1.12                    | 26340              | 0.60                  | 4540        | 2116              | <b>625</b>       |
| South      | 190762          | 4.38               | 153767               | 3.53                    | 36995              | 0.85                  | 17031       | 6399              | <b>3480</b>      |



**ARLINGTON GARDEN  
APARTMENTS  
ARLINGTON, WA**

**TESC NOTES:**

- CONTRACTOR SHALL PROVIDE FENCING, SIGNAGE AND BARRIERS REQUIRED BY THE CITY TO PREVENT UNAUTHORIZED ACCESS INTO THE CONSTRUCTION AREA.
- CONTRACTOR SHALL PROVIDE TRAFFIC MANAGEMENT FOR WORK WITHIN THE ROW.
- CONTRACTOR SHALL PROVIDE PROTECTION IN ALL DOWNSTREAM INLETS AND CATCH BASINS WITHIN 500 FEET OF THE PROPERTY.
- CONTRACTOR SHALL FIELD LOCATE TESC CONTROLS AND ADJUST AS NEEDED TO REFLECT CHANGING SIDE CONDITIONS AND CONSTRUCTION PROGRESS.
- CONTRACTOR SHALL PREVENT SEDIMENT FROM LEAVING THE CONSTRUCTION SITE THROUGH THE USE OF PERIMETER CONTROLS, SUCH AS FILTER FABRIC FENCE, COMPOST SOCKS, TEMPORARY SWALES OR BERMS.
- CONTRACTOR SHALL REMOVE AND DISPOSE OF ALL TESC MEASURES AT THE COMPLETION OF THE PROJECT WHEN ALL DISTURBED AREAS HAVE BEEN FULLY AND FINALLY STABILIZED.
- CONTRACTOR SHALL TAKE PRECAUTIONS TO PROTECT PERMANENT STORMWATER INFILTRATION AREAS FROM ANY SEDIMENT LADEN RUNOFF. NO CONSTRUCTION STORMWATER SHALL BE DIRECTED TO THESE AREAS AND CONTRACTOR SHALL BE RESPONSIBLE FOR REMEDIATION AND REPAIR SHOULD FOULING OF ANY INFILTRATION AREAS OCCUR.

**GENERAL NOTES:**

- ALL EXISTING ABOVE AND BELOW GRADE IMPROVEMENTS WITHIN LIMITS OF WORK SHALL BE DEMOLISHED UNLESS NOTED OTHERWISE.
- CONTRACTOR SHALL PROVIDE FENCING, SIGNAGE AND BARRIERS, AS REQUIRED TO PREVENT UNAUTHORIZED ACCESS INTO THE CONSTRUCTION AREA.
- CONTRACTOR SHALL PROVIDE TRAFFIC CONTROL PLAN FOR WORK WITHIN THE ROW.
- CONTRACTOR SHALL FIELD VERIFY THE LOCATION OF ALL UTILITIES PRIOR TO DEMOLITION AND CONSTRUCTION ACTIVITIES.
- CONTRACTOR SHALL PROTECT ALL EXISTING SURVEY MONUMENTS DURING CONSTRUCTION. ANY DISTURBING OF EXISTING SURVEY MONUMENTS MUST BE DONE UNDER A PERMIT FROM WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES.
- ALL EXISTING SIGNS WITHIN THE ROW AFFECTED BY PROJECT CONSTRUCTION SHALL BE PROTECTED OR REMOVED AND REPLACED TO ORIGINAL LOCATION AFTER SURFACE IMPROVEMENTS HAVE BEEN MADE, UNLESS NOTED OTHERWISE.
- CONTRACTOR SHALL PROTECT AND MAINTAIN UNINTERRUPTED UTILITY SERVICE TO EXISTING NEIGHBORING BUILDINGS DURING DEMOLITION AND CONSTRUCTION.
- SURFACE AND BELOW GRADE IMPROVEMENTS INTENDED TO REMAIN SHALL BE REPLACED AT THE CONTRACTOR'S EXPENSE IF DAMAGED DURING DEMOLITION OR CONSTRUCTION ACTIVITIES.
- ALL EXISTING UTILITIES AND IMPROVEMENTS IN THE PUBLIC R.O.W., ABOVE AND BELOW GRADE, SHALL BE PROTECTED UNLESS NOTED OTHERWISE.
- CONTRACTOR SHALL COORDINATE WITH PROJECT OWNER AND UTILITY OWNER FOR RETIREMENT AND REMOVAL OF EXISTING UTILITY SERVICES TO THE SITE.
- IF EXISTING WELLS ARE ENCOUNTERED ON THE SITE, CONTRACTOR SHALL FOLLOW WASHINGTON STATE DEPARTMENT OF ECOLOGY REQUIREMENTS FOR DECOMMISSIONING THE WELL.
- IF EXISTING SEPTIC SYSTEMS ARE ENCOUNTERED ON THE SITE, CONTRACTOR SHALL COORDINATE WITH THE KING COUNTY HEALTH DEPARTMENT FOR DECOMMISSIONING AND DOCUMENTING REMOVAL.
- PROTECT EXISTING TREES TO REMAIN WITHIN WETLAND BOUNDARY.

**REVISIONS:**

| NO. | DATE | DESCRIPTION |
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DATE: 08/15/2025  
JOB NO: 2400346  
DESIGNED BY: MMM  
DRAWN BY: CEP  
CHECKED BY: MNF  
APPROVED BY: JSF

**TEMPORARY EROSION  
AND SEDIMENT CONTROL  
PLAN**

**C1.00**

CLEAR AND GRADING PERMIT

**CITY OF ARLINGTON  
CONSTRUCTION DRAWING REVIEW APPROVAL**

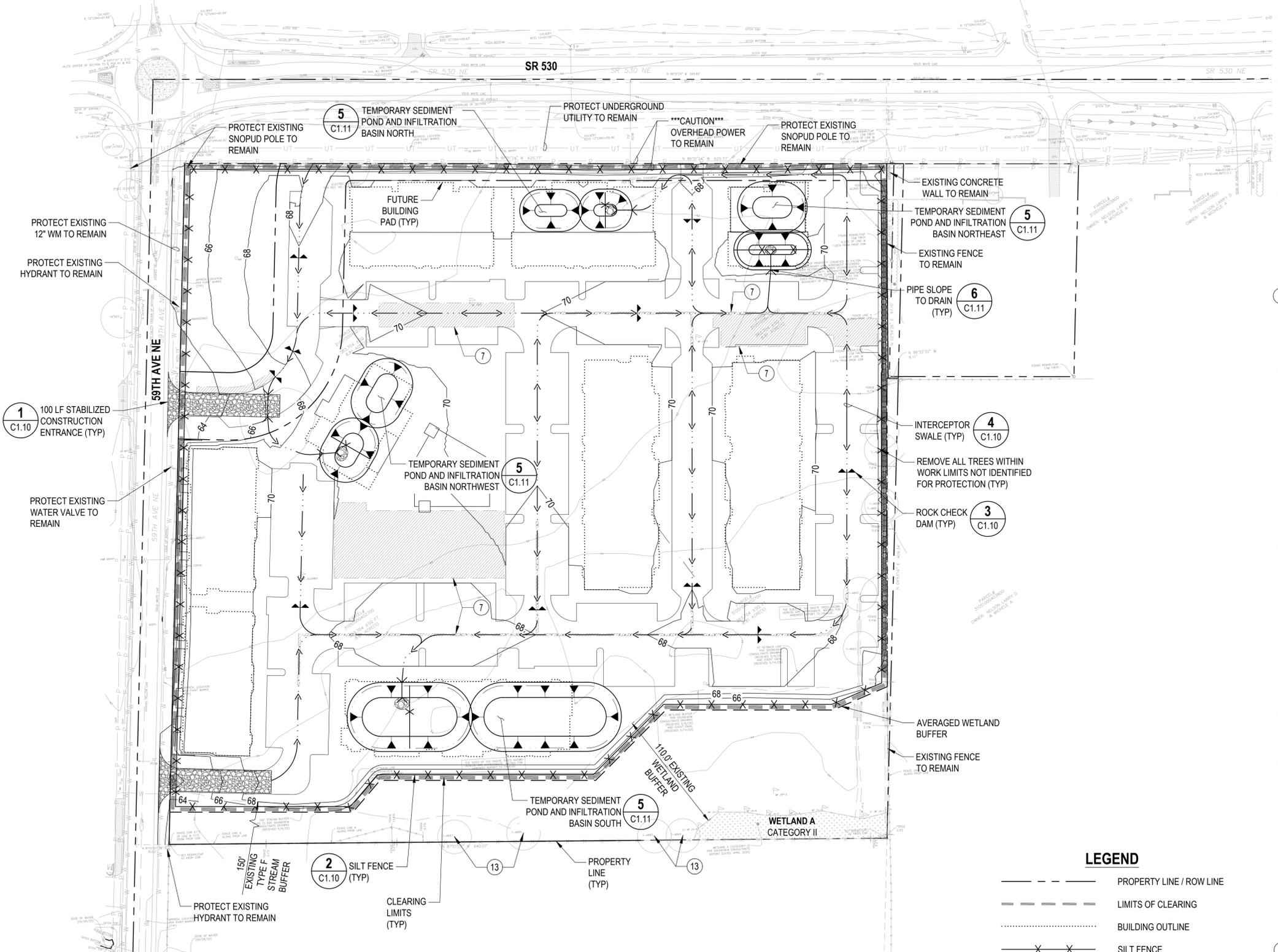
THIS PLAN SHEET HAS BEEN REVIEWED AND APPROVED PER THE CONDITIONS ON THE TITLE SHEET.

BY: \_\_\_\_\_  
Development Services Manager

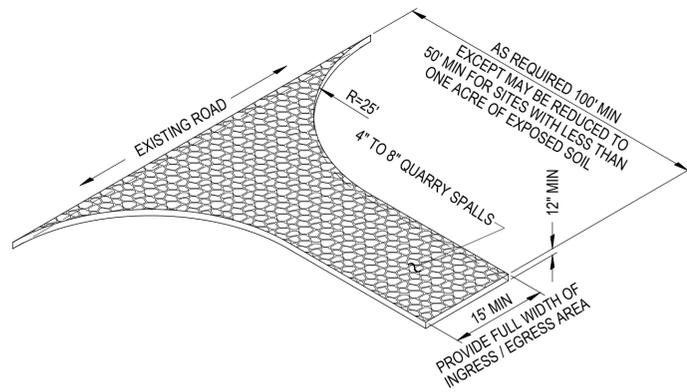
DATE: \_\_\_\_\_ THIS APPROVAL VALID FOR 18 MONTHS

**LEGEND**

- PROPERTY LINE / ROW LINE
- - - - - LIMITS OF CLEARING
- ..... BUILDING OUTLINE
- x - x - SILT FENCE
- - - - - TEMPORARY INTERCEPTOR SWALE
- ▲▲▲ ROCK CHECK DAM
- > - > - TEMPORARY CULVERT
- - - - - WETLAND BUFFER
- ▨ CONSTRUCTION ENTRANCE
- ▨ FUTURE INFILTRATION FACILITY FOOTPRINT ⑦



Z:\2400001-2409999\2400346 Arlington Apartments CAD\Design\ECOC\ECOC C1.00 AA TESC.dwg  
MeghanM  
Aug 14, 2025 - 2:17pm



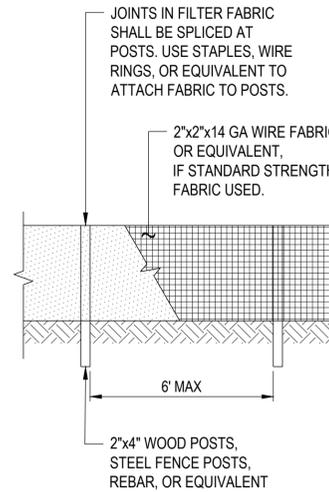
**MAINTENANCE STANDARDS:**

1. QUARRY SPALLS (TYPE I) SHALL BE ADDED IF THE PAD IS NO LONGER IN ACCORDANCE WITH THE SPECIFICATIONS.
2. A SEPARATION GEOTEXTILE SHALL BE PLACED UNDER THE QUARRY SPALLS TO PREVENT FINE SEDIMENT FROM PUMPING UP INTO THE ROCK PAD.
3. IF THE ENTRANCE 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 STREET SWEEPING, AN INCREASE IN THE DIMENSIONS OF THE ENTRANCE, OR THE INSTALLATION OF A WHEEL WASH. IF WASHING IS USED, IT SHALL BE DONE ON AN AREA COVERED WITH CRUSHED ROCK, AND WASH WATER SHALL DRAIN TO A SEDIMENT TRAP OR POND.
4. ANY SEDIMENT THAT IS TRACKED ONTO PAVEMENT SHALL BE REMOVED IMMEDIATELY BY 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 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 SHALL BE CONSIDERED. THE SEDIMENT WOULD THEN BE WASHED INTO THE SUMP.
5. ANY QUARRY SPALLS THAT ARE LOOSENED FROM THE PAD AND END UP ON THE ROADWAY SHALL BE REMOVED IMMEDIATELY.
6. IF VEHICLES ARE ENTERING OR EXITING THE SITE AT POINTS OTHER THAN THE CONSTRUCTION ENTRANCE(S), FENCING SHALL BE INSTALLED TO CONTROL TRAFFIC.

**STABILIZED CONSTRUCTION ENTRANCE DETAIL 1**

NTS

C1.00



**TYPICAL CROSS SECTION**

**NOTES**

1. SILT FENCES SHALL BE INSTALLED ALONG CONTOUR WHENEVER POSSIBLE.
2. ANGLE SILT FENCE BACK UP THE SLOPE AT THE END OF THE RUN.
3. SILT FENCE SHALL BE REMOVED AT THE END OF THE JOB.
4. WHERE THE FENCE IS INSTALLED, THE SLOPE SHALL BE NO STEEPER THAN 2H:1V.
5. JOINTS IN FILTER FABRIC SHALL BE SPICED AT POSTS. USE STAPLES, WIRE RINGS, OR EQUIVALENT TO ATTACH FABRIC TO POSTS.

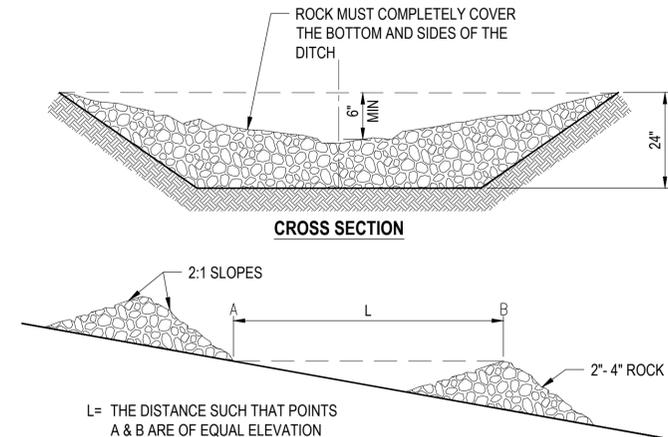
**MAINTENANCE STANDARDS**

1. ANY DAMAGE SHALL BE REPAIRED IMMEDIATELY.
2. IF CONCENTRATED FLOWS ARE EVIDENT UPHILL OF THE FENCE, THEY MUST BE INTERCEPTED AND CONVEYED TO A SEDIMENT TRAP OR POND.
3. IT IS IMPORTANT TO CHECK THE UPHILL SIDE OF THE 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 OR REMOVE THE TRAPPED SEDIMENT.
4. SEDIMENT MUST BE REMOVED WHEN THE SEDIMENT IS 6" HIGH.
5. IF THE FILTER FABRIC HAS DETERIORATED, IT SHALL BE REPLACED.

**FILTER FABRIC FENCE DETAIL 2**

NTS

C1.00



**CHECK DAM SPACING**

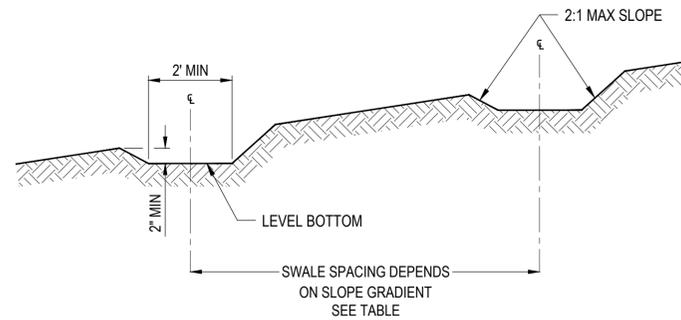
**MAINTENANCE STANDARDS:**

1. ANY SEDIMENT DEPOSITION OF MORE THAN 0.5 FEET SHALL BE REMOVED SO THAT THE CHANNEL IS RESTORED TO ITS DESIGN CAPACITY.
2. IF THE CHANNEL CAPACITY IS INSUFFICIENT FOR THE DESIGN STORM, IT MUST BE DETERMINED WHETHER THE PROBLEM IS LOCAL (E.G., A CONSTRICTION OR BEND) OR THE CHANNEL IS UNDER DESIGNED. IF THE PROBLEM IS LOCAL, THE CHANNEL CAPACITY MUST BE INCREASED THROUGH CONSTRUCTION OF A BERM(S) OR BY EXCAVATION. IF THE PROBLEM IS UNDER DESIGNED, THE DESIGN ENGINEER SHALL BE NOTIFIED AND THE CHANNEL REDESIGNED TO A MORE CONSERVATIVE STANDARD.
3. THE CHANNEL SHALL BE EXAMINED FOR SIGNS OF SCOURING AND EROSION OF THE BED AND BANKS. IF SCOURING OR EROSION HAS OCCURRED, AFFECTED AREAS SHALL BE PROTECTED BY RIP-RAP OR AN EROSION CONTROL BLANKET OR NET.

**ROCK CHECK DAM DETAIL 3**

NTS

C1.00



| SWALE SPACING   |               |                 |
|-----------------|---------------|-----------------|
| AVERAGE SLOPE   | SLOPE PERCENT | FLOWPATH LENGTH |
| 20(H) : 1(V)    | 3-5%          | 300 FEET        |
| 10-20(H) : 1(V) | 5-10%         | 200 FEET        |
| 4-10(H) : 1(V)  | 10-25%        | 100 FEET        |
| 2-4(H) : 1(V)   | 25-50%        | 50 FEET         |

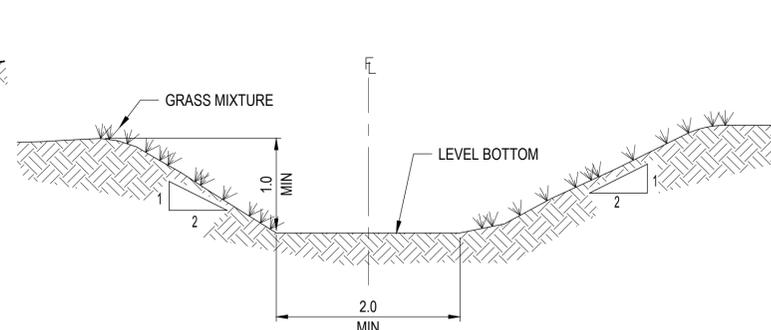
**MAINTENANCE STANDARDS:**

1. DAMAGE RESULTING FROM RUNOFF OR CONSTRUCTION ACTIVITY SHALL BE REPAIRED IMMEDIATELY.
2. IF THE FACILITIES DO NOT REGULARLY RETAIN STORM RUNOFF, THE CAPACITY AND/OR FREQUENCY OF THE DIKES/SWALES SHALL BE INCREASED.

**INTERCEPTOR SWALE DETAIL 4**

NTS

C1.00



| HYDROSEED WITH THE FOLLOWING SEED MIXTURE:  |            |          |               |
|---|------------|----------|---------------|
| NAME  | PROP BY WT | % PURITY | % GERMINATION |
| REDTOP (AGROSTIS ALBA)  | 10%        | 90%      | 90%           |
| ANNUAL RYEGRASS (LOLIUM MULTIFORUM)   | 0-10%      | 90%      | 90%           |
| CHEWINGA FESCUE (FESTUCA RUBRA "COMMUTATA") (JAMESSTOWN, BANNER, SHADOW KOKAT, CASCADE)         | 20%        | 90%      | 90%           |
| PERENNIAL RYEGRASS (LOLIUM PERENNE, MANHATTANIL) (SATURN, CITATIONIL, BARCLAY, VANTAGE, MAGNUM) | 30-40%     | 90%      | 90%           |
| RED FESCUE (FESTUCA RUBRA, PENNLAWN, ILLAHEE)   | 20%        | 90%      | 90%           |
| WHITE DUTCH CLOVER (TRIFOLIUM ROPONS)   | 10%        | 90%      | 90%           |

**CITY OF ARLINGTON  
CONSTRUCTION DRAWING REVIEW APPROVAL**

THIS PLAN SHEET HAS BEEN REVIEWED AND APPROVED PER THE CONDITIONS ON THE TITLE SHEET.

BY: \_\_\_\_\_  
Development Services Manager

DATE: \_\_\_\_\_ THIS APPROVAL VALID FOR 18 MONTHS

**kpff**

1601 5th Avenue, Suite 1600  
Seattle, WA 98101  
206.622.5822  
www.kpff.com



**ARLINGTON GARDEN  
APARTMENTS  
ARLINGTON, WA**

REVISIONS:

| NO. | DATE | DESCRIPTION |
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DATE: 08/15/2025  
JOB NO: 2400346  
DESIGNED BY: MMM  
DRAWN BY: CEP  
CHECKED BY: MNF  
APPROVED BY: JSF

**TEMPORARY EROSION  
AND SEDIMENT CONTROL  
DETAILS**

**C1.10**

CLEAR AND GRADING PERMIT



**ARLINGTON GARDEN  
APARTMENTS  
ARLINGTON, WA**

REVISIONS:

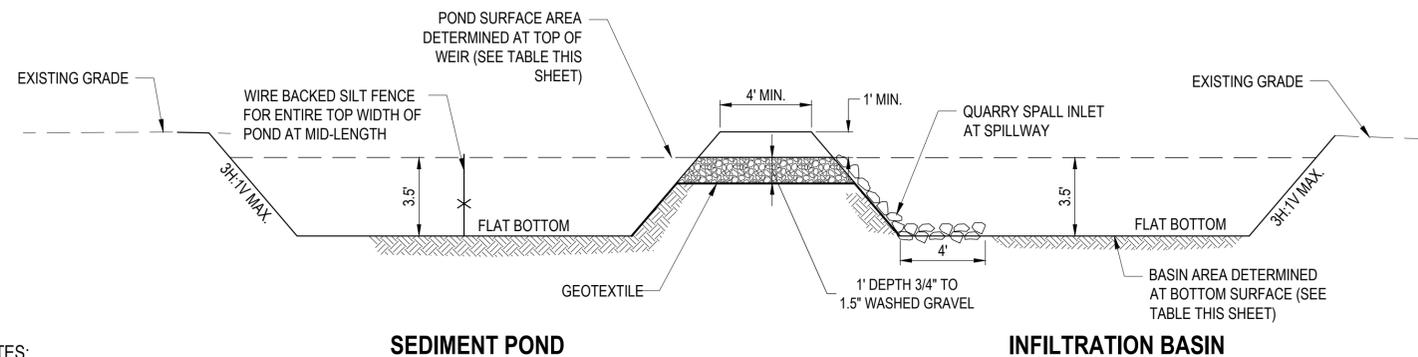
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DATE: 08/15/2025  
JOB NO: 2400346  
DESIGNED BY: MMM  
DRAWN BY: CEP  
CHECKED BY: MNF  
APPROVED BY: JSF

**TEMPORARY EROSION  
AND SEDIMENT CONTROL  
DETAILS**

**C1.11**

CLEAR AND GRADING PERMIT



NOTES:

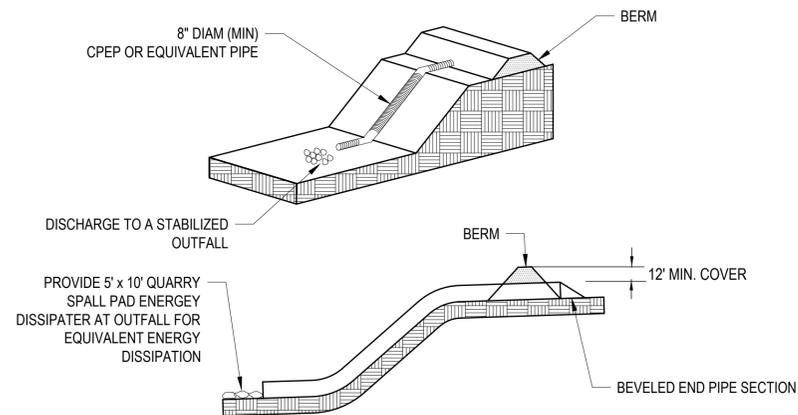
- POND MAY BE FORMED BY BERM OR BY PARTIAL OR COMPLETE EXCAVATION.
- SEDIMENT SHALL BE REMOVED FROM THE POND WHEN IT REACHES 1 FOOT IN DEPTH.
- ANY DAMAGE TO THE POND OR BASIN EMBANKMENTS OR SLOPES SHALL BE REPAIRED.
- CONTRACTOR SHALL DREDGE INFILTRATION BASIN AS NECESSARY TO MAINTAIN PERFORMANCE.
- FOLLOWING CONSTRUCTION THE INFILTRATION BASIN AND SEDIMENT POND AREAS SHALL BE OVER-EXCAVATED TO REMOVE UNSUITABLE MATERIAL AND BACKFILLED WITH STRUCTURAL FILL AND COMPACTED TO GEOTECHNICAL ENGINEER'S RECOMMENDATIONS FOR BUILDING PAD PREPARATION.
- QUARRY SPALLS SHALL BE PER WSDOT STANDARD SPECIFICATIONS SECTION 9-13.6.

| SEDIMENT POND AND INFILTRATION BASIN TABLE |                            |                                |
|--|----------------------------|--------------------------------|
| SUB-BASIN                                  | SEDIMENT POND SURFACE AREA | INFILTRATION BASIN BOTTOM AREA |
| N  | 1,094 SF                   | 273 SF                         |
| NE   | 1,648 SF                   | 580 SF                         |
| NW   | 1,763 SF                   | 625 SF                         |
| S  | 5,206 SF                   | 3,480 SF                       |

**TEMPORARY SEDIMENT POND  
AND INFILTRATION BASIN**

NTS

5  
C1.00



NOTES:

- INLET AND ALL SECTIONS MUST BE SECURELY FASTENED TOGETHER WITH GASKETED WATERTIGHT FITTINGS

**PIPE SLOPE DRAIN**

NTS

6  
C1.00

**CITY OF ARLINGTON  
CONSTRUCTION DRAWING REVIEW APPROVAL**

THIS PLAN SHEET HAS BEEN REVIEWED AND APPROVED PER THE CONDITIONS ON THE TITLE SHEET.

BY: \_\_\_\_\_  
Development Services Manager

DATE: \_\_\_\_\_ THIS APPROVAL VALID FOR 18 MONTHS

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# MGS FLOOD PROJECT REPORT

**Program Version: MGSFlood 4.64**  
**Program License Number: 200410007**  
**Project Simulation Performed on: 08/14/2025 12:17 PM**  
**Report Generation Date: 08/14/2025 12:20 PM**

---

Input File Name: AA TESC Infiltration Pond N Basin.fld  
Project Name: Arlington Apartments - TESC  
Analysis Title: Infiltration Pond - North Basin Pond  
Comments: Temporary infiltration pond sizing

---

## PRECIPITATION INPUT

---

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected

Full Period of Record Available used for Routing

Climatic Region Number: 17  
Precipitation Station : 96004805 Puget East 48 in\_5min 10/01/1939-10/01/2097  
Evaporation Station : 961048 Puget East 48 in MAP

Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1  
HSPF Parameter Region Name : Ecology Default

\*\*\*\*\* Default HSPF Parameters Used (Not Modified by User) \*\*\*\*\*

\*\*\*\*\* **WATERSHED DEFINITION** \*\*\*\*\*

### Predevelopment/Post Development Tributary Area Summary

|  | Predeveloped | Post Developed |
|--|--------------|----------------|
| Total Subbasin Area (acres)                    | 0.930        | 0.930          |
| Area of Links that Include Precip/Evap (acres) | 0.000        | 0.000          |
| Total (acres)                                  | 0.930        | 0.930          |

-----**SCENARIO: PREDEVELOPED**

Number of Subbasins: 1

|                                   |       |
|-----------------------------------|-------|
| ----- Subbasin : Subbasin 1 ----- |       |
| -----Area (Acres) -----           |       |
| C, Lawn, Flat                     | 0.200 |
| ROADS/FLAT                        | 0.730 |
| -----                             |       |
| Subbasin Total                    | 0.930 |

PROPOSED BASIN CONDITIONS  
TO CALCULATE UNMITIGATED  
10-YEAR STORM (FOR SIZING OF  
TEMPORARY SEDIMENT POND)

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 1

|                                   |       |
|-----------------------------------|-------|
| ----- Subbasin : Subbasin 1 ----- |       |
| -----Area (Acres) -----           |       |
| C, Lawn, Flat                     | 0.200 |
| ROADS/FLAT                        | 0.730 |
| -----                             |       |
| Subbasin Total                    | 0.930 |

FINAL CONDITIONS

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Links: 0

\*\*\*\*\* LINK DATA \*\*\*\*\*

|  |                                       |
|--|---------------------------------------|
| -----SCENARIO: POSTDEVELOPED               |                                       |
| Number of Links: 2                         |                                       |
| -----                                      |                                       |
| <b>Link Name: N TESC Infiltration Pond</b> |                                       |
| Link Type: Structure                       |                                       |
| Downstream Link Name: New Copy Lnk2        |                                       |
| Prismatic Pond Option Used                 |                                       |
| Pond Floor Elevation (ft)                  | : 100.00                              |
| Riser Crest Elevation (ft)                 | : 103.50                              |
| Max Pond Elevation (ft)                    | : 104.00                              |
| Storage Depth (ft)                         | : 3.50                                |
| Pond Bottom Length (ft)                    | : 13.0                                |
| Pond Bottom Width (ft)                     | : 21.0                                |
| Pond Side Slopes (ft/ft)                   | : Z1= 3.00 Z2= 3.00 Z3= 3.00 Z4= 3.00 |
| Bottom Area (sq-ft)                        | : 273.                                |
| Area at Riser Crest El (sq-ft)             | : 1,428.                              |
| (acres)                                    | : 0.033                               |
| Volume at Riser Crest (cu-ft)              | : 2,719.                              |
| (ac-ft)                                    | : 0.062                               |
| Area at Max Elevation (sq-ft)              | : 1665.                               |
| (acres)                                    | : 0.038                               |
| Vol at Max Elevation (cu-ft)               | : 3,492.                              |
| (ac-ft)                                    | : 0.080                               |
| Constant Infiltration Option Used          |                                       |
| Infiltration Rate (in/hr): 4.50            |                                       |
| Riser Geometry                             |                                       |
| Riser Structure Type                       | : Circular                            |
| Riser Diameter (in)                        | : 10.00                               |
| Common Length (ft)                         | : 0.000                               |
| Riser Crest Elevation                      | : 103.50 ft                           |
| Hydraulic Structure Geometry               |                                       |
| Number of Devices: 0                       |                                       |

INFILTRATION POND DESIGN

-----  
**Link Name: New Copy Lnk2**

Link Type: Copy  
Downstream Link: None

\*\*\*\*\***FLOOD FREQUENCY AND DURATION STATISTICS**\*\*\*\*\*

-----**SCENARIO: PREDEVELOPED**

Number of Subbasins: 1  
Number of Links: 0

-----**SCENARIO: POSTDEVELOPED**

Number of Subbasins: 1  
Number of Links: 2

\*\*\*\*\***Groundwater Recharge Summary**\*\*\*\*\*

Recharge is computed as input to PerInd Groundwater Plus Infiltration in Structures

| Total Predeveloped Recharge During Simulation |                         |
|---|-------------------------|
| Model Element                                 | Recharge Amount (ac-ft) |
| Subbasin: Subbasin 1                          | 26.811                  |
| -----   |                         |
| Total:  | 26.811                  |

| Total Post Developed Recharge During Simulation |                         |
|---|-------------------------|
| Model Element                                   | Recharge Amount (ac-ft) |
| Subbasin: Subbasin 1                            | 26.811                  |
| Link: N TESC Infiltration                       | Not Computed            |
| Link: New Copy Lnk2                             | 0.000                   |
| -----   |                         |
| Total:  | 26.811                  |

**Total Predevelopment Recharge Equals Post Developed  
Average Recharge Per Year, (Number of Years= 158)  
Predeveloped: 0.170 ac-ft/year, Post Developed: 0.170 ac-ft/year**

\*\*\*\*\***Water Quality Facility Data**\*\*\*\*\*

-----**SCENARIO: PREDEVELOPED**

Number of Links: 0

-----**SCENARIO: POSTDEVELOPED**

Number of Links: 2

\*\*\*\*\* Link: New Copy Lnk2 \*\*\*\*\*

2-Year Discharge Rate : 0.000 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge  
 On-line Design Discharge Rate (91% Exceedance): 0.20 cfs  
 Off-line Design Discharge Rate (91% Exceedance): 0.13 cfs

Infiltration/Filtration Statistics-----  
 Inflow Volume (ac-ft): 0.25  
 Inflow Volume Including PPT-Evap (ac-ft): 0.25  
 Total Runoff Infiltrated (ac-ft): 0.00, 0.00%  
 Total Runoff Filtered (ac-ft): 0.00, 0.00%  
 Primary Outflow To Downstream System (ac-ft): 0.25  
 Secondary Outflow To Downstream System (ac-ft): 0.00  
 Volume Lost to ET (ac-ft): 0.00  
 Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 0.00%

\*\*\*\*\*Compliance Point Results \*\*\*\*\*

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: New Copy Lnk2

SEDIMENT POND  
 SIZED USING THE  
 10-YEAR STORM  
 (SA = 2 x Q2/0.00096)

\*\*\* Point of Compliance Flow Frequency Data \*\*\*  
 Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff |                 | Postdevelopment Runoff |                 |
|-----------------------|-----------------|------------------------|-----------------|
| Tr (Years)            | Discharge (cfs) | Tr (Years)             | Discharge (cfs) |
| 2-Year                | 0.334           | 2-Year                 | 0.000           |
| 5-Year                | 0.417           | 5-Year                 | 0.000           |
| 10-Year               | 0.525           | 10-Year                | 0.000           |
| 25-Year               | 0.630           | 25-Year                | 0.180           |
| 50-Year               | 0.795           | 50-Year                | 0.203           |
| 100-Year              | 0.914           | 100-Year               | 0.216           |
| 200-Year              | 0.976           | 200-Year               | 0.224           |
| 500-Year              | 1.057           | 500-Year               | 0.235           |

INFILTRATION POND  
 SIZED TO FULLY  
 INFILTRATE UP TO  
 THE 10-YEAR STORM

\*\* Record too Short to Compute Peak Discharge for These Recurrence Intervals

\*\*\*\* Flow Duration Performance \*\*\*\*

|  |        |      |
|--|--------|------|
| Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):    | -99.6% | PASS |
| Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%): | -99.6% | PASS |
| Maximum Excursion from Q2 to Q50 (Must be less than 10%):              | -91.7% | PASS |
| Percent Excursion from Q2 to Q50 (Must be less than 50%):              | 0.0%   | PASS |

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

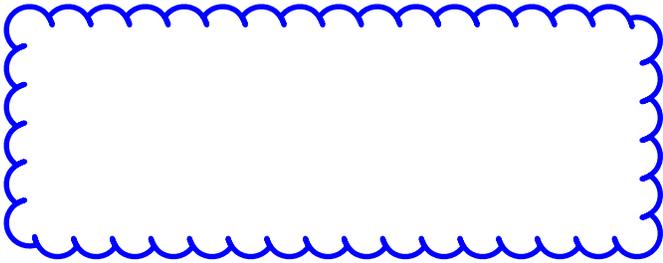
\*\*\*\* LID Duration Performance \*\*\*\*

|  |         |      |
|--|---------|------|
| Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):       | -100.0% | PASS |
| Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): | -99.6%  | PASS |

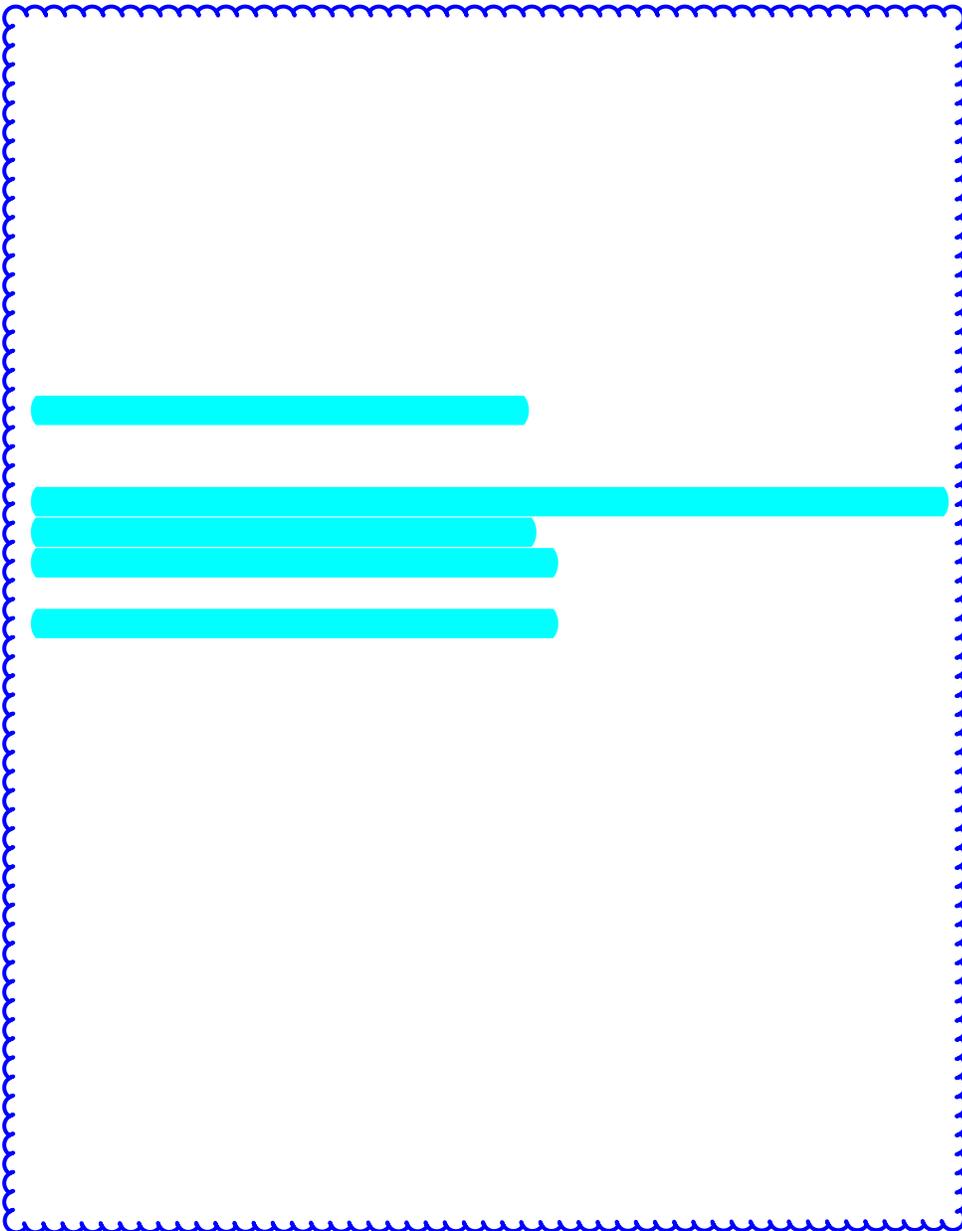
MEETS ALL LID DURATION DESIGN CRITERIA: PASS



PROPOSED BASIN CONDITIONS  
TO CALCULATE UNMITIGATED  
10-YEAR STORM (FOR SIZING OF  
TEMPORARY SEDIMENT POND)

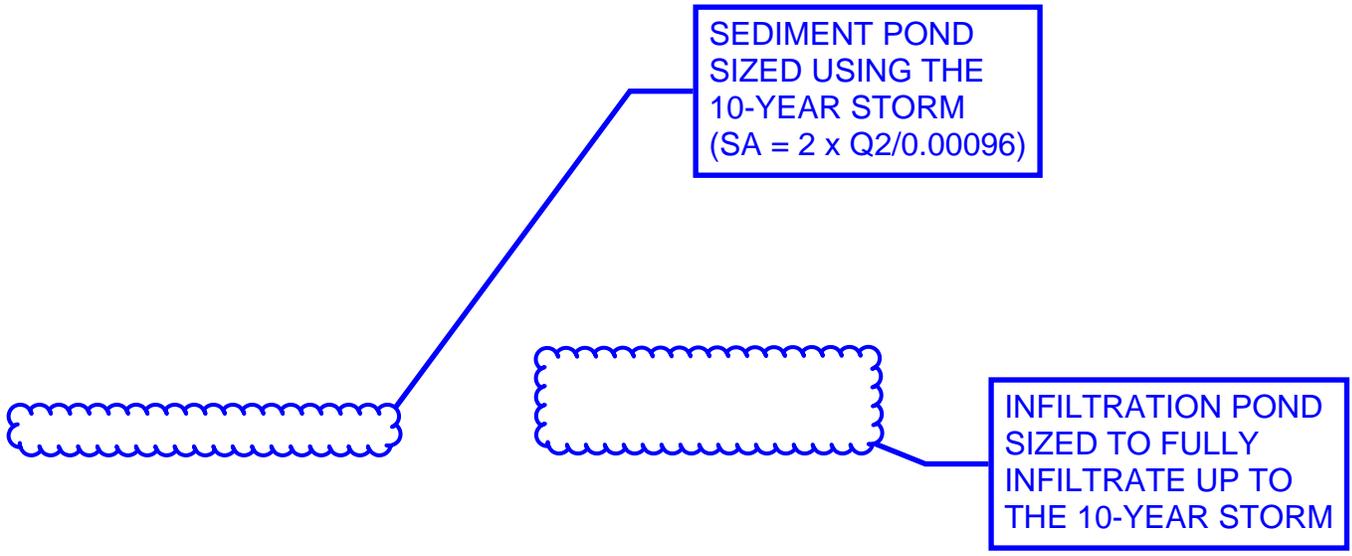


FINAL CONDITIONS



INFILTRATION  
POND DESIGN





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# MGS FLOOD PROJECT REPORT

**Program Version: MGSFlood 4.64**  
**Program License Number: 200410007**  
**Project Simulation Performed on: 08/14/2025 12:23 PM**  
**Report Generation Date: 08/14/2025 12:23 PM**

---

Input File Name: AA TESC Infiltration Pond NW Basin.fld  
Project Name: Arlington Apartments - TESC  
Analysis Title: Infiltration Pond - Northwest Basin Pond  
Comments: Temporary infiltration pond sizing

---

## PRECIPITATION INPUT

---

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected

Full Period of Record Available used for Routing

Climatic Region Number: 17  
Precipitation Station : 96004805 Puget East 48 in\_5min 10/01/1939-10/01/2097  
Evaporation Station : 961048 Puget East 48 in MAP

Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1  
HSPF Parameter Region Name : Ecology Default

\*\*\*\*\* Default HSPF Parameters Used (Not Modified by User) \*\*\*\*\*

\*\*\*\*\* **WATERSHED DEFINITION** \*\*\*\*\*

### Predevelopment/Post Development Tributary Area Summary

|  | Predeveloped | Post Developed |
|--|--------------|----------------|
| Total Subbasin Area (acres)                    | 1.720        | 1.720          |
| Area of Links that Include Precip/Evap (acres) | 0.000        | 0.000          |
| Total (acres)                                  | 1.720        | 1.720          |

-----**SCENARIO: PREDEVELOPED**

Number of Subbasins: 1

|                                   |       |
|-----------------------------------|-------|
| ----- Subbasin : Subbasin 1 ----- |       |
| -----Area (Acres) -----           |       |
| C, Lawn, Flat                     | 0.600 |
| ROADS/FLAT                        | 1.120 |
| -----                             |       |
| Subbasin Total                    | 1.720 |

**PROPOSED BASIN CONDITIONS  
TO CALCULATE UNMITIGATED  
10-YEAR STORM (FOR SIZING OF  
TEMPORARY SEDIMENT POND)**

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 1

|                                   |       |
|-----------------------------------|-------|
| ----- Subbasin : Subbasin 1 ----- |       |
| -----Area (Acres) -----           |       |
| C, Lawn, Flat                     | 0.600 |
| ROADS/FLAT                        | 1.120 |
| -----                             |       |
| Subbasin Total                    | 1.720 |

FINAL CONDITIONS

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Links: 0

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: POSTDEVELOPED

Number of Links: 2

**Link Name: NW TESC Infiltration Pond**

Link Type: Structure

Downstream Link Name: New Copy Lnk2

Prismatic Pond Option Used

Pond Floor Elevation (ft) : 100.00  
 Riser Crest Elevation (ft) : 103.50  
 Max Pond Elevation (ft) : 104.00

Storage Depth (ft) : 3.50

Pond Bottom Length (ft) : 25.0

Pond Bottom Width (ft) : 25.0

Pond Side Slopes (ft/ft) : Z1= 3.00 Z2= 3.00 Z3= 3.00 Z4= 3.00

Bottom Area (sq-ft) : 625.

Area at Riser Crest El (sq-ft) : 2,116.

(acres) : 0.049

Volume at Riser Crest (cu-ft) : 4,540.

(ac-ft) : 0.104

Area at Max Elevation (sq-ft) : 2401.

(acres) : 0.055

Vol at Max Elevation (cu-ft) : 5,668.

(ac-ft) : 0.130

Constant Infiltration Option Used

Infiltration Rate (in/hr): 4.90

Riser Geometry

Riser Structure Type : Circular

Riser Diameter (in) : 10.00

Common Length (ft) : 0.000

Riser Crest Elevation : 103.50 ft

Hydraulic Structure Geometry

Number of Devices: 0

INFILTRATION POND DESIGN

-----  
**Link Name: New Copy Lnk2**

Link Type: Copy  
Downstream Link: None

\*\*\*\*\***FLOOD FREQUENCY AND DURATION STATISTICS**\*\*\*\*\*

-----**SCENARIO: PREDEVELOPED**

Number of Subbasins: 1  
Number of Links: 0

-----**SCENARIO: POSTDEVELOPED**

Number of Subbasins: 1  
Number of Links: 2

\*\*\*\*\***Groundwater Recharge Summary**\*\*\*\*\*

Recharge is computed as input to PerInd Groundwater Plus Infiltration in Structures

| Total Predeveloped Recharge During Simulation |                         |
|---|-------------------------|
| Model Element                                 | Recharge Amount (ac-ft) |
| Subbasin: Subbasin 1                          | 80.433                  |
| -----   |                         |
| Total:  | 80.433                  |

| Total Post Developed Recharge During Simulation |                         |
|---|-------------------------|
| Model Element                                   | Recharge Amount (ac-ft) |
| Subbasin: Subbasin 1                            | 80.433                  |
| Link: NW TESC Infiltration                      | Not Computed            |
| Link: New Copy Lnk2                             | 0.000                   |
| -----   |                         |
| Total:  | 80.433                  |

**Total Predevelopment Recharge Equals Post Developed  
Average Recharge Per Year, (Number of Years= 158)  
Predeveloped: 0.509 ac-ft/year, Post Developed: 0.509 ac-ft/year**

\*\*\*\*\***Water Quality Facility Data**\*\*\*\*\*

-----**SCENARIO: PREDEVELOPED**

Number of Links: 0

-----**SCENARIO: POSTDEVELOPED**

Number of Links: 2

\*\*\*\*\* Link: New Copy Lnk2 \*\*\*\*\*

2-Year Discharge Rate : 0.000 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge  
 On-line Design Discharge Rate (91% Exceedance): 0.35 cfs  
 Off-line Design Discharge Rate (91% Exceedance): 0.24 cfs

**Infiltration/Filtration Statistics-----**

Inflow Volume (ac-ft): 0.35  
 Inflow Volume Including PPT-Evap (ac-ft): 0.35  
 Total Runoff Infiltrated (ac-ft): 0.00, 0.00%  
 Total Runoff Filtered (ac-ft): 0.00, 0.00%  
 Primary Outflow To Downstream System (ac-ft): 0.35  
 Secondary Outflow To Downstream System (ac-ft): 0.00  
 Volume Lost to ET (ac-ft): 0.00  
 Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 0.00%

**\*\*\*\*\*Compliance Point Results \*\*\*\*\***

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: New Copy Lnk2

SEDIMENT POND  
 SIZED USING THE  
 10-YEAR STORM  
 (SA = 2 x Q2/0.00096)

**\*\*\* Point of Compliance Flow Frequency Data \*\*\***

Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff |                 | Postdevelopment Runoff |                 |
|-----------------------|-----------------|------------------------|-----------------|
| Tr (Years)            | Discharge (cfs) | Tr (Years)             | Discharge (cfs) |
| 2-Year                | 0.550           | 2-Year                 | 0.000           |
| 5-Year                | 0.695           | 5-Year                 | 0.000           |
| 10-Year               | 0.846           | 10-Year                | 0.000           |
| 25-Year               | 1.037           | 25-Year                | 0.270           |
| 50-Year               | 1.354           | 50-Year                | 0.353           |
| 100-Year              | 1.549           | 100-Year               | 0.399           |
| 200-Year              | 1.644           | 200-Year               | 0.410           |
| 500-Year              | 1.767           | 500-Year               | 0.424           |

INFILTRATION POND  
 SIZED TO FULLY  
 INFILTRATE UP TO  
 THE 10-YEAR STORM

\*\* Record too Short to Compute Peak Discharge for These Recurrence Intervals

**\*\*\*\* Flow Duration Performance \*\*\*\***

|  |        |      |
|--|--------|------|
| Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):    | -99.6% | PASS |
| Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%): | -99.5% | PASS |
| Maximum Excursion from Q2 to Q50 (Must be less than 10%):              | -91.7% | PASS |
| Percent Excursion from Q2 to Q50 (Must be less than 50%):              | 0.0%   | PASS |

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

**\*\*\*\* LID Duration Performance \*\*\*\***

|  |         |      |
|--|---------|------|
| Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):       | -100.0% | PASS |
| Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): | -99.5%  | PASS |

MEETS ALL LID DURATION DESIGN CRITERIA: PASS

---

# MGS FLOOD PROJECT REPORT

**Program Version: MGSFlood 4.64**  
**Program License Number: 200410007**  
**Project Simulation Performed on: 08/14/2025 12:17 PM**  
**Report Generation Date: 08/14/2025 12:20 PM**

---

Input File Name: AA TESC Infiltration Pond N Basin.fld  
Project Name: Arlington Apartments - TESC  
Analysis Title: Infiltration Pond - North Basin Pond  
Comments: Temporary infiltration pond sizing

---

## PRECIPITATION INPUT

---

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected

Full Period of Record Available used for Routing

Climatic Region Number: 17  
Precipitation Station : 96004805 Puget East 48 in\_5min 10/01/1939-10/01/2097  
Evaporation Station : 961048 Puget East 48 in MAP

Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1  
HSPF Parameter Region Name : Ecology Default

\*\*\*\*\* Default HSPF Parameters Used (Not Modified by User) \*\*\*\*\*

\*\*\*\*\* **WATERSHED DEFINITION** \*\*\*\*\*

### Predevelopment/Post Development Tributary Area Summary

|  | Predeveloped | Post Developed |
|--|--------------|----------------|
| Total Subbasin Area (acres)                    | 0.930        | 0.930          |
| Area of Links that Include Precip/Evap (acres) | 0.000        | 0.000          |
| Total (acres)                                  | 0.930        | 0.930          |

-----**SCENARIO: PREDEVELOPED**

Number of Subbasins: 1

|                                   |       |
|-----------------------------------|-------|
| ----- Subbasin : Subbasin 1 ----- |       |
| -----Area (Acres) -----           |       |
| C, Lawn, Flat                     | 0.200 |
| ROADS/FLAT                        | 0.730 |
| -----                             |       |
| Subbasin Total                    | 0.930 |

**PROPOSED BASIN CONDITIONS  
TO CALCULATE UNMITIGATED  
10-YEAR STORM (FOR SIZING OF  
TEMPORARY SEDIMENT POND)**

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 1

|                                   |       |
|-----------------------------------|-------|
| ----- Subbasin : Subbasin 1 ----- |       |
| -----Area (Acres) -----           |       |
| C, Lawn, Flat                     | 0.200 |
| ROADS/FLAT                        | 0.730 |
| -----                             |       |
| Subbasin Total                    | 0.930 |

FINAL CONDITIONS

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Links: 0

\*\*\*\*\* LINK DATA \*\*\*\*\*

|  |                                       |
|--|---------------------------------------|
| -----SCENARIO: POSTDEVELOPED               |                                       |
| Number of Links: 2                         |                                       |
| -----                                      |                                       |
| <b>Link Name: N TESC Infiltration Pond</b> |                                       |
| Link Type: Structure                       |                                       |
| Downstream Link Name: New Copy Lnk2        |                                       |
| Prismatic Pond Option Used                 |                                       |
| Pond Floor Elevation (ft)                  | : 100.00                              |
| Riser Crest Elevation (ft)                 | : 103.50                              |
| Max Pond Elevation (ft)                    | : 104.00                              |
| Storage Depth (ft)                         | : 3.50                                |
| Pond Bottom Length (ft)                    | : 13.0                                |
| Pond Bottom Width (ft)                     | : 21.0                                |
| Pond Side Slopes (ft/ft)                   | : Z1= 3.00 Z2= 3.00 Z3= 3.00 Z4= 3.00 |
| Bottom Area (sq-ft)                        | : 273.                                |
| Area at Riser Crest El (sq-ft)             | : 1,428.                              |
| (acres)                                    | : 0.033                               |
| Volume at Riser Crest (cu-ft)              | : 2,719.                              |
| (ac-ft)                                    | : 0.062                               |
| Area at Max Elevation (sq-ft)              | : 1665.                               |
| (acres)                                    | : 0.038                               |
| Vol at Max Elevation (cu-ft)               | : 3,492.                              |
| (ac-ft)                                    | : 0.080                               |
| Constant Infiltration Option Used          |                                       |
| Infiltration Rate (in/hr): 4.50            |                                       |
| Riser Geometry                             |                                       |
| Riser Structure Type                       | : Circular                            |
| Riser Diameter (in)                        | : 10.00                               |
| Common Length (ft)                         | : 0.000                               |
| Riser Crest Elevation                      | : 103.50 ft                           |
| Hydraulic Structure Geometry               |                                       |
| Number of Devices: 0                       |                                       |

INFILTRATION POND DESIGN

-----  
**Link Name: New Copy Lnk2**

Link Type: Copy  
Downstream Link: None

\*\*\*\*\***FLOOD FREQUENCY AND DURATION STATISTICS**\*\*\*\*\*

-----**SCENARIO: PREDEVELOPED**

Number of Subbasins: 1  
Number of Links: 0

-----**SCENARIO: POSTDEVELOPED**

Number of Subbasins: 1  
Number of Links: 2

\*\*\*\*\***Groundwater Recharge Summary**\*\*\*\*\*

Recharge is computed as input to PerInd Groundwater Plus Infiltration in Structures

| Total Predeveloped Recharge During Simulation |                         |
|---|-------------------------|
| Model Element                                 | Recharge Amount (ac-ft) |
| Subbasin: Subbasin 1                          | 26.811                  |
| -----   |                         |
| Total:  | 26.811                  |

| Total Post Developed Recharge During Simulation |                         |
|---|-------------------------|
| Model Element                                   | Recharge Amount (ac-ft) |
| Subbasin: Subbasin 1                            | 26.811                  |
| Link: N TESC Infiltration                       | Not Computed            |
| Link: New Copy Lnk2                             | 0.000                   |
| -----   |                         |
| Total:  | 26.811                  |

**Total Predevelopment Recharge Equals Post Developed  
Average Recharge Per Year, (Number of Years= 158)  
Predeveloped: 0.170 ac-ft/year, Post Developed: 0.170 ac-ft/year**

\*\*\*\*\***Water Quality Facility Data**\*\*\*\*\*

-----**SCENARIO: PREDEVELOPED**

Number of Links: 0

-----**SCENARIO: POSTDEVELOPED**

Number of Links: 2

\*\*\*\*\* Link: New Copy Lnk2 \*\*\*\*\*

2-Year Discharge Rate : 0.000 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge  
 On-line Design Discharge Rate (91% Exceedance): 0.20 cfs  
 Off-line Design Discharge Rate (91% Exceedance): 0.13 cfs

Infiltration/Filtration Statistics-----  
 Inflow Volume (ac-ft): 0.25  
 Inflow Volume Including PPT-Evap (ac-ft): 0.25  
 Total Runoff Infiltrated (ac-ft): 0.00, 0.00%  
 Total Runoff Filtered (ac-ft): 0.00, 0.00%  
 Primary Outflow To Downstream System (ac-ft): 0.25  
 Secondary Outflow To Downstream System (ac-ft): 0.00  
 Volume Lost to ET (ac-ft): 0.00  
 Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 0.00%

\*\*\*\*\*Compliance Point Results \*\*\*\*\*

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: New Copy Lnk2

SEDIMENT POND  
 SIZED USING THE  
 10-YEAR STORM  
 (SA = 2 x Q2/0.00096)

\*\*\* Point of Compliance Flow Frequency Data \*\*\*  
 Recurrence Interval Computed Using Gringorten Plotting Position

| Predevelopment Runoff |                 | Postdevelopment Runoff |                 |
|-----------------------|-----------------|------------------------|-----------------|
| Tr (Years)            | Discharge (cfs) | Tr (Years)             | Discharge (cfs) |
| 2-Year                | 0.334           | 2-Year                 | 0.000           |
| 5-Year                | 0.417           | 5-Year                 | 0.000           |
| 10-Year               | 0.525           | 10-Year                | 0.000           |
| 25-Year               | 0.630           | 25-Year                | 0.180           |
| 50-Year               | 0.795           | 50-Year                | 0.203           |
| 100-Year              | 0.914           | 100-Year               | 0.216           |
| 200-Year              | 0.976           | 200-Year               | 0.224           |
| 500-Year              | 1.057           | 500-Year               | 0.235           |

INFILTRATION POND  
 SIZED TO FULLY  
 INFILTRATE UP TO  
 THE 10-YEAR STORM

\*\* Record too Short to Compute Peak Discharge for These Recurrence Intervals

\*\*\*\* Flow Duration Performance \*\*\*\*

|  |        |      |
|--|--------|------|
| Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):    | -99.6% | PASS |
| Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%): | -99.6% | PASS |
| Maximum Excursion from Q2 to Q50 (Must be less than 10%):              | -91.7% | PASS |
| Percent Excursion from Q2 to Q50 (Must be less than 50%):              | 0.0%   | PASS |

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

\*\*\*\* LID Duration Performance \*\*\*\*

|  |         |      |
|--|---------|------|
| Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):       | -100.0% | PASS |
| Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%): | -99.6%  | PASS |

MEETS ALL LID DURATION DESIGN CRITERIA: PASS

# Appendix H

SWPPP



Construction Stormwater General Permit (CSWGP)

# Stormwater Pollution Prevention Plan (SWPPP)

for  
**Arlington Apartments**

Prepared for:  
**Department of Ecology**  
**Northwest Regional Office**  
**3190 160th Ave. Bellevue, WA 98008**

| Permittee / Owner           | Developer                         | Operator / Contractor |
|-----------------------------|-----------------------------------|-----------------------|
| QMC Arlington Holdings, LLC | Quarterra Multifamily Communities | TBD                   |

**21117 59<sup>th</sup> Avenue Northeast, Arlington, WA 98223**  
**Certified Erosion and Sediment Control Lead (CESCL)**

| Name | Organization | Contact Phone Number |
|------|--------------|----------------------|
| TBD  | TBD          | TBD                  |

### SWPPP Prepared By

| Name               | Organization  | Contact Phone Number |
|--------------------|---|----------------------|
| Jessica Lloyd, EIT | KPFF Consulting Engineers<br>1601 Fifth Avenue, Suite 1600<br>Seattle, WA 98101 | 206-622-5822         |

### SWPPP Preparation Date

August 2025

### Project Construction Dates

| Activity / Phase      | Start Date | End Date |
|-----------------------|------------|----------|
| Early Clear and Grade | TBD        | TBD      |

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## List of Acronyms and Abbreviations

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

## Project Information (1.0)

Project/Site Name: Arlington Apartments

Street/Location: 21117 59th Avenue Northeast

City: Arlington State: WA Zip code: 98223

Subdivision: N/A

Receiving waterbody: Portage Creek

## Existing Conditions (1.1)

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

Total acreage: 8.81 acres

Disturbed acreage: 8.81 acres

Existing structures: The site is currently undeveloped pasture.

Landscape topography: The site is generally flat with a difference of approximately 4 feet across the site with slopes generally sloping southeast to northwest. The flat site results in micro-low points scattered throughout the property with typical slopes of less than 2 percent.

Drainage patterns: There are no existing drainage structures or facilities within the property boundaries. Given these numerous micro-low points, stormwater is generally assumed to infiltrate on-site, with potential sheet flow off-site during peak storm events.

Existing Vegetation: The site is currently undeveloped and consists of pasture lands with sparse trees and shrubs.

Critical Areas (wetlands, streams, high erosion risk, steep or difficult to stabilize slopes):  
Within the project boundaries there is a category 2 wetland with a 110-ft wetland buffer on the southeast corner of the site and 150-ft stream buffer on the southwest corner of the site.

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

- Category 4A – Bacteria fecal coliform
- Category 4A – Dissolved Oxygen

Known and Suspected Contaminants:

- None



## **Proposed Construction Activities (1.2)**

### Description of site development:

The Arlington Apartments project proposes to construct 206 apartment units across 5 three-story residential buildings and 3 mixed-use buildings surrounding a central clubhouse and outdoor pool/spa area. This proposal includes approximately 12,000 square feet of retail/commercial space across 3 mixed-use buildings, along with associated and requisite parking, open space and recreation space, road extensions and improvements, and utility extensions and services.

### Description of construction activities:

The proposed development includes the construction of 9 buildings along with all associated utilities. Development will also include sidewalks, ramps, landscape strips, roads, parking, retaining walls, and a multi-use trail along a newly designated right-of-way proposed by the development. The project will restore parts of the wetland and stream buffer as well as raising the site approximately 3-6 feet.

Construction activities will consist of site preparation, TESC installation, site demolition, utility trenching, grading, building construction, landscaping, asphalt and concrete paving. The schedule and phasing of BMPs during construction is provided in Section 2.

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

All surface runoff on-site of the new development will be infiltrated. Runoff will be directed towards water quality vaults that route to infiltration trenches. Any overflow will be directed to StormTech infiltration chambers, where runoff will be fully infiltrated. ROW runoff will be collected in the public storm system and routed to a detention pipe located in the 59<sup>th</sup> Avenue NE ROW that will eventually discharge to the stream south of the site, matching the existing conditions.

### Description of final stabilization:

In the final condition, all exposed soils will be stabilized with the placement of new paving/building or landscaping.

### Contaminated Site Information:

Not applicable for this project.

### Proposed activities regarding contaminated soils or groundwater:

Not applicable for this project.

# Construction Stormwater Best Management Practices (BMPs) (2.0)

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

## The 13 Elements (2.1)

Alternatives for all listed BMPs are included in Appendix B as a quick reference tool for the onsite inspector in the event the BMP(s) listed below are deemed ineffective or inappropriate during construction to satisfy the requirements set forth in this document. To avoid potential erosion and sediment control issues that may cause a violation(s) of the Ecology requirements, the Certified Erosion and Sediment Control Lead will promptly initiate the implementation of one or more of the alternative BMPs listed in Appendix B after the first sign that existing BMPs are ineffective or failing.

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

To protect adjacent properties and to reduce the area of soil exposed to construction, the limits of construction shall be clearly marked before and during land-disturbing activities begin. Trees that are to be preserved, as well as all sensitive areas and their buffers, shall be clearly delineated, both in the field and on the plans. The BMPs relevant to marking and clearing limits that shall be applied for this project include:

#### List and describe BMPs:

- High Visibility Fence (C103) / metal fence

High-visibility metal fencing shall be placed around the perimeter of the site, abutting ROW limits and easements to prevent intentional or unintentional access. A secure gate shall be located at the construction entrances to restrict access to construction areas.

- Silt Fence (BMP C233)

Silt fences shall be installed along the boundary of the limits of disturbance prior to grading.

- Buffer Zones (BMP C102)

Buffer zones shall be used, as necessary, along the boundary of the wetland and stream buffer.

#### Installation Schedules:

Installation prior to construction.

Inspection and Maintenance plan: Construction fencing (high visibility and silt fence) shall be inspected daily to ensure it is in good condition and in the correct location. See BMP maintenance standards noted in Appendix B.

Responsible Staff: Contractor, CESCL

## Element 2: Establish Construction Access (2.1.2)

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 if necessary to prevent sediment from entering state waters. All wash wastewater shall be controlled on site. The specific BMPs related to establishing construction access that shall be used on this project include:

### List and describe BMPs:

- Stabilized Construction Entrance (BMP C105)

The construction site will have two stabilized construction entrances/exits on 59<sup>th</sup> Ave NE which all vehicles will use to prevent erosion and transportation of sediment from the site. Full and permanent stabilization of construction entrances will occur as soon as possible according to construction staging. Stabilization shall occur on all permanent and temporary roadways immediately after grading to reduce erosion from both runoff and construction traffic.

- Wheel Wash (BMP C106)

A wheel wash will be used, if necessary, at the construction entrance/exit in order to further prevent sediment from being tracked outside of the demolition site. All wash wastewater shall be controlled on site. Discharge wheel wash or tire bath wastewater to a separate onsite treatment system that prevents discharge to surface water, such as closed-loop recirculation or upland land application, or to the sanitary sewer. For discharges to the sanitary sewer, permits must be obtained from the wastewater management agency presiding over the project site. Wheel wash or tire bath wastewater should not include wastewater from concrete washout areas.

- Construction Road/Parking Area Stabilization (BMP C107)

The construction site will prioritize the stabilization of onsite roads, parking areas, and other on-site vehicle transportation routes immediately after grading to reduce erosion caused by construction traffic or stormwater runoff.

### Installation Schedules:

Installation prior to construction.

### Inspection and Maintenance plan:

Construction access elements shall be inspected daily to ensure it is in good condition and effectively preventing sediment from being tracked into the roadway. See BMP maintenance standards noted in Appendix B.

### Responsible Staff:

Contractor, CESCL

### Element 3: Control Flow Rates (2.1.3)

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

Will you construct stormwater retention and/or detention facilities?

Yes  No

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

Yes   No

List and describe BMPs:

- Temporary Interceptor Swale/Dikes (BMP C200)

Interceptor swales will be used to direct runoff from drainage areas on or above disturbed slopes and channelize runoff on-site. If erosion is noted in on-site channels, they should be stabilized

- Temporary Sediment Pond (BMP C241)

All runoff shall pass either settling tanks or sediment ponds prior to being infiltrated. This will allow for suspended sediment in the water to settle before it is infiltrated.

- Check Dams (BMP C207)

If erosion is noted in any interceptor swales, check dams will be used to lower the flow rate of runoff in the channel and prevent erosion

Installation Schedules:

Temporary sediment ponds/tanks and all other construction flow rate control measures shall be installed prior to grade and fill.

Inspection and Maintenance plan:

Temporary sediment ponds/tanks shall be inspected daily to ensure they are in good condition and effectively reducing sediment from leaving the site. Swales and dikes shall be inspected daily to ensure they are in good condition and effectively reducing sediment from leaving the site. See BMP maintenance standards noted in Appendix B.

Responsible Staff:

Contractor, CESCL

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

All stormwater runoff from disturbed areas shall pass through an appropriate sediment removal BMP before being infiltrated onsite. In addition, sediment shall be removed from paved areas in and adjacent to the site manually or using mechanical sweepers, as needed, to minimize tracking of sediments on vehicle tires away from the site and to minimize wash off sediments from adjacent streets in runoff. Whenever possible, sediment laden water shall be discharged into onsite, relatively level, vegetated areas. If sediment control BMPs are determined to be ineffective and turbid water is observed , the CESCL shall be contacted immediately and additional sediment control BMPs shall be implemented, as necessary, until the problem is resolved. The specific BMPs to be used for controlling sediment on this project include:

##### List and describe BMPs:

- Silt Fence (BMP C233)

Silt fences shall be installed along the boundary of the limits of disturbance prior to grading.

- Temporary Sediment Pond (BMP C241)

All runoff shall pass either settling tanks or sediment ponds prior to being infiltrated. This will allow for suspended sediment in the water to settle before it is infiltrated.

- Wattles (BMP C235)

If necessary, wattles shall be used to reduce velocity and capture/retain sediment .

##### Installation Schedules:

Temporary sediment ponds/tanks and all other construction sediment control measures shall be installed prior to grade and fill. Fencing installation prior to construction.

##### Inspection and Maintenance plan:

Sediment control elements shall be inspected daily to ensure they are in good condition and effectively prevent sediment from leaving the site. Per BMP maintenance standards noted in Appendix B.

##### Responsible Staff:

Contractor, CESCL

## Element 5: Stabilize Soils (2.1.5)

Exposed and unworked soils at grade will be stabilized using approved BMPs from the following list to prevent erosion throughout the life of the project. From October 1 through April 30, no at grade soils will remain exposed and/or unworked for more than two days. From May 1 to September 30, no soil will remain exposed and/or unworked for more than seven days. 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. Most site activity will occur below existing grade in which soil stabilization BMPs are not applicable.

Final stabilization will consist of building construction, paved building access, sidewalk, and permanent landscaping. If areas are to be left undeveloped for an extended period of time, those areas will be hydro-seeded.

**Table 1 West of the Cascade Mountains Crest**

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

Soils must be stabilized at the end of the shift before a holiday or weekend if needed based on the weather forecast.

Exposed and unworked soils shall be stabilized with the application of effective BMPs to prevent erosion throughout the life of the project.

Anticipated project dates:

Start date: TBD

End date: TBD

Will you construct during the wet season?

Yes

No

List and describe BMPs:

- Plastic Covering (BMP C123)

Plastic covering shall be implemented to protect stockpiles, slopes, and disturbed areas as needed. Plastic covering shall also be placed over all exposed slopes during the wet season to help prevent erosion of the slopes during construction.

- Temporary and Permanent Seeding (BMP C120)

Where feasible, temporary and permanent seeding shall be implemented to reduce erosion and stabilize exposed soils.

- Mulching (BMP C121)

Mulching soils will be used to ensure stabilization of soils and to provide erosion protection to stockpiles, slopes, and disturbed areas.

- Dust Control (BMP C140)

Dust control will be implemented in areas subject to surface and air movement of dust to prevent impacts to roadways, drainage way, and surface waters.

- Nets and Blankets (BMP C122)

Nets and blankets will be used in disturbed areas to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become established.

Installation Schedules: As needed, according to the time period set forth for dry and wet seasons.

Inspection and Maintenance plan: Soil stabilizing elements shall be inspected daily to ensure they are in good condition. Per BMP maintenance standards noted in Appendix B.

Responsible Staff: Contractor, CESCL

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.

## Element 6: Protect Slopes (2.1.6)

Temporary seeding will be implemented along any disturbed areas of the site prior to construction to insure stabilization of the soil. Permanent seeding will be implemented at the end of construction along the same disturbed site areas. Interceptor swales will be used where runoff from disturbed slopes must be conveyed to an erosion control facility. Interceptors will reduce the velocity of the runoff flowing across the site. All temporary pipe slopes shall be designed to handle the peak 10-minute flow rate from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. All cut and fill slopes shall be designed, constructed, and protected in a manner that minimizes erosion while aligning with finished site topography. The following specific BMPs shall be used to protect slopes for this project:

Will steep slopes be present at the site during construction?

Yes

No

### List and describe BMPs:

- Temporary and Permanent Seeding (BMP C120)

Where feasible, temporary and permanent seeding shall be implemented to reduce erosion and stabilize exposed soils

- Mulching (BMP C121)

Mulching soils will be used to ensure stabilization of soils and to provide erosion protection to stockpiles, slopes, and disturbed areas.

- Nets and Blankets (BMP C122)

Nets and blankets will be used in disturbed areas to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become established.

- Clear Plastic Covering (BMP C123)

Plastic covering shall be implemented to protect stockpiles, slopes, and disturbed areas as needed. Plastic covering shall also be placed over all exposed slopes during the wet season to help prevent erosion of the slopes during construction.

- Interceptor Dike and Swale (BMP C200)

Interceptor swales will be used to direct runoff from drainage areas on or above disturbed slopes and channelize runoff on-site. If erosion is noted in on-site channels, they should be stabilized.

- Check Dams (BMP C207)

If erosion is noted in any interceptor swales, check dams will be used to lower the flow rate of runoff in the channel and prevent erosion.

- Pipe Slope Drains (BMP C204)

Pipe slope drains will be used as necessary to prevent channel erosion and saturation of slide-prone soils in areas.

- Sodding (BMP C124)

Sodding will be used as necessary to establish turf for immediate erosion protection and to stabilize drainage paths.

Installation Schedules:

Slope protection elements shall be installed as necessary before and after mass grading and shall be maintained and adjusted as needed.

Inspection and Maintenance plan:

Slope protection elements shall be inspected daily to ensure they are in good condition and effectively preventing slope erosion. Per BMP maintenance standards noted in Appendix B.

Responsible Staff:

Contractor, CESCL

## Element 7: Protect Drain Inlets (2.1.7)

All storm drain inlets made operable during construction shall be protected to prevent unfiltered or untreated water from entering the drainage conveyance system. 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. Inlet protection is considered the last component of the overall treatment train for the site and will be implemented for all drainage inlets that could potentially be impacted by sediment-laden runoff on and near the project site. Inlets will be inspected weekly at a minimum and daily during storm events.

To protect downstream drainage systems, inlet protection devices shall be cleaned (or removed and replaced) when sediment has filled the device by one-third (1/3) or as specified by the manufacturer. The contractor shall provide protection for inlets and catch basins onsite and including elements within 500 feet downstream of the project site. Inlets shall be inspected weekly at a minimum and daily during storm events.

### List and describe BMPs:

- Inlet Protection (BMP C220)

Storm drain inlet protection shall be installed in all existing and constructed catch basins in proximity of the site during construction to prevent runoff from the site from entering the drainage system. Inlets are to be inspected weekly at a minimum and daily during storm events

### Installation Schedules:

Storm drain inlet protection shall be installed at the beginning of construction and will be maintained and adjusted as needed.

### Inspection and Maintenance plan:

Storm drain inlet protection shall be inspected weekly at a minimum and daily during storm events to ensure it is in good condition and cleaned or replaced as needed. Per BMP maintenance standards noted in Appendix B.

### Responsible Staff:

Contractor, CESCL

## Element 8: Stabilize Channels and Outlets (2.1.8)

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

### List and describe BMPs:

- Nets and Blankets (BMP C122)

Nets and blankets will be used in disturbed areas to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become established.

- Check Dams (BMP C207)

If erosion is noted in any interceptor swales, check dams will be used to lower the flow rate of runoff in the channel and prevent erosion.

### Installation Schedules:

See Element 3 for BMP installation schedule. Accompanying stabilizing BMPs shall be installed in conjunction with Element 3.

### Inspection and Maintenance plan:

Nets and Blankets shall be inspected daily to ensure they are in good contact with the ground and repair or staple areas that are damaged or not in close contact with the ground. Check dams shall be inspected during and after each rainfall that produces runoff and sediment shall be removed when it reaches one half the sump depth. Per BMP maintenance standards noted in Appendix B.

### Responsible Staff:

Contractor, CESCL

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

## Element 9: Control Pollutants (2.1.9)

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 shall 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 pollution are discussed below.

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

**Table 2 Pollutants**

| <b>Pollutant (and source, if applicable)</b>          |
|---|
| Dust (from demolition activities)                     |
| pH Control (concrete pour, washout, etc.)             |
| Petroleum hydrocarbons (fuels, etc.)                  |
| Diesel fuel – heavy equipment onsite                  |
| Hydraulic oil – heavy equipment onsite                |
| General demolition debris                             |
| Concrete and concrete slurry – concrete trucks onsite |

### List and describe BMPs:

- Dust Control (BMP C140)

Dust control will be implemented in areas subject to surface and air movement of dust to prevent impacts to roadways, drainage way, and surface waters.

- Concrete Handling (BMP C151)

Process water and slurry resulting from concrete work will be prevented from entering the waters of the State by implementing concrete handling measures.

- Material Delivery, Storage and Containment (BMP (C153)

To prevent, reduce, or eliminate the discharge of pollutants from material delivery and storage to the stormwater system, 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. Spill prevention measures, such as drip pans, will be used when conducting maintenance and repair of vehicles or equipment. To perform emergency repairs on site, temporary plastic will be placed beneath and, if raining, over the vehicle. If on-site fueling tanks and petroleum product storage containers are used, they shall include secondary containment with a capacity of 110% of the combined capacity of the contents. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident.

- Concrete Washout Area (BMP C154)

Concrete washout areas will be implemented in designated areas to prevent pollutants from entering surface waters or groundwater. All concrete washout waters shall be vacuumed while the work is actively occurring to prevent migration offsite and shall not remain on existing asphalt or concrete surfaces. The washout waters shall be disposed of in a manner that does not violate surface water or groundwater quality standards. These areas will be designated to allow convenient access for concrete trucks but at least 50 feet from sensitive areas, such as storm drains, open ditches, or water bodies.

- Sawcutting and Surfacing Pollution Prevention (BMP C152)

Pollution prevention measures will be taken to minimize and eliminate process water and slurry from entering waters of the State.

Installation Schedules: Prior to and during work involving known sources of pollutants. Pollutant control elements shall be installed, maintained, and adjusted as needed.

Inspection and Maintenance plan: Pollutant control elements shall be inspected and maintained as necessary. Per BMP maintenance standards noted in Appendix B.

Responsible Staff: Contractor, CESCL

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

Yes       No

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.

List and describe BMPs:

- Material Delivery, Storage and Containment (BMP C153)

To prevent, reduce, or eliminate the discharge of pollutants from material delivery and storage to the stormwater system, 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. Spill prevention measures, such as drip pans, will be used when conducting maintenance and repair of vehicles or equipment. To perform emergency repairs on site, temporary plastic will be placed beneath and, if raining, over the vehicle. If on-site fueling tanks and petroleum product storage containers are used, they shall include secondary containment with a capacity of 110% of the combined capacity of the contents. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident.

Installation Schedules:

Prior to and during work involving known sources of pollutants. Pollution control elements shall be installed as needed and shall be maintained and adjusted as needed.

Inspection and Maintenance plan:

Pollution control elements shall be inspected and maintained as necessary. Per BMP maintenance standards noted in Appendix B.

Responsible Staff:

Contractor, CESCL

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

Yes       No

List and describe BMPs:

- Wheel Wash (BMP C106)

A wheel wash will be used, if necessary, at the construction entrance/exit in order to further prevent sediment from being tracked outside of the demolition site. All wash wastewater shall be controlled on site. Discharge wheel wash or tire bath wastewater to a separate onsite treatment system that prevents discharge to surface water, such as closed-loop recirculation or upland land application, or to the sanitary sewer. For discharges to the sanitary sewer, permits must be obtained from the wastewater management agency presiding over the project site. Wheel wash or tire bath wastewater should not include wastewater from concrete washout areas.

Installation Schedules:

Wheel wash systems shall be installed beginning of grade and fill construction. Wheel wash systems shall be onsite daily during construction and may be used multiple times a day at the contractor's discretion.

Inspection and Maintenance plan: Wheel wash system shall be inspected and maintained as needed and after use. Per BMP maintenance standards noted in Appendix B.

Responsible Staff: Contractor, CESCL

Will pH-modifying sources be present on-site?

Yes

No

**Table 3 pH-Modifying Sources**

|   |   |
|---|---|
|   | None  |
| Y | Bulk cement   |
| Y | Cement kiln dust  |
| Y | Fly ash   |
| Y | Other cementitious materials                              |
| Y | New concrete washing or curing waters                     |
| Y | Waste streams generated from concrete grinding and sawing |
| Y | Exposed aggregate processes                               |
|   | Dewatering concrete vaults                                |
| Y | Concrete pumping and mixer washout waters                 |
| Y | Recycled concrete   |
|   | Other (i.e. calcium lignosulfate) [please describe]       |

List and describe BMPs:

- Concrete Washout Area (BMP C154)

Concrete washout areas will be implemented in designated areas to prevent pollutants from entering surface waters or groundwater. All concrete washout waters shall be vacuumed while the work is actively occurring to prevent migration offsite and shall not remain on existing asphalt or concrete surfaces. The washout waters shall be disposed of in a manner that does not violate surface water or groundwater quality standards. These areas will be designated to allow convenient access for concrete trucks but at least 50 feet from sensitive areas, such as storm drains, open ditches, or water bodies.

Installation Schedules: Prior to and during work involving known sources of pollutants. BMPs relating to pH-modifying sources shall be implemented as necessary.

Inspection and Maintenance plan: BMPs relating to pH-modifying sources shall be inspected and maintained as necessary. Per BMP maintenance standards noted in Appendix B.

Responsible Staff:

Contractor, CESCL

Concrete trucks must not be washed out onto the ground, or into storm drains, open ditches, streets, or streams. Excess concrete must not be dumped on-site, except in designated concrete washout areas with appropriate BMPs installed.

Demolition:

- Dust released from demolished sidewalks, buildings, or structures will be controlled using Dust Control measures (BMP C140).
- Storm drain inlets vulnerable to stormwater discharge carrying dust, soil, or debris will be protected using Storm Drain Inlet Protection (BMP C220 as described above for Element 7).
- Process water and slurry resulting from sawcutting and surfacing operations will be prevented from entering the waters of the State by implementing Sawcutting and Surfacing Pollution Prevention measures (BMP C152).

Concrete and grout:

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

## Element 10: Control Dewatering (2.1.10)

Excavation is anticipated to be in the proximity of the water table. Earthwork activities for this project are not expected to encounter existing contamination. Temporary dewatering is anticipated to be limited to accumulated rainwater falling into the excavation or trenches. All trench de-watering water shall be discharged into a controlled conveyance system before discharge to the temporary sediment pond. Clean, non-turbid de-watering water, such as well-point ground water, shall be discharged to systems tributary to, or directly into surface waters of the State, as specified in Element #8, provided the de-watering flow does not cause erosion or flooding of receiving waters. Clean de-watering water shall not be routed through the temporary sediment pond.

**Table 4 Dewatering BMPs**

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

List and describe BMPs:

- No BMPs are planned for dewatering.

Installation Schedules: N/A

Inspection and Maintenance plan: N/A

Responsible Staff: N/A

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

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

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

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

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

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

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

## Element 12: Manage the Project (2.1.12)

The project will be managed based on the following principles:

- Projects will be phased to the maximum extent practicable and seasonal work limitations will be taken into account.
- Inspection and monitoring:
  - Inspection, maintenance and repair of all BMPs will occur as needed to ensure performance of their intended function.
  - Site inspections and monitoring will be conducted in accordance with Special Condition S4 of the CSWGP. Sampling locations are indicated on the [Site Map](#). Sampling station(s) are located in accordance with applicable requirements of the CSWGP.
- Maintain an updated SWPPP.
  - The SWPPP will be updated, maintained, and implemented in accordance with Special Conditions S3, S4, and S9 of the CSWGP.

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

**Table 5 Management**

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

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

Infiltrating bioretention planters and infiltrating chamber systems will be constructed within the site. Prevent construction team and equipment from entering the planters to avoid packing of the bioretention soils. Once infiltration soils has been placed for the chamber systems, ensure the construction team avoids incidental compaction of the soils with construction activities or equipment.

Completed landscaped areas will be protected from compaction due to construction equipment.

## Pollution Prevention Team (3.0)

Table 6 Team Information

| <b>Title</b>   | <b>Name(s)</b>                       | <b>Phone Number</b> |
|--|--------------------------------------|---------------------|
| <b>Certified Erosion and Sediment Control Lead (CESCL)</b> | TBD                                  | TBD                 |
| <b>Resident Engineer</b>                                   | Jeremy Febus, KPFF                   | 206-622-5822        |
| <b>Emergency Ecology Contact</b>                           | TBD                                  | TBD                 |
| <b>Emergency Permittee/ Owner Contact</b>                  | TBD                                  | TBD                 |
| <b>Non-Emergency Owner Contact</b>                         | TBD                                  | TBD                 |
| <b>Monitoring Personnel</b>                                | TBD                                  | TBD                 |
| <b>Ecology Regional Office</b>                             | Northwest Regional Office - Bellevue | 425-649-7000        |

## Monitoring and Sampling Requirements (4.0)

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

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

Refer to Appendix C for the Ecology Construction Stormwater Site Inspection Form or download one from Ecology's website.

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

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

### Site Inspection (4.1)

Site inspections will be conducted at least once every calendar week and within 24 hours following any discharge from the site. For sites that are temporarily stabilized and inactive, the required frequency is reduced to once per calendar month.

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

### Stormwater Quality Sampling (4.2)

#### Turbidity Sampling (4.2.1)

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

Method for sampling turbidity:

#### Table 7 Turbidity Sampling Method

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

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

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

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

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

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

1. Telephone or submit an electronic report to the applicable Ecology Region's Environmental Report Tracking System (ERTS) within 24 hours.  
<https://www.ecology.wa.gov/About-us/Get-involved/Report-an-environmental-issue>
  - Northwest Region (King, Kitsap, Island, San Juan, Skagit, Snohomish, Whatcom): (425) 649-7000
2. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible. Address the problems within 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period
3. Document BMP implementation and maintenance in the site log book.
4. Continue to sample discharges daily until one of the following is true:
  - Turbidity is 25 NTU (or lower).
  - Transparency is 33 cm (or greater).
  - Compliance with the water quality limit for turbidity is achieved.
    - 1 - 5 NTU over background turbidity, if background is less than 50 NTU
    - 1% - 10% over background turbidity, if background is 50 NTU or greater
  - The discharge stops or is eliminated.

## pH Sampling (4.2.2)

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

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

For engineered soils and recycled concrete, pH sampling begins when engineered soils or recycled concrete are first exposed to precipitation and continues until the area is fully stabilized.

If the measured pH is 8.5 or greater, the following measures will be taken:

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

Method for sampling pH:

**Table 8 pH Sampling Method**

|   |                               |
|---|-------------------------------|
|   | pH meter                      |
|   | pH test kit                   |
|   | Wide range pH indicator paper |
| Y | TBD                           |

## Discharges to 303(d) or Total Maximum Daily Load (TMDL) Waterbodies (5.0)

### 303(d) Listed Waterbodies (5.1)

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

Yes

No

List the impairment(s):

- Category 4A – Bacteria fecal coliform
- Category 4A – Dissolved Oxygen

List and describe BMPs:

Portage Creek is not listed for turbidity, fine sediment, phosphorus, or pH and as such no BMPs are needed.

### TMDL Waterbodies (5.2)

Waste Load Allocation for CWSGP discharges:

None known.

List and describe BMPs:

Not applicable at this time.

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

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

## **Reporting and Record Keeping (6.0)**

### **Record Keeping (6.1)**

#### **Site Log Book (6.1.1)**

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

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

#### **Records Retention (6.1.2)**

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

Permit documentation to be retained on-site:

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

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

#### **Updating the SWPPP (6.1.3)**

The SWPPP will be modified if:

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

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

## Reporting (6.2)

### Discharge Monitoring Reports (6.2.1)

**Cumulative soil disturbance is one (1) acre or larger; therefore,** Discharge Monitoring Reports (DMRs) will be submitted to Ecology monthly. If there was no discharge during a given monitoring period the DMR will be submitted as required, reporting "No Discharge". The DMR due date is fifteen (15) days following the end of each calendar month. DMRs will be reported online through Ecology's WQWebDMR System.

### Notification of Noncompliance (6.2.2)

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

1. Ecology will be notified within 24-hours of the failure to comply by calling the applicable Regional office ERTS phone number (Regional office numbers listed below).
2. Immediate action will be taken to prevent the discharge/pollution or otherwise stop or correct the noncompliance. If applicable, sampling and analysis of any noncompliance will be repeated immediately and the results submitted to Ecology within five (5) days of becoming aware of the violation.
3. A detailed written report describing the noncompliance will be submitted to Ecology within five (5) days, unless requested earlier by Ecology.
4. Specific information to be included in the noncompliance report is found in Special Condition S5.F.3 of the CSWGP.

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

- Northwest Region at (425) 649-7000 for Island, King, Kitsap, San Juan, Skagit, Snohomish, or Whatcom County

Include the following information:

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

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

## **Appendix/Glossary**

**A. Site Map**

**B. BMP Detail**

**C. Site Inspection Form**

**D. Construction Stormwater General Permit (CSWGP)**

## **Appendix A - Site Map**

**TESC NOTES:**

1. CONTRACTOR SHALL PROVIDE FENCING, SIGNAGE AND BARRIERS REQUIRED BY THE CITY TO PREVENT UNAUTHORIZED ACCESS INTO THE CONSTRUCTION AREA.
2. CONTRACTOR SHALL PROVIDE TRAFFIC MANAGEMENT FOR WORK WITHIN THE ROW.
3. CONTRACTOR SHALL PROVIDE PROTECTION IN ALL DOWNSTREAM INLETS AND CATCH BASINS WITHIN 500 FEET OF THE PROPERTY.
4. CONTRACTOR SHALL FIELD LOCATE TESC CONTROLS AND ADJUST AS NEEDED TO REFLECT CHANGING SIDE CONDITIONS AND CONSTRUCTION PROGRESS.
5. CONTRACTOR SHALL PREVENT SEDIMENT FROM LEAVING THE CONSTRUCTION SITE THROUGH THE USE OF PERIMETER CONTROLS, SUCH AS FILTER FABRIC FENCE, COMPOST SOCKS, TEMPORARY SWALES OR BERMS.
6. CONTRACTOR SHALL REMOVE AND DISPOSE OF ALL TESC MEASURES AT THE COMPLETION OF THE PROJECT WHEN ALL DISTURBED AREAS HAVE BEEN FULLY AND FINALLY STABILIZED.
7. CONTRACTOR SHALL TAKE PRECAUTIONS TO PROTECT PERMANENT STORMWATER INFILTRATION AREAS FROM ANY SEDIMENT LADEN RUNOFF. NO CONSTRUCTION STORMWATER SHALL BE DIRECTED TO THESE AREAS AND CONTRACTOR SHALL BE RESPONSIBLE FOR REMEDIATION AND REPAIR SHOULD FOULING OF ANY INFILTRATION AREAS OCCUR.

**kpff**

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Seattle, WA 98101  
206.622.5822  
www.kpff.com



**ARLINGTON GARDEN  
APARTMENTS  
ARLINGTON, WA**

**REVISIONS:**

| NO. | DATE | DESCRIPTION |
|-----|------|-------------|
|     |      |             |
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DATE: 08/01/2025  
JOB NO: 2400346  
DESIGNED BY: MMM  
DRAWN BY: CEP  
CHECKED BY: MNF  
APPROVED BY: JSF

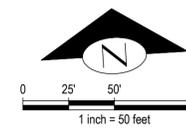
**TEMPORARY EROSION  
AND SEDIMENT CONTROL  
PLAN**

**C3.00**

CLEAR AND GRADING PERMIT

**LEGEND**

- PROPERTY LINE / ROW LINE
- - - LIMITS OF CLEARING
- ..... BUILDING OUTLINE
- X X SILT FENCE
- - - - - TEMPORARY INTERCEPTOR SWALE
- ▲▲ ROCK CHECK DAM
- >—> TEMPORARY CULVERT
- - - WETLAND BUFFER
- (P) PUMP
- FM FORCE MAIN
- [Pattern] CONSTRUCTION ENTRANCE
- [Pattern] FUTURE INFILTRATION FACILITY FOOTPRINT (9)

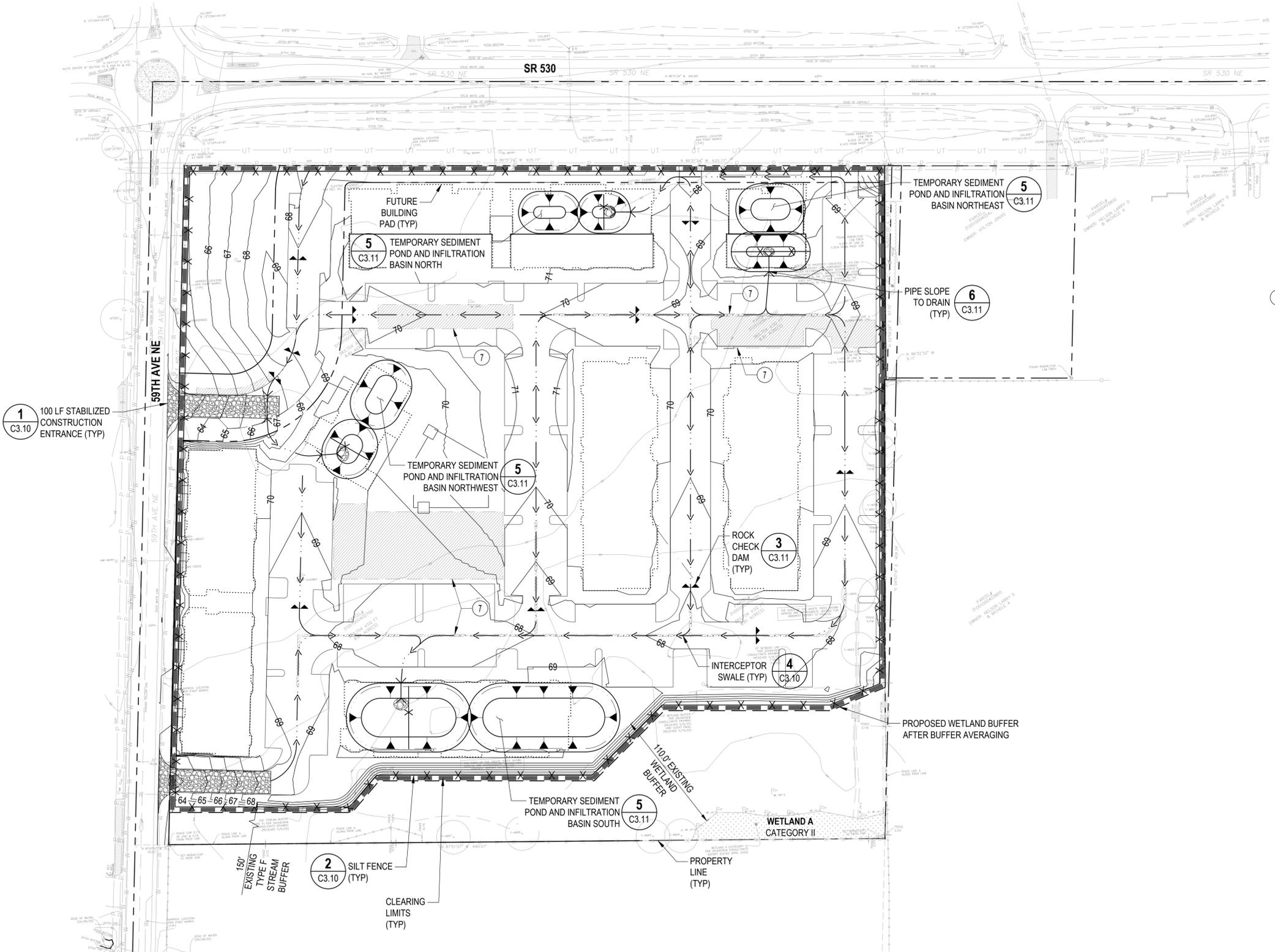


**CITY OF ARLINGTON  
CONSTRUCTION DRAWING REVIEW APPROVAL**

THIS PLAN SHEET HAS BEEN REVIEWED AND APPROVED PER THE CONDITIONS ON THE TITLE SHEET.

BY: \_\_\_\_\_  
Development Services Manager

DATE: \_\_\_\_\_ THIS APPROVAL VALID FOR 18 MONTHS



Z:\2400001-2409999\2400346 Arlington Apartments CAD\Design\ECG\ECG\_C3.00\_AA\_TESC.dwg  
MeghanM  
Aug 07, 2025 - 7:47pm

**Appendix B - BMP Detail**

## II-3 Construction Stormwater BMPs

### II-3.1 A Summary of Construction Stormwater BMPs

This chapter contains standards and specifications for temporary BMPs, used as appropriate during the construction phase of a project. Often using BMPs in combination is the best method to meet Construction Stormwater Pollution Prevention Plan (Construction SWPPP) requirements.

The standards and specifications in this chapter are not intended to limit innovative efforts to effectively control erosion and sedimentation. Construction SWPPPs can contain experimental BMPs or make minor modifications to standard BMPs. However, the permitting authority (state, local, or both) must approve such practices before use. Experimental and modified BMPs must achieve the same or better performance than the BMPs listed below.

None of the BMPs listed below will work successfully throughout the construction project without inspection and maintenance. Regular inspections to identify problems with the operation of each BMP, and the timely repair of any problems are essential to the continued operation of the BMPs. As site conditions change, BMPs must change to remain in compliance.

Construction stormwater BMPs are divided into two categories: Construction Source Control BMPs and Construction Runoff BMPs.

[Table II-3.1: Construction Stormwater BMPs by SWPPP Element](#) shows the relationship of the Construction Stormwater BMPs to the Construction SWPPP Elements described in [I-3.4.2 MR2: Construction Stormwater Pollution Prevention Plan \(SWPPP\)](#).

**Table II-3.1: Construction Stormwater BMPs by SWPPP Element**

| Construction Stormwater BMP                              | Construction SWPPP Element # |    |    |    |    |    |    |    |    |     |     |     |     |
|--|------------------------------|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
|  | #1                           | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | #10 | #11 | #12 | #13 |
| <b>Construction Source Control BMPs</b>                  |                              |    |    |    |    |    |    |    |    |     |     |     |     |
| <a href="#">BMP C101: Preserving Natural Vegetation</a>  | ✓                            |    |    |    |    |    |    |    |    |     |     |     |     |
| <a href="#">BMP C102: Buffer Zones</a>                   | ✓                            |    |    |    |    |    |    |    |    |     |     |     | ✓   |
| <a href="#">BMP C103: High-Visibility Fence</a>          | ✓                            |    |    |    |    |    |    |    |    |     |     |     | ✓   |
| <a href="#">BMP C105: Stabilized Construction Access</a> |                              | ✓  |    |    |    |    |    |    |    |     |     |     |     |
| <a href="#">BMP C106: Wheel Wash</a>                     |                              | ✓  |    |    |    |    |    |    |    |     |     |     |     |

**Table II-3.1: Construction Stormwater BMPs by SWPPP Element  
(continued)**

| Construction Storm-water BMP   | Construction SWPPP Element # |    |    |    |    |    |    |    |    |     |     |     |     |
|--|------------------------------|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
|  | #1                           | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | #10 | #11 | #12 | #13 |
| <a href="#">BMP C107: Construction Road / Parking Area Stabilization</a>   |                              | ✓  |    |    |    |    |    |    |    |     |     |     |     |
| <a href="#">BMP C120: Temporary and Permanent Seeding</a>                  |                              |    |    |    | ✓  | ✓  |    |    |    |     |     |     |     |
| <a href="#">BMP C121: Mulching</a>   |                              |    |    |    | ✓  | ✓  |    |    |    |     |     |     |     |
| <a href="#">BMP C122: Nets and Blankets</a>                                |                              |    |    |    | ✓  | ✓  |    | ✓  |    |     |     |     |     |
| <a href="#">BMP C123: Plastic Covering</a>                                 |                              |    |    |    | ✓  | ✓  |    |    |    |     |     |     |     |
| <a href="#">BMP C124: Sodding</a>  |                              |    |    |    | ✓  | ✓  |    |    |    |     |     |     |     |
| <a href="#">BMP C125: Topsoiling / Composting</a>                          |                              |    |    |    | ✓  |    |    |    |    |     |     |     |     |
| <a href="#">BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection</a> |                              |    |    |    | ✓  |    |    |    |    |     |     |     |     |
| <a href="#">BMP C130: Surface Roughening</a>                               |                              |    |    |    | ✓  | ✓  |    |    |    |     |     |     |     |
| <a href="#">BMP C131: Gradient Terraces</a>                                |                              |    |    |    | ✓  | ✓  |    |    |    |     |     |     |     |
| <a href="#">BMP C140: Dust Control</a>                                     |                              |    |    |    | ✓  |    |    |    |    |     |     |     |     |
| <a href="#">BMP C150: Materials on Hand</a>                                |                              |    |    |    |    |    |    |    |    |     | ✓   | ✓   |     |
| <a href="#">BMP C151: Concrete Handling</a>                                |                              |    |    |    |    |    |    |    | ✓  |     |     |     |     |
| <a href="#">BMP C152: Sawcutting and Surfacing Pollution Prevention</a>    |                              |    |    |    |    |    |    |    | ✓  |     |     |     |     |
| <a href="#">BMP C153: Material Delivery, Storage, and Containment</a>      |                              |    |    |    |    |    |    |    | ✓  |     |     |     |     |

**Table II-3.1: Construction Stormwater BMPs by SWPPP Element  
(continued)**

| Construction Storm-water BMP  | Construction SWPPP Element # |    |    |    |    |    |    |    |    |     |     |     |     |
|---|------------------------------|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
|   | #1                           | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | #10 | #11 | #12 | #13 |
| <a href="#">BMP C154: Concrete Washout Area</a>                       |                              |    |    |    |    |    |    |    | ✓  |     |     |     |     |
| <a href="#">BMP C160: Certified Erosion and Sediment Control Lead</a> |                              |    |    |    |    |    |    |    |    |     | ✓   | ✓   |     |
| <a href="#">BMP C162: Scheduling</a>                                  |                              |    |    |    |    |    |    |    |    |     |     | ✓   |     |
| <b>Construction Runoff BMPs</b>                                       |                              |    |    |    |    |    |    |    |    |     |     |     |     |
| <a href="#">BMP C200: Interceptor Dike and Swale</a>                  |                              |    |    |    |    | ✓  |    |    |    |     |     |     | ✓   |
| <a href="#">BMP C201: Grass-Lined Channels</a>                        |                              |    |    |    |    | ✓  |    |    |    |     |     |     | ✓   |
| <a href="#">BMP C202: Riprap Channel Lining</a>                       |                              |    |    |    |    |    |    | ✓  |    |     |     |     |     |
| <a href="#">BMP C203: Water Bars</a>                                  |                              |    | ✓  |    |    | ✓  |    |    |    | ✓   |     |     |     |
| <a href="#">BMP C204: Pipe Slope Drains</a>                           |                              |    |    |    |    | ✓  |    |    |    |     |     |     |     |
| <a href="#">BMP C205: Subsurface Drains</a>                           |                              |    |    |    |    | ✓  |    |    |    |     |     |     |     |
| <a href="#">BMP C206: Level Spreader</a>                              |                              |    |    |    |    | ✓  |    |    |    | ✓   |     |     |     |
| <a href="#">BMP C207: Check Dams</a>                                  |                              |    | ✓  |    |    | ✓  |    | ✓  |    |     |     |     | ✓   |
| <a href="#">BMP C208: Triangular Silt Dike (TSD)</a>                  |                              |    |    |    |    | ✓  |    |    |    |     |     |     | ✓   |
| <a href="#">BMP C209: Outlet Protection</a>                           |                              |    | ✓  |    |    |    |    | ✓  |    |     |     |     |     |
| <a href="#">BMP C220: Inlet Protection</a>                            |                              |    |    |    |    |    | ✓  |    |    |     |     |     |     |
| <a href="#">BMP C231: Brush Barrier</a>                               |                              |    |    | ✓  |    |    |    |    |    |     |     |     | ✓   |
| <a href="#">BMP C232: Gravel Filter Berm</a>                          |                              |    |    | ✓  |    |    |    |    |    |     |     |     |     |

**Table II-3.1: Construction Stormwater BMPs by SWPPP Element  
(continued)**

| Construction Storm-water BMP  | Construction SWPPP Element # |    |    |    |    |    |    |    |    |     |     |     |     |
|---|------------------------------|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
|   | #1                           | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | #10 | #11 | #12 | #13 |
| <a href="#">BMP C233: Silt Fence</a>  |                              |    |    | ✓  |    |    |    |    |    |     |     |     | ✓   |
| <a href="#">BMP C234: Vegetated Strip</a>   |                              |    |    | ✓  |    |    |    |    |    |     |     |     | ✓   |
| <a href="#">BMP C235: Wattles</a>   |                              |    | ✓  | ✓  |    |    |    |    |    |     |     |     |     |
| <a href="#">BMP C236: Vegetative Filtration</a>   |                              |    |    |    |    |    |    |    |    | ✓   |     |     |     |
| <a href="#">BMP C240: Sediment Trap</a>   |                              |    | ✓  | ✓  |    |    |    |    |    |     |     |     |     |
| <a href="#">BMP C241: Sediment Pond (Temporary)</a>   |                              |    | ✓  | ✓  |    |    |    |    |    |     |     |     |     |
| <a href="#">BMP C250: Construction Stormwater Chemical Treatment</a>  |                              |    |    | ✓  |    |    |    |    | ✓  |     |     |     |     |
| <a href="#">BMP C251: Construction Stormwater Filtration</a>  |                              |    |    | ✓  |    |    |    |    | ✓  |     |     |     |     |
| <a href="#">BMP C252: Treating and Disposing of High pH Water</a>   |                              |    |    |    |    |    |    |    | ✓  |     |     |     |     |
| <b>Construction SWPPP Elements:</b><br><a href="#">Element 1: Preserve Vegetation / Mark Clearing Limits</a><br><a href="#">Element 2: Establish Construction Access</a><br><a href="#">Element 3: Control Flow Rates</a><br><a href="#">Element 4: Install Sediment Controls</a><br><a href="#">Element 5: Stabilize Soils</a><br><a href="#">Element 6: Protect Slopes</a><br><a href="#">Element 7: Protect Drain Inlets</a><br><a href="#">Element 8: Stabilize Channels and Outlets</a><br><a href="#">Element 9: Control Pollutants</a><br><a href="#">Element 10: Control Dewatering</a><br><a href="#">Element 11: Maintain BMPs</a><br><a href="#">Element 12: Manage the Project</a><br><a href="#">Element 13: Protect Low Impact Development BMPs</a> |                              |    |    |    |    |    |    |    |    |     |     |     |     |

## II-3.2 Construction Source Control BMPs

# **BMP C101: Preserving Natural Vegetation**

## ***Purpose***

The purpose of preserving natural vegetation is to reduce erosion wherever practicable. Limiting site disturbance is the single most effective method for reducing erosion. For example, conifers can hold up to about 50 percent of all rain that falls during a storm. Up to 20-30 percent of this rain may never reach the ground but is taken up by the tree or evaporates. Another benefit is that the rain held in the tree can be released slowly to the ground after the storm.

## ***Conditions of Use***

Natural vegetation should be preserved on steep slopes, near perennial and intermittent water-courses or swales, and on building sites in wooded areas.

- As required by local governments.
- Phase construction to preserve natural vegetation on the project site for as long as possible during the construction period.

## ***Design and Installation Specifications***

Natural vegetation can be preserved in natural clumps or as individual trees, shrubs and vines.

The preservation of individual plants is more difficult because heavy equipment is generally used to remove unwanted vegetation. The points to remember when attempting to save individual plants are:

- Is the plant worth saving? Consider the location, species, size, age, vigor, and the work involved. Local governments may also have ordinances to save natural vegetation and trees.
- Fence or clearly mark areas around trees that are to be saved. It is preferable to keep ground disturbance away from the trees at least as far out as the dripline.

Plants need protection from three kinds of injuries:

- *Construction Equipment* - This injury can be above or below the ground level. Damage results from scarring, cutting of roots, and compaction of the soil. Placing a fenced buffer zone around plants to be saved prior to construction can prevent construction equipment injuries.
- *Grade Changes* - Changing the natural ground level will alter grades, which affects the plant's ability to obtain the necessary air, water, and minerals. Minor fills usually do not cause problems although sensitivity between species does vary and should be checked. Trees can typically tolerate fill of 6 inches or less. For shrubs and other plants, the fill should be less.

When there are major changes in grade, it may become necessary to supply air to the roots of plants. This can be done by placing a layer of gravel and a tile system over the roots before the fill is made. The tile system should be laid out on the original grade leading from a dry well

around the tree trunk. The system should then be covered with small stones to allow air to circulate over the root area.

Lowering the natural ground level can seriously damage trees and shrubs. The highest percentage of the plant roots are in the upper 12 inches of the soil and cuts of only 2-3 inches can cause serious injury. To protect the roots it may be necessary to terrace the immediate area around the plants to be saved. If roots are exposed, construction of retaining walls may be needed to keep the soil in place. Plants can also be preserved by leaving them on an undisturbed, gently sloping mound. To increase the chances for survival, it is best to limit grade changes and other soil disturbances to areas outside the dripline of the plant.

- *Excavations* - Protect trees and other plants when excavating for drainfields, power, water, and sewer lines. Where possible, the trenches should be routed around trees and large shrubs. When this is not possible, it is best to tunnel under them. This can be done with hand tools or with power augers. If it is not possible to route the trench around plants to be saved, then the following should be observed:
  - Cut as few roots as possible. When you have to cut, cut clean. Paint cut root ends with a wood dressing like asphalt base paint if roots will be exposed for more than 24-hours.
  - Backfill the trench as soon as possible.
  - Tunnel beneath root systems as close to the center of the main trunk to preserve most of the important feeder roots.

Some problems that can be encountered with a few specific trees are:

- Maple, Dogwood, Red alder, Western hemlock, Western red cedar, and Douglas fir do not readily adjust to changes in environment and special care should be taken to protect these trees.
- The windthrow hazard of Pacific silver fir and madrona is high, while that of Western hemlock is moderate. The danger of windthrow increases where dense stands have been thinned. Other species (unless they are on shallow, wet soils less than 20 inches deep) have a low windthrow hazard.
- Cottonwoods, maples, and willows have water-seeking roots. These can cause trouble in sewer lines and infiltration fields. On the other hand, they thrive in high moisture conditions that other trees would not.
- Thinning operations in pure or mixed stands of Grand fir, Pacific silver fir, Noble fir, Sitka spruce, Western red cedar, Western hemlock, Pacific dogwood, and Red alder can cause serious disease problems. Disease can become established through damaged limbs, trunks, roots, and freshly cut stumps. Diseased and weakened trees are also susceptible to insect attack.

## ***Maintenance Standards***

Inspect flagged and/or fenced areas regularly to make sure flagging or fencing has not been removed or damaged. If the flagging or fencing has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

If tree roots have been exposed or injured, “prune” cleanly with an appropriate pruning saw or loppers directly above the damaged roots and recover with native soils. Treatment of sap flowing trees (fir, hemlock, pine, soft maples) is not advised as sap forms a natural healing barrier.

## **BMP C102: Buffer Zones**

### ***Purpose***

Creation of an undisturbed area or strip of natural vegetation or an established suitable planting that will provide a living filter to reduce soil erosion and stormwater runoff velocities.

### ***Conditions of Use***

Buffer zones are used along streams, wetlands and other bodies of water that need protection from erosion and sedimentation. Contractors can use vegetative buffer zone BMPs to protect natural swales and they can incorporate them into the natural landscaping of an area.

Do not use critical-areas buffer zones as sediment treatment areas. These areas shall remain completely undisturbed. The local permitting authority may expand the buffer widths temporarily to allow the use of the expanded area for removal of sediment.

The types of buffer zones can change the level of protection required as shown below:

Designated Critical Area Buffers - buffers that protect Critical Areas, as defined by the Washington State Growth Management Act, and are established and managed by the local permitting authority. These should not be disturbed and must be protected with sediment control BMPs to prevent impacts. The local permitting authority may expand the buffer widths temporarily to allow the use of the expanded area for removal of sediment.

Vegetative Buffer Zones - areas that may be identified in undisturbed vegetation areas or managed vegetation areas that are outside any Designated Critical Area Buffer. They may be utilized to provide an additional sediment control area and/or reduce runoff velocities. If being used for preservation of natural vegetation, they should be arranged in clumps or strips. They can be used to protect natural swales and incorporated into the natural landscaping area.

### ***Design and Installation Specifications***

- Preserving natural vegetation or plantings in clumps, blocks, or strips is generally the easiest and most successful method.
- Leave all unstable steep slopes in natural vegetation.
- Mark clearing limits and keep all equipment and construction debris out of the natural areas and buffer zones. Steel construction fencing is the most effective method to protect sensitive areas and buffers. Alternatively, wire-backed silt fence on steel posts is marginally effective. Flagging alone is typically not effective.
- Keep all excavations outside the dripline of trees and shrubs.
- Do not push debris or extra soil into the buffer zone area because it will cause damage by

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 C 103: 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.

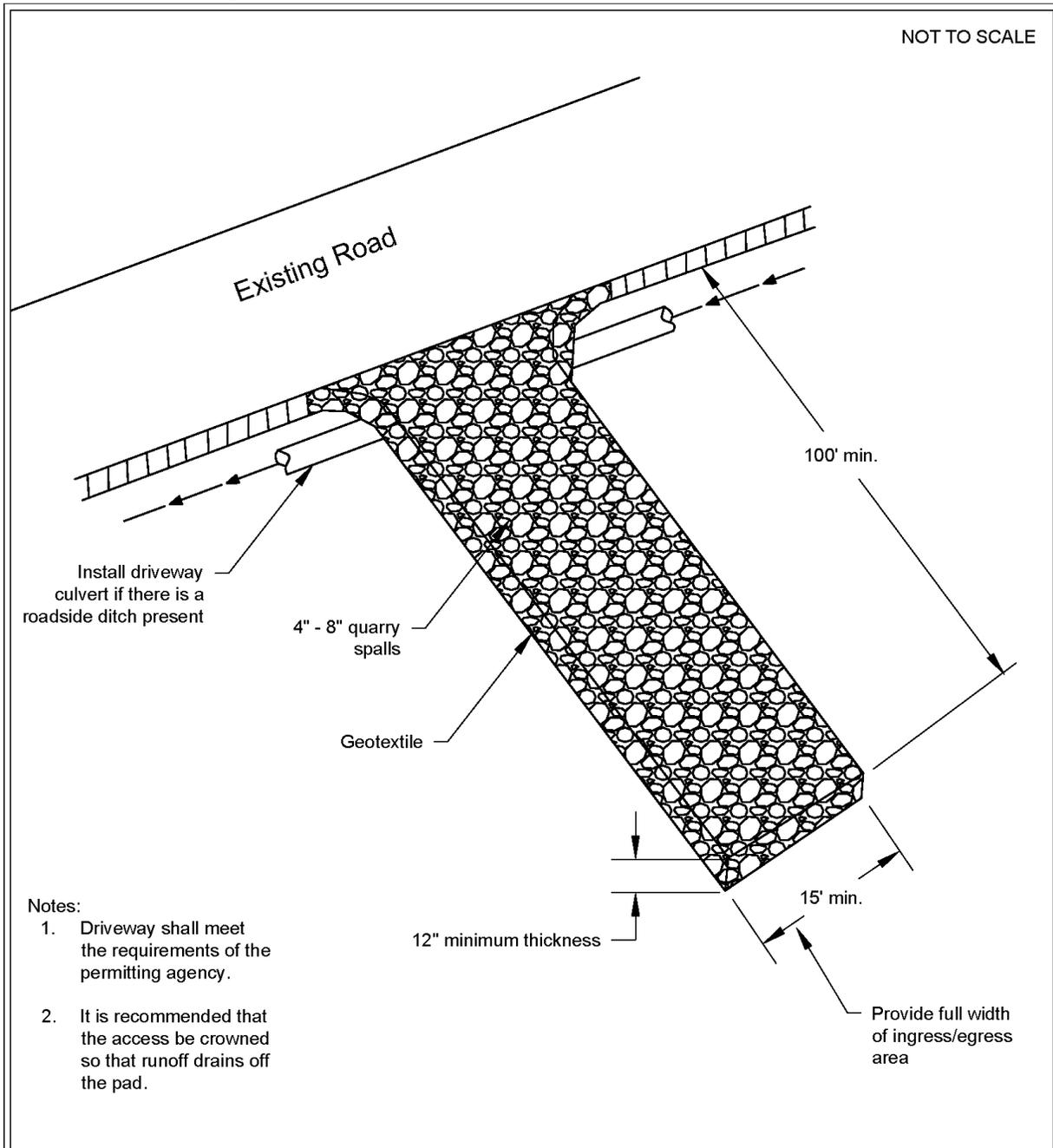
### ***Maintenance Standards***

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**



## Stabilized Construction Access

Revised June 2018

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## ***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 C 105: 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 C 105: Stabilized Construction Access](#). Locate the wheel wash such that vehicles exiting the wheel wash will enter directly onto [BMP C 105: Stabilized Construction Access](#). In order to achieve this, [BMP C 105: 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.

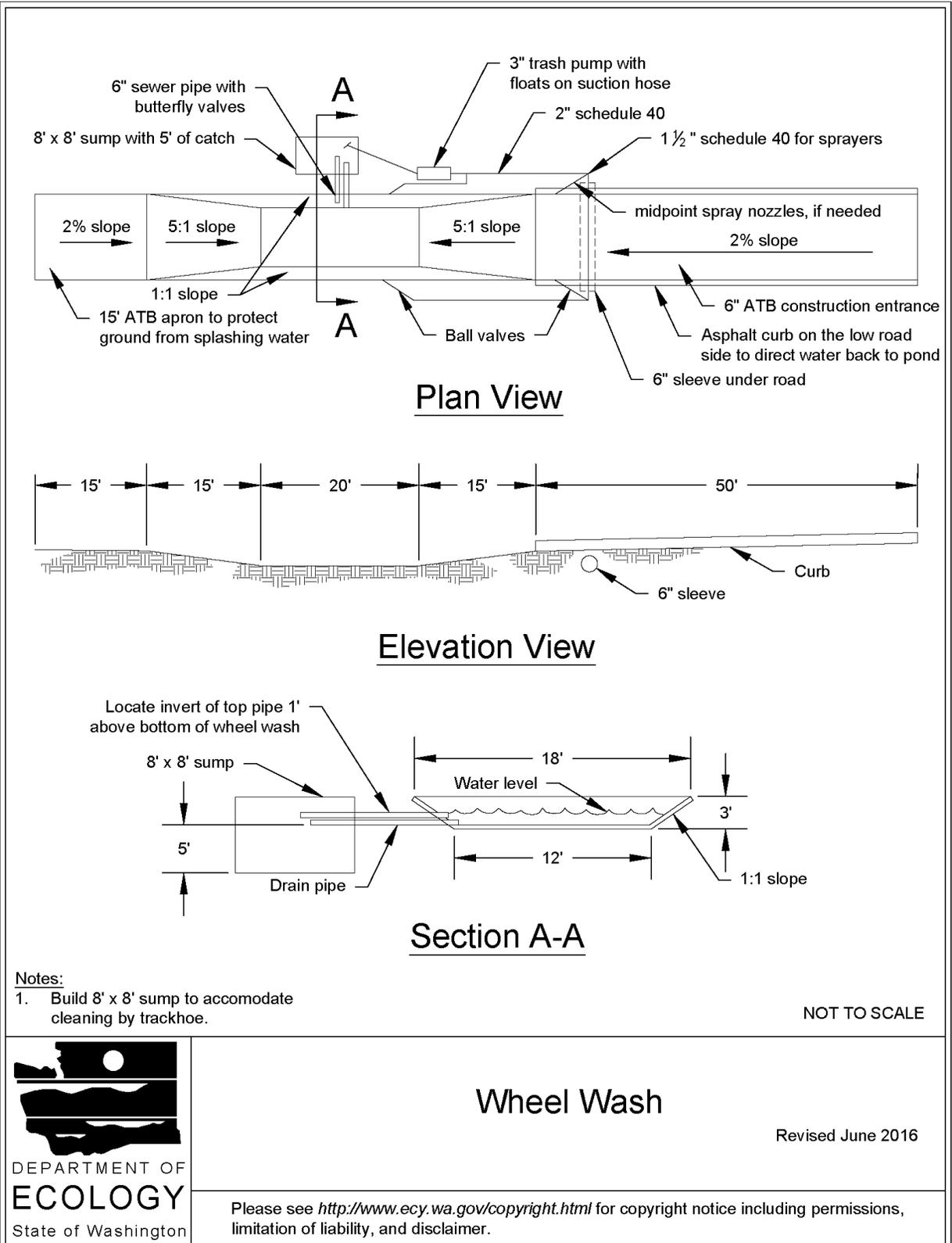
The wheel wash water should be changed a minimum of once per day. On large earthwork jobs where more than 10-20 trucks per hour are expected, the wheel wash water will need to be changed more often.

### ***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:

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**Figure II-3.2: Wheel Wash**



## **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 |
|--|---|----------|----------|---------------|
| <b>Temporary Erosion Control Seed Mix</b>  |   |          |          |               |
| A standard mix for areas requiring a temporary vegetative cover.   |   |          |          |               |
| Chewings or annual blue grass  | <i>Festuca rubra var. commutata</i> or <i>Poa anna</i>      | 40       | 98       | 90            |
| Perennial rye  | <i>Lolium perenne</i>                                       | 50       | 98       | 90            |
| Redtop or colonial bentgrass   | <i>Agrostis alba</i> or <i>Agrostis tenuis</i>              | 5        | 92       | 85            |
| White dutch clover   | <i>Trifolium repens</i>                                     | 5        | 98       | 90            |
| <b>Landscaping Seed Mix</b>  |   |          |          |               |
| A recommended mix for landscaping seed.  |   |          |          |               |
| Perennial rye blend  | <i>Lolium perenne</i>                                       | 70       | 98       | 90            |
| Chewings and red fescue blend  | <i>Festuca rubra var. commutata</i> or <i>Festuca rubra</i> | 30       | 98       | 90            |
| <b>Low-Growing Turf Seed Mix</b>   |   |          |          |               |
| 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)  | <i>Festuca arundinacea var.</i>                             | 45       | 98       | 90            |
| Dwarf perennial rye (Barclay)  | <i>Lolium perenne var. barclay</i>                          | 30       | 98       | 90            |
| Red fescue   | <i>Festuca rubra</i>  | 20       | 98       | 90            |
| Colonial bentgrass   | <i>Agrostis tenuis</i>                                      | 5        | 98       | 90            |
| <b>Bioswale Seed Mix</b>   |   |          |          |               |
| A seed mix for bioswales and other intermittently wet areas.   |   |          |          |               |
| Tall or meadow fes-  | <i>Festuca arundin-</i>                                     | 75-80    | 98       | 90            |

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

| Common Name  | Latin Name   | % Weight | % Purity | % Germination |
|--|--|----------|----------|---------------|
| cue  | <i>acea</i> or <i>Festuca elatior</i>                |          |          |               |
| Seaside/Creeping bentgrass   | <i>Agrostis palustris</i>                            | 10-15    | 92       | 85            |
| Redtop bentgrass   | <i>Agrostis alba</i> or <i>Agrostis gigantea</i>     | 5-10     | 90       | 80            |
| <b>Wet Area Seed Mix</b>   |  |          |          |               |
| 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  | <i>Festuca arundinacea</i> or <i>Festuca elatior</i> | 60-70    | 98       | 90            |
| Seaside/Creeping bentgrass   | <i>Agrostis palustris</i>                            | 10-15    | 98       | 85            |
| Meadow foxtail   | <i>Alepocurus pratensis</i>                          | 10-15    | 90       | 80            |
| Alsike clover  | <i>Trifolium hybridum</i>                            | 1-6      | 98       | 90            |
| Redtop bentgrass   | <i>Agrostis alba</i>                                 | 1-6      | 92       | 85            |
| <b>Meadow Seed Mix</b>   |  |          |          |               |
| 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   | <i>Agrostis alba</i> or <i>Agrostis oregonensis</i>  | 20       | 92       | 85            |
| Red fescue   | <i>Festuca rubra</i>                                 | 70       | 98       | 90            |
| White dutch clover   | <i>Trifolium repens</i>                              | 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:
  - BFMs 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 <a href="#">WAC 173-350</a> , 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 <a href="#">BMP C125: Topsoiling / Composting</a> or <a href="#">BMP T5.13: Post-Construction Soil Quality and Depth</a> . 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  |
|--------------------------|--------------------------|--|
|                          | <b>Remarks</b>           | <p>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.</p> <p>Note: thick application of this material over existing grass, herbaceous species, and some groundcovers could smother and kill vegetation.</p> |
| <b>Wood-Based Mulch</b>  | <b>Quality Standards</b> | 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.   |
|                          | <b>Application Rates</b> | 2" thick min.; approx. 100 tons per acre (approx. 750 lbs. per cubic yard)   |
|                          | <b>Remarks</b>           | 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).   |
| <b>Wood Strand Mulch</b> | <b>Quality Standards</b> | A blend of loose, long, thin wood pieces derived from native conifer or deciduous trees with high length-to-width ratio.   |
|                          | <b>Application Rates</b> | 2" thick min.  |
|                          | <b>Remarks</b>           | 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 <i>Standard Specifications for Road, Bridge, and Municipal Construction</i> ( <a href="#">WSDOT, 2016</a> )   |

## **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

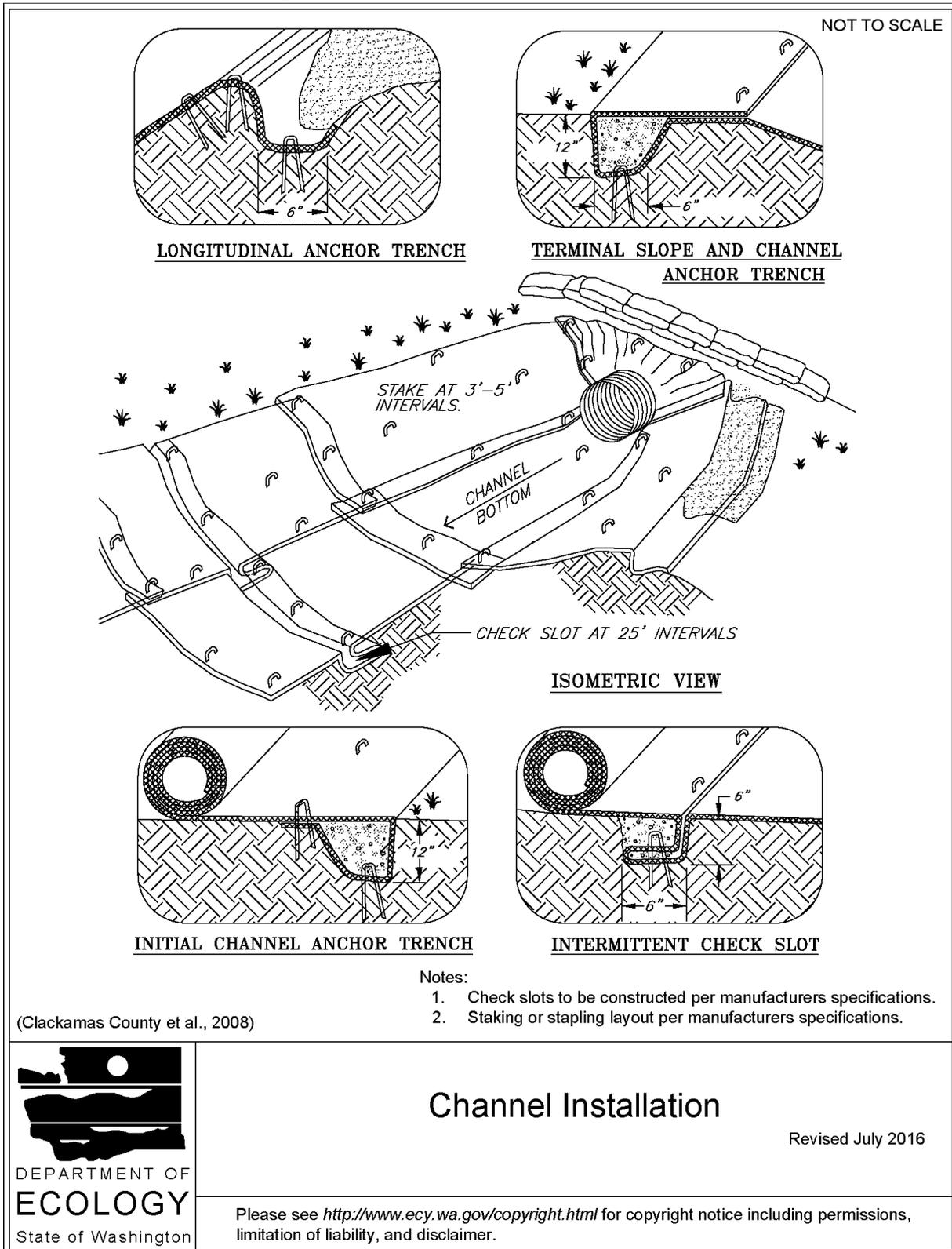
synthetic blankets are used, the soil should be hydromulched first.

- 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.

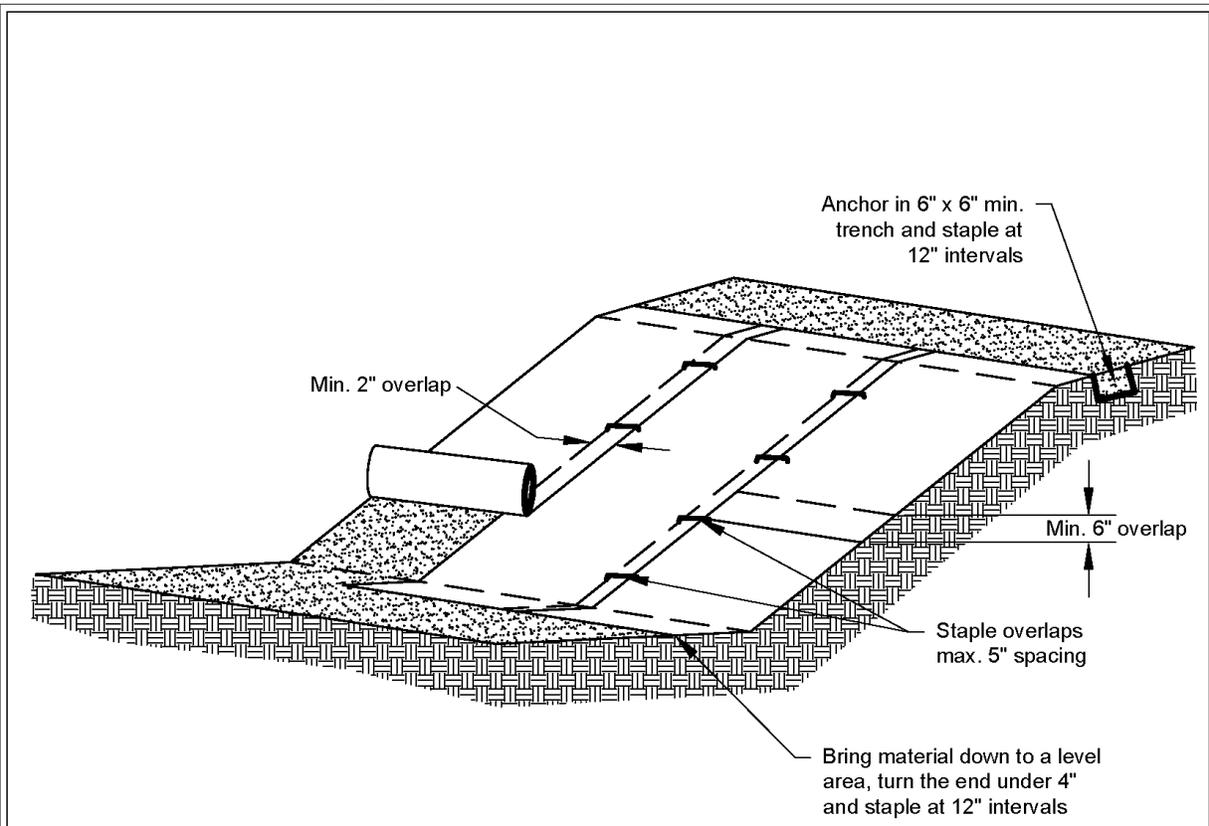
### ***Maintenance Standards***

- 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**



**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/matting 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



## Slope Installation

Revised June 2016

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## **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**

| <b>Disturbed Area (ac)</b> | <b>PAM (lbs)</b> | <b>Water (gal)</b> |
|----------------------------|------------------|--------------------|
| 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.

- Slopes with a stable rock face do not require roughening.
- Slopes where mowing is planned should not be excessively roughened.

## ***Design and Installation Specifications***

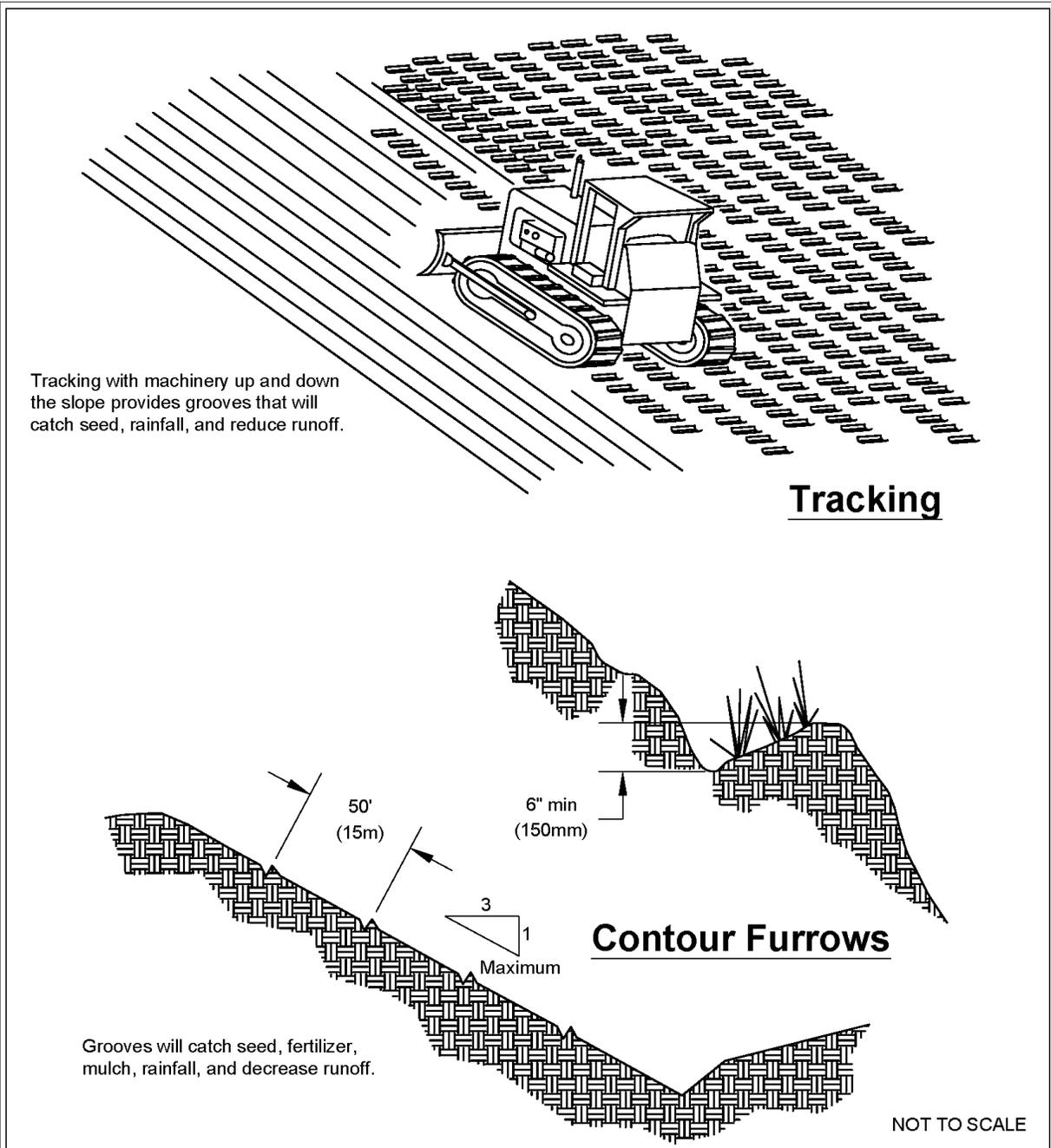
There are different methods for achieving a roughened soil surface on a slope, and the selection of an appropriate method depends upon the type of slope. Roughening methods include stair-step grading, grooving, contour furrows, and tracking. See [Figure II-3.5: Surface Roughening by Tracking and Contour Furrows](#). Factors to be considered in choosing a roughening method are slope steepness, mowing requirements, and whether the slope is formed by cutting or filling.

- Disturbed areas that will not require mowing may be stair-step graded, grooved, or left rough after filling.
- Stair-step grading is particularly appropriate in soils containing large amounts of soft rock. Each "step" catches material that sloughs from above, and provides a level site where vegetation can become established. Stairs should be wide enough to work with standard earth moving equipment. Stair steps must be on contour or gullies will form on the slope.
- Areas that will be mowed (these areas should have slopes less steep than 3H:1V) may have small furrows left by disking, harrowing, raking, or seed-planting machinery operated on the contour.
- Graded areas with slopes steeper than 3H:1V but less than 2H:1V should be roughened before seeding. This can be accomplished in a variety of ways, including "track walking," or driving a crawler tractor up and down the slope, leaving a pattern of cleat imprints parallel to slope contours.
- Tracking is done by operating equipment up and down the slope to leave horizontal depressions in the soil.

## ***Maintenance Standards***

- Areas that are surface roughened should be seeded as quickly as possible.
- Regular inspections should be made of the area. If rills appear, they should be re-roughened and re-seeded immediately.

**Figure II-3.5: Surface Roughening by Tracking and Contour Furrows**



Surface Roughening by Tracking  
and Contour Furrows

Revised June 2016

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## **BMP C131: Gradient Terraces**

### ***Purpose***

Gradient terraces reduce erosion damage by intercepting surface runoff and conveying it to a stable outlet at a non-erosive velocity.

### ***Conditions of Use***

Gradient terraces are normally limited to bare land having a water erosion problem. They should not be constructed on deep sands or on soils that are too stony, steep, or shallow to permit practical and economical installation and maintenance. Gradient terraces may only be used where suitable outlets are or will be made available.

### ***Design and Installation Specifications***

- The maximum vertical spacing of gradient terraces should be determined by the following method:

$$VI = (0.8)s + y$$

Where:

VI = vertical interval in feet

s = land rise per 100 feet, expressed in feet

y = a soil and cover variable with values from 1.0 to 4.0

Values of “y” are influenced by soil erodibility and cover practices. The lower values are applicable to erosive soils where little to no residue is left on the surface. The higher value is applicable only to erosion-resistant soils where a large amount of residue (1½ tons of straw/acre equivalent) is on the surface.

- The minimum constructed cross-section should meet the design dimensions.
- The top of the constructed ridge should not be lower at any point than the design elevation plus the specified overfill for settlement. The opening at the outlet end of the terrace should have a cross section equal to that specified for the terrace channel.
- Channel grades may be either uniform or variable with a maximum grade of 0.6 feet per 100 feet length (0.6%). For short distances, terrace grades may be increased to improve alignment. The channel velocity should not exceed that which is nonerosive for the soil type.
- All gradient terraces should have adequate outlets. Such an outlet may be a grassed waterway, vegetated area, or tile outlet. In all cases the outlet must convey runoff from the terrace or terrace system to a point where the outflow will not cause damage. Vegetative cover and energy dissipators should be used in the outlet channel.
- The design elevation of the water surface of the terrace should not be lower than the design elevation of the water surface in the outlet at their junction, when both are operating at design

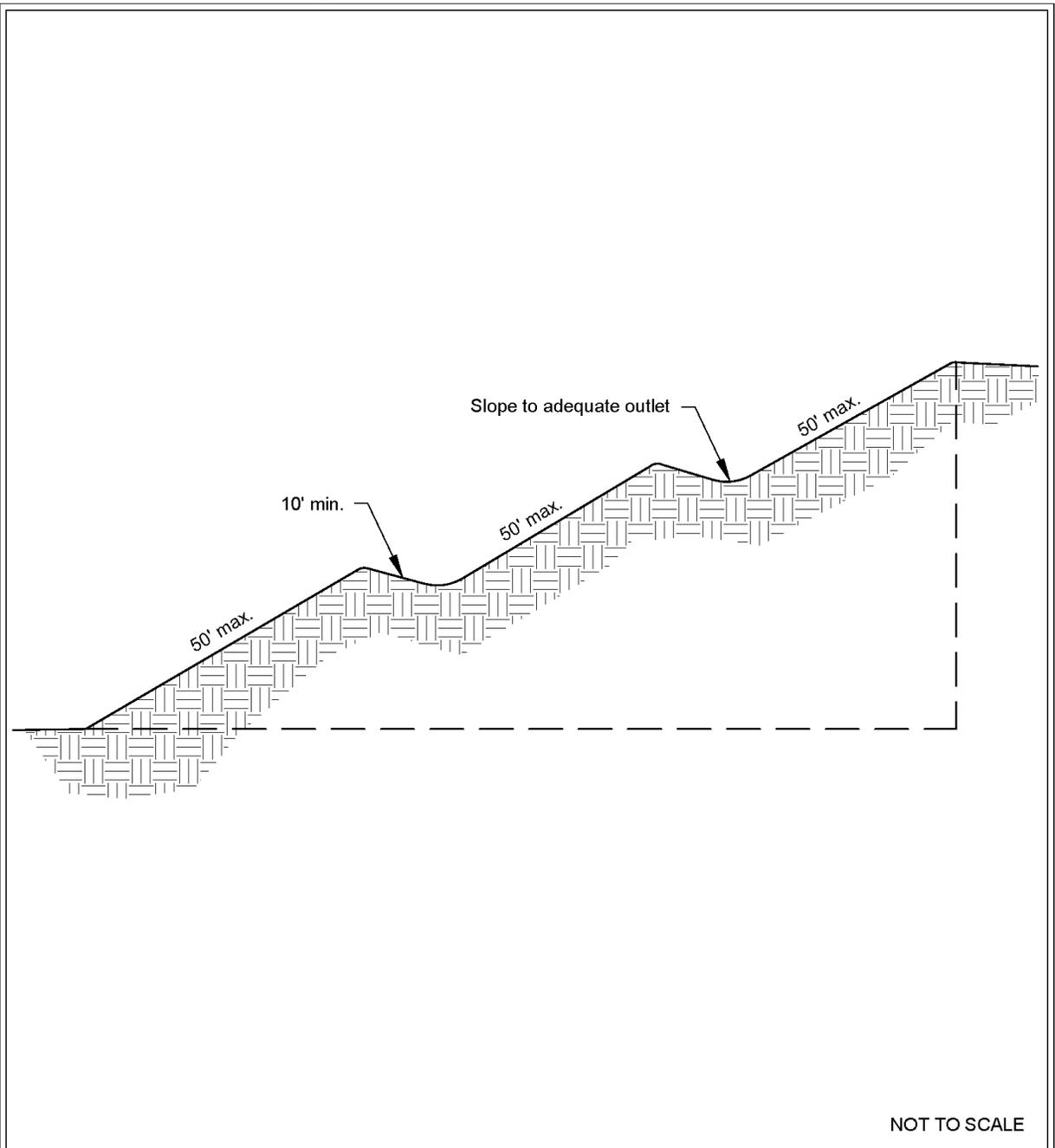
flow.

- Vertical spacing determined by the above methods may be increased as much as 0.5 feet or 10 percent, whichever is greater, to provide better alignment or location, to avoid obstacles, to adjust for equipment size, or to reach a satisfactory outlet. The drainage area above the terrace should not exceed the area that would be drained by a terrace with normal spacing.
- The terrace should have enough capacity to handle the peak runoff expected from a 2-year, 24-hour design storm without overtopping.
- The terrace cross-section should be proportioned to fit the land slope.
- The ridge height should include a reasonable settlement factor.
- The ridge should have a minimum top width of 3 feet at the design height.
- The minimum cross-sectional area of the terrace channel should be 8 square feet for land slopes of 5 percent or less, 7 square feet for slopes from 5 to 8 percent, and 6 square feet for slopes steeper than 8 percent. The terrace can be constructed wide enough to be maintained using a small vehicle.

### ***Maintenance Standards***

Maintenance should be performed as needed. Terraces should be inspected regularly; at least once per year, and after large storm events.

**Figure II-3.6: Gradient Terraces**



## Gradient Terraces

Revised June 2016

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## **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 C 105: Stabilized Construction Access](#) and [BMP C 106: 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 C 126: 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 C 126: Polyacrylamide \(PAM\) for Soil Erosion Protection](#), but the downstream protections still apply.

Refer to [BMP C 126: 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 wheelbarrows) 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,

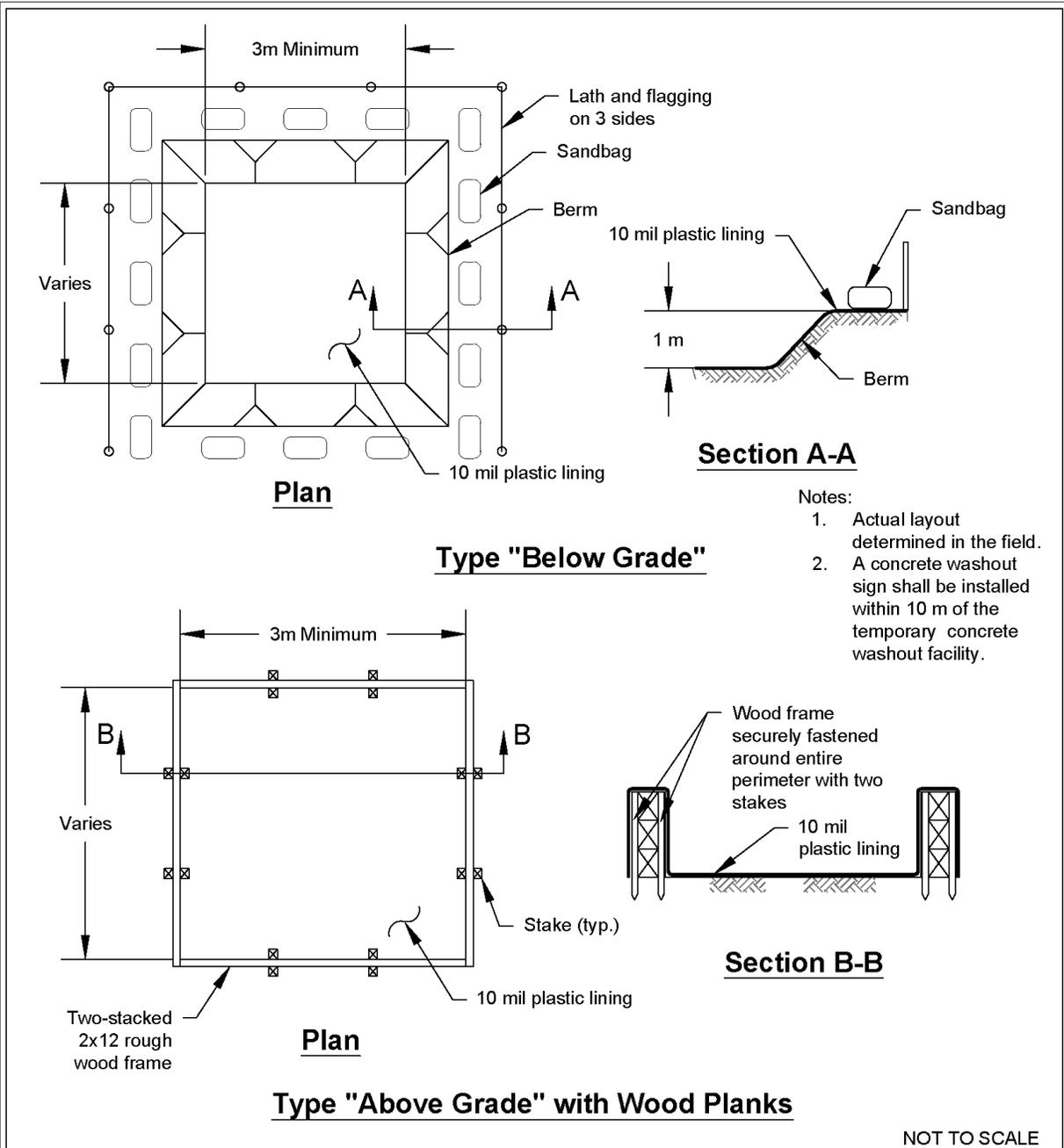
the concrete should be broken up, removed, and disposed of per applicable solid waste regulations. Dispose of hardened concrete on a regular basis.

- 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 side-walls 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**

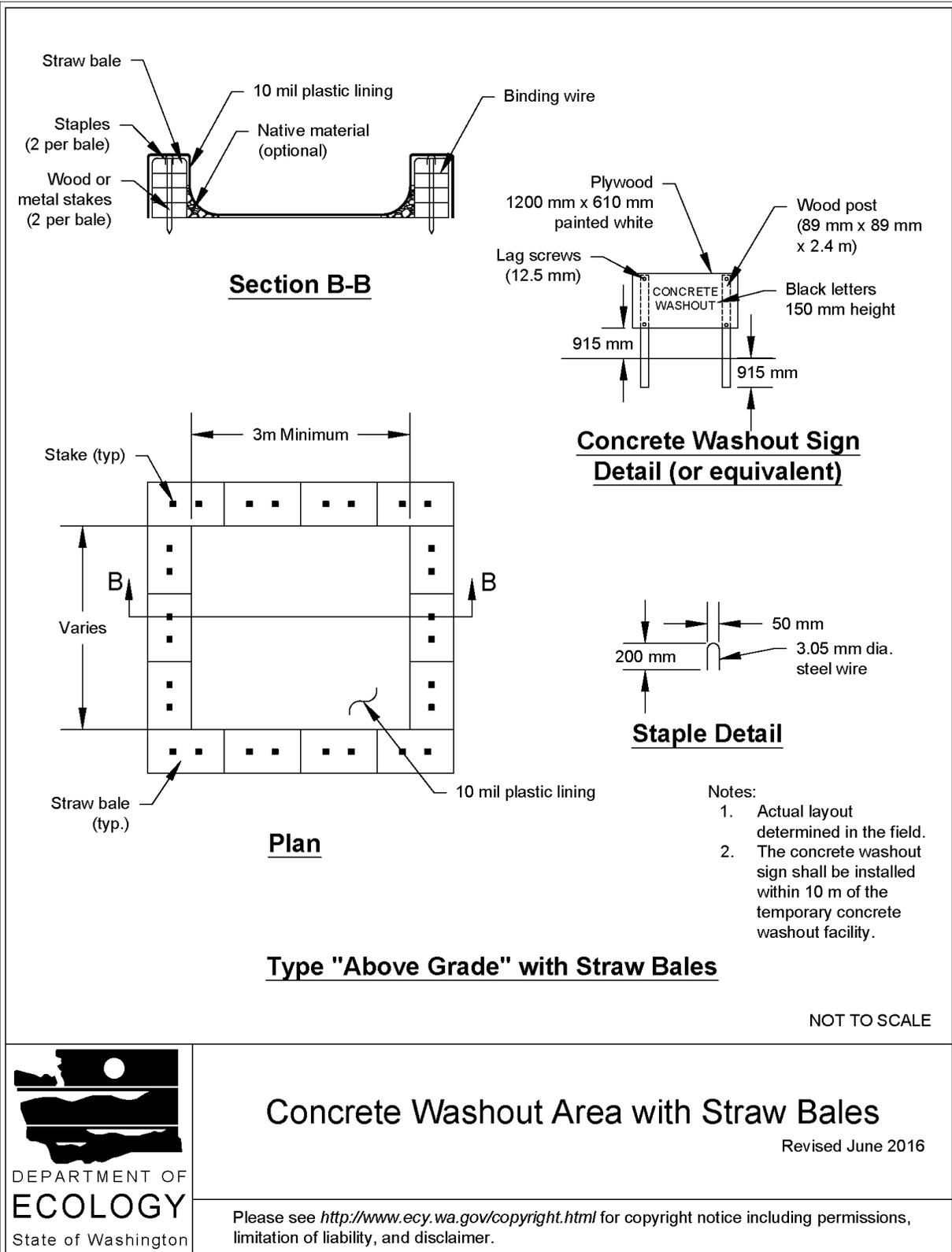


**Concrete Washout Area with Wood Planks**

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**Figure II-3.8: Concrete Washout Area with Straw Bales**

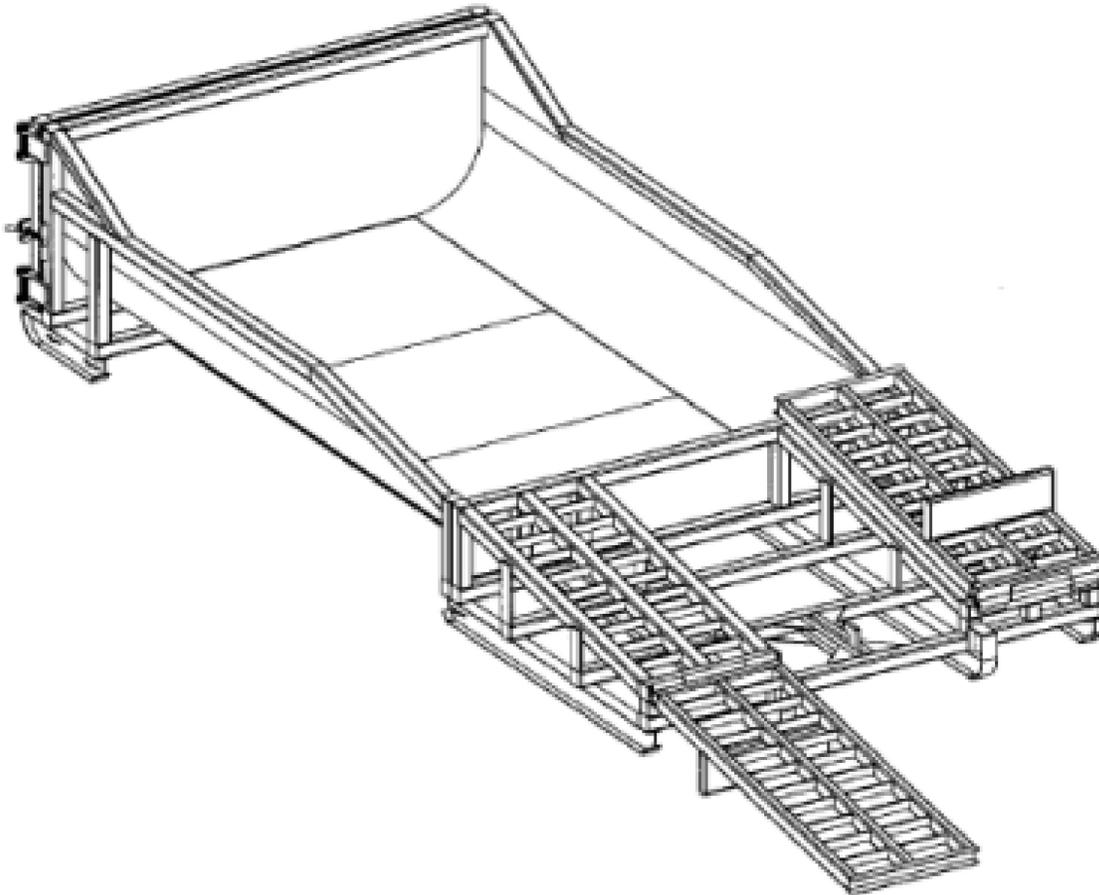


**Concrete Washout Area with Straw Bales**

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



NOT TO SCALE



DEPARTMENT OF  
**ECOLOGY**  
State of Washington

## Prefabricated Concrete Washout Container w/Ramp

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# **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 \(Temporary\)](#)).

## ***Design and Installation Specifications***

- Dike and/or swale and channel must be stabilized with temporary or permanent vegetation or other channel protection during construction.
  - Steep grades require channel protection and check dams.
  - Review construction for areas where overtopping may occur.
  - Can be used at the top of new fill before vegetation is established.
  - May be used as a permanent diversion channel to carry the runoff.
  - Contributing area for an individual dike or swale should be one acre or less.
  - Design the dike and/or swale to contain flows calculated by one of the following methods:
    - Single Event Hydrograph Method: The peak volumetric flow rate calculated using a 10-minute time step from a Type 1A, 10-year, 24-hour frequency storm for the worst-case land cover condition.
- OR
- Continuous Simulation Method: The 10-year peak flow rate, as determined by an approved continuous runoff model with a 15-minute time step for the worst-case land cover condition.

Worst-case land cover conditions (i.e., producing the most runoff) should be used for analysis (in most cases, this would be the land cover conditions just prior to final landscaping).

### **Interceptor Dikes**

Interceptor dikes shall meet the following criteria:

- Top Width: 2 feet minimum.
- Height: 1.5 feet minimum on berm.
- Side Slope: 2H:1V or flatter.
- Grade: Depends on topography, however, dike system minimum is 0.5%, and maximum is 1%.
- Compaction: Minimum of 90 percent ASTM D698 standard proctor.
- Stabilization: Depends on velocity and reach. Inspect regularly to ensure stability.
- Ground Slopes <5%: Seed and mulch applied within 5 days of dike construction (see [BMP C121: Mulching](#)).
- Ground Slopes 5 - 40%: Dependent on runoff velocities and dike materials. Stabilization should be done immediately using either sod or riprap, or other measures to avoid erosion.
- The upslope side of the dike shall provide positive drainage to the dike outlet. No erosion shall

occur at the outlet. Provide energy dissipation measures as necessary. Sediment-laden runoff must be released through a sediment trapping facility.

- Minimize construction traffic over temporary dikes. Use temporary cross culverts for channel crossing.
- See [Table II-3.8: Horizontal Spacing of Interceptor Dikes Along Ground Slope](#) for recommended horizontal spacing between dikes.

**Table II-3.8: Horizontal Spacing of Interceptor Dikes Along Ground Slope**

| Average Slope  | Slope Percent | Flowpath Length |
|----------------|---------------|-----------------|
| 20H:1V or less | 3-5%          | 300 feet        |
| (10 to 20)H:1V | 5-10%         | 200 feet        |
| (4 to 10)H:1V  | 10-25%        | 100 feet        |
| (2 to 4)H:1V   | 25-50%        | 50 feet         |

### **Interceptor Swales**

Interceptor swales shall meet the following criteria:

- Bottom Width: 2 feet minimum; the cross-section bottom shall be level.
- Depth: 1-foot minimum.
- Side Slope: 2H:1V or flatter.
- Grade: Maximum 5 percent, with positive drainage to a suitable outlet (such as [BMP C241: Sediment Pond \(Temporary\)](#)).
- Stabilization: Seed as per [BMP C120: Temporary and Permanent Seeding](#), or [BMP C202: Riprap Channel Lining](#), 12 inches thick riprap pressed into the bank and extending at least 8 inches vertical from the bottom.

### ***Maintenance Standards***

- Inspect diversion dikes and interceptor swales once a week and after every rainfall. Immediately remove sediment from the flow area.
- Damage caused by construction traffic or other activity must be repaired before the end of each working day.
- Check outlets and make timely repairs as needed to avoid gully formation. When the area below the temporary diversion dike is permanently stabilized, remove the dike and fill and stabilize the channel to blend with the natural surface.

# BMP C201: Grass-Lined Channels

## *Purpose*

To provide a channel with a vegetative lining for conveyance of runoff. The purpose of the vegetative lining is to prevent transport of sediment and erosion.

## *Conditions of Use*

This practice applies to construction sites where concentrated runoff needs to be directed to prevent erosion or flooding.

- Use this BMP when a vegetative lining can provide sufficient stability for the channel cross section and at lower velocities of water (normally dependent on grade). This means that the channel slopes are generally less than 5 percent and space is available for a relatively large cross section.
- Typical uses include roadside ditches, channels at property boundaries, outlets for diversions, and other channels and drainage ditches in low areas.
- Channels that will be vegetated should be installed before major earthwork and hydroseeded with a bonded fiber matrix (BFM). The vegetation should be well established (i.e., 75 percent cover) before water is allowed to flow in the ditch unless [BMP C122: Nets and Blankets](#) is used to protect the channel. With channels that will have high flows, erosion control blankets should be installed over the hydroseed. If vegetation cannot be established from seed before water is allowed in the ditch, sod should be installed in the bottom of the ditch in lieu of hydro-mulch and blankets.

## *Design and Installation Specifications*

See [Figure II-3.10: Typical Grass-Lined Channels](#)

Locate channels where they can conform to the topography and other features such as roads. Use natural drainage systems to the greatest extent possible

- Avoid sharp changes in alignment or bends and changes in grade.
  - Do not reshape the landscape to fit the drainage channel.
  - The maximum design velocity shall be based on soil conditions, type of vegetation, and method of revegetation, but at no time shall velocity exceed 5 feet/second. The channel shall not be overtopped by the peak volumetric flow rate calculated by one of the following methods:
    - Single Event Hydrograph Method: The peak volumetric flow rate calculated using a 10-minute time step from a Type 1A, 10-year, 24-hour frequency storm for the worst-case land cover condition.
- OR
- Continuous Simulation Method: The 10-year peak flow rate, as determined by an

approved continuous runoff model with a 15-minute time step for the worst-case land cover condition..

Worst-case land cover conditions (i.e., producing the most runoff) should be used for analysis (in most cases, this would be the land cover conditions just prior to final landscaping).

- Where the grass-lined channel will also function as a permanent stormwater conveyance facility, consult the drainage conveyance requirements of the local jurisdiction.
- An established grass or vegetated lining is required before the channel can be used to convey stormwater, unless stabilized with nets or blankets (See [BMP C122: Nets and Blankets](#)).
- If design velocity of a channel to be vegetated by seeding exceeds 2 ft/sec, a temporary channel liner is required. Geotextile or special mulch protection such as fiberglass roving or straw and netting provides stability until the vegetation is fully established. See [Figure II-3.11: Temporary Channel Liners](#).
- Check dams shall be removed when the grass has matured sufficiently to protect the ditch or swale unless the slope of the swale is greater than 4 percent. The area beneath the check dams shall be seeded and mulched immediately after dam removal.
- If vegetation is established by sodding, the permissible velocity for established vegetation may be used and no temporary liner is needed.
- Do not subject the grass-lined channel to sedimentation from disturbed areas. Use sediment-trapping BMPs upstream of the channel.
- V-shaped grass channels generally apply where the quantity of water is small, such as in short reaches along roadsides. The V-shaped cross section is least desirable because it is difficult to stabilize the bottom where velocities may be high.
- Trapezoidal grass channels are used where runoff volumes are large and slope is low so that velocities are nonerosive to vegetated linings. (Note: it is difficult to construct small parabolic shaped channels.)
- Subsurface drainage or riprap channel bottoms may be necessary on sites that are subject to prolonged wet conditions due to long duration flows or a high water table.
- Provide outlet protection at culvert ends and at channel intersections.
- Grass channels, at a minimum, should carry peak runoff for temporary construction drainage facilities from the 10-year, 24-hour storm without eroding. Where flood hazard exists, increase the capacity according to the potential damage.
- Grassed channel side slopes generally are constructed 3H:1V or flatter to aid in the establishment of vegetation and for maintenance.
- Construct channels a minimum of 0.2 foot larger around the periphery to allow for soil bulking during seedbed preparations and sod buildup.

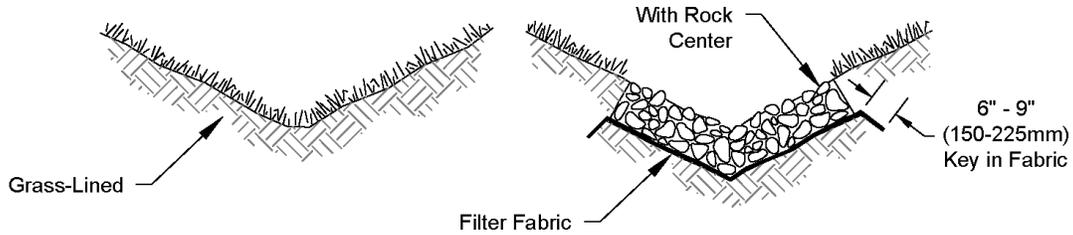
## **Maintenance Standards**

During the establishment period, check grass-lined channels after every rainfall.

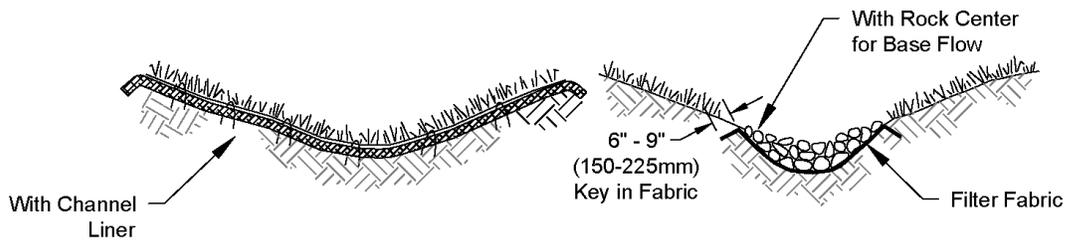
- After grass is established, periodically check the channel; check it after every heavy rainfall event. Immediately make repairs.
- Check the channel outlet and all road crossings for bank stability and evidence of piping or scour holes.
- Remove all significant sediment accumulations to maintain the designed carrying capacity. Keep the grass in a healthy, vigorous condition at all times, since it is the primary erosion protection for the channel.

**Figure II-3.10: Typical Grass-Lined Channels**

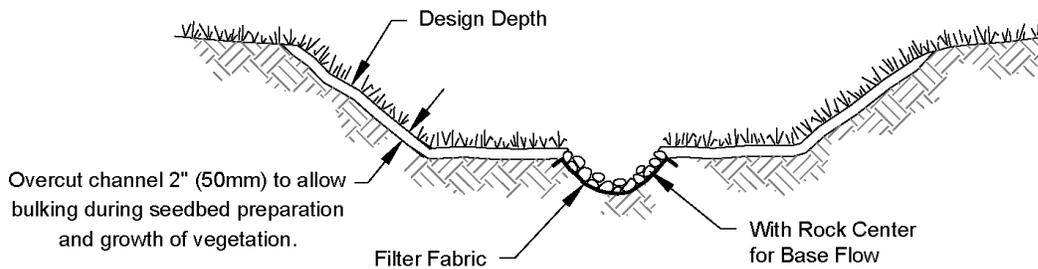
Typical V-Shaped Channel Cross-Section



Typical Parabolic Channel Cross-Section



Typical Trapezoidal Channel Cross-Section



NOT TO SCALE

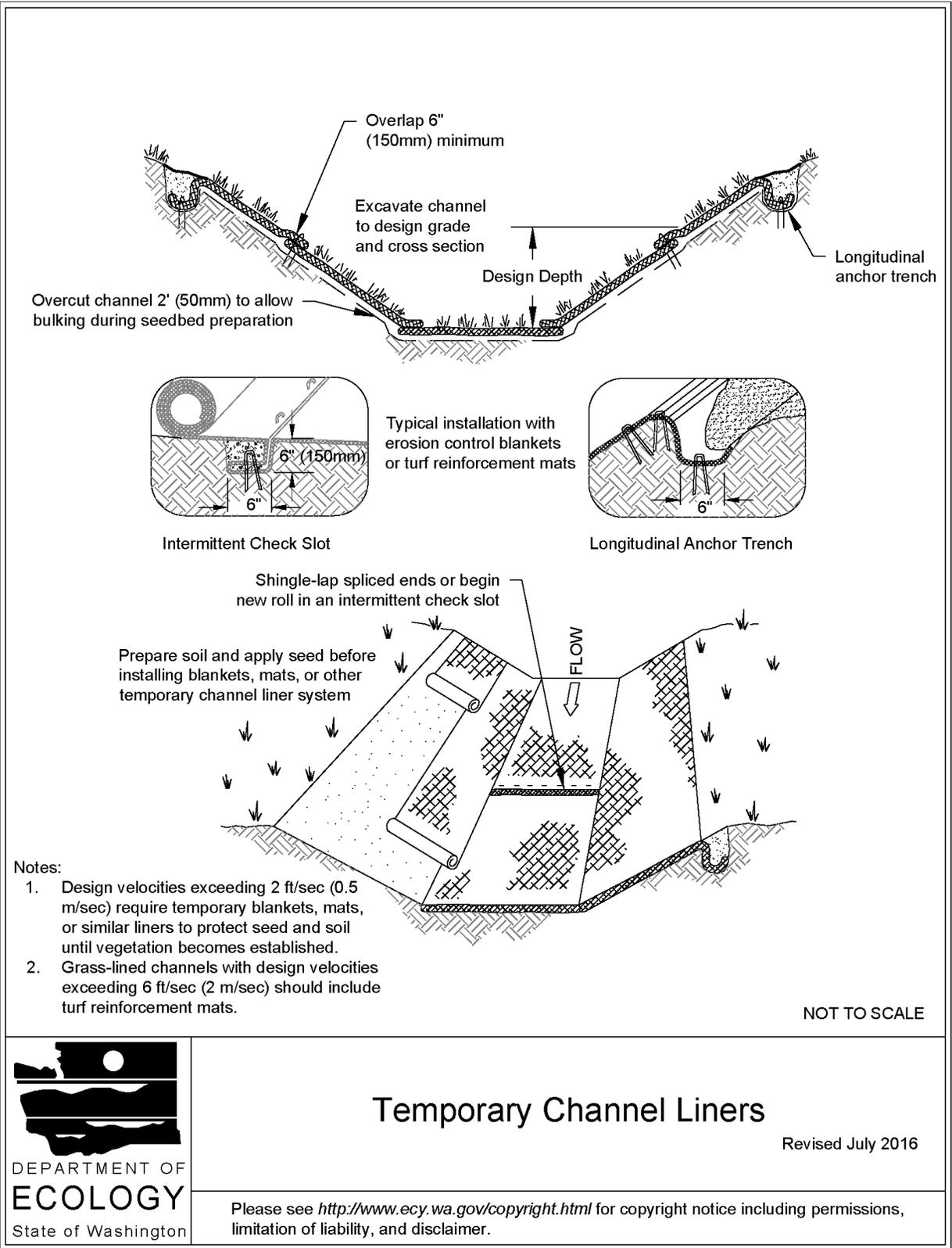


**Typical Grass-Lined Channels**

Revised June 2016

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**Figure II-3.11: Temporary Channel Liners**



## Temporary Channel Liners

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## **BMP C202: Riprap Channel Lining**

### ***Purpose***

To protect channels by providing a channel liner using riprap.

### ***Conditions of Use***

Use this BMP when natural soils or vegetated stabilized soils in a channel are not adequate to prevent channel erosion.

Use this BMP when a permanent ditch or pipe system is to be installed and a temporary measure is needed.

An alternative to riprap channel lining is [BMP C122: Nets and Blankets](#).

The Federal Highway Administration recommends not using geotextile liners whenever the slope exceeds 10 percent or the shear stress exceeds 8 lbs/ft<sup>2</sup>.

### ***Design and Installation Specifications***

- Since riprap is typically used where erosion potential is high, construction must be sequenced so that the riprap is put in place with the minimum possible delay.
- Disturb areas awaiting riprap only when final preparation and placement of the riprap can follow immediately behind the initial disturbance. Where riprap is used for outlet protection, the riprap should be placed before or in conjunction with the construction of the pipe or channel so that it is in place when the pipe or channel begins to operate.
- The designer, after determining the riprap size that will be stable under the flow conditions, shall consider that size to be a minimum size and then, based on riprap gradations actually available in the area, select the size or sizes that equal or exceed the minimum size. The possibility of drainage structure damage by others shall be considered in selecting a riprap size, especially if there is nearby water or a gully in which to toss the stones.
- Stone for riprap shall consist of field stone or quarry stone of approximately rectangular shape. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering and it shall be suitable in all respects for the purpose intended. See Section 9-13 of WSDOT's *Standard Specifications for Road, Bridge, and Municipal Construction* ([WSDOT, 2016](#)).
- A lining of engineering filter fabric (geotextile) shall be placed between the riprap and the underlying soil surface to prevent soil movement into or through the riprap. The geotextile should be keyed in at the top of the bank.
- Filter fabric shall not be used on slopes greater than 1.5H:1V as slippage may occur. It should be used in conjunction with a layer of coarse aggregate (granular filter blanket) when the riprap to be placed is 12 inches and larger.

## Maintenance Standards

Replace riprap as needed.

## BMP C203: Water Bars

### Purpose

A water bar is a small ditch or ridge of material that is constructed diagonally across a road or right-of-way to divert stormwater runoff from the road surface, wheel tracks, or a shallow road ditch. See [Figure II-3.12: Water Bar](#).

### Conditions of Use

Clearing right-of-way and construction of access for power lines, pipelines, and other similar installations often require long narrow right-of-ways over sloping terrain. Disturbance and compaction promotes gully formation in these cleared strips by increasing the volume and velocity of runoff. Gully formation may be especially severe in tire tracks and ruts. To prevent gullying, runoff can often be diverted across the width of the right-of-way to undisturbed areas by using small predesigned diversions.

Give special consideration to each individual outlet area, as well as to the cumulative effect of added diversions. Use gravel to stabilize the diversion where significant vehicular traffic is anticipated.

### Design and Installation Specifications

- Height: 8-inch minimum, measured from the channel bottom to the ridge top.
- Side slope of channel: 2H:1V maximum; 3H:1V or flatter when vehicles will cross.
- Top width of ridge: 6-inch minimum.
- Locate water bars to use natural drainage systems and to discharge into well vegetated stable areas.
- See [Table II-3.9: Water Bar Spacing Guidelines](#):

**Table II-3.9: Water Bar Spacing Guidelines**

| Slope Along Road (%) | Spacing (ft)         |
|----------------------|----------------------|
| < 5                  | 125                  |
| 5 - 10               | 100                  |
| 10 - 20              | 75                   |
| 20 - 35              | 50                   |
| > 35                 | Use rock lined ditch |

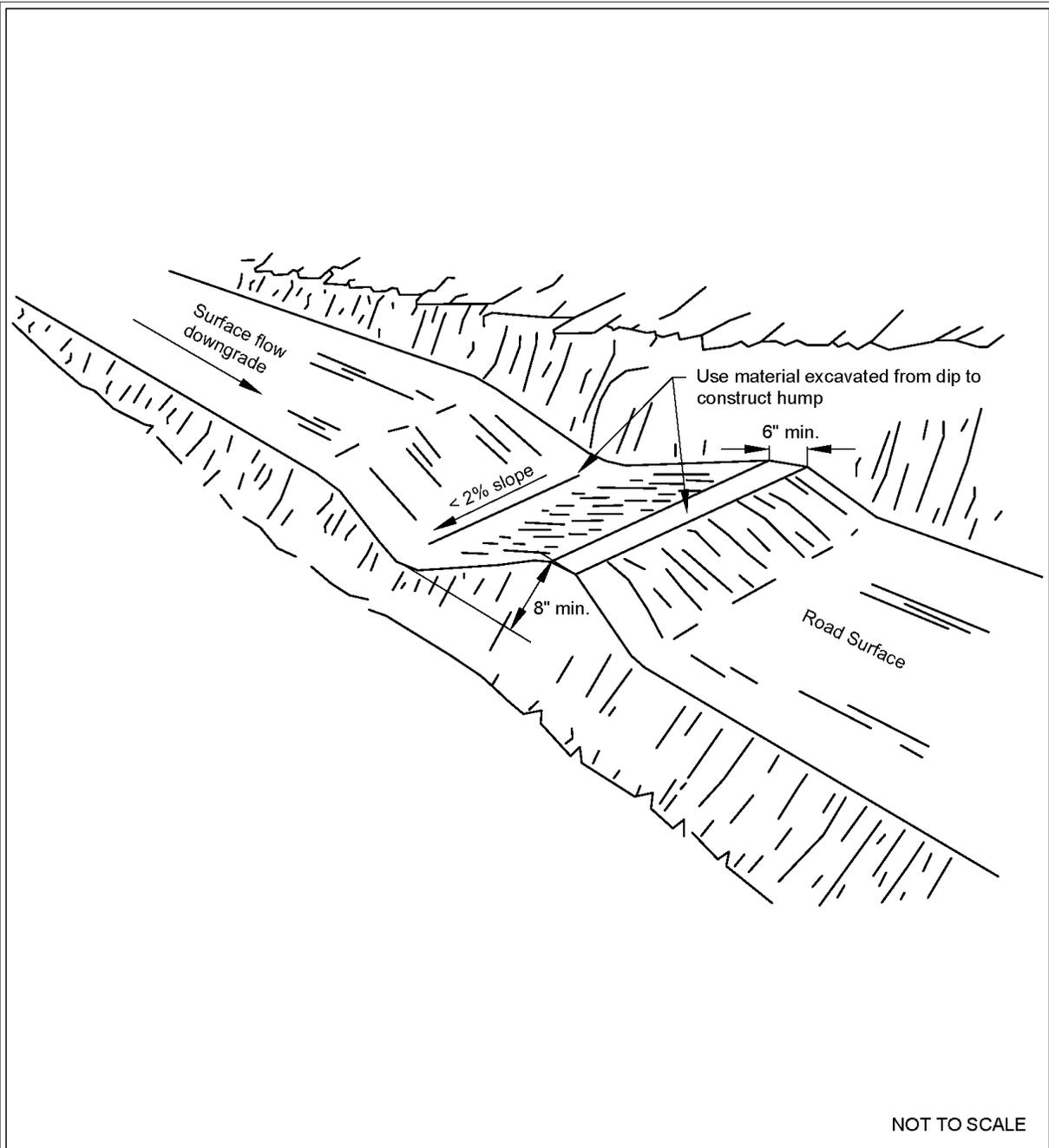
- Grade of water bar and angle: Select an angle that results in a ditch slope less than 2 percent.
- Install the water bar as soon as the clearing and grading is complete. When utilities are being installed, reconstruct the water bar as construction is complete in each section.
- Compact the water bar ridge.
- Stabilize, seed, and mulch the portions that are not subject to traffic. Gravel the areas crossed by vehicles.
- Note that [BMP C208: Triangular Silt Dike \(TSD\)](#) can be used to create the ridge for the water bar.

## ***Maintenance Standards***

Periodically inspect water bars after every heavy rainfall for wear and erosion damage.

- Immediately remove sediment from the flow area and repair the dike.
- Check outlet areas and make timely repairs as needed.
- When permanent road drainage is established and the area above the temporary water bar is permanently stabilized, remove the dikes and fill the channel to blend with the natural ground, and appropriately stabilize the disturbed area.

**Figure II-3.12: Water Bar**



## Water Bar

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## **BMP C204: Pipe Slope Drains**

### ***Purpose***

The purpose of pipe slope drains is to prevent gullies, channel erosion, and saturation of slide-prone soils by using a pipe to convey stormwater away from or over bare soil.

### ***Conditions of Use***

Pipe slope drains should be used when a temporary or permanent stormwater conveyance is needed to move water down a steep slope to avoid erosion.

Pipe slope drains should be used at bridge ends to collect runoff and convey it to the base of the fill slopes along the bridge approaches. Another use on road projects is to collect runoff from pavement in a pipe slope drain and convey it away from side slopes.

Temporary installations of pipe slope drains can be useful because there is generally a time lag between having the first lift of asphalt installed and the curbs, gutters, and permanent drainage installed. Used in conjunction with sand bags, or other temporary diversion devices, these will prevent massive amounts of sediment from leaving a project.

Pipe slope drains can serve the following purposes:

- Connection to new catch basins and temporarily use until permanent piping is installed.
- Drainage of water collected from aquifers exposed on cut slopes and conveyance of water to the base of the slope.
- Collection of clean runoff from plastic sheeting and routing the runoff away from exposed soil.
- Installation in conjunction with silt fence to drain collected water to a controlled area.
- Diversion of small seasonal streams away from construction. They have been used successfully on culvert replacement and extension jobs. Large flex pipe can be used on larger streams during culvert removal, repair, or replacement.
- Connection to existing downspouts and roof drains and diversion of water away from work areas during building renovation, demolition, and construction projects.

There are several commercially available collectors that attach to the pipe inlet and help prevent erosion at the inlet.

### ***Design and Installation Specifications***

See [Figure II-3.13: Pipe Slope Drain](#).

Size the pipe to convey the projected flow. The capacity for temporary drains shall be sufficient to handle flows calculated by one of the following methods:

- Single Event Hydrograph Method: The peak volumetric flow rate calculated using a 10-minute time step from a Type 1A, 10-year, 24-hour frequency storm for the worst-case land cover

condition.

OR

- Continuous Simulation Method: The 10-year peak flow rate, as determined by an approved continuous runoff model with a 15-minute time step for the worst-case land cover condition.

Worst-case land cover conditions (i.e., producing the most runoff) should be used for analysis (in most cases, this would be the land cover conditions just prior to final landscaping).

Consult local drainage requirements for sizing permanent pipe slope drains.

- Use care in clearing vegetated slopes for installation.
- Re-establish cover immediately on areas disturbed by installation.
- Use temporary drains on new cut or fill slopes.
- Use [BMP C200: Interceptor Dike and Swale](#) to collect water at the top of the slope.
- Ensure that the entrance area is stable and large enough to direct flow into the pipe.
- Piping of water through the berm at the entrance area is a common failure mode.
- The entrance shall consist of a standard flared end section for culverts 12 inches and larger with a minimum 6-inch metal toe plate to prevent runoff from undercutting the pipe inlet. The slope of the entrance shall be at least 3 percent. Sand bags may also be used at pipe entrances as a temporary measure.
- The soil around and under the pipe and entrance section shall be thoroughly compacted to prevent undercutting.
- The flared inlet section shall be securely connected to the slope drain and have watertight connecting bands.
- Slope drain sections shall be securely fastened together, fused or have gasketed watertight fittings, and shall be securely anchored into the soil.
- Thrust blocks should be installed anytime 90 degree bends are utilized. Depending on size of pipe and flow, these can be constructed with sand bags, straw bales staked in place, “t” posts and wire, or ecology blocks.
- Pipe needs to be secured along its full length to prevent movement. This can be done with steel “t” posts and wire. Install a post on each side of the pipe and wire the pipe to them. This should be done every 10-20 feet of pipe length or so, depending on the size of the pipe and quantity of water to divert.
- [BMP C200: Interceptor Dike and Swale](#) shall be used to direct runoff into a pipe slope drain. The height of the dike shall be at least 1 foot higher at all points than the top of the inlet pipe.
- The area below the outlet must be stabilized. See [BMP C209: Outlet Protection](#).
- If the pipe slope drain is conveying sediment-laden water, direct all flows into a sediment trap-

ping facility.

- Materials specifications for any permanent piped system shall be set by the local government.

## ***Maintenance Standards***

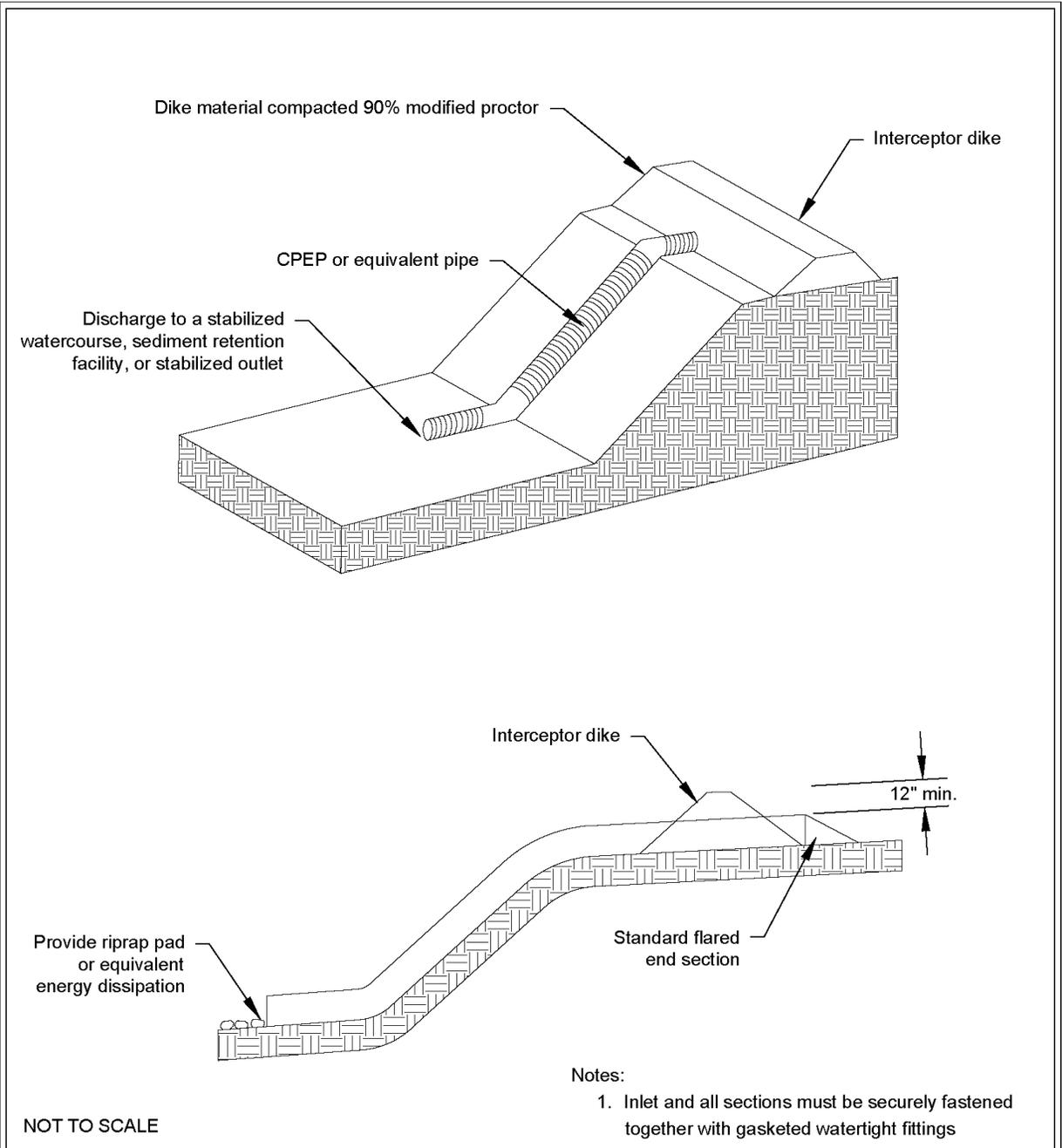
Check inlet and outlet points regularly, especially after storms.

- The inlet should be free of undercutting, and no water should be going around the point of entry. If there are problems, the headwall should be reinforced with compacted earth or sand bags.
- The outlet point should be free of erosion and installed with appropriate outlet protection.

For permanent installations, inspect the pipe periodically for vandalism and physical distress such as slides and wind-throw. Clean the pipe and outlet structure at the completion of construction.

Normally the pipe slope is so steep that clogging is not a problem with smooth wall pipe, however, debris may become lodged in the pipe.

**Figure II-3.13: Pipe Slope Drain**



**Pipe Slope Drain**

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## **BMP C205: Subsurface Drains**

### ***Purpose***

The purpose of subsurface drains is to intercept, collect, and convey ground water to a satisfactory outlet, using a perforated pipe or other conduit below the ground surface. Subsurface drains are also known as “french drains.” The perforated pipe provides a dewatering mechanism to drain excessively wet soils, provide a stable base for construction, improve stability of structures with shallow foundations, or to reduce hydrostatic pressure to improve slope stability.

### ***Conditions of Use***

Use subsurface drains when excessive water must be removed from the soil. The soil permeability, depth to water table, and impervious layers are all factors which may govern the use of subsurface drains.

### ***Design and Installation Specifications***

#### **Subsurface Drain Type: Relief Drains**

Relief drains are used to lower the water table in large, relatively flat areas, improve the growth of vegetation, or to remove surface water.

Relief drains are installed along a slope and drain in the direction of the slope.

Relief drains can be installed in a grid pattern, a herringbone pattern, or a random pattern.

#### **Subsurface Drain Type: Interceptor Drains**

Interceptor drains are used to remove excess ground water from a slope, stabilize steep slopes, and lower the water table immediately below a slope to prevent the soil from becoming saturated.

Interceptor drains are installed perpendicular to a slope and drain to the side of the slope.

Interceptor drains usually consist of a single pipe or series of single pipes instead of a patterned layout.

#### **Subsurface Drain Depth and Spacing**

- The depth of a subsurface drain is determined primarily by the depth to which the water table is to be lowered or the depth to a confining layer. For practical reasons, the maximum depth is usually limited to 6 feet, with a minimum cover of 2 feet to protect the conduit.
- The soil should have depth and sufficient permeability to permit installation of an effective drainage system at a depth of 2 to 6 feet.

## **Subsurface Drain Sizing and Placement**

- The quantity and quality of discharge needs to be accounted for in the receiving stream (additional detention may be required).
- The size of a subsurface drain is determined by first calculating the maximum rate of ground water flow to be intercepted, and then choosing a subsurface drain pipe (or pipes) with enough capacity to convey that flow. Therefore, it is good practice to make complete subsurface investigations, including hydraulic conductivity of the soil, before designing a subsurface drainage system.
- Size subsurface drains to carry the required capacity without pressure flow. Minimum diameter for a subsurface drain is 4 inches.
- The minimum velocity in the pipe required to prevent silting is 1.4 ft/sec. Grade the subsurface drain to achieve this velocity at a minimum. The maximum allowable velocity using a sand-gravel filter or envelope is 9 ft/sec.
- Filter material and fabric shall be used around all drains for proper bedding and filtration of fine materials. Envelopes and filters should surround the drain to a minimum of 3-inch thickness.
- The trench shall be constructed on a continuous grade with no reverse grades or low spots.
- Soft or yielding soils under the subsurface drain shall be stabilized with gravel or other suitable material.
- Backfilling shall be done immediately after placement of the pipe. No sections of pipe shall remain uncovered overnight or during a rainstorm. Backfill material shall be placed in the trench in such a manner that the drain pipe is not displaced or damaged.
- Do not install permanent drains near trees to avoid the tree roots that tend to clog the line. Use solid pipe with watertight connections where it is necessary to pass a subsurface drainage system through a stand of trees.

## **Subsurface Drain Outlets**

- An adequate outlet for the subsurface drain must be available either by gravity or by pumping.
- The outlet of the subsurface drain shall empty into a sediment trapping BMP through a catch basin. If free of sediment, it can then empty into a receiving channel, swale, or stable vegetated area adequately protected from erosion and undermining.
- Ensure that the outlet of a subsurface drain empties into a channel or other watercourse above the normal water level.
- Secure an animal guard to the outlet end of the pipe to keep out rodents.
- Use outlet pipe of corrugated metal, cast iron, or heavy-duty plastic without perforations and at least 10 feet long. Do not use an envelope or filter material around the outlet pipe, and bury at least two-thirds of the pipe length.

- When outlet velocities exceed those allowable for the receiving stream, outlet protection must be provided.

## ***Maintenance Standards***

Subsurface drains shall be checked periodically to ensure that they are free-flowing and not clogged with sediment or roots.

- The outlet shall be kept clean and free of debris.
- Surface inlets shall be kept open and free of sediment and other debris.
- Trees located too close to a subsurface drain often clog the system with their roots. If a drain becomes clogged, relocate the drain or remove the trees as a last resort. Drain placement should be planned to minimize this problem.
- Where drains are crossed by heavy vehicles, the line shall be checked to ensure that it is not crushed.

## **BMP C206: Level Spreader**

### ***Purpose***

The purpose of a level spreader as a Construction Stormwater BMP is to provide a temporary outlet for dikes and diversions and convert concentrated runoff to sheet flow prior to releasing it to stabilized areas.

### ***Conditions of Use***

Use level spreaders when a concentrated flow of water needs to be dispersed over a large area with existing stable vegetation.

Use only where the slopes are gentle, the water volume is relatively low, and the soil will adsorb most of the low flow events.

Items to consider are:

- What is the risk of erosion or damage if the flow becomes concentrated?
- Is an easement required if discharged to adjoining property?

### ***Design and Installation Specifications***

- Use above undisturbed areas that are stabilized by existing vegetation.
- Discharge area below the outlet must be uniform with a slope flatter than 5H:1V.
- Do not allow any low points in the level spreader. If the level spreader has any low points, flow will concentrate, create channels and may cause erosion.
- Ensure the outlet is level in a stable, undisturbed soil profile (not on fill).

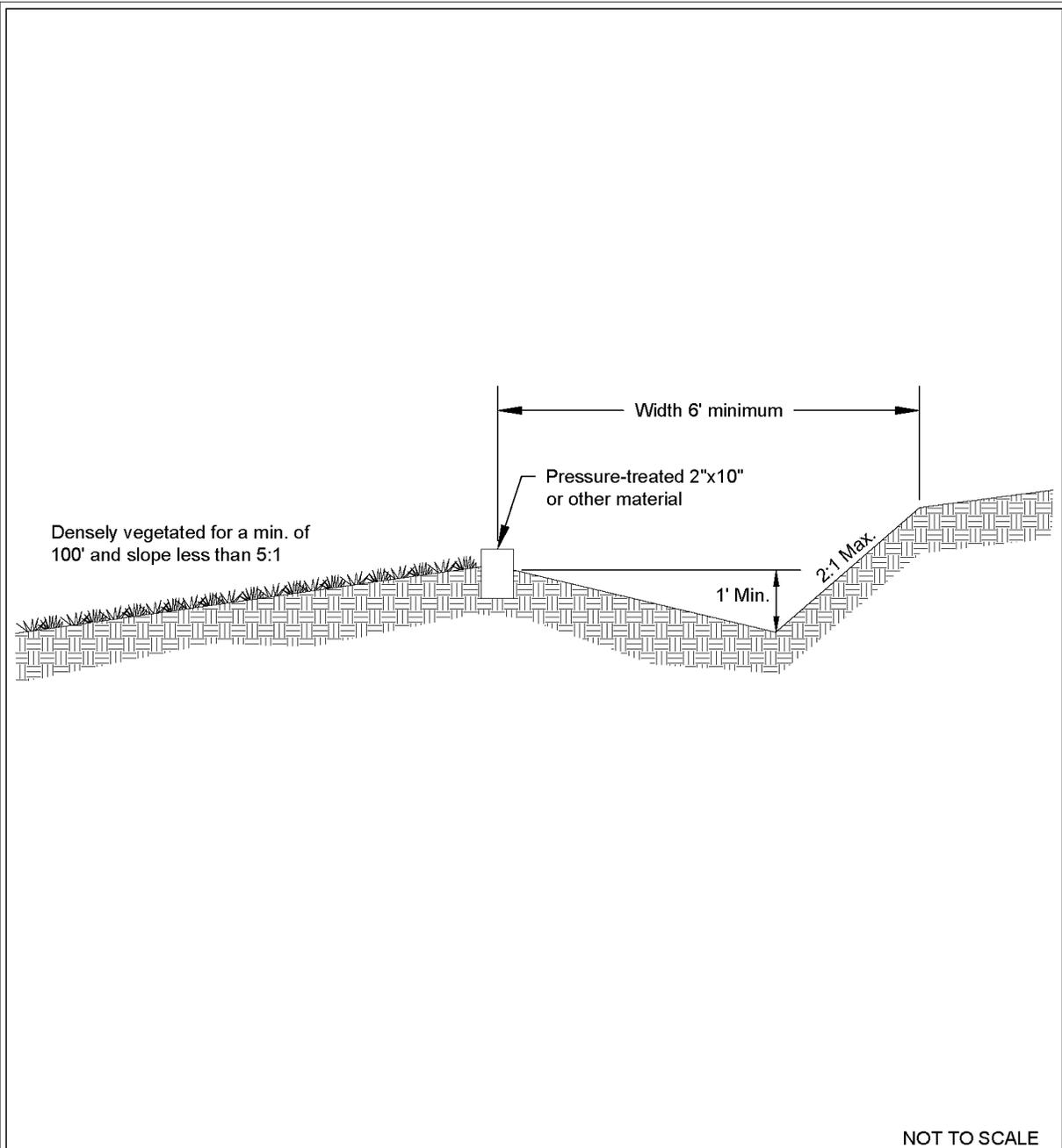
- The runoff shall not re-concentrate on site after release from the level spreader unless it is intercepted by another downstream measure.
- The grade of the channel for the last 20 feet of the dike or interceptor entering the level spreader shall be less than or equal to 1 percent. The grade of the level spreader shall be 0 percent to ensure uniform spreading of runoff.
- A 6-inch high gravel berm placed across the level lip shall consist of washed crushed rock, 2- to 4-inch or 3/4-inch to 1½-inch size.
- The spreader length shall be determined by calculating the peak volumetric flow rate using a 10-minute time step from a Type 1A, 10-year, 24-hour design storm. The length of the spreader shall be a minimum of 15 feet for 0.1 cfs and shall increase by 10 feet for each 0.1 cfs thereafter to a maximum of 0.5 cfs per spreader. Use multiple spreaders for higher flows.
- The width of the approach to the spreader should be at least 6 feet.
- The depth of the spreader as measured from the lip should be at least 6 inches and it should be uniform across the entire length.
- Level spreaders shall be set back from the property line unless there is an easement for flow.
- Materials that can be used for level spreaders include sand bags, lumber, logs, concrete, pipe, and capped perforated pipe. To function properly, the material needs to be installed level and on contour.
- See [Figure II-3.14: Cross Section of Level Spreader](#) and [Figure II-3.15: Detail of Level Spreader](#).

### ***Maintenance Standards***

The level spreader should be inspected during and after runoff events to ensure that it is functioning correctly.

- The contractor should avoid the placement of any material on the level spreader, and should prevent construction traffic from crossing over the level spreader.
- If the level spreader is damaged by construction traffic, it shall be immediately repaired.

**Figure II-3.14: Cross Section of Level Spreader**

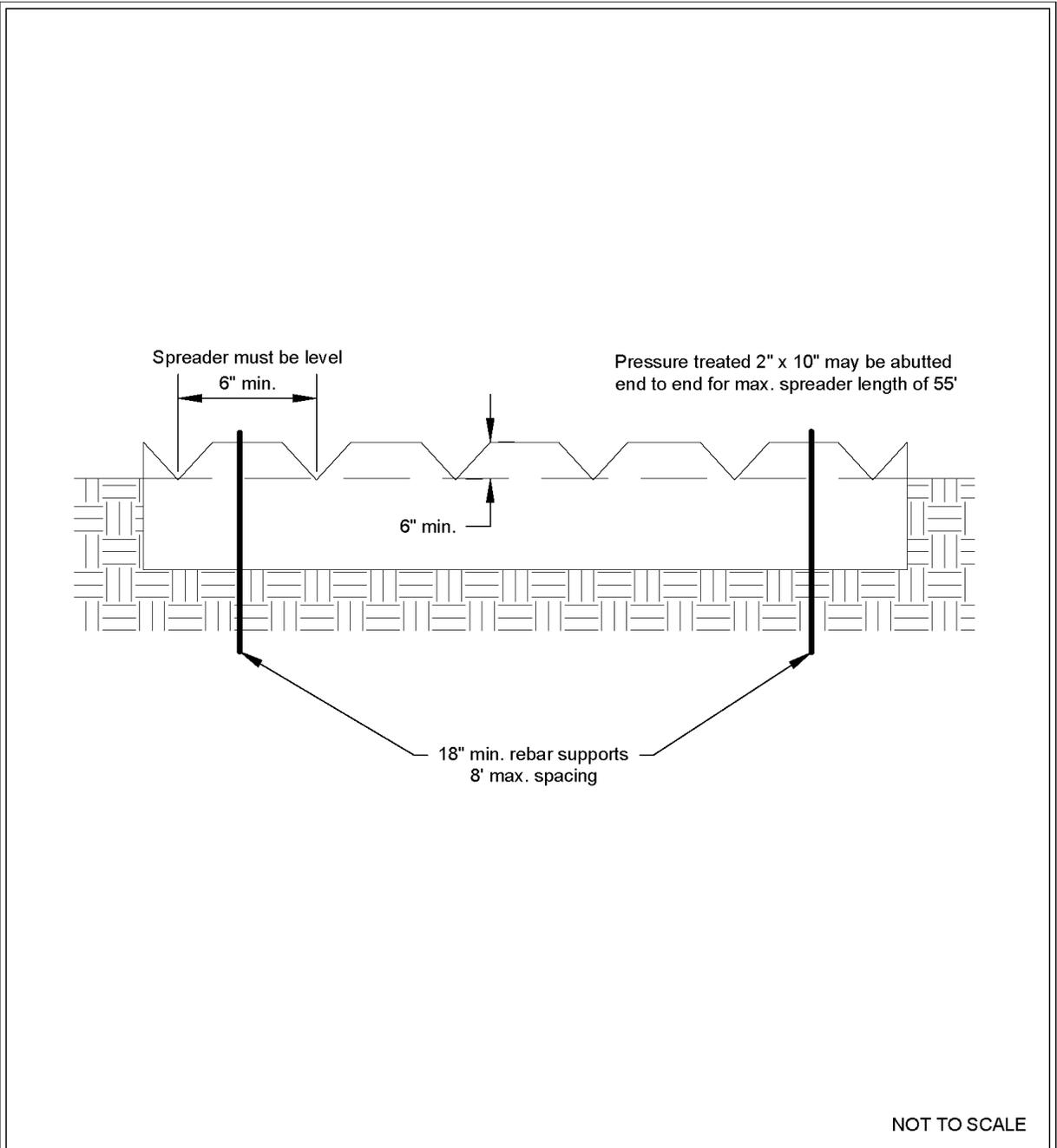


### Cross Section of Level Spreader

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**Figure II-3.15: Detail of Level Spreader**



## Detail of Level Spreader

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## **BMP C207: Check Dams**

### ***Purpose***

Construction of check dams across a swale or ditch reduces the velocity of concentrated flow and dissipates energy at the check dam.

### ***Conditions of Use***

Use check dams where temporary or permanent channels are not yet vegetated, channel lining is infeasible, and/or velocity checks are required.

- Check dams may not be placed in streams unless approved by the State Department of Fish and Wildlife.
- Check dams may not be placed in wetlands without approval from a permitting agency.
- Do not place check dams below the expected backwater from any salmonid bearing water between October 1 and May 31 to ensure that there is no loss of high flow refuge habitat for overwintering juvenile salmonids and emergent salmonid fry.

### ***Design and Installation Specifications***

- Construct rock check dams from appropriately sized rock. The rock used must be large enough to stay in place given the expected design flow through the channel. The rock must be placed by hand or by mechanical means (do not dump the rock to form the dam) to achieve complete coverage of the ditch or swale and to ensure that the center of the dam is lower than the edges.
- Check dams may also be constructed of either rock or pea-gravel filled bags. Numerous new products are also available for this purpose. They tend to be re-usable, quick and easy to install, effective, and cost efficient.
- Place check dams perpendicular to the flow of water.
- The check dam should form a triangle when viewed from the side. This prevents undercutting as water flows over the face of the check dam rather than falling directly onto the ditch bottom.
- Before installing check dams, impound and bypass upstream water flow away from the work area. Options for bypassing include pumps, siphons, or temporary channels.
- Check dams combined with sumps work more effectively at slowing flow and retaining sediment than a check dam alone. A deep sump should be provided immediately upstream of the check dam.
- In some cases, if carefully located and designed, check dams can remain as permanent installations with very minor regrading. They may be left as either spillways, in which case accumulated sediment would be graded and seeded, or as check dams to prevent further sediment from leaving the site.
- The maximum spacing between check dams shall be such that the downstream toe of the

upstream dam is at the same elevation as the top of the downstream dam.

- Keep the maximum height at 2 feet at the center of the check dam.
- Keep the center of the check dam at least 12 inches lower than the outer edges at natural ground elevation.
- Keep the side slopes of the check dam at 2H:1V or flatter.
- Key the stone into the ditch banks and extend it beyond the abutments a minimum of 18 inches to avoid washouts from overflow around the dam.
- Use filter fabric foundation under a rock or sand bag check dam. If a blanket ditch liner is used, filter fabric is not necessary. A piece of organic or synthetic blanket cut to fit will also work for this purpose.
- In the case of grass-lined ditches and swales, all check dams and accumulated sediment shall be removed when the grass has matured sufficiently to protect the ditch or swale - unless the slope of the swale is greater than 4 percent. The area beneath the check dams shall be seeded and mulched immediately after dam removal.
- Ensure that channel appurtenances, such as culvert entrances below check dams, are not subject to damage or blockage from displaced stones.
- See [Figure II-3.16: Rock Check Dam](#).

### ***Maintenance Standards***

Check dams shall be monitored for performance and sediment accumulation during and after each rainfall that produces runoff. Sediment shall be removed when it reaches one half the sump depth.

- Anticipate submergence and deposition above the check dam and erosion from high flows around the edges of the dam.
- If significant erosion occurs between dams, install a protective riprap liner in that portion of the channel. See [BMP C202: Riprap Channel Lining](#).

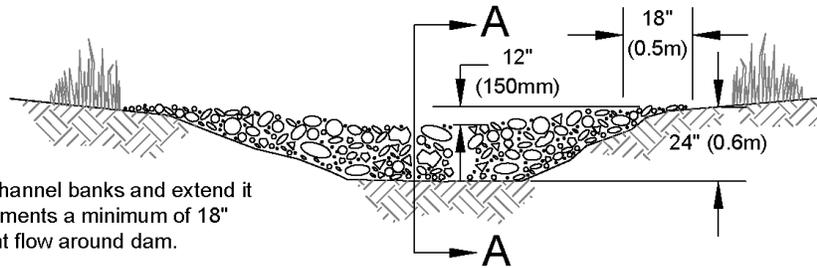
### ***Approved as Functionally Equivalent***

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>

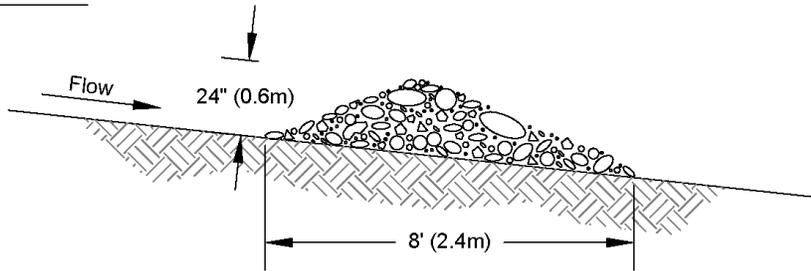
**Figure II-3.16: Rock Check Dam**

View Looking Upstream

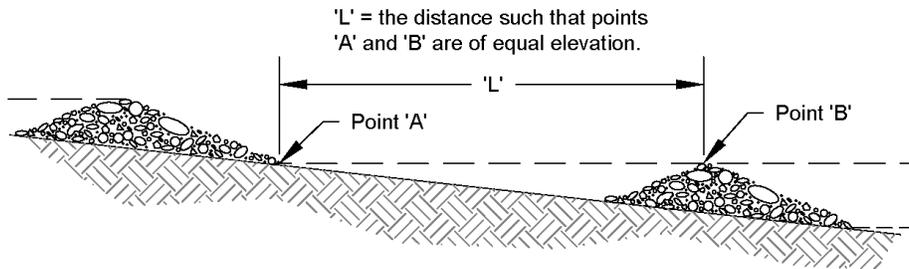


Note:  
Key stone into channel banks and extend it beyond the abutments a minimum of 18" (0.5m) to prevent flow around dam.

Section A-A



Spacing Between Check Dams



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**Rock Check Dam**

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## **BMP C208: Triangular Silt Dike (TSD)**

### ***Purpose***

Triangular silt dikes (TSDs) may be used as check dams, for perimeter protection, for temporary soil stockpile protection, for drop inlet protection, or as a temporary interceptor dike.

### ***Conditions of Use***

- TSDs may be used on soil or pavement with adhesive or staples.
- TSDs have been used to build temporary:
  - [BMP C241: Sediment Pond \(Temporary\)](#);
  - [BMP C200: Interceptor Dike and Swale](#);
  - [BMP C154: Concrete Washout Area](#);
  - [BMP C203: Water Bars](#);
  - [BMP C206: Level Spreader](#);
  - [BMP C220: Inlet Protection](#);
  - [BMP C207: Check Dams](#)
  - curbing; and
  - berms.

### ***Design and Installation Specifications***

- TSDs are made of urethane foam sewn into a woven geosynthetic fabric.
- TSDs are triangular, 10 inches to 14 inches high in the center, with a 20-inch to 28-inch base. A 2 foot apron extends beyond both sides of the triangle along its standard section of 7 feet. A sleeve at one end allows attachment of additional sections as needed.
- Install with ends curved up to prevent water from flowing around the ends.
- The fabric flaps and check dam units are attached to the ground with wire staples. Wire staples should be No. 11 gauge wire and should be 200 mm to 300 mm in length.
- When multiple units are installed, the sleeve of fabric at the end of the unit shall overlap the abutting unit and be stapled.
- When used as check dams:
  - TSDs should be located and installed as soon as construction will allow.
  - TSDs should be placed perpendicular to the flow of water.
  - The leading edge of the TSD must be secured with rocks, sandbags, or a small key slot

and staples.

- In the case of grass-lined ditches and swales, check dams and accumulated sediment shall be removed when the grass has matured sufficiently to protect the ditch or swale unless the slope of the swale is greater than 4 percent. The area beneath the check dams shall be seeded and mulched immediately after dam removal.

## ***Maintenance Standards***

- Inspect TSDs for performance and sediment accumulation during and after each rainfall that produces runoff. Remove sediment when it reaches one half the height of the TSD.
- Anticipate submergence and deposition above the TSD and erosion from high flows around the edges of the TSD. Immediately repair any damage or any undercutting of the TSD.

## **BMP C209: Outlet Protection**

### ***Purpose***

Outlet protection prevents scour at conveyance outlets and minimizes the potential for downstream erosion by reducing the velocity of concentrated stormwater flows.

### ***Conditions of Use***

Use outlet protection at the outlets of all ponds, pipes, ditches, or other conveyances that discharge to a natural or manmade drainage feature such as a stream, wetland, lake, or ditch.

### ***Design and Installation Specifications***

- The receiving channel at the outlet of a pipe shall be protected from erosion by lining a minimum of 6 feet downstream and extending up the channel sides a minimum of 1-foot above the maximum tailwater elevation, or 1-foot above the crown, whichever is higher. For pipes larger than 18 inches in diameter, the outlet protection lining of the channel shall be four times the diameter of the outlet pipe.
- Standard wingwalls, tapered outlets, and paved channels should also be considered when appropriate for permanent culvert outlet protection ([WSDOT, 2015](#)).
- [BMP C122: Nets and Blankets](#) or [BMP C202: Riprap Channel Lining](#) provide suitable options for lining materials.
- With low flows, [BMP C201: Grass-Lined Channels](#) can be an effective alternative for lining material.
- The following guidelines shall be used for outlet protection with riprap:
  - If the discharge velocity at the outlet is less than 5 fps, use 2-inch to 8-inch riprap. Minimum thickness is 1-foot.
  - For 5 to 10 fps discharge velocity at the outlet, use 24-inch to 48-inch riprap. Minimum

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  |
|--|-----------------------------------|--|--|
| <b>Drop Inlet Protection</b>           |                                   |  |  |
| 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.   |
| <b>Curb Inlet Protection</b>           |                                   |  |  |
| 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.  |
| <b>Culvert Inlet Protection</b>        |                                   |  |  |
| 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.

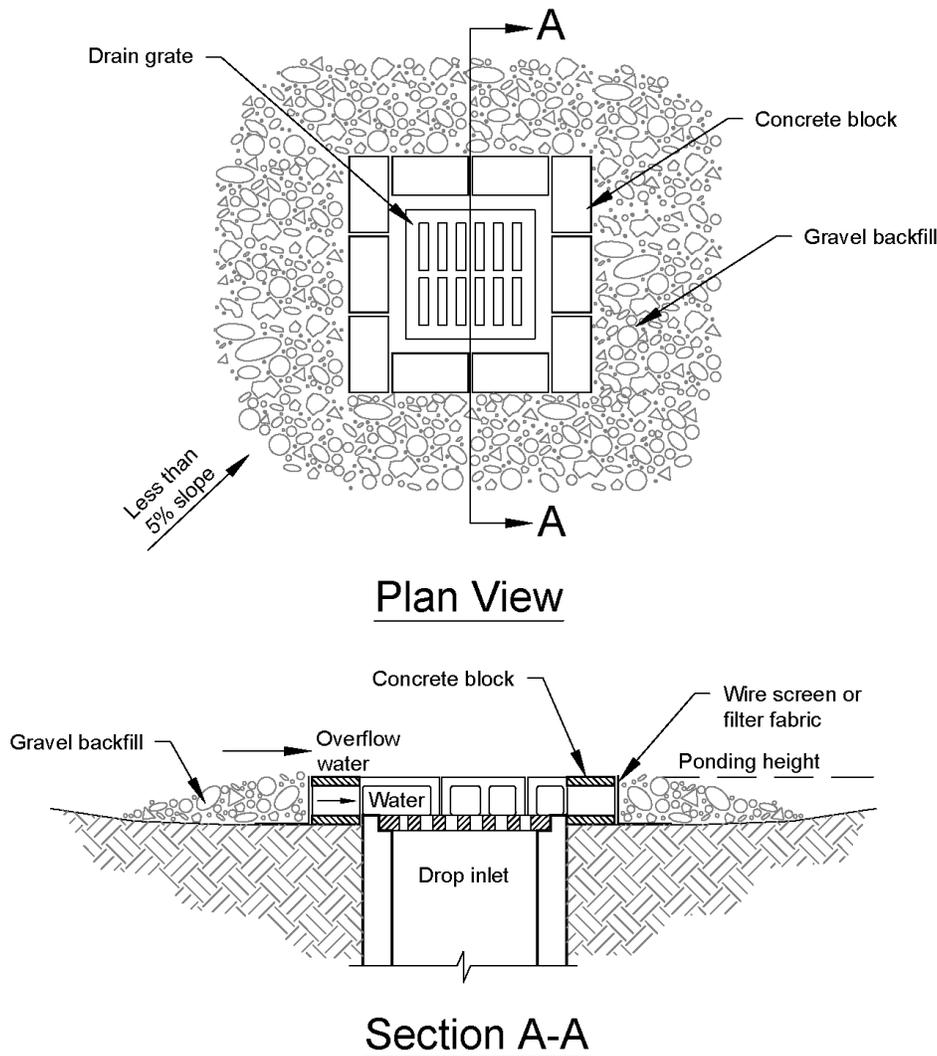
- Grade the approach to the inlet uniformly.
- Drill weep holes into the side of the inlet.
- Protect weep holes with screen wire and washed aggregate.
- Seal weep holes when removing structure and stabilizing area.
- Build a temporary dike, if necessary, to the down slope side of the structure to prevent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

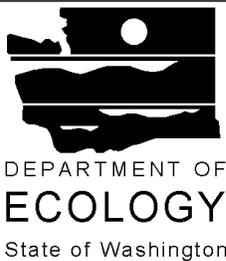
**Figure II-3.17: Block and Gravel Filter**



**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.

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**Block and Gravel Filter**

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### **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:

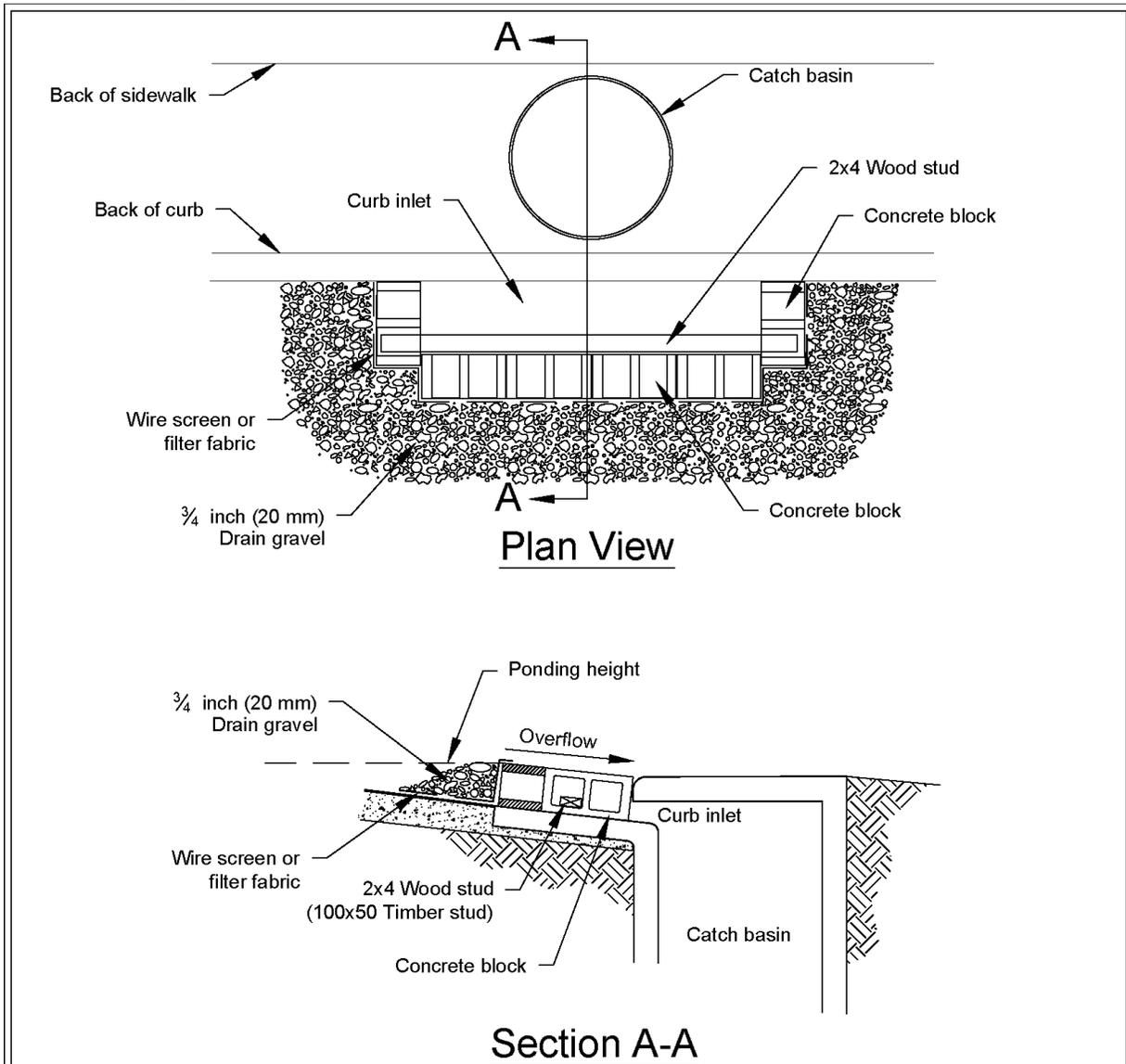
- Use wire mesh with ½-inch openings.
- Use extra strength filter cloth.
- Construct a frame.
- Attach the wire and filter fabric to the frame.
- Pile coarse washed aggregate against the wire and fabric.
- Place weight on the frame anchors.

### **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**



**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.

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**Block and Gravel Curb Inlet Protection**

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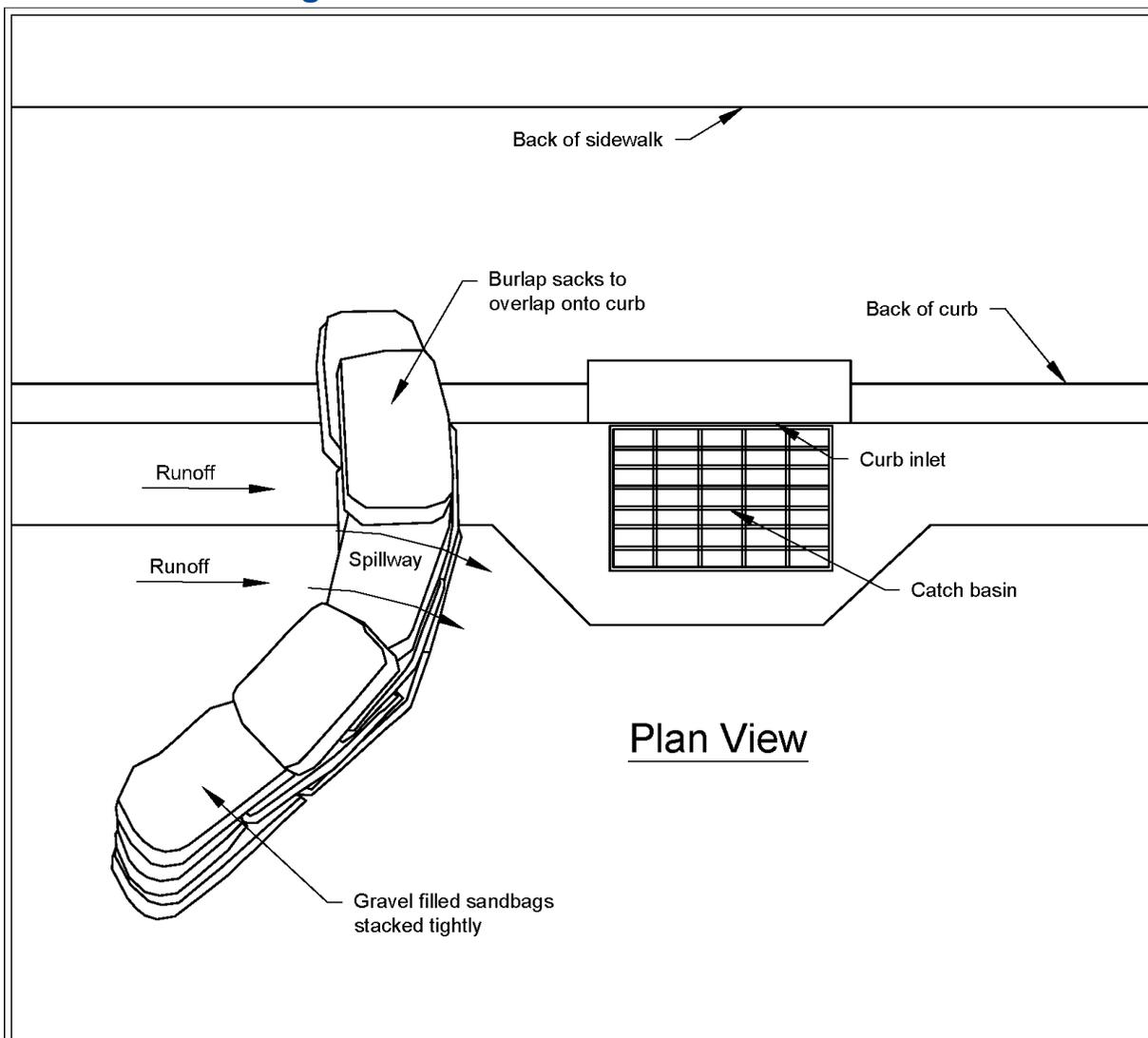
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### **Curb and Gutter Sediment Barrier**

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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**Curb and Gutter Barrier**

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## ***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***

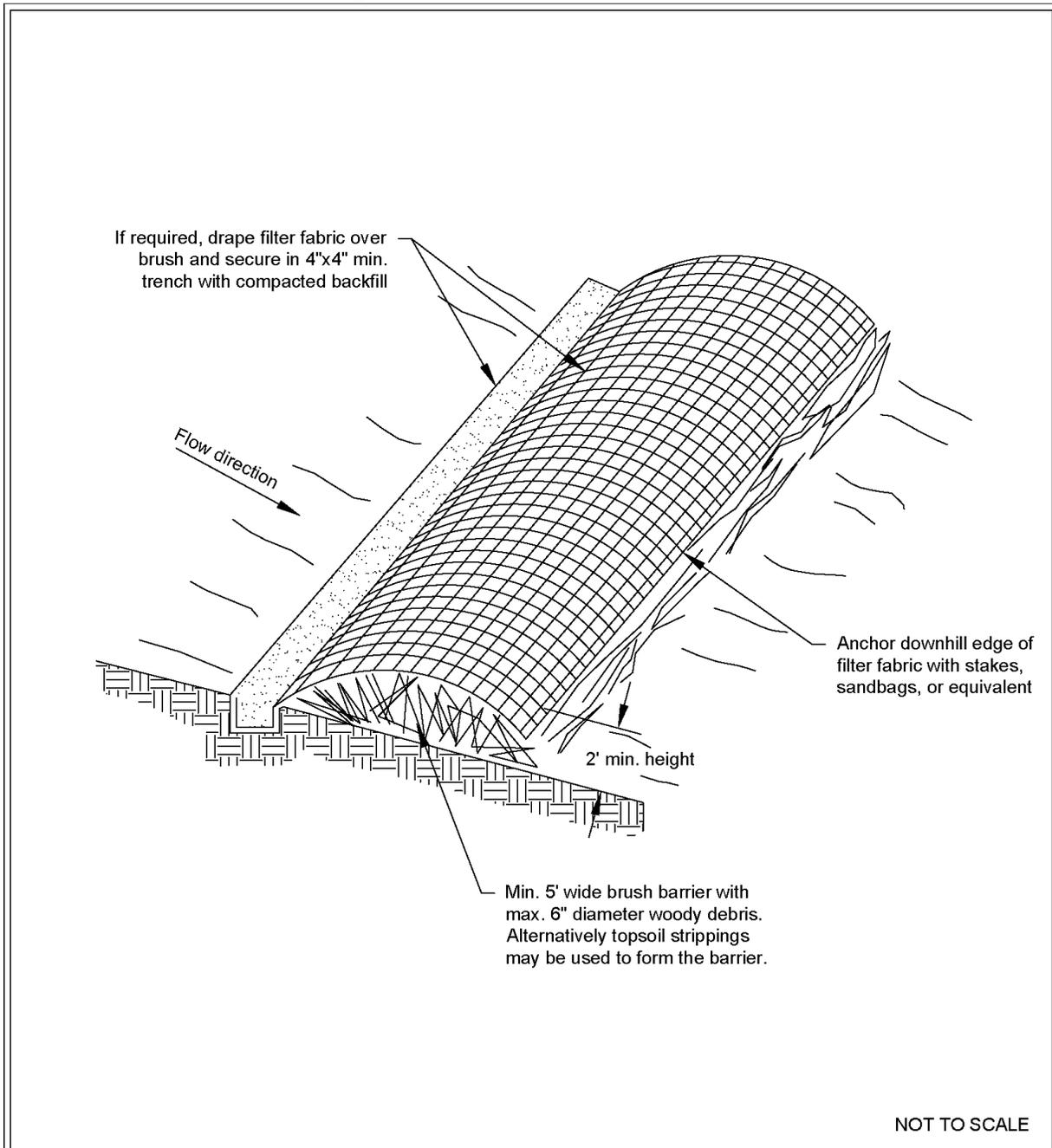
- Height: 2 feet (minimum) to 5 feet (maximum).
- Width: 5 feet at base (minimum) to 15 feet (maximum).
- Filter fabric (geotextile) may be anchored over the brush berm to enhance the filtration ability of the barrier. Ten-ounce burlap is an adequate alternative to filter fabric.

- Chipped site vegetation, composted mulch, or wood-based mulch (hog fuel) are acceptable materials to construct brush barriers.
- A 100 percent biodegradable installation can be constructed using 10-ounce burlap held in place by wooden stakes.
- [Figure II-3.20: Brush Barrier](#) depicts a typical brush barrier.

### ***Maintenance Standards***

- There shall be no signs of erosion or concentrated runoff under or around the barrier. If concentrated flows are bypassing the barrier, it must be expanded or augmented by toed-in filter fabric.
- The dimensions of the barrier must be maintained.

**Figure II-3.20: Brush Barrier**



## Brush Barrier

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## **BMP C232: Gravel Filter Berm**

### ***Purpose***

A gravel filter berm retains sediment by filtering runoff through a berm of gravel or crushed rock.

### ***Conditions of Use***

Use a gravel filter berm where a temporary measure is needed to retain sediment from construction sites.

Do not place gravel filter berms in traffic areas; gravel filter berms are not intended to be driven over.

Place gravel filter berms perpendicular to the flow of runoff, such that the runoff will filter through the berm prior to leaving the site.

### ***Design and Installation Specifications***

- Berm material shall be  $\frac{3}{4}$  to 3 inches in size, washed well-grade gravel or crushed rock with less than 5 percent fines. Do not use crushed concrete.
- Spacing of berms:
  - Every 300 feet on slopes less than 5 percent
  - Every 200 feet on slopes between 5 percent and 10 percent
  - Every 100 feet on slopes greater than 10 percent
- Berm dimensions:
  - 1 foot high with 3H:1V side slopes
  - 8 linear feet per 1 cfs runoff based on the 10-year, 24-hour design storm
- See [Figure II-3.21: Gravel Filter Berm](#) for a photo of a gravel filter berm application.

### ***Maintenance Standards***

Regular inspection is required. Sediment shall be removed and filter material replaced as needed.

**Figure II-3.21: Gravel Filter Berm**



### Gravel Filter Berm

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## **BMP C233: Silt Fence**

### ***Purpose***

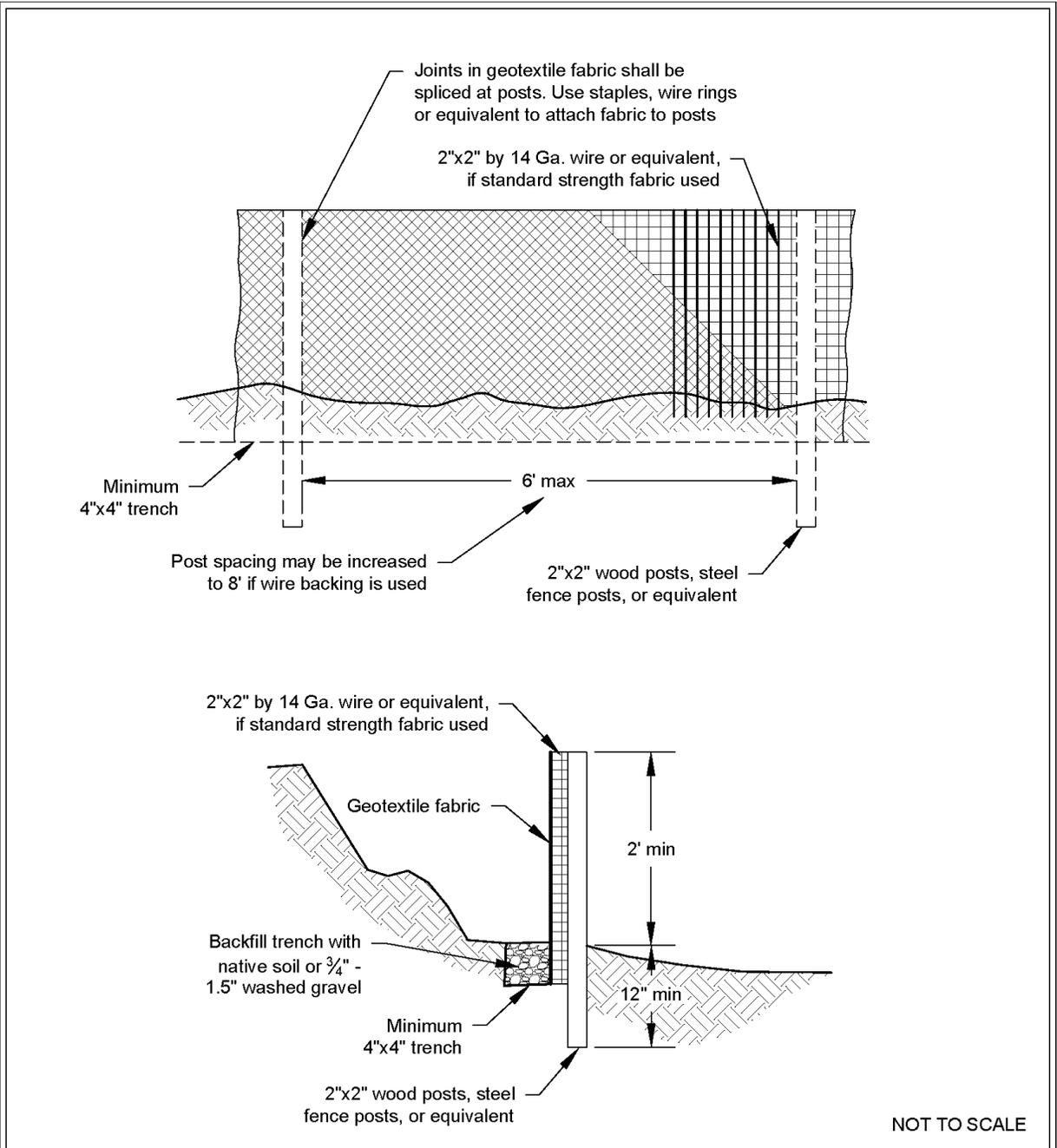
Silt fence reduces the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

### ***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**



**Silt Fence**

Revised July 2017

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## 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<br>(ASTM D4751)     | 0.60 mm maximum for slit film woven (#30 sieve).<br>0.30 mm maximum for all other geotextile types (#50 sieve).<br>0.15 mm minimum for all fabric types (#100 sieve). |
| Water Permittivity<br>(ASTM D4491)     | 0.02 sec <sup>-1</sup> minimum  |
| Grab Tensile Strength<br>(ASTM D4632)  | 180 lbs. Minimum for extra strength fabric.<br>100 lbs minimum for standard strength fabric.  |
| Grab Tensile Strength<br>(ASTM D4632)  | 30% maximum   |
| Ultraviolet Resistance<br>(ASTM D4355) | 70% minimum   |

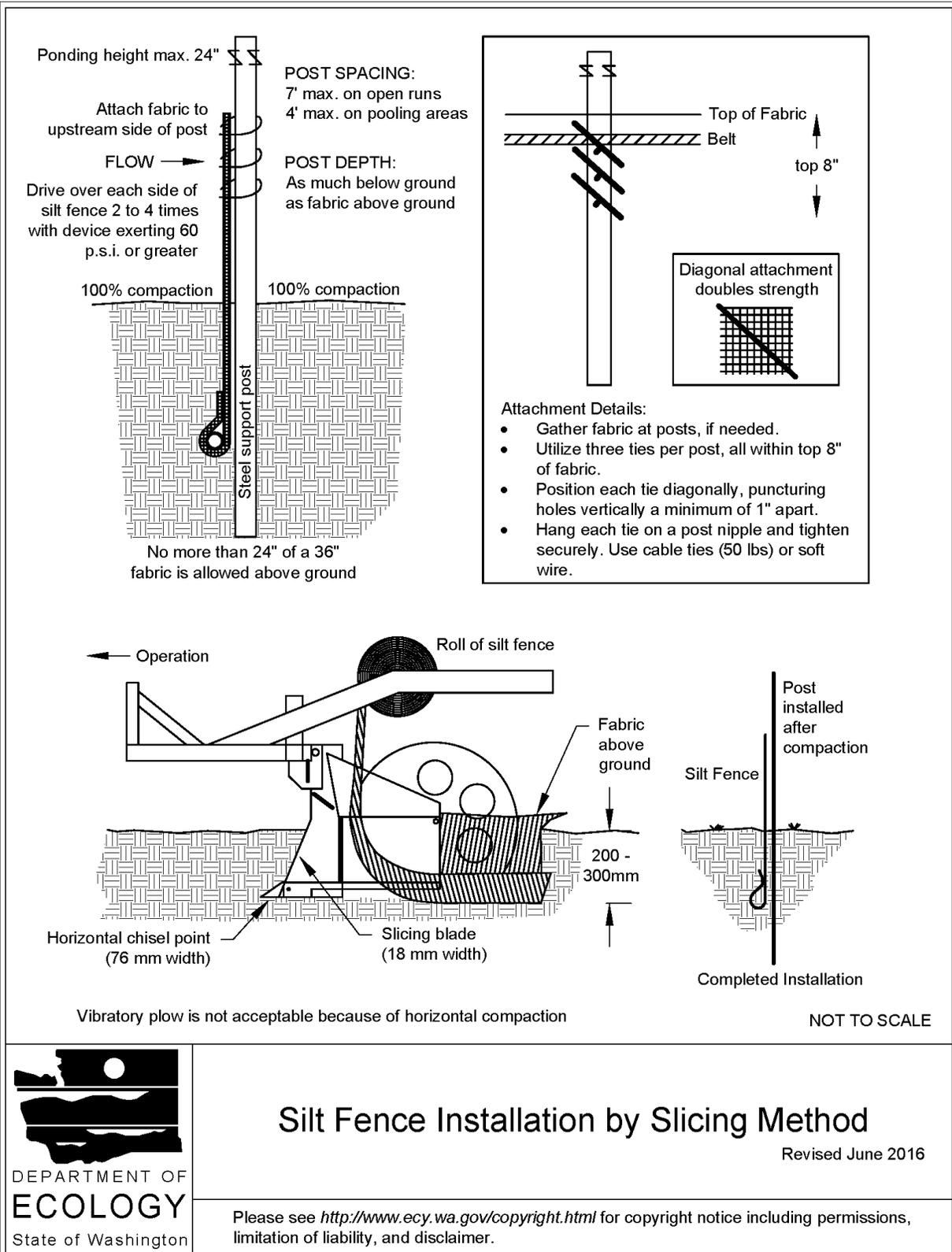
- Support standard strength geotextiles with wire mesh, chicken wire, 2-inch x 2-inch wire, safety fence, or jute mesh to increase the strength of the geotextile. Silt fence materials are available that have synthetic mesh backing attached.
- Silt fence material shall contain ultraviolet ray inhibitors 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-foot min. and a 2½-foot 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**



## Silt Fence Installation by Slicing Method

Revised June 2016

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## 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                              |

## ***Design and Installation Specifications***

- The vegetated strip shall consist of a continuous strip of dense vegetation with topsoil for a minimum of a 25-foot length along the flowpath. Grass-covered, landscaped areas are generally not adequate because the volume of sediment overwhelms the grass. Ideally, vegetated strips shall consist of undisturbed native growth with a well-developed soil that allows for infiltration of runoff.
- The slope within the vegetated strip shall not exceed 4H:1V.
- The uphill boundary of the vegetated strip shall be delineated with clearing limits.

## ***Maintenance Standards***

- Any areas damaged by erosion or construction activity shall be seeded immediately and protected by mulch.
- If more than 5 feet of the original vegetated strip width has had vegetation removed or is being eroded, sod must be installed.
- If there are indications that concentrated flows are traveling across the vegetated strip, storm-water runoff controls must be installed to reduce the flows entering the vegetated strip, or additional perimeter protection must be installed.

## **BMP C235: Wattles**

### ***Purpose***

Wattles are temporary erosion and sediment control barriers consisting of straw, compost, or other material that is wrapped in netting made of natural plant fiber or similar encasing material. They reduce the velocity and can spread the flow of rill and sheet runoff, and can capture and retain sediment.

### ***Conditions of Use***

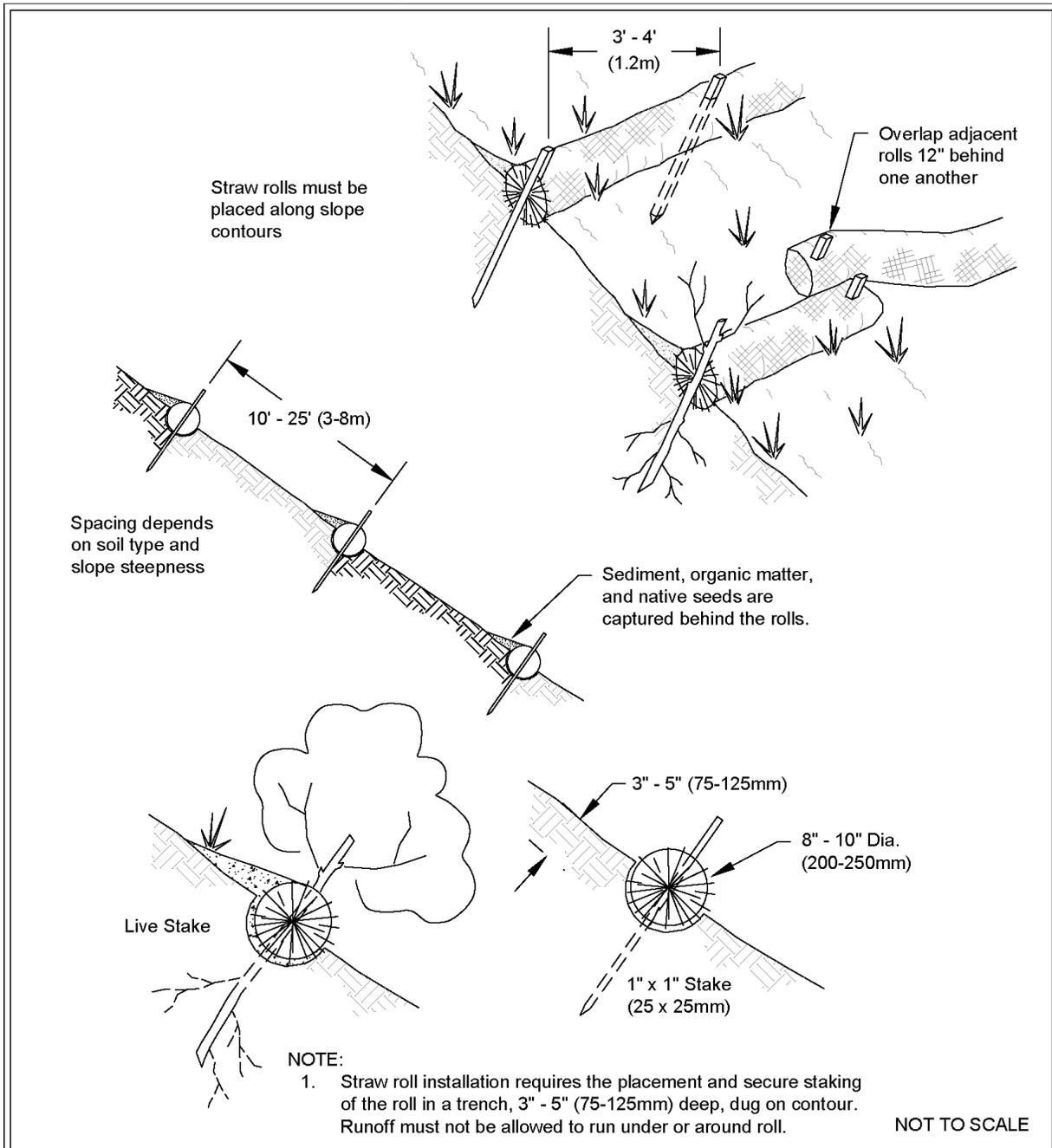
- Wattles shall consist of cylinders of plant material such as weed-free straw, coir, wood chips, excelsior, or wood fiber or shavings encased within netting made of natural plant fibers unaltered by synthetic materials.
- Use wattles:
  - In disturbed areas that require immediate erosion protection.
  - On exposed soils during the period of short construction delays, or over winter months.
  - On slopes requiring stabilization until permanent vegetation can be established.
- The material used dictates the effectiveness period of the wattle. Generally, wattles are effective for one to two seasons.

- Prevent rilling beneath wattles by entrenching and overlapping wattles to prevent water from passing between them.

## **Design Criteria**

- See [Figure II-3.24: Wattles](#) for typical construction details.
- Wattles are typically 8 to 10 inches in diameter and 25 to 30 feet in length.
- Install wattles perpendicular to the flow direction and parallel to the slope contour.
- Place wattles in shallow trenches, staked along the contour of disturbed or newly constructed slopes. Dig narrow trenches across the slope (on contour) to a depth of 3- to 5-inches on clay soils and soils with gradual slopes. On loose soils, steep slopes, and areas with high rainfall, the trenches should be dug to a depth of 5- to 7- inches, or 1/2 to 2/3 of the thickness of the wattle.
- Start building trenches and installing wattles from the base of the slope and work up. Spread excavated material evenly along the uphill slope and compact it using hand tamping or other methods.
- Construct trenches at intervals of 10- to 25-feet depending on the steepness of the slope, soil type, and rainfall. The steeper the slope the closer together the trenches.
- Install the wattles snugly into the trenches and overlap the ends of adjacent wattles 12 inches behind one another.
- Install stakes at each end of the wattle, and at 4-foot centers along entire length of wattle.
- If required, install pilot holes for the stakes using a straight bar to drive holes through the wattle and into the soil.
- Wooden stakes should be approximately 0.75 x 0.75 x 24 inches min. Willow cuttings or 3/8-inch rebar can also be used for stakes.
- Stakes should be driven through the middle of the wattle, leaving 2 to 3 inches of the stake protruding above the wattle.

**Figure II-3.24: Wattles**



## Wattles

Revised December 2016

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## ***Maintenance Standards***

- Wattles may require maintenance to ensure they are in contact with soil and thoroughly entrenched, especially after significant rainfall on steep sandy soils.
- Inspect the slope after significant storms and repair any areas where wattles are not tightly abutted or water has scoured beneath the wattles.

## ***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 C236: Vegetative Filtration**

### ***Purpose***

Vegetative filtration as a BMP is used in conjunction with detention storage in the form of portable tanks or [BMP C241: Sediment Pond \(Temporary\)](#), [BMP C206: Level Spreader](#), and a pumping system with surface intake. Vegetative filtration improves turbidity levels of stormwater discharges by filtering runoff through existing vegetation where undisturbed forest floor duff layer or established lawn with thatch layer are present. Vegetative filtration can also be used to infiltrate dewatering waste from foundations, vaults, and trenches as long as runoff does not occur.

### ***Conditions of Use***

- For every five acres of disturbed soil use one acre of grass field, farm pasture, or wooded area. Reduce or increase this area depending on project size, ground water table height, and other site conditions.
- Wetlands shall not be used for vegetative filtration.
- Do not use this BMP in areas with a high ground water table, or in areas that will have a high seasonal ground water table during the use of this BMP.
- This BMP may be less effective on soils that prevent the infiltration of the water, such as hard till.
- Using other effective source control measures throughout a construction site will prevent the generation of additional highly turbid water and may reduce the time period or area need for this BMP.
- Stop distributing water into the vegetated filtration area if standing water or erosion results.

- On large projects that phase the clearing of the site, areas retained with native vegetation may be used as a temporary vegetative filtration area.

## Design Criteria

- Find land adjacent to the project site that has a vegetated field, preferably a farm field, or wooded area.
- If the site does not contain enough vegetated field area consider obtaining permission from adjacent landowners (especially for farm fields).
- Install a pump and downstream distribution manifold depending on the project size. Generally, the main distribution line should reach 100 to 200-feet long (large projects, or projects on tight soil, will require systems that reach several thousand feet long with numerous branch lines off of the main distribution line).
- The manifold should have several valves, allowing for control over the distribution area in the field.
- Install several branches of 4-inch diameter schedule 20 polyvinyl chloride (PVC), swaged-fit common septic tight-lined sewer line, or 6-inch diameter fire hose, which can convey the turbid water out to various sections of the field. See [Figure II-3.25: Manifold and Branches in a Wooded, Vegetated Spray Field](#).
- Determine the branch length based on the field area geography and number of branches. Typically, branches stretch from 200-feet to several thousand feet. Lay the branches on contour with the slope.
- On uneven ground, sprinklers perform well. Space sprinkler heads so that spray patterns do not overlap.
- On relatively even surfaces, a level spreader using 4-inch perforated pipe may be used as an alternative option to the sprinkler head setup. Install drain pipe at the highest point on the field and at various lower elevations to ensure full coverage of the filtration area. Place the pipe with the holes up to allow for gentle weeping evenly out all holes. Leveling the pipe by staking and using sandbags may be required.
- To prevent over saturating of the vegetative filtration area, rotate the use of branches or spray heads. Repeat as needed based on monitoring the spray field.

**Table II-3.13: Flowpath Guidelines for Vegetative Filtration**

| Average Slope | Average Area % Slope | Estimated Flowpath Length (ft) |
|---------------|----------------------|--------------------------------|
| 1.5H:1V       | 67%                  | 250                            |
| 2H:1V         | 50%                  | 200                            |
| 4H:1V         | 25%                  | 150                            |
| 6H:1V         | 16.7%                | 115                            |
| 10H:1V        | 10%                  | 100                            |

**Figure II-3.25: Manifold and Branches in a Wooded, Vegetated Spray Field**



NOT TO SCALE



DEPARTMENT OF  
**ECOLOGY**  
State of Washington

### Manifold and Branches in a Wooded, Vegetated Spray Field

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## **Maintenance Standards**

- Monitor the spray field on a daily basis to ensure that over saturation of any portion of the field doesn't occur at any time. The presence of standing puddles of water or creation of concentrated flows visually signify that over saturation of the field has occurred.
- Monitor the vegetated spray field all the way down to the nearest surface water, or farthest spray area, to ensure that the water has not caused overland or concentrated flows, and has not created erosion around the spray nozzle(s).
- Do not exceed water quality standards for turbidity.
- Ecology recommends that a separate inspection log be developed, maintained and kept with the existing site logbook to aid the operator conducting inspections. This separate "Field Filtration Logbook" can also aid in demonstrating compliance with permit conditions.
- Inspect the spray nozzles daily, at a minimum, for leaks and plugging from sediment particles.
- If erosion, concentrated flows, or over saturation of the field occurs, rotate the use of branches or spray heads or move the branches to a new field location.
- Check all branches and the manifold for unintended leaks.

## **BMP C240: Sediment Trap**

### **Purpose**

A sediment trap is a small temporary ponding area with a gravel outlet used to collect and store sediment from sites during construction. Sediment traps, along with other perimeter controls, shall be installed before any land disturbance takes place in the drainage area.

### **Conditions of Use**

- Sediment traps are intended for use on sites where the tributary drainage area is less than 3 acres, with no unusual drainage features, and a projected build-out time of six months or less. The sediment trap is a temporary measure (with a design life of approximately 6 months) and shall be maintained until the tributary area is permanently protected against erosion by vegetation and/or structures.
- Sediment traps are only effective in removing sediment down to about the medium silt size fraction. Runoff with sediment of finer grades (fine silt and clay) will pass through untreated, emphasizing the need to control erosion to the maximum extent first.
- Projects that are constructing permanent Flow Control BMPs, or Runoff Treatment BMPs that use ponding for treatment, may use the rough-graded or final-graded permanent BMP footprint for the temporary sediment trap. When permanent BMP footprints are used as temporary sediment traps, the surface area requirement of the sediment trap must be met. If the surface area requirement of the sediment trap is larger than the surface area of the permanent BMP, then the sediment trap shall be enlarged beyond the permanent BMP footprint to comply with the surface area requirement.

- A floating pond skimmer may be used for the sediment trap outlet if approved by the Local Permitting Authority.
- Sediment traps may not be feasible on utility projects due to the limited work space or the short-term nature of the work. Portable tanks may be used in place of sediment traps for utility projects.

## ***Design and Installation Specifications***

- See [Figure II-3.26: Cross Section of Sediment Trap](#) and [Figure II-3.27: Sediment Trap Outlet](#) for details.
- To determine the sediment trap geometry, first calculate the design surface area (SA) of the trap, measured at the invert of the weir. Use the following equation:

$$SA = FS(Q_2/V_s)$$

where

$Q_2 =$

- Option 1 - Single Event Hydrograph Method:

$Q_2$  = Peak volumetric flow rate calculated using a 10-minute time step from a Type 1A, 2-year, 24-hour frequency storm for the developed condition. The 10-year peak volumetric flow rate shall be used if the project size, expected timing and duration of construction, or downstream conditions warrant a higher level of protection.

- Option 2 - For construction sites that are less than 1 acre, the Rational Method may be used to determine  $Q_2$ .

$V_s$  = The settling velocity of the soil particle of interest. The 0.02 mm (medium silt) particle with an assumed density of 2.65 g/cm<sup>3</sup> has been selected as the particle of interest and has a settling velocity ( $V_s$ ) of 0.00096 ft/sec.

FS = A safety factor of 2 to account for non-ideal settling.

Therefore, the equation for computing sediment trap surface area becomes:

$$SA = 2 \times Q_2 / 0.00096$$

or

2080 square feet per cfs of inflow

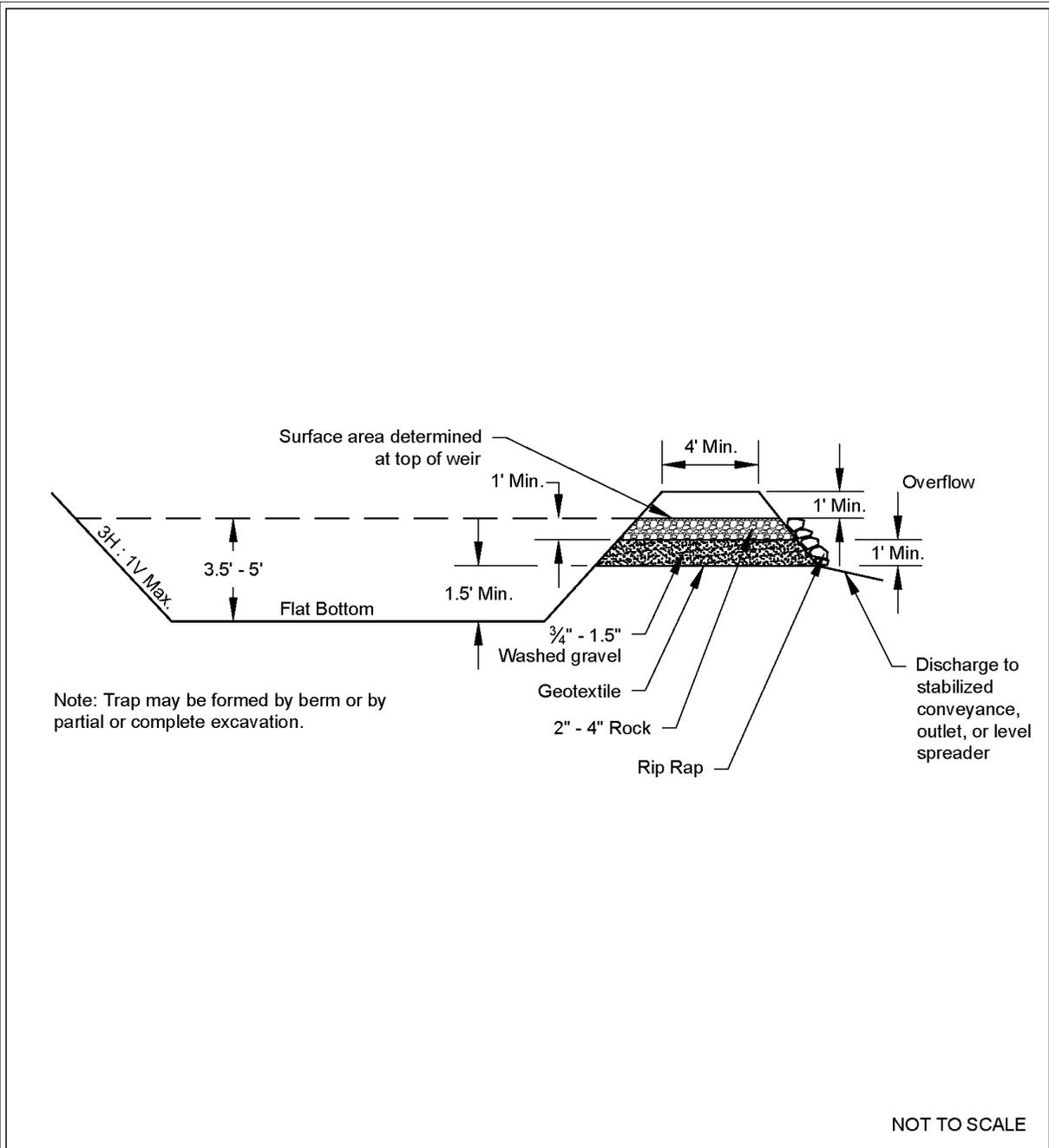
- Sediment trap depth shall be 3.5 feet minimum from the bottom of the trap to the top of the overflow weir.
- To aid in determining sediment depth, all sediment traps shall have a staff gauge with a prominent mark 1-foot above the bottom of the trap.

- Design the discharge from the sediment trap by using the guidance for discharge from temporary sediment ponds in [BMP C241: Sediment Pond \(Temporary\)](#).

### ***Maintenance Standards***

- Sediment shall be removed from the trap when it reaches 1-foot in depth.
- Any damage to the trap embankments or slopes shall be repaired.

**Figure II-3.26: Cross Section of Sediment Trap**

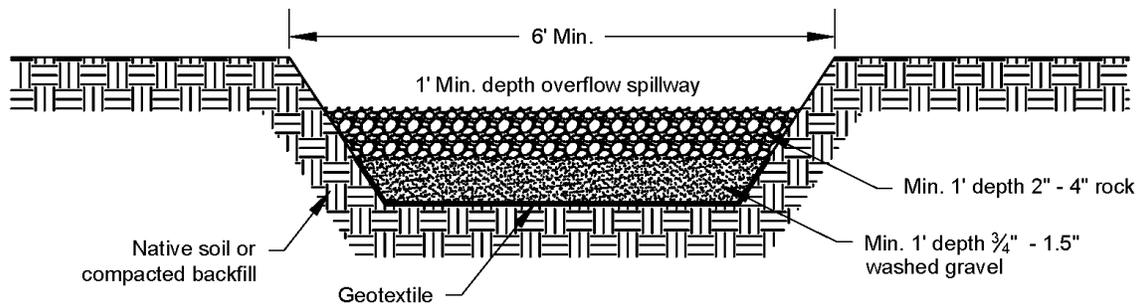


## Cross Section of Sediment Trap

Revised June 2016

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**Figure II-3.27: Sediment Trap Outlet**



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## Sediment Trap Outlet

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## **BMP C241: Sediment Pond (Temporary)**

### ***Purpose***

Sediment ponds are temporary ponds used during construction to remove sediment from runoff originating from disturbed areas of the project site. Sediment ponds are typically designed to remove sediment no smaller than medium silt (0.02 mm). Consequently, they usually reduce turbidity only slightly.

### ***Conditions of Use***

- Use a sediment pond where the contributing drainage area to the pond is 3 acres or more. Ponds must be used in conjunction with other Construction Stormwater BMPs to reduce the amount of sediment flowing into the pond.
- Do not install sediment ponds on sites where failure of the BMP would result in loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities. Also, sediment ponds are attractive to children and can be dangerous. Compliance with local ordinances regarding health and safety must be addressed. If fencing of the pond is required, show the type of fence and its location on the drawings in the Construction SWPPP.
- Sediment ponds that can impound 10 acre-ft (435,600 cu-ft, or 3.26 million gallons) or more, or have an embankment of more than 6 feet, are subject to the Washington Dam Safety Regulations ([Chapter 173-175 WAC](#)). See [BMP D.1: Detention Ponds](#) for more information regarding dam safety considerations for detention ponds.
- Projects that are constructing permanent Flow Control BMPs or Runoff Treatment BMPs that use ponding for treatment may use the rough-graded or final-graded permanent BMP footprint for the temporary sediment pond. When permanent BMP footprints are used as temporary sediment ponds, the surface area requirement of the temporary sediment pond must be met. If the surface area requirement of the sediment pond is larger than the surface area of the permanent BMP, then the sediment pond shall be enlarged beyond the permanent BMP footprint to comply with the surface area requirement.

The permanent control structure must be temporarily replaced with a control structure that only allows water to leave the temporary sediment pond from the surface or by pumping. Alternatively, the permanent control structure may be used if it is temporarily modified by plugging any outlet holes below the riser. The permanent control structure must be installed as part of the permanent BMP after the site is fully stabilized.

### ***Design and Installation Specifications***

#### **General**

- See [Figure II-3.28: Sediment Pond Plan View](#), [Figure II-3.29: Sediment Pond Cross Section](#), and [Figure II-3.30: Sediment Pond Riser Detail](#) for details.
- Use of permanent infiltration BMP footprints for temporary sediment ponds during

construction tends to clog the soils and reduce their capacity to infiltrate. If permanent infiltration BMP footprints are used, the sides and bottom of the temporary sediment pond must only be rough excavated to a minimum of 2 feet above final grade of the permanent infiltration BMP. Final grading of the permanent infiltration BMP shall occur only when all contributing drainage areas are fully stabilized. Any proposed permanent pretreatment BMP prior to the infiltration BMP should be fully constructed and used with the temporary sediment pond to help prevent clogging of the soils. See [Element 13: Protect Low Impact Development BMPs](#) for more information about protecting permanent infiltration BMPs.

- The pond shall be divided into two roughly equal volume cells by a permeable divider that will reduce turbulence while allowing movement of water between the cells. The divider shall be at least one-half the height of the riser, and at least one foot below the top of the riser. Wire-backed, 2- to 3-foot high, high strength geotextile fabric supported by treated 4"x4"s can be used as a divider. Alternatively, staked straw bales wrapped with geotextile fabric may be used. If the pond is more than 6 feet deep, a different divider design must be proposed. A riprap embankment is one acceptable method of separation for deeper ponds. Other designs that satisfy the intent of this provision are allowed as long as the divider is permeable, structurally sound, and designed to prevent erosion under and around the divider.
- The most common structural failure of sediment ponds is caused by piping. Piping refers to two phenomena: (1) water seeping through fine-grained soil, eroding the soil grain by grain and forming pipes or tunnels; and, (2) water under pressure flowing upward through a granular soil with a head of sufficient magnitude to cause soil grains to lose contact and capability for support.

The most critical construction practices to prevent piping are:

- Tight connections between the riser and outlet pipe, and other pipe connections.
- Adequate anchoring of the riser.
- Proper soil compaction of the embankment and riser footing.
- Proper construction of anti-seep devices.

### **Sediment Pond Geometry**

To determine the sediment pond geometry, first calculate the design surface area (SA) of the pond, measured at the top of the riser pipe. Use the following equation:

$$SA = 2 \times Q_2 / 0.00096$$

or

2080 square feet per cfs of inflow

See [BMP C240: Sediment Trap](#) for more information on the above equation.

The basic geometry of the pond can now be determined using the following design criteria:

- Required surface area SA (from the equation above) at the top of the riser.
- Minimum 3.5-foot depth from the top of the riser to the bottom of the pond.

- Maximum 3H:1V interior side slopes and maximum 2H:1V exterior slopes. The interior slopes can be increased to a maximum of 2H:1V if fencing is provided at or above the maximum water surface.
- One foot of freeboard between the top of the riser and the crest of the emergency spillway.
- Flat bottom.
- Minimum 1-foot deep spillway.
- Length-to-width ratio between 3:1 and 6:1.

### **Sediment Pond Discharge**

The outlet for the pond consists of a combination of principal and emergency spillways. These outlets must pass the peak runoff expected from the contributing drainage area for a 100-year storm. If, due to site conditions and basin geometry, a separate emergency spillway is not feasible, the principal spillway must pass the entire peak runoff expected from the 100-year storm. However, an attempt to provide a separate emergency spillway should always be made. Base the runoff calculations on the site conditions during construction. The flow through the dewatering orifice cannot be utilized when calculating the 100-year storm elevation because of its potential to become clogged; therefore, available spillway storage must begin at the principal spillway riser crest.

The principal spillway designed by the procedures described below will result in some reduction in the peak rate of runoff. However, the design will not control the discharge flow rates to the extent required to comply with [I-3.4.7 MR7: Flow Control](#). The size of the contributing basin, the expected life of the construction project, the anticipated downstream effects, and the anticipated weather conditions during construction should be considered to determine the need for additional discharge control.

**Principal Spillway:** Determine the required diameter for the principal spillway (riser pipe). The diameter shall be the minimum necessary to pass the peak volumetric flow rate using a 15-minute time step from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Use [Figure II-3.31: Riser Inflow Curves](#) to determine the riser diameter.

To aid in determining sediment depth, one-foot intervals shall be prominently marked on the riser.

**Emergency Overflow Spillway:** Size the emergency overflow spillway for the peak volumetric flow rate using a 10-minute time step from a Type 1A, 100-year, 24-hour frequency storm for the developed condition. See [BMP D.1: Detention Ponds](#) for additional guidance for Emergency Overflow Spillway design

**Dewatering Orifice:** Size of the dewatering orifice(s) (minimum 1-inch diameter) using a modified version of the discharge equation for a vertical orifice and a basic equation for the area of a circular orifice. Determine the required area of the orifice with the following equation:

$$A_o = \frac{A_s(2h)^{0.5}}{0.6 \times 3600T_g^{0.5}}$$

where

$A_o$  = orifice area (square feet)

$A_S$  = pond surface area (square feet)

$h$  = head of water above orifice (height of riser in feet)

$T$  = dewatering time (24 hours)

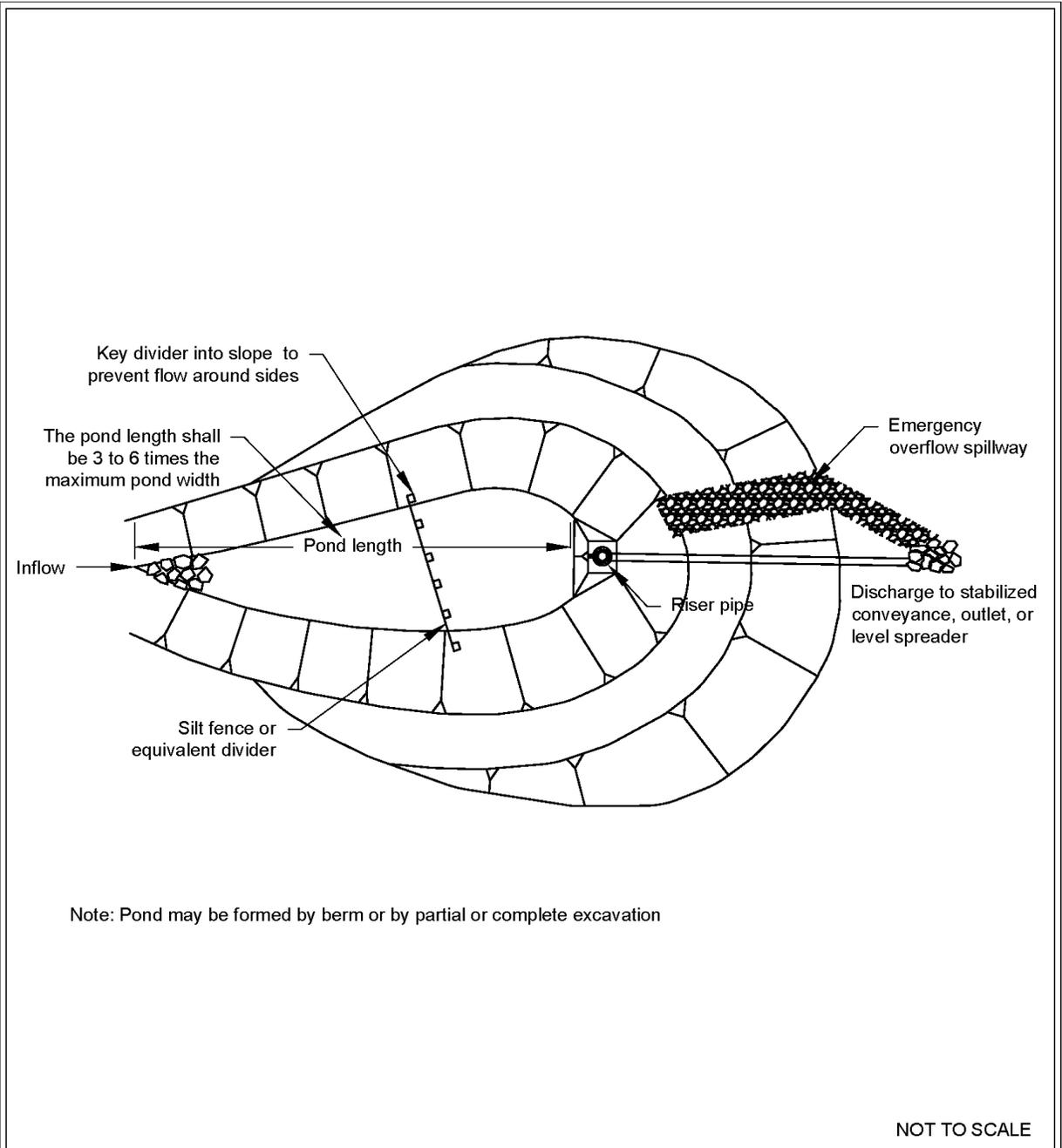
$g$  = acceleration of gravity (32.2 feet/second<sup>2</sup>)

Convert the orifice area (in square feet) to the orifice diameter  $D$  (in inches):

$$D = 24 \times \sqrt{\frac{A_o}{\pi}} = 13.54 \times \sqrt{A_o}$$

The vertical, perforated tubing connected to the dewatering orifice must be at least 2 inches larger in diameter than the orifice to improve flow characteristics. The size and number of perforations in the tubing should be large enough so that the tubing does not restrict flow. The orifice should control the flow rate.

**Figure II-3.28: Sediment Pond Plan View**

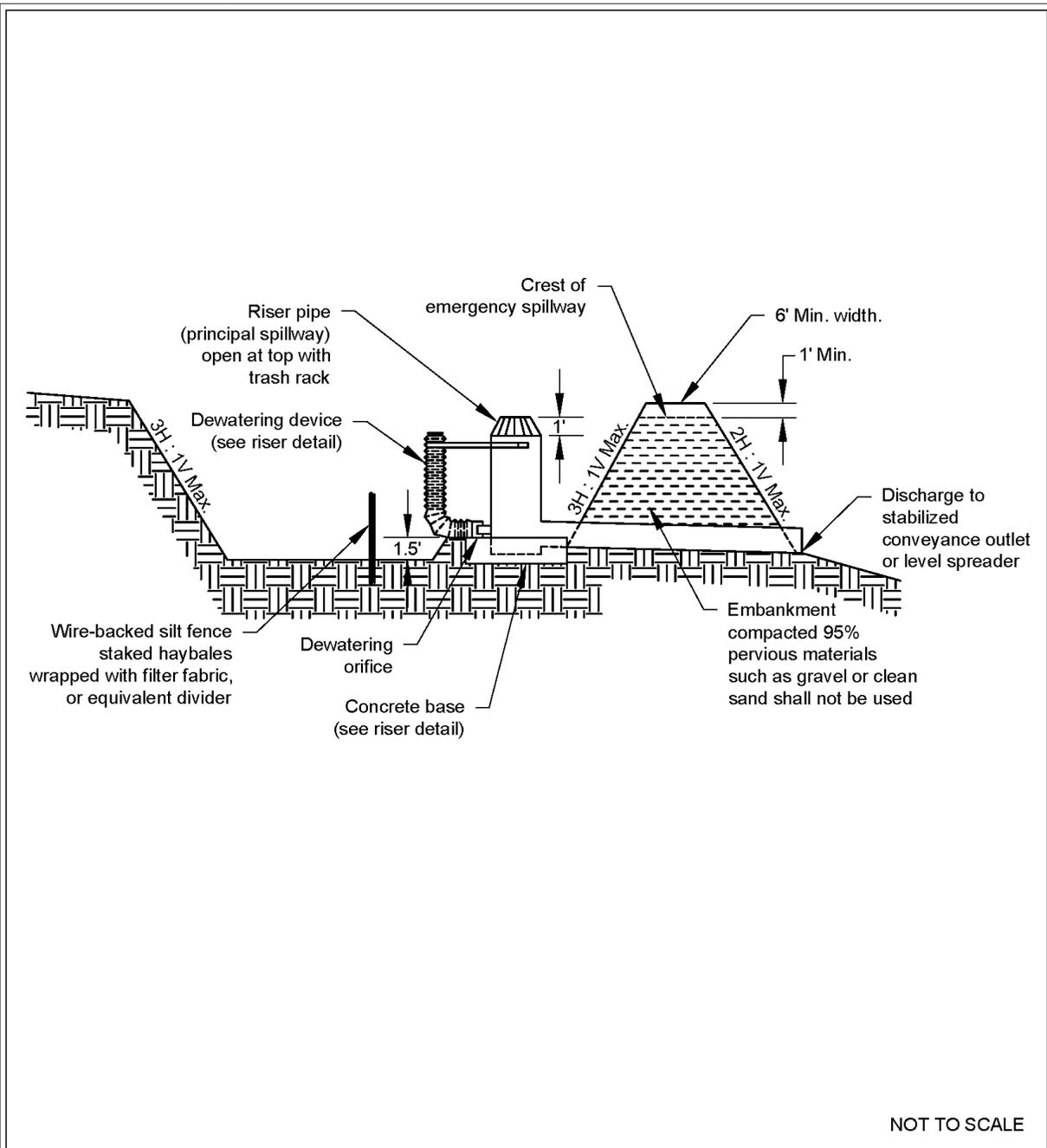


**Sediment Pond Plan View**

Revised June 2016

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**Figure II-3.29: Sediment Pond Cross Section**

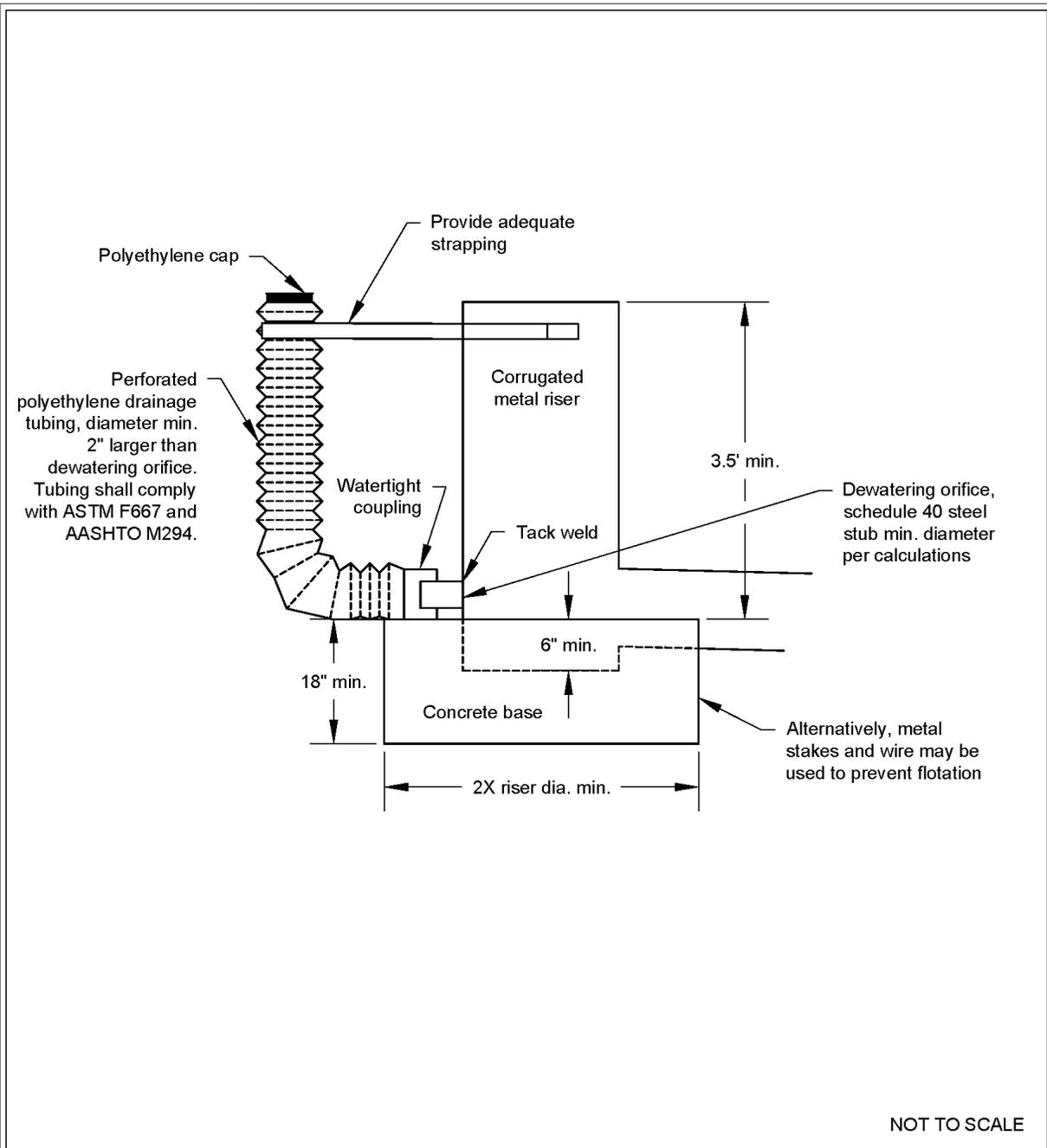


## Sediment Pond Cross Section

Revised June 2016

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**Figure II-3.30: Sediment Pond Riser Detail**

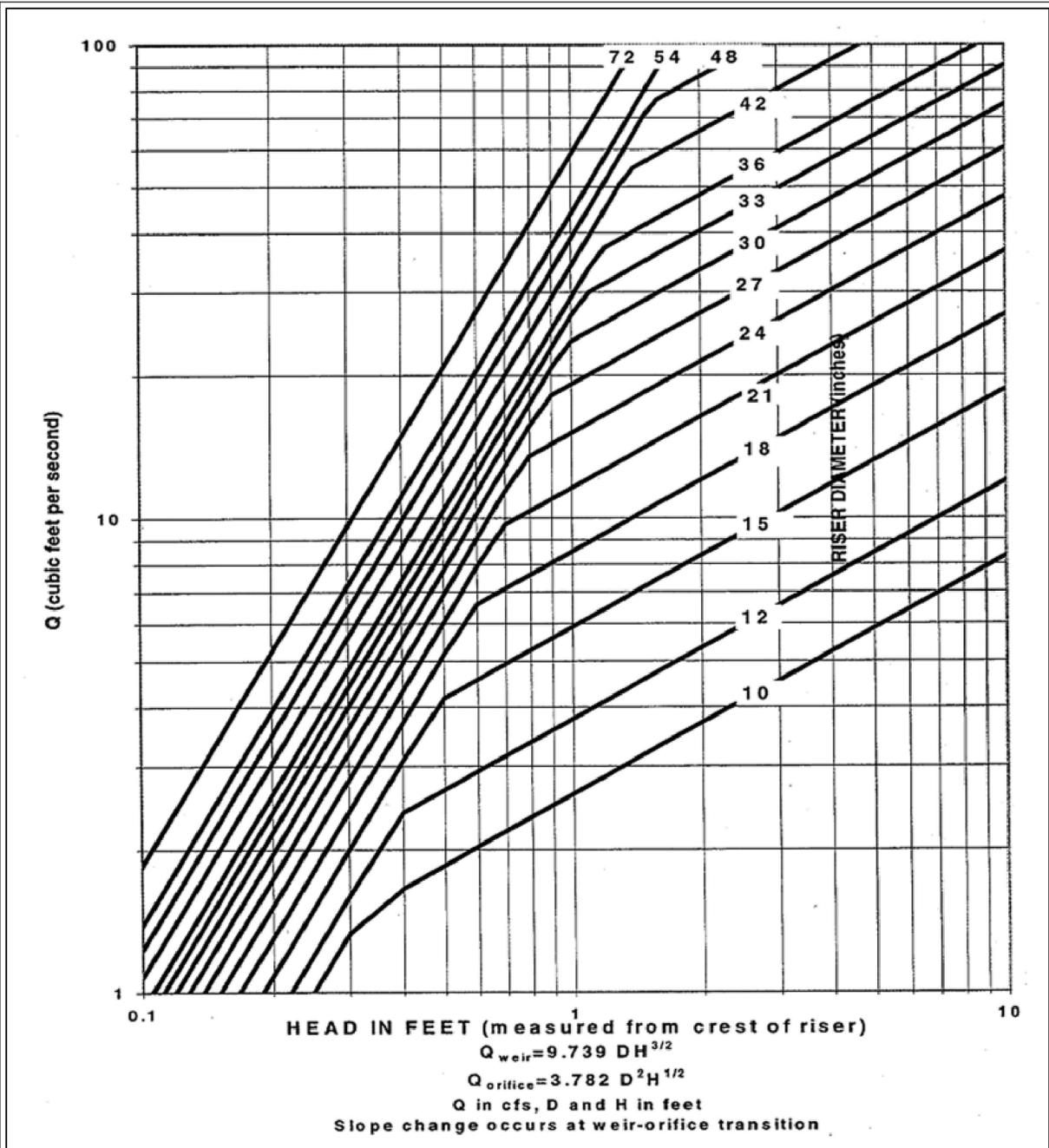


## Sediment Pond Riser Detail

Revised June 2016

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**Figure II-3.31: Riser Inflow Curves**



**Riser Inflow Curves**

Revised June 2016

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## ***Maintenance Standards***

- Remove sediment from the pond when it reaches 1 foot in depth.
- Repair any damage to the pond embankments or slopes.

## **BMP C250: Construction Stormwater Chemical Treatment**

### ***Purpose***

This BMP applies when using chemicals to treat turbidity in stormwater by either batch or flow-through chemical treatment.

Turbidity is difficult to control once fine particles are suspended in stormwater runoff from a construction site. [BMP C241: Sediment Pond \(Temporary\)](#) is effective at removing larger particulate matter by gravity settling, but is ineffective at removing smaller particulates such as clay and fine silt. Traditional Construction Stormwater BMPs may not be adequate to ensure compliance with the water quality standards for turbidity in the receiving water.

Chemical treatment can reliably provide exceptional reductions of turbidity and associated pollutants. Chemical treatment may be required to meet turbidity stormwater discharge requirements, especially when construction proceeds through the wet season.

### ***Conditions of Use***

Formal written approval from Ecology is required for the use of chemical treatment, regardless of site size. See <https://fortress.wa.gov/ecy/publications/SummaryPages/ecy070258.html> for a copy of the Request for Chemical Treatment form. The Local Permitting Authority may also require review and approval. When authorized, the chemical treatment systems must be included in the Construction Stormwater Pollution Prevention Plan (SWPPP).

Chemically treated stormwater discharged from construction sites must be nontoxic to aquatic organisms. The Chemical Technology Assessment Protocol - Ecology (CTAPE) must be used to evaluate chemicals proposed for stormwater treatment. Only chemicals approved by Ecology under the CTAPE may be used for stormwater treatment. The approved chemicals, their allowable application techniques (batch treatment or flow-through treatment), allowable application rates, and conditions of use can be found at the Department of Ecology Emerging Technologies website:

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

### ***Background on Chemical Treatment Systems***

Coagulation and flocculation have been used for over a century to treat water. The use of coagulation and flocculation to treat stormwater is a very recent application. Experience with the treatment of water and wastewater has resulted in a basic understanding of the process, in particular factors

that affect performance. This experience can provide insights as to how to most effectively design and operate similar systems in the treatment of stormwater.

Fine particles suspended in water give it a milky appearance, measured as *turbidity*. Their small size, often much less than 1 µm in diameter, give them a very large surface area relative to their volume. These fine particles typically carry a negative surface charge. Largely because of these two factors (small size and negative charge), these particles tend to stay in suspension for extended periods of time. Thus, removal is not practical by gravity settling. These are called stable suspensions. Chemicals like polymers, as well as inorganic chemicals such as alum, speed the settling process. The added chemical destabilizes the suspension and causes the smaller particles to flocculate. The process consists of three primary steps: *coagulation*, *flocculation*, and settling or *clarification*. Ecology requires a fourth step, *filtration*, on all stormwater chemical treatment systems to reduce floc discharge and to provide monitoring prior to discharge.

## **General Design and Installation Specifications**

- Chemicals approved for use in Washington State are listed on Ecology's TAPE website, <http://www.ecy.wa.gov/programs/wq/stormwater/newtech/technologies.html>, under the "Construction" tab.
- Care must be taken in the design of the withdrawal system to minimize outflow velocities and to prevent floc discharge. Stormwater that has been chemically treated must be filtered through [BMP C251: Construction Stormwater Filtration](#) for filtration and monitoring prior to discharge.
- System discharge rates must take into account downstream conveyance integrity.
- The following equipment should be located on site in a lockable shed:
  - The chemical injector.
  - Secondary containment for acid, caustic, buffering compound, and treatment chemical.
  - Emergency shower and eyewash.
  - Monitoring equipment which consists of a pH meter and a turbidimeter.
- There are two types of systems for applying the chemical treatment process to stormwater: the batch chemical treatment system and the flow-through chemical treatment system. See below for further details for both types of systems.

## **Batch Chemical Treatment Systems**

A batch chemical treatment system consists of four steps: *coagulation*, *flocculation*, *clarification*, and polishing and monitoring via *filtration*.

### **Step 1: Coagulation**

Coagulation is the process by which negative charges on the fine particles are disrupted. By disrupting the negative charges, the fine particles are able to flocculate. Chemical addition is one method of destabilizing the suspension, and polymers are one class of chemicals that are generally effective. Chemicals that are used for this purpose are called coagulants. Coagulation is complete

when the suspension is destabilized by the neutralization of the negative charges. Coagulants perform best when they are thoroughly and evenly dispersed under relatively intense mixing. This rapid mixing involves adding the coagulant in a manner that promotes rapid dispersion, followed by a short time period for destabilization of the particle suspension. The particles are still very small and are not readily separated by clarification until flocculation occurs.

### **Step 2: Flocculation**

Flocculation is the process by which fine particles that have been destabilized bind together to form larger particles that settle rapidly. Flocculation begins naturally following coagulation, but is enhanced by gentle mixing of the destabilized suspension. Gentle mixing helps to bring particles in contact with one another such that they bind and continually grow to form "flocs." As the size of the flocs increase, they become heavier and settle.

### **Step 3: Clarification**

The final step is the settling of the particles, or clarification. Particle density, size and shape are important during settling. Dense, compact flocs settle more readily than less dense, fluffy flocs. Because of this, flocculation to form dense, compact flocs is particularly important during chemical treatment. Water temperature is important during settling. Both the density and viscosity of water are affected by temperature; these in turn affect settling. Cold temperatures increase viscosity and density, thus slowing down the rate at which the particles settle.

The conditions under which clarification is achieved can affect performance. Currents can affect settling. Currents can be produced by wind, by differences between the temperature of the incoming water and the water in the clarifier, and by flow conditions near the inlets and outlets. Quiescent water, such as that which occurs during batch clarification, provides a good environment for settling. One source of currents in batch chemical treatment systems is movement of the water leaving the clarifier unit. Because flocs are relatively small and light, the velocity of the water must be as low as possible. Settled flocs can be resuspended and removed by fairly modest currents.

### **Step 4: Filtration**

After clarification, Ecology requires stormwater that has been chemically treated to be filtered and monitored prior to discharge. The sand filtration system continually monitors the stormwater effluent for turbidity and pH. If the discharge water is ever out of an acceptable range for turbidity or pH, the water is returned to the untreated stormwater pond where it will begin the treatment process again.

## **Design and Installation of Batch Chemical Treatment Systems**

A batch chemical treatment system consists of a stormwater collection system (either a temporary diversion or the permanent site drainage system), an untreated stormwater storage pond, pumps, a chemical feed system, treatment cells, a filtering and monitoring system, and interconnecting piping.

The batch treatment system uses a storage pond for untreated stormwater, followed by a minimum of two lined treatment cells. Multiple treatment cells allow for clarification of chemically treated water in one cell, while other cells are being filled or emptied. Treatment cells may be ponds or tanks. Ponds with constructed earthen embankments greater than six feet high or which impound more than 10 acre-feet are subject to the Washington Dam Safety Regulations ([Chapter 173-175 WAC](#)).

See [BMP D.1: Detention Ponds](#) for more information regarding dam safety considerations for ponds.

Stormwater is collected at interception point(s) on the site and is diverted by gravity or by pumping to an untreated stormwater storage pond or other untreated stormwater holding area. The stormwater is stored until treatment occurs. It is important that the storage pond is large enough to provide adequate storage.

The first step in the treatment sequence is to check the pH of the stormwater in the untreated stormwater storage pond. The pH is adjusted by the application of carbon dioxide or a base until the stormwater in the untreated storage pond is within the desired pH range, 6.5 to 8.5. When used, carbon dioxide is added immediately downstream of the transfer pump. Typically sodium bicarbonate (baking soda) is used as a base, although other bases may be used. When needed, base is added directly to the untreated stormwater storage pond. The stormwater is recirculated with the treatment pump to provide mixing in the storage pond. Initial pH adjustments should be based on daily bench tests. Further pH adjustments can be made at any point in the process. See [BMP C252: Treating and Disposing of High pH Water](#) for more information on pH adjustments as a part of chemical treatment.

Once the stormwater is within the desired pH range (which is dependant on the coagulant being used), the stormwater is pumped from the untreated stormwater storage pond to a lined treatment cell as a coagulant is added. The coagulant is added upstream of the pump to facilitate rapid mixing.

The water is kept in the lined treatment cell for clarification. In a batch mode process, clarification typically takes from 30 minutes to several hours. Prior to discharge, samples are withdrawn for analysis of pH, coagulant concentration, and turbidity. If these levels are acceptable, the treated water is withdrawn, filtered, and discharged.

Several configurations have been developed to withdraw treated water from the treatment cell. The original configuration is a device that withdraws the treated water from just beneath the water surface using a float with adjustable struts that prevent the float from settling on the cell bottom. This reduces the possibility of picking up floc from the bottom of the cell. The struts are usually set at a minimum clearance of about 12 inches; that is, the float will come within 12 inches of the bottom of the cell. Other systems have used vertical guides or cables which constrain the float, allowing it to drift up and down with the water level. More recent designs have an H-shaped array of pipes, set on the horizontal. This scheme provides for withdrawal from four points rather than one. This configuration reduces the likelihood of sucking settled solids from the bottom. It also reduces the tendency for a vortex to form. Inlet diffusers, a long floating or fixed pipe with many small holes in it, are also an option.

Safety is a primary concern. Design should consider the hazards associated with operations, such as sampling. Facilities should be designed to reduce slip hazards and drowning. Tanks and ponds should have life rings, ladders, or steps extending from the bottom to the top.

### **Sizing Batch Chemical Treatment Systems**

Chemical treatment systems must be designed to control the velocity and peak volumetric flow rate that is discharged from the system and consequently the project site. See [Element 3: Control Flow Rates](#) for further details on this requirement.

The total volume of the untreated stormwater storage pond and treatment cells must be large enough to treat stormwater that is produced during multiple day storm events. It is recommended that at a minimum the untreated stormwater storage pond be sized to hold 1.5 times the volume of runoff generated from the site during the 10-year, 24-hour storm event. Bypass should be provided around the chemical treatment system to accommodate extreme storm events. Runoff volume shall be calculated using the methods presented in [III-2.3 Single Event Hydrograph Method](#). Worst-case land cover conditions (i.e., producing the most runoff) should be used for analyses (in most cases, this would be the land cover conditions just prior to final landscaping).

Primary settling should be encouraged in the untreated stormwater storage pond. A forebay with access for maintenance may be beneficial.

There are two opposing considerations in sizing the treatment cells. A larger cell is able to treat a larger volume of water each time a batch is processed. However, the larger the cell, the longer the time required to empty the cell. A larger cell may also be less effective at flocculation and therefore require a longer settling time. The simplest approach to sizing the treatment cell is to multiply the allowable discharge flow rate (as determined by the guidance in [Element 3: Control Flow Rates](#)) times the desired drawdown time. A 4-hour drawdown time allows one batch per cell per 8-hour work period, given 1 hour of flocculation followed by two hours of settling.

See [BMP C251: Construction Stormwater Filtration](#) for details on sizing the filtration system at the end of the batch chemical treatment system.

If the chemical treatment system design does not allow you to discharge at the rates as required by [Element 3: Control Flow Rates](#), and if the site has a permanent Flow Control BMP that will serve the planned development, the discharge from the chemical treatment system may be directed to the permanent Flow Control BMP to comply with [Element 3: Control Flow Rates](#). In this case, all discharge (including water passing through the treatment system and stormwater bypassing the treatment 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.

## ***Flow-Through Chemical Treatment Systems***

### **Background on Flow-Through Chemical Treatment Systems**

A flow-through chemical treatment system adds a sand filtration component to the batch chemical treatment system's treatment train following flocculation. The coagulant is added to the stormwater upstream of the sand filter so that the coagulation and flocculation step occur immediately prior to the filter. The advantage of a flow-through chemical treatment system is the time saved by immediately filtering the water, as opposed to waiting for the clarification process necessary in a batch chemical

treatment system. See [BMP C251: Construction Stormwater Filtration](#) for more information on filtration.

### **Design and Installation of Flow-Through Chemical Treatment Systems**

At a minimum, a flow-through chemical treatment system consists of a stormwater collection system (either a temporary diversion or the permanent site drainage system), an untreated stormwater storage pond, and a chemically enhanced sand filtration system.

As with a batch treatment system, stormwater is collected at interception point(s) on the site and is diverted by gravity or by pumping to an untreated stormwater storage pond or other untreated stormwater holding area. The stormwater is stored until treatment occurs. It is important that the holding pond be large enough to provide adequate storage.

Stormwater is then pumped from the untreated stormwater storage pond to the chemically enhanced sand filtration system where a coagulant is added. Adjustments to pH may be necessary before coagulant addition. The sand filtration system continually monitors the stormwater effluent for turbidity and pH. If the discharge water is ever out of an acceptable range for turbidity or pH, the water is returned to the untreated stormwater pond where it will begin the treatment process again.

### **Sizing Flow-Through Chemical Treatment Systems**

Refer to [BMP C251: Construction Stormwater Filtration](#) for sizing requirements of flow-through chemical treatment systems.

## ***Factors Affecting the Chemical Treatment Process***

### **Coagulants**

Cationic polymers can be used as coagulants to destabilize negatively charged turbidity particles present in natural waters, wastewater and stormwater. Polymers are large organic molecules that are made up of subunits linked together in a chain-like structure. Attached to these chain-like structures are other groups that carry positive or negative charges, or have no charge. Polymers that carry groups with positive charges are called cationic, those with negative charges are called anionic, and those with no charge (neutral) are called nonionic. In practice, the only way to determine whether a polymer is effective for a specific application is to perform preliminary or on-site testing.

Aluminum sulfate (alum) can also be used as a coagulant, as this chemical becomes positively charged when dispersed in water.

Polymers are available as powders, concentrated liquids, and emulsions (which appear as milky liquids). The latter are petroleum based, which are not allowed for construction stormwater treatment. Polymer effectiveness can degrade with time and also from other influences. Thus, manufacturers' recommendations for storage should be followed. Manufacturer's recommendations usually do not provide assurance of water quality protection or safety to aquatic organisms. Consideration of water quality protection is necessary in the selection and use of all polymers.

## **Application**

Application of coagulants at the appropriate concentration or dosage rate for optimum turbidity removal is important for management of chemical cost, for effective performance, and to avoid aquatic toxicity. The optimum dose in a given application depends on several site-specific features. Turbidity of untreated water can be important with turbidities greater than 5,000 NTU. The surface charge of particles to be removed is also important. Environmental factors that can influence dosage rate are water temperature, pH, and the presence of constituents that consume or otherwise affect coagulant effectiveness. Laboratory experiments indicate that mixing previously settled sediment (floc sludge) with the untreated stormwater significantly improves clarification, therefore reducing the effective dosage rate. Preparation of working solutions and thorough dispersal of coagulants in water to be treated is also important to establish the appropriate dosage rate.

For a given water sample, there is generally an optimum dosage rate that yields the lowest residual turbidity after settling. When dosage rates below this optimum value (underdosing) are applied, there is an insufficient quantity of coagulant to react with, and therefore destabilize, all of the turbidity present. The result is residual turbidity (after flocculation and settling) that is higher than with the optimum dose. Overdosing, application of dosage rates greater than the optimum value, can also negatively impact performance. Like underdosing, the result of overdosing is higher residual turbidity than that with the optimum dose.

## **Mixing**

The G-value, or just "G", is often used as a measure of the mixing intensity applied during coagulation and flocculation. The symbol G stands for "velocity gradient", which is related in part to the degree of turbulence generated during mixing. High G-values mean high turbulence, and vice versa.

High G-values provide the best conditions for coagulant addition. With high G's, turbulence is high and coagulants are rapidly dispersed to their appropriate concentrations for effective destabilization of particle suspensions.

Low G-values provide the best conditions for flocculation. Here, the goal is to promote formation of dense, compact flocs that will settle readily. Low G's provide low turbulence to promote particle collisions so that flocs can form. Low G's generate sufficient turbulence such that collisions are effective in floc formation, but do not break up flocs that have already formed.

## **pH Adjustment**

The pH must be in the proper range for the coagulants to be effective, which is typically 6.5 to 8.5. As polymers tend to lower the pH, it is important that the stormwater have sufficient buffering capacity. Buffering capacity is a function of alkalinity. Without sufficient alkalinity, the application of the polymer may lower the pH to below 6.5. A pH below 6.5 not only reduces the effectiveness of the polymer as a coagulant, but it may also create a toxic condition for aquatic organisms. Stormwater may not be discharged without readjustment of the pH to above 6.5. The target pH should be within 0.2 standard units of the receiving water's pH.

Experience gained at several projects in the City of Redmond has shown that the alkalinity needs to be at least 50 mg/L to prevent a drop in pH to below 6.5 when the polymer is added.

## ***Maintenance Standards***

### **Monitoring**

At a minimum, the following monitoring shall be conducted. Test results shall be recorded on a daily log kept on site. Additional testing may be required by the NPDES permit based on site conditions.

- Operational Monitoring
  - Total volume treated and discharged.
  - Flow must be continuously monitored and recorded at not greater than 15-minute intervals.
  - Type and amount of chemical used for pH adjustment.
  - Type and amount of coagulant used for treatment.
  - Settling time.
- Compliance Monitoring
  - Influent and effluent pH, flocculent chemical concentration, and turbidity must be continuously monitored and recorded at not greater than 15-minute intervals.
  - pH and turbidity of the receiving water.
- Biomonitoring
  - Treated stormwater must be non-toxic to aquatic organisms. Treated stormwater must be tested for aquatic toxicity or residual chemicals. Frequency of biomonitoring will be determined by Ecology.
  - Residual chemical tests must be approved by Ecology prior to their use.
  - If testing treated stormwater for aquatic toxicity, you must test for acute (lethal) toxicity. Bioassays shall be conducted by a laboratory accredited by Ecology, unless otherwise approved by Ecology. Acute toxicity tests shall be conducted per the CTAPE protocol and Appendix G of *Whole Effluent Toxicity Testing Guidance and Test Review Criteria* ([Marshall, 2016](#)).

### **Discharge Compliance**

Prior to discharge, treated stormwater must be sampled and tested for compliance with pH, flocculent chemical concentration, and turbidity limits. These limits may be established by the Construction Stormwater General Permit or a site-specific discharge permit. Sampling and testing for other pollutants may also be necessary at some sites. pH must be within the range of 6.5 to 8.5 standard units and not cause a change in the pH of the receiving water by more than 0.2 standard units. Treated stormwater samples and measurements shall be taken from the discharge pipe or another location representative of the nature of the treated stormwater discharge. Samples used for determining compliance with the water quality standards in the receiving water shall not be taken from the

treatment pond prior to decanting. Compliance with the water quality standards is determined in the receiving water.

### **Operator Training**

Each project site using chemical treatment must have a trained operator who is certified for operation of an Enhanced Chemical Treatment system. The operator must be trained and certified by an organization approved by Ecology. Organizations approved for operator training are found at the following website:

<https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Contaminated-water-on-construction-sites>

### **Sediment Removal and Disposal**

- Sediment shall be removed from the untreated stormwater storage pond and treatment cells as necessary. Typically, sediment removal is required at least once during a wet season and at the decommissioning of the chemical treatment system. Sediment remaining in the cells between batches may enhance the settling process and reduce the required chemical dosage.
- Sediment that is known to be non-toxic may be incorporated into the site away from drainages.

## **BMP C251: Construction Stormwater Filtration**

### ***Purpose***

Filtration removes sediment from runoff originating from disturbed areas of the site.

### ***Conditions of Use***

Traditional Construction Stormwater BMPs used to control soil erosion and sediment loss from construction sites may not be adequate to ensure compliance with the water quality standard for turbidity in the receiving water. Filtration may be used in conjunction with gravity settling to remove sediment as small as fine silt (0.5 µm). The reduction in turbidity will be dependent on the particle size distribution of the sediment in the stormwater. In some circumstances, sedimentation and filtration may achieve compliance with the water quality standard for turbidity.

The use of construction stormwater filtration does not require approval from Ecology as long as treatment chemicals are not used. Filtration in conjunction with [BMP C250: Construction Stormwater Chemical Treatment](#) requires testing under the Chemical Technology Assessment Protocol – Ecology (CTAPE) before it can be initiated. Approval from Ecology must be obtained at each site where chemical use is proposed prior to use. See <https://fortress.wa.gov/ecy/publications/SummaryPages/ecy070258.html> for a copy of the Request for Chemical Treatment form.

## ***Design and Installation Specifications***

Two types of filtration systems may be applied to construction stormwater treatment: rapid and slow.

Rapid filtration systems are the typical system used for water and wastewater treatment. They can achieve relatively high hydraulic flow rates, on the order of 2 to 20 gpm/sf, because they have automatic backwash systems to remove accumulated solids.

Slow filtration systems have very low hydraulic rates, on the order of 0.02 gpm/sf, because they do not have backwash systems. Slow filtration systems have generally been used as post construction BMPs to treat stormwater (see [V-6 Filtration BMPs](#)). Slow filtration is mechanically simple in comparison to rapid filtration, but requires a much larger filter area.

### **Filter Types and Efficiencies**

Sand media filters are available with automatic backwashing features that can filter to 50 µm particle size. Screen or bag filters can filter down to 5 µm. Fiber wound filters can remove particles down to 0.5 µm. Filters should be sequenced from the largest to the smallest pore opening. Sediment removal efficiency will be related to particle size distribution in the stormwater.

### **Treatment Process and Description**

Stormwater is collected at interception point(s) on the site and diverted to an untreated stormwater sediment pond or tank for removal of large sediment, and storage of the stormwater before it is treated by the filtration system. In a rapid filtration system, the untreated stormwater is pumped from the pond or tank through the filtration media. Slow filtration systems are designed using gravity to convey water from the pond or tank to and through the filtration media.

### **Sizing**

Filtration treatment systems must be designed to control the velocity and peak volumetric flow rate that is discharged from the system and consequently the project site. See [Element 3: Control Flow Rates](#) for further details on this requirement.

The untreated stormwater storage pond or tank should be sized to hold 1.5 times the volume of runoff generated from the site during the 10-year, 24-hour storm event, minus the filtration treatment system flowrate for an 8-hour period. For a chitosan-enhanced sand filtration system, the filtration treatment system flowrate should be sized using a hydraulic loading rate between 6-8 gpm/ft<sup>2</sup>. Other hydraulic loading rates may be more appropriate for other systems. Bypass should be provided around the filtration treatment system to accommodate extreme storm events. Runoff volume shall be calculated using the methods presented in [III-2.3 Single Event Hydrograph Method](#). Worst-case land cover conditions (i.e., producing the most runoff) should be used for analyses (in most cases, this would be the land cover conditions just prior to final landscaping).

If the filtration treatment system design does not allow you to discharge at the rates as required by [Element 3: Control Flow Rates](#), and if the site has a permanent Flow Control BMP that will serve the planned development, the discharge from the filtration treatment system may be directed to the permanent Flow Control BMP to comply with [Element 3: Control Flow Rates](#). In this case, all discharge (including water passing through the treatment system and stormwater bypassing the treatment

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<sub>2</sub> 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<sub>2</sub>) is added to water (H<sub>2</sub>O), carbonic acid (H<sub>2</sub>CO<sub>3</sub>) is formed which can further dissociate into a proton (H<sup>+</sup>) and a bicarbonate anion (HCO<sub>3</sub><sup>-</sup>) as shown below:



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<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> sparging, but add food grade vinegar instead of CO<sub>2</sub>.

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<sub>2</sub> 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.

**Appendix C - Site Inspection Form**

# Construction Stormwater Site Inspection Form

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

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

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

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

Current Weather    Clear     Cloudy     Mist     Rain     Wind     Fog

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

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

|  |                          |                                 |                          |                            |                          |
|--|--------------------------|---------------------------------|--------------------------|----------------------------|--------------------------|
| Pre Construction/installation of erosion/sediment controls | <input type="checkbox"/> | Clearing/Demo/Grading           | <input type="checkbox"/> | Infrastructure/storm/roads | <input type="checkbox"/> |
| Concrete pours   | <input type="checkbox"/> | Vertical Construction/buildings | <input type="checkbox"/> | Utilities                  | <input type="checkbox"/> |
| Offsite improvements                                       | <input type="checkbox"/> | Site temporary stabilized       | <input type="checkbox"/> | Final stabilization        | <input type="checkbox"/> |

**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? ( <i>refer to permit conditions S4 &amp; S5</i> ) | 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 |            |
| <i>Turbidity</i> | tube, meter, laboratory |        |    |    |            |
| <i>pH</i>        | Paper, kit, meter       |        |    |    |            |

# Construction Stormwater Site Inspection Form

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

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

## Construction Stormwater Site Inspection Form

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

# Construction Stormwater Site Inspection Form

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

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

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

## Construction Stormwater Site Inspection Form

---

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: \_\_\_\_\_

**Appendix D - Construction Stormwater General Permit  
(CSWGP)**

Issuance Date: November 18, 2020  
Effective Date: January 1, 2021  
Expiration Date: December 31, 2025

# CONSTRUCTION STORMWATER GENERAL PERMIT

National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge  
General Permit for Stormwater Discharges Associated with Construction Activity

**State of Washington**  
**Department of Ecology**  
Olympia, Washington 98504

In compliance with the provisions of  
Chapter 90.48 Revised Code of Washington  
(State of Washington Water Pollution Control Act)  
and  
Title 33 United States Code, Section 1251 et seq.  
The Federal Water Pollution Control Act (The Clean Water Act)

Until this permit expires, is modified, or revoked, Permittees that have properly  
obtained coverage under this general permit are authorized to discharge in accordance  
with the special and general conditions that follow.



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Vincent McGowan, P.E.  
Water Quality Program Manager  
Washington State Department of Ecology

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## SUMMARY OF PERMIT REPORT SUBMITTALS

Refer to the Special and General Conditions within this permit for additional submittal requirements. Appendix A provides a list of definitions. Appendix B provides a list of acronyms.

**Table 1 Summary of Required Submittals**

| Permit Section                              | Submittal   | Frequency      | First Submittal Date  |
|---|---|----------------|---|
| <a href="#">S5.A</a> and <a href="#">S8</a> | High Turbidity/Transparency Phone Reporting                 | As Necessary   | Within 24 hours   |
| <a href="#">S5.B</a>                        | Discharge Monitoring Report                                 | Monthly*       | Within 15 days following the end of each month  |
| <a href="#">S5.F</a> and <a href="#">S8</a> | Noncompliance Notification – Telephone Notification         | As necessary   | Within 24 hours   |
| <a href="#">S5.F</a>                        | Noncompliance Notification – Written Report                 | As necessary   | Within 5 Days of non-compliance   |
| <a href="#">S9.D</a>                        | Request for Chemical Treatment Form                         | As necessary   | Written approval from Ecology is required prior to using chemical treatment (with the exception of dry ice, CO <sub>2</sub> or food grade vinegar to adjust pH) |
| <a href="#">G2</a>                          | Notice of Change in Authorization                           | As necessary   |   |
| <a href="#">G6</a>                          | Permit Application for Substantive Changes to the Discharge | As necessary   |   |
| <a href="#">G8</a>                          | Application for Permit Renewal                              | 1/permit cycle | No later than 180 days before expiration  |
| <a href="#">S2.A</a>                        | Notice of Permit Transfer                                   | As necessary   |   |
| <a href="#">G19</a>                         | Notice of Planned Changes                                   | As necessary   |   |
| <a href="#">G21</a>                         | Reporting Anticipated Non-compliance                        | As necessary   |   |

**NOTE:** \*Permittees must submit electronic Discharge Monitoring Reports (DMRs) to the Washington State Department of Ecology monthly, regardless of site discharge, for the full duration of permit coverage. Refer to Section S5.B of this General Permit for more specific information regarding DMRs.

**Table 2 Summary of Required On-site Documentation**

| Document Title                                 | Permit Conditions     |
|--|-----------------------|
| Permit Coverage Letter                         | See Conditions S2, S5 |
| Construction Stormwater General Permit (CSWGP) | See Conditions S2, S5 |
| Site Log Book                                  | See Conditions S4, S5 |
| Stormwater Pollution Prevention Plan (SWPPP)   | See Conditions S5, S9 |
| Site Map                                       | See Conditions S5, S9 |

# SPECIAL CONDITIONS

## S1. PERMIT COVERAGE

### A. Permit Area

This Construction Stormwater General Permit (CSWGP) covers all areas of Washington State, except for federal operators and Indian Country as specified in Special Condition S1.E.3 and 4.

### B. Operators Required to Seek Coverage Under this General Permit

1. Operators of the following construction activities are required to seek coverage under this CSWGP:
  - a. Clearing, grading and/or excavation that results in the disturbance of one or more acres (including off-site disturbance acreage related to construction-support activity as authorized in S1.C.2) and discharges stormwater to surface waters of the State; and clearing, grading and/or excavation on sites smaller than one acre that are part of a larger common plan of development or sale, if the common plan of development or sale will ultimately disturb one acre or more and discharge stormwater to surface waters of the State.
    - i. This category includes forest practices (including, but not limited to, class IV conversions) that are part of a construction activity that will result in the disturbance of one or more acres, and discharge to surface waters of the State (that is, forest practices that prepare a site for construction activities); and
  - b. Any size construction activity discharging stormwater to waters of the State that the Washington State Department of Ecology (Ecology):
    - i. Determines to be a significant contributor of pollutants to waters of the State of Washington.
    - ii. Reasonably expects to cause a violation of any water quality standard.
2. Operators of the following activities are not required to seek coverage under this CSWGP (unless specifically required under Special Condition S1.B.1.b, above):
  - a. Construction activities that discharge all stormwater and non-stormwater to groundwater, sanitary sewer, or combined sewer, and have no point source discharge to either surface water or a storm sewer system that drains to surface waters of the State.
  - b. Construction activities covered under an Erosivity Waiver (Special Condition S1.F).
  - c. Routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of a facility.

### C. Authorized Discharges

1. **Stormwater Associated with Construction Activity.** Subject to compliance with the terms and conditions of this permit, Permittees are authorized to discharge stormwater associated with construction activity to surface waters of the State or to a storm sewer system that drains to surface waters of the State. (Note that “surface waters of the

State” may exist on a construction site as well as off site; for example, a creek running through a site.)

2. **Stormwater Associated with Construction Support Activity.** This permit also authorizes stormwater discharge from support activities related to the permitted construction site (for example, an on-site portable rock crusher, off-site equipment staging yards, material storage areas, borrow areas, etc.) provided:
  - a. The support activity relates directly to the permitted construction site that is required to have an NPDES permit; and
  - b. The support activity is not a commercial operation serving multiple unrelated construction projects, and does not operate beyond the completion of the construction activity; and
  - c. Appropriate controls and measures are identified in the Stormwater Pollution Prevention Plan (SWPPP) for the discharges from the support activity areas.
3. **Non-Stormwater Discharges.** The categories and sources of non-stormwater discharges identified below are authorized conditionally, provided the discharge is consistent with the terms and conditions of this permit:
  - a. Discharges from fire-fighting activities.
  - b. Fire hydrant system flushing.
  - c. Potable water, including uncontaminated water line flushing.
  - d. Hydrostatic test water.
  - e. Uncontaminated air conditioning or compressor condensate.
  - f. Uncontaminated groundwater or spring water.
  - g. Uncontaminated excavation dewatering water (in accordance with S9.D.10).
  - h. Uncontaminated discharges from foundation or footing drains.
  - i. Uncontaminated or potable water used to control dust. Permittees must minimize the amount of dust control water used.
  - j. Routine external building wash down that does not use detergents.
  - k. Landscape irrigation water.

The SWPPP must adequately address all authorized non-stormwater discharges, except for discharges from fire-fighting activities, and must comply with Special Condition S3. At a minimum, discharges from potable water (including water line flushing), fire hydrant system flushing, and pipeline hydrostatic test water must undergo the following: dechlorination to a concentration of 0.1 parts per million (ppm) or less, and pH adjustment to within 6.5 – 8.5 standard units (su), if necessary.

#### **D. Prohibited Discharges**

The following discharges to waters of the State, including groundwater, are prohibited:

1. Concrete wastewater
2. Wastewater from washout and clean-up of stucco, paint, form release oils, curing compounds and other construction materials.
3. Process wastewater as defined by 40 Code of Federal Regulations (CFR) 122.2 (See Appendix A of this permit).
4. Slurry materials and waste from shaft drilling, including process wastewater from shaft drilling for construction of building, road, and bridge foundations unless managed according to Special Condition S9.D.9.j.
5. Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance.
6. Soaps or solvents used in vehicle and equipment washing.
7. Wheel wash wastewater, unless managed according to Special Condition S9.D.9.
8. Discharges from dewatering activities, including discharges from dewatering of trenches and excavations, unless managed according to Special Condition S9.D.10.

#### **E. Limits on Coverage**

Ecology may require any discharger to apply for and obtain coverage under an individual permit or another more specific general permit. Such alternative coverage will be required when Ecology determines that this CSWGP does not provide adequate assurance that water quality will be protected, or there is a reasonable potential for the project to cause or contribute to a violation of water quality standards.

The following stormwater discharges are not covered by this permit:

1. Post-construction stormwater discharges that originate from the site after completion of construction activities and the site has undergone final stabilization.
2. Non-point source silvicultural activities such as nursery operations, site preparation, reforestation and subsequent cultural treatment, thinning, prescribed burning, pest and fire control, harvesting operations, surface drainage, or road construction and maintenance, from which there is natural runoff as excluded in 40 CFR Subpart 122.
3. Stormwater from any federal operator.
4. Stormwater from facilities located on **Indian Country** as defined in 18 U.S.C. §1151, except portions of the Puyallup Reservation as noted below.

**Indian Country** includes:

- a. All land within any Indian Reservation notwithstanding the issuance of any patent, and, including rights-of-way running through the reservation. This includes all federal, tribal, and Indian and non-Indian privately owned land within the reservation.
- b. All off-reservation Indian allotments, the Indian titles to which have not been extinguished, including rights-of-way running through the same.
- c. All off-reservation federal trust lands held for Native American Tribes.

Puyallup Exception: Following the *Puyallup Tribes of Indians Land Settlement Act of 1989*, 25 U.S.C. §1773; the permit does apply to land within the Puyallup Reservation except for discharges to surface water on land held in trust by the federal government.

5. Stormwater from any site covered under an existing NPDES individual permit in which stormwater management and/or treatment requirements are included for all stormwater discharges associated with construction activity.
6. Stormwater from a site where an applicable Total Maximum Daily Load (TMDL) requirement specifically precludes or prohibits discharges from construction activity.

#### **F. Erosivity Waiver**

Construction site operators may qualify for an Erosivity Waiver from the CSWGP if the following conditions are met:

1. The site will result in the disturbance of fewer than five (5) acres and the site is not a portion of a common plan of development or sale that will disturb five (5) acres or greater.
2. Calculation of Erosivity “R” Factor and Regional Timeframe:
  - a. The project’s calculated rainfall erosivity factor (“R” Factor) must be less than five (5) during the period of construction activity, (See the CSWGP homepage <http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html> for a link to the EPA’s calculator and step by step instructions on computing the “R” Factor in the *EPA Erosivity Waiver Fact Sheet*). The period of construction activity starts when the land is first disturbed and ends with final stabilization. In addition:
  - b. The entire period of construction activity must fall within the following timeframes:
    - i. For sites west of the Cascades Crest: June 15 – September 15.
    - ii. For sites east of the Cascades Crest, excluding the Central Basin: June 15 – October 15.
    - iii. For sites east of the Cascades Crest, within the Central Basin: no timeframe restrictions apply. The Central Basin is defined as the portions of Eastern Washington with mean annual precipitation of less than 12 inches. For a map of the Central Basin (Average Annual Precipitation Region 2), refer to: <http://www.ecy.wa.gov/programs/wq/stormwater/construction/resourcesguidance.html>.
3. Construction site operators must submit a complete Erosivity Waiver certification form at least one week before disturbing the land. Certification must include statements that the operator will:
  - a. Comply with applicable local stormwater requirements; and
  - b. Implement appropriate erosion and sediment control BMPs to prevent violations of water quality standards.
4. This waiver is not available for facilities declared significant contributors of pollutants as defined in Special Condition S1.B.1.b or for any size construction activity that could

reasonably expect to cause a violation of any water quality standard as defined in Special Condition S1.B.1.b.ii.

5. This waiver does not apply to construction activities which include non-stormwater discharges listed in Special Condition S1.C.3.
6. If construction activity extends beyond the certified waiver period for any reason, the operator must either:
  - a. Recalculate the rainfall erosivity “R” factor using the original start date and a new projected ending date and, if the “R” factor is still under 5 *and* the entire project falls within the applicable regional timeframe in Special Condition S1.F.2.b, complete and submit an amended waiver certification form before the original waiver expires; *or*
  - b. Submit a complete permit application to Ecology in accordance with Special Condition S2.A and B before the end of the certified waiver period.

## S2. APPLICATION REQUIREMENTS

### A. Permit Application Forms

#### 1. *Notice of Intent Form*

- a. Operators of new or previously unpermitted construction activities must submit a complete and accurate permit application (Notice of Intent, or NOI) to Ecology.
- b. Operators must apply using the electronic application form (NOI) available on Ecology’s website (<http://ecy.wa.gov/programs/wq/stormwater/construction/index.html>). Permittees unable to submit electronically (for example, those who do not have an internet connection) must contact Ecology to request a waiver and obtain instructions on how to obtain a paper NOI.

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Olympia, Washington 98504-7696

- c. The operator must submit the NOI at least 60 days before discharging stormwater from construction activities and must submit it prior to the date of the first public notice (See Special Condition S2.B, below, for details). The 30-day public comment period begins on the publication date of the second public notice. Unless Ecology responds to the complete application in writing, coverage under the general permit will automatically commence on the 31<sup>st</sup> day following receipt by Ecology of a *completed* NOI, or the issuance date of this permit, whichever is later; unless Ecology specifies a later date in writing as required by WAC173-226-200(2). See S8.B for Limits on Coverage for New Discharges to TMDL or 303(d)-Listed Waters.
- d. If an applicant intends to use a Best Management Practice (BMP) selected on the basis of Special Condition S9.C.4 (“demonstrably equivalent” BMPs), the applicant must notify Ecology of its selection as part of the NOI. In the event the applicant selects BMPs after submission of the NOI, the applicant must provide notice of the

selection of an equivalent BMP to Ecology at least 60 days before intended use of the equivalent BMP.

- e. Applicants must notify Ecology if they are aware of contaminated soils and/or groundwater associated with the construction activity. Provide detailed information with the NOI (as known and readily available) on the nature and extent of the contamination (concentrations, locations, and depth), as well as pollution prevention and/or treatment BMPs proposed to control the discharge of soil and/or groundwater contaminants in stormwater. Examples of such detail may include, but are not limited to:
  - i. List or table of all known contaminants with laboratory test results showing concentration and depth,
  - ii. Map with sample locations,
  - iii. Related portions of the Stormwater Pollution Prevention Plan (SWPPP) that address the management of contaminated and potentially contaminated construction stormwater and dewatering water,
  - iv. Dewatering plan and/or dewatering contingency plan.

## 2. ***Transfer of Coverage Form***

The Permittee can transfer current coverage under this permit to one or more new operators, including operators of sites within a Common Plan of Development, provided:

- i. The Permittee submits a complete Transfer of Coverage Form to Ecology, signed by the current and new discharger and containing a specific date for transfer of permit responsibility, coverage and liability (including any Administrative Orders associated with the permit); and
- ii. Ecology does not notify the current discharger and new discharger of intent to revoke coverage under the general permit. If this notice is not given, the transfer is effective on the date specified in the written agreement.

When a current discharger (Permittee) transfers a portion of a permitted site, the current discharger must also indicate the remaining permitted acreage after the transfer. Transfers do not require public notice.

## 3. ***Modification of Coverage Form***

Permittees must notify Ecology regarding any changes to the information provided on the NOI by submitting an Update/Modification of Permit Coverage form in accordance with General Conditions G6 and G19. Examples of such changes include, but are not limited to:

- i. Changes to the Permittee's mailing address,
- ii. Changes to the on-site contact person information, and
- iii. Changes to the area/acreage affected by construction activity.

## B. Public Notice

For new or previously unpermitted construction activities, the applicant must publish a public notice at least one time each week for two consecutive weeks, at least 7 days apart, in a newspaper with general circulation in the county where the construction is to take place. The notice must be run after the NOI has been submitted and must contain:

1. A statement that *“The applicant is seeking coverage under the Washington State Department of Ecology’s Construction Stormwater NPDES and State Waste Discharge General Permit.”*
2. The name, address, and location of the construction site.
3. The name and address of the applicant.
4. The type of construction activity that will result in a discharge (for example, residential construction, commercial construction, etc.), and the total number of acres to be disturbed over the lifetime of the project.
5. The name of the receiving water(s) (that is, the surface water(s) to which the site will discharge), or, if the discharge is through a storm sewer system, the name of the operator of the system and the receiving water(s) the system discharges to.
6. The statement: *Any persons desiring to present their views to the Washington State Department of Ecology regarding this application, or interested in Ecology’s action on this application, may notify Ecology in writing no later than 30 days of the last date of publication of this notice. Ecology reviews public comments and considers whether discharges from this project would cause a measurable change in receiving water quality, and, if so, whether the project is necessary and in the overriding public interest according to Tier II antidegradation requirements under WAC 173-201A-320. Comments can be submitted to: Department of Ecology, PO Box 47696, Olympia, Washington 98504-7696 Attn: Water Quality Program, Construction Stormwater.*

## S3. COMPLIANCE WITH STANDARDS

- A. **Discharges must not** cause or contribute to a violation of surface water quality standards (Chapter 173-201A WAC), groundwater quality standards (Chapter 173-200 WAC), sediment management standards (Chapter 173-204 WAC), and human health-based criteria in the Federal water quality criteria applicable to Washington. (40 CFR Part 131.45) Discharges that are not in compliance with these standards are prohibited.
- B. **Prior to the discharge** of stormwater and non-stormwater to waters of the State, the Permittee must apply All Known, Available, and Reasonable methods of prevention, control, and Treatment (AKART). This includes the preparation and implementation of an adequate SWPPP, with all appropriate BMPs installed and maintained in accordance with the SWPPP and the terms and conditions of this permit.
- C. **Ecology presumes** that a Permittee complies with water quality standards unless discharge monitoring data or other site-specific information demonstrates that a discharge causes or contributes to a violation of water quality standards, when the Permittee complies with the following conditions. The Permittee must fully:

1. Comply with all permit conditions, including; planning, sampling, monitoring, reporting, and recordkeeping conditions.
  2. Implement stormwater BMPs contained in stormwater management manuals published or approved by Ecology, or BMPs that are demonstrably equivalent to BMPs contained in stormwater management manuals published or approved by Ecology, including the proper selection, implementation, and maintenance of all applicable and appropriate BMPs for on-site pollution control. (For purposes of this section, the stormwater manuals listed in Appendix 10 of the *Phase I Municipal Stormwater Permit* are approved by Ecology.)
- D. Where construction sites** also discharge to groundwater, the groundwater discharges must also meet the terms and conditions of this CSWGP. Permittees who discharge to groundwater through an injection well must also comply with any applicable requirements of the Underground Injection Control (UIC) regulations, Chapter 173-218 WAC.

## **S4. MONITORING REQUIREMENTS, BENCHMARKS, AND REPORTING TRIGGERS**

### **A. Site Log Book**

The Permittee must maintain a site log book that contains a record of the implementation of the SWPPP and other permit requirements, including the installation and maintenance of BMPs, site inspections, and stormwater monitoring.

### **B. Site Inspections**

Construction sites one (1) acre or larger that discharge stormwater to surface waters of the State must have site inspections conducted by a Certified Erosion and Sediment Control Lead (CESCL). Sites less than one (1) acre may have a person without CESCL certification conduct inspections. (See Special Conditions S4.B.3 and B.4, below, for detailed requirements of the Permittee's CESCL.)

Site inspections must include all areas disturbed by construction activities, all BMPs, and all stormwater discharge points under the Permittee's operational control.

1. The Permittee must have staff knowledgeable in the principles and practices of erosion and sediment control. The CESCL (sites one acre or more) or inspector (sites less than one acre) must have the skills to assess the:
  - a. Site conditions and construction activities that could impact the quality of stormwater; and
  - b. Effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges. The SWPPP must identify the CESCL or inspector, who must be present on site or on-call at all times. The CESCL (sites one (1) acre or more) must obtain this certification through an approved erosion and sediment control training program that meets the minimum training standards established by Ecology. (See BMP C160 in the manual, referred to in Special Condition S9.C.1 and 2.)
2. The CESCL or inspector must examine stormwater visually for the presence of suspended sediment, turbidity, discoloration, and oil sheen. BMP effectiveness must be evaluated to

determine if it is necessary to install, maintain, or repair BMPs to improve the quality of stormwater discharges.

Based on the results of the inspection, the Permittee must correct the problems identified, by:

- a. Reviewing the SWPPP for compliance with Special Condition S9 and making appropriate revisions within 7 days of the inspection.
  - b. Immediately beginning the process of fully implementing and maintaining appropriate source control and/or treatment BMPs, within 10 days of the inspection. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when an extension is requested by a Permittee within the initial 10-day response period.
  - c. Documenting BMP implementation and maintenance in the site log book.
3. The CESCL or inspector must inspect all areas disturbed by construction activities, all BMPs, and all stormwater discharge points at least once every calendar week and within 24 hours of any discharge from the site. (For purposes of this condition, individual discharge events that last more than one (1) day do not require daily inspections. For example, if a stormwater pond discharges continuously over the course of a week, only one (1) inspection is required that week.) Inspection frequency may be reduced to once every calendar month for inactive sites that are temporarily stabilized.
4. The Permittee must summarize the results of each inspection in an inspection report or checklist and enter the report/checklist into, or attach it to, the site log book. At a minimum, each inspection report or checklist must include:
- a. Inspection date and time.
  - b. Weather information.
  - c. The general conditions during inspection.
  - d. The approximate amount of precipitation since the last inspection.
  - e. The approximate amount of precipitation within the last 24 hours.
  - f. A summary or list of all implemented BMPs, including observations of all erosion/sediment control structures or practices.
  - g. A description of:
    - i. BMPs inspected (including location).
    - ii. BMPs that need maintenance and why.
    - iii. BMPs that failed to operate as designed or intended, and
    - iv. Where additional or different BMPs are needed, and why.
  - h. A description of stormwater discharged from the site. The Permittee must note the presence of suspended sediment, turbidity, discoloration, and oil sheen, as applicable.

- i. Any water quality monitoring performed during inspection.
- j. General comments and notes, including a brief description of any BMP repairs, maintenance, or installations made following the inspection.
- k. An implementation schedule for the remedial actions that the Permittee plans to take if the site inspection indicates that the site is out of compliance. The remedial actions taken must meet the requirements of the SWPPP and the permit.
- l. A summary report of the inspection.
- m. The name, title, and signature of the person conducting the site inspection, a phone number or other reliable method to reach this person, and the following statement:  
*I certify that this report is true, accurate, and complete to the best of my knowledge and belief.*

**Table 3 Summary of Primary Monitoring Requirements**

| Size of Soil Disturbance <sup>1</sup>  | Weekly Site Inspections | Weekly Sampling w/ Turbidity Meter             | Weekly Sampling w/ Transparency Tube | Weekly pH Sampling <sup>2</sup> | CESCL Required for Inspections? |
|--|-------------------------|--|--------------------------------------|---------------------------------|---------------------------------|
| Sites that disturb less than 1 acre, but are part of a larger Common Plan of Development | Required                | Not Required                                   | Not Required                         | Not Required                    | No                              |
| Sites that disturb 1 acre or more, but fewer than 5 acres                                | Required                | Sampling Required – either method <sup>3</sup> |                                      | Required                        | Yes                             |
| Sites that disturb 5 acres or more   | Required                | Required                                       | Not Required <sup>4</sup>            | Required                        | Yes                             |

<sup>1</sup> Soil disturbance is calculated by adding together all areas that will be affected by construction activity. Construction activity means clearing, grading, excavation, and any other activity that disturbs the surface of the land, including ingress/egress from the site.

<sup>2</sup> If construction activity results in the disturbance of 1 acre or more, and involves significant concrete work (1,000 cubic yards of concrete or recycled concrete placed or poured over the life of a project) or the use of engineered soils (soil amendments including but not limited to Portland cement-treated base [CTB], cement kiln dust [CKD], or fly ash), and stormwater from the affected area drains to surface waters of the State or to a storm sewer stormwater collection system that drains to other surface waters of the State, the Permittee must conduct pH sampling in accordance with Special Condition S4.D.

<sup>3</sup> Sites with one or more acres, but fewer than 5 acres of soil disturbance, must conduct turbidity or transparency sampling in accordance with Special Condition S4.C.4.a or b.

<sup>4</sup> Sites equal to or greater than 5 acres of soil disturbance must conduct turbidity sampling using a turbidity meter in accordance with Special Condition S4.C.4.a.

## C. Turbidity/Transparency Sampling Requirements

### 1. Sampling Methods

- a. If construction activity involves the disturbance of five (5) acres or more, the Permittee must conduct turbidity sampling per Special Condition S4.C.4.a, below.
- b. If construction activity involves one (1) acre or more but fewer than five (5) acres of soil disturbance, the Permittee must conduct either transparency sampling *or* turbidity sampling per Special Condition S4.C.4.a or b, below.

### 2. Sampling Frequency

- a. The Permittee must sample all discharge points at least once every calendar week when stormwater (or authorized non-stormwater) discharges from the site or enters any on-site surface waters of the state (for example, a creek running through a site); sampling is not required on sites that disturb less than an acre.
- b. Samples must be representative of the flow and characteristics of the discharge.
- c. Sampling is not required when there is no discharge during a calendar week.
- d. Sampling is not required outside of normal working hours or during unsafe conditions.
- e. If the Permittee is unable to sample during a monitoring period, the Permittee must include a brief explanation in the monthly Discharge Monitoring Report (DMR).
- f. Sampling is not required before construction activity begins.
- g. The Permittee may reduce the sampling frequency for temporarily stabilized, inactive sites to once every calendar month.

### 3. Sampling Locations

- a. Sampling is required at all points where stormwater associated with construction activity (or authorized non-stormwater) is discharged off site, including where it enters any on-site surface waters of the state (for example, a creek running through a site).
- b. The Permittee may discontinue sampling at discharge points that drain areas of the project that are fully stabilized to prevent erosion.
- c. The Permittee must identify all sampling point(s) in the SWPPP and on the site map and clearly mark these points in the field with a flag, tape, stake or other visible marker.
- d. Sampling is not required for discharge that is sent directly to sanitary or combined sewer systems.
- e. The Permittee may discontinue sampling at discharge points in areas of the project where the Permittee no longer has operational control of the construction activity.

4. Sampling and Analysis Methods

- a. The Permittee performs turbidity analysis with a calibrated turbidity meter (turbidimeter) either on site or at an accredited lab. The Permittee must record the results in the site log book in nephelometric turbidity units (NTUs).
- b. The Permittee performs transparency analysis on site with a 1¾ inch diameter, 60 centimeter (cm)-long transparency tube. The Permittee will record the results in the site log book in centimeters (cm).

**Table 4 Monitoring and Reporting Requirements**

| Parameter    | Unit | Analytical Method                              | Sampling Frequency     | Benchmark Value |
|--------------|------|--|------------------------|-----------------|
| Turbidity    | NTU  | SM2130   | Weekly, if discharging | 25 NTUs         |
| Transparency | Cm   | Manufacturer instructions, or Ecology guidance | Weekly, if discharging | 33 cm           |

5. Turbidity/Transparency Benchmark Values and Reporting Triggers

The benchmark value for turbidity is 25 NTUs. The benchmark value for transparency is 33 centimeters (cm). Note: Benchmark values do not apply to discharges to segments of water bodies on Washington State’s 303(d) list (Category 5) for turbidity, fine sediment, or phosphorus; these discharges are subject to a numeric effluent limit for turbidity. Refer to Special Condition S8 for more information and follow S5.F – Noncompliance Notification for reporting requirements applicable to discharges which exceed the numeric effluent limit for turbidity.

- a. Turbidity 26 – 249 NTUs, or Transparency 32 – 7 cm:

If the discharge turbidity is 26 to 249 NTUs; or if discharge transparency is 32 to 7 cm, the Permittee must:

- i. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs, and no later than 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period.
- ii. Review the SWPPP for compliance with Special Condition S9 and make appropriate revisions within 7 days of the date the discharge exceeded the benchmark.
- iii. Document BMP implementation and maintenance in the site log book.

- b. Turbidity 250 NTUs or greater, or Transparency 6 cm or less:

If a discharge point’s turbidity is 250 NTUs or greater, or if discharge transparency is less than or equal to 6 cm, the Permittee must complete the reporting and adaptive

management process described below. For discharges which are subject to a numeric effluent limit for turbidity, see S5.F – Noncompliance Notification.

- i. Within 24 hours, telephone or submit an electronic report to the applicable Ecology Region’s Environmental Report Tracking System (ERTS) number (or through Ecology’s Water Quality Permitting Portal [WQWebPortal] – Permit Submittals when the form is available), in accordance with Special Condition S5.A.
  - **Central Region** (Okanogan, Chelan, Douglas, Kittitas, Yakima, Klickitat, Benton): (509) 575-2490
  - **Eastern Region** (Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman): (509) 329-3400
  - **Northwest Region** (Kitsap, Snohomish, Island, King, San Juan, Skagit, Whatcom): (425) 649-7000
  - **Southwest Region** (Grays Harbor, Lewis, Mason, Thurston, Pierce, Clark, Cowlitz, Skamania, Wahkiakum, Clallam, Jefferson, Pacific): (360) 407-6300

These numbers and a link to the ERTS reporting page are also listed at the following website: <http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html>.

- ii. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible, addressing the problems within 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period.
- iii. Sample discharges daily until:
  - a) Turbidity is 25 NTUs (or lower); or
  - b) Transparency is 33 cm (or greater); or
  - c) The Permittee has demonstrated compliance with the water quality standard for turbidity:
    - 1) No more than 5 NTUs over background turbidity, if background is less than 50 NTUs, or
    - 2) No more than 10% over background turbidity, if background is 50 NTUs or greater; or

\*Note: background turbidity in the receiving water must be measured immediately upstream (upgradient) or outside of the area of influence of the discharge.
  - d) The discharge stops or is eliminated.
- iv. Review the SWPPP for compliance with Special Condition S9 and make appropriate revisions within seven (7) days of the date the discharge exceeded the benchmark.

- v. Document BMP implementation and maintenance in the site log book.

Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with permit benchmarks.

#### **D. pH Sampling Requirements – Significant Concrete Work or Engineered Soils**

If construction activity results in the disturbance of 1 acre or more, *and* involves significant concrete work (significant concrete work means greater than 1000 cubic yards placed or poured concrete or recycled concrete used over the life of a project) or the use of engineered soils (soil amendments including but not limited to Portland cement-treated base [CTB], cement kiln dust [CKD], or fly ash), and stormwater from the affected area drains to surface waters of the State or to a storm sewer system that drains to surface waters of the State, the Permittee must conduct pH sampling as set forth below. Note: In addition, discharges to segments of water bodies on Washington State's 303(d) list (Category 5) for high pH are subject to a numeric effluent limit for pH; refer to Special Condition S8.

1. The Permittee must perform pH analysis on site with a calibrated pH meter, pH test kit, or wide range pH indicator paper. The Permittee must record pH sampling results in the site log book.
2. During the applicable pH monitoring period defined below, the Permittee must obtain a representative sample of stormwater and conduct pH analysis at least once per week.
  - a. For sites with significant concrete work, the Permittee must begin the pH sampling period when the concrete is first placed or poured and exposed to precipitation, and continue weekly throughout and after the concrete placement, pour and curing period, until stormwater pH is in the range of 6.5 to 8.5 (su).
  - b. For sites with recycled concrete where monitoring is required, the Permittee must begin the weekly pH sampling period when the recycled concrete is first exposed to precipitation and must continue until the recycled concrete is fully stabilized with the stormwater pH in the range of 6.5 to 8.5 (su).
  - c. For sites with engineered soils, the Permittee must begin the pH sampling period when the soil amendments are first exposed to precipitation and must continue until the area of engineered soils is fully stabilized.
3. The Permittee must sample pH in the sediment trap/pond(s) or other locations that receive stormwater runoff from the area of significant concrete work or engineered soils before the stormwater discharges to surface waters.
4. The benchmark value for pH is 8.5 standard units. Anytime sampling indicates that pH is 8.5 or greater, the Permittee must either:
  - a. Prevent the high pH water (8.5 or above) from entering storm sewer systems or surface waters of the state; *or*
  - b. If necessary, adjust or neutralize the high pH water until it is in the range of pH 6.5 to 8.5 (su) using an appropriate treatment BMP such as carbon dioxide (CO<sub>2</sub>) sparging, dry ice or food grade vinegar. The Permittee must obtain written approval from Ecology before using any form of chemical treatment other than CO<sub>2</sub> sparging, dry ice or food grade vinegar.

## S5. REPORTING AND RECORDKEEPING REQUIREMENTS

### A. High Turbidity Reporting

Anytime sampling performed in accordance with Special Condition S4.C indicates turbidity has reached the 250 NTUs or more (or transparency less than or equal to 6 cm), high turbidity reporting level, the Permittee must notify Ecology within 24 hours of analysis either by calling the applicable Ecology Region's Environmental Report Tracking System (ERTS) number by phone or by submitting an electronic ERTS report (through Ecology's Water Quality Permitting Portal (WQWebPortal) – Permit Submittals when the form is available). See the CSWGP website for links to ERTS and the WQWebPortal. (<http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html>) Also, see phone numbers in Special Condition S4.C.5.b.i.

### B. Discharge Monitoring Reports (DMRs)

Permittees required to conduct water quality sampling in accordance with Special Conditions S4.C (Turbidity/Transparency), S4.D (pH), S8 (303[d]/TMDL sampling), and/or G12 (Additional Sampling) must submit the results to Ecology.

Permittees must submit monitoring data using Ecology's WQWebDMR web application accessed through Ecology's Water Quality Permitting Portal.

Permittees unable to submit electronically (for example, those who do not have an internet connection) must contact Ecology to request a waiver and obtain instructions on how to obtain a paper copy DMR at:

Department of Ecology  
Water Quality Program - Construction Stormwater  
PO Box 47696  
Olympia, WA 98504-7696

Permittees who obtain a waiver not to use WQWebDMR must use the forms provided to them by Ecology; submittals must be mailed to the address above. Permittees must submit DMR forms to be received by Ecology within 15 days following the end of each month.

If there was no discharge during a given monitoring period, all Permittees must submit a DMR as required with "no discharge" entered in place of the monitoring results. DMRs are required for the full duration of permit coverage (from the first full month following the effective date of permit coverage up until Ecology has approved termination of the coverage). For more information, contact Ecology staff using information provided at the following website: [www.ecy.wa.gov/programs/wq/permits/paris/contacts.html](http://www.ecy.wa.gov/programs/wq/permits/paris/contacts.html).

### C. Records Retention

The Permittee must retain records of all monitoring information (site log book, sampling results, inspection reports/checklists, etc.), Stormwater Pollution Prevention Plan, copy of the permit coverage letter (including Transfer of Coverage documentation) and any other documentation of compliance with permit requirements for the entire life of the construction project and for a minimum of five (5) years following the termination of permit coverage. Such information must include all calibration and maintenance records, and records of all data used to complete the application for this permit. This period of retention must be extended during

the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by Ecology.

#### **D. Recording Results**

For each measurement or sample taken, the Permittee must record the following information:

1. Date, place, method, and time of sampling or measurement.
2. The first and last name of the individual who performed the sampling or measurement.
3. The date(s) the analyses were performed.
4. The first and last name of the individual who performed the analyses.
5. The analytical techniques or methods used.
6. The results of all analyses.

#### **E. Additional Monitoring by the Permittee**

If the Permittee samples or monitors any pollutant more frequently than required by this permit using test procedures specified by Special Condition S4 of this permit, the sampling results for this monitoring must be included in the calculation and reporting of the data submitted in the Permittee's DMR.

#### **F. Noncompliance Notification**

In the event the Permittee is unable to comply with any part of the terms and conditions of this permit, and the resulting noncompliance may cause a threat to human health or the environment (such as but not limited to spills or fuels or other materials, catastrophic pond or slope failure, and discharges that violate water quality standards), or exceed numeric effluent limitations (see S8 – Discharges to 303(d) or TMDL Waterbodies), the Permittee must, upon becoming aware of the circumstance:

1. Notify Ecology within 24 hours of the failure to comply by calling the applicable Regional office ERTS phone number (refer to Special Condition S4.C.5.b.i, or go to <https://ecology.wa.gov/About-us/Get-involved/Report-an-environmental-issue> to find contact information for the regional offices.)
2. Immediately take action to prevent the discharge/pollution, or otherwise stop or correct the noncompliance, and, if applicable, repeat sampling and analysis of any noncompliance immediately and submit the results to Ecology within five (5) days of becoming aware of the violation (See S5.F.3, below, for details on submitting results in a report).
3. Submit a detailed written report to Ecology within five (5) days of the time the Permittee becomes aware of the circumstances, unless requested earlier by Ecology. The report must be submitted using Ecology's Water Quality Permitting Portal (WQWebPortal) – Permit Submittals, unless a waiver from electronic reporting has been granted according to S5.B. The report must contain a description of the noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

The Permittee must report any unanticipated bypass and/or upset that exceeds any effluent limit in the permit in accordance with the 24-hour reporting requirement contained in 40 C.F.R. 122.41(l)(6).

Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply. Upon request of the Permittee, Ecology may waive the requirement for a written report on a case-by-case basis, if the immediate notification is received by Ecology within 24 hours.

#### **G. Access to Plans and Records**

1. The Permittee must retain the following permit documentation (plans and records) on site, or within reasonable access to the site, for use by the operator or for on-site review by Ecology or the local jurisdiction:
  - a. General Permit
  - b. Permit Coverage Letter
  - c. Stormwater Pollution Prevention Plan (SWPPP)
  - d. Site Log Book
  - e. Erosivity Waiver (if applicable)
2. The Permittee must address written requests for plans and records listed above (Special Condition S5.G.1) as follows:
  - a. The Permittee must provide a copy of plans and records to Ecology within 14 days of receipt of a written request from Ecology.
  - b. The Permittee must provide a copy of plans and records to the public when requested in writing. Upon receiving a written request from the public for the Permittee's plans and records, the Permittee must either:
    - i. Provide a copy of the plans and records to the requester within 14 days of a receipt of the written request; *or*
    - ii. Notify the requester within 10 days of receipt of the written request of the location and times within normal business hours when the plans and records may be viewed; and provide access to the plans and records within 14 days of receipt of the written request; *or*

Within 14 days of receipt of the written request, the Permittee may submit a copy of the plans and records to Ecology for viewing and/or copying by the requester at an Ecology office, or a mutually agreed location. If plans and records are viewed and/or copied at a location other than at an Ecology office, the Permittee will provide reasonable access to copying services for which a reasonable fee may be charged. The Permittee must notify the requester within 10 days of receipt of the request where the plans and records may be viewed and/or copied.

## S6. PERMIT FEES

The Permittee must pay permit fees assessed by Ecology. Fees for stormwater discharges covered under this permit are established by Chapter 173-224 WAC. Ecology continues to assess permit fees until the permit is terminated in accordance with Special Condition S10 or revoked in accordance with General Condition G5.

## S7. SOLID AND LIQUID WASTE DISPOSAL

The Permittee must handle and dispose of solid and liquid wastes generated by construction activity, such as demolition debris, construction materials, contaminated materials, and waste materials from maintenance activities, including liquids and solids from cleaning catch basins and other stormwater facilities, in accordance with:

- A. Special Condition S3, Compliance with Standards.
- B. WAC 173-216-110.
- C. Other applicable regulations.

## S8. DISCHARGES TO 303(d) OR TMDL WATERBODIES

### A. Sampling and Numeric Effluent Limits For Certain Discharges to 303(d)-Listed Water Bodies

1. Permittees who discharge to segments of water bodies listed as impaired by the State of Washington under Section 303(d) of the Clean Water Act for turbidity, fine sediment, high pH, or phosphorus, must conduct water quality sampling according to the requirements of this section, and Special Conditions S4.C.2.b-f and S4.C.3.b-d, and must comply with the applicable numeric effluent limitations in S8.C and S8.D.
2. All references and requirements associated with Section 303(d) of the Clean Water Act mean the most current listing by Ecology of impaired waters (Category 5) that exists on January 1, 2021, or the date when the operator's complete permit application is received by Ecology, whichever is later.

### B. Limits on Coverage for New Discharges to TMDL or 303(d)-Listed Waters

Construction sites that discharge to a TMDL or 303(d)-listed waterbody are not eligible for coverage under this permit *unless* the operator:

1. Prevents exposing stormwater to pollutants for which the waterbody is impaired, and retains documentation in the SWPPP that details procedures taken to prevent exposure on site; *or*
2. Documents that the pollutants for which the waterbody is impaired are not present at the site, and retains documentation of this finding within the SWPPP; *or*
3. Provides Ecology with data indicating the discharge is not expected to cause or contribute to an exceedance of a water quality standard, and retains such data on site with the SWPPP. The operator must provide data and other technical information to Ecology that sufficiently demonstrate:
  - a. For discharges to waters without an EPA-approved or -established TMDL, that the discharge of the pollutant for which the water is impaired will meet in-stream water quality criteria at the point of discharge to the waterbody; *or*
  - b. For discharges to waters with an EPA-approved or -established TMDL, that there is sufficient remaining wasteload allocation in the TMDL to allow construction stormwater discharge and that existing dischargers to the waterbody are subject to compliance schedules designed to bring the waterbody into attainment with water quality standards.

Operators of construction sites are eligible for coverage under this permit only after Ecology makes an affirmative determination that the *discharge will not cause or contribute to the existing impairment or exceed the TMDL.*

**C. Sampling and Numeric Effluent Limits for Discharges to Water Bodies on the 303(d) List for Turbidity, Fine Sediment, or Phosphorus**

1. Permittees who discharge to segments of water bodies on the 303(d) list (Category 5) for turbidity, fine sediment, or phosphorus must conduct turbidity sampling in accordance with Special Condition S4.C.2 and comply with either of the numeric effluent limits noted in Table 5 below.
2. As an alternative to the 25 NTUs effluent limit noted in Table 5 below (applied at the point where stormwater [or authorized non-stormwater] is discharged off-site), Permittees may choose to comply with the surface water quality standard for turbidity. The standard is: no more than 5 NTUs over background turbidity when the background turbidity is 50 NTUs or less, or no more than a 10% increase in turbidity when the background turbidity is more than 50 NTUs. In order to use the water quality standard requirement, the sampling must take place at the following locations:
  - a. Background turbidity in the 303(d)-listed receiving water immediately upstream (upgradient) or outside the area of influence of the discharge.
  - b. Turbidity at the point of discharge into the 303(d)-listed receiving water, inside the area of influence of the discharge.
3. Discharges that exceed the numeric effluent limit for turbidity constitute a violation of this permit.
4. Permittees whose discharges exceed the numeric effluent limit must sample discharges daily until the violation is corrected and comply with the non-compliance notification requirements in Special Condition S5.F.

**Table 5 Turbidity, Fine Sediment & Phosphorus Sampling and Limits for 303(d)-Listed Waters**

| Parameter identified in 303(d) listing   | Parameter Sampled | Unit | Analytical Method | Sampling Frequency     | Numeric Effluent Limit <sup>1</sup>  |
|--|-------------------|------|-------------------|------------------------|--|
| <ul style="list-style-type: none"> <li>• Turbidity</li> <li>• Fine Sediment</li> <li>• Phosphorus</li> </ul> | Turbidity         | NTU  | SM2130            | Weekly, if discharging | 25 NTUs, at the point where stormwater is discharged from the site; <b><i>OR</i></b><br>In compliance with the surface water quality standard for turbidity (S8.C.2.a) |

<sup>1</sup> Permittees subject to a numeric effluent limit for turbidity may, at their discretion, choose either numeric effluent limitation based on site-specific considerations including, but not limited to, safety, access and convenience.

**D. Discharges to Water Bodies on the 303(d) List for High pH**

1. Permittees who discharge to segments of water bodies on the 303(d) list (Category 5) for high pH must conduct pH sampling in accordance with the table below, and comply with the numeric effluent limit of pH 6.5 to 8.5 su (Table 6).

**Table 6 pH Sampling and Limits for 303(d)-Listed Waters**

| Parameter identified in 303(d) listing | Parameter Sampled/Units | Analytical Method | Sampling Frequency     | Numeric Effluent Limit       |
|--|-------------------------|-------------------|------------------------|------------------------------|
| High pH                                | pH /Standard Units      | pH meter          | Weekly, if discharging | In the range of 6.5 – 8.5 su |

2. At the Permittee’s discretion, compliance with the limit shall be assessed at one of the following locations:
  - a. Directly in the 303(d)-listed waterbody segment, inside the immediate area of influence of the discharge; *or*
  - b. Alternatively, the Permittee may measure pH at the point where the discharge leaves the construction site, rather than in the receiving water.
3. Discharges that exceed the numeric effluent limit for pH (outside the range of 6.5 – 8.5 su) constitute a violation of this permit.
4. Permittees whose discharges exceed the numeric effluent limit must sample discharges daily until the violation is corrected and comply with the non-compliance notification requirements in Special Condition S5.F.

**E. Sampling and Limits for Sites Discharging to Waters Covered by a TMDL or another Pollution Control Plan**

1. Discharges to a waterbody that is subject to a Total Maximum Daily Load (TMDL) for turbidity, fine sediment, high pH, or phosphorus must be consistent with the TMDL. Refer to <http://www.ecy.wa.gov/programs/wq/tmdl/TMDLsbyWria/TMDLbyWria.html> for more information on TMDLs.
  - a. Where an applicable TMDL sets specific waste load allocations or requirements for discharges covered by this permit, discharges must be consistent with any specific waste load allocations or requirements established by the applicable TMDL.
    - i. The Permittee must sample discharges weekly, unless otherwise specified by the TMDL, to evaluate compliance with the specific waste load allocations or requirements.
    - ii. Analytical methods used to meet the monitoring requirements must conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 CFR Part 136.
    - iii. Turbidity and pH methods need not be accredited or registered unless conducted at a laboratory which must otherwise be accredited or registered.
  - b. Where an applicable TMDL has established a general waste load allocation for construction stormwater discharges, but has not identified specific requirements, compliance with Special Conditions S4 (Monitoring) and S9 (SWPPPs) will constitute compliance with the approved TMDL.
  - c. Where an applicable TMDL has not specified a waste load allocation for construction stormwater discharges, but has not excluded these discharges, compliance with Special Conditions S4 (Monitoring) and S9 (SWPPPs) will constitute compliance with the approved TMDL.
  - d. Where an applicable TMDL specifically precludes or prohibits discharges from construction activity, the operator is not eligible for coverage under this permit.

## S9. STORMWATER POLLUTION PREVENTION PLAN

The Permittee must prepare and properly implement an adequate Stormwater Pollution Prevention Plan (SWPPP) for construction activity in accordance with the requirements of this permit beginning with initial soil disturbance and until final stabilization.

### **A. The Permittee's SWPPP must meet the following objectives:**

1. To identify best management practices (BMPs) which prevent erosion and sedimentation, and to reduce, eliminate or prevent stormwater contamination and water pollution from construction activity.
2. To prevent violations of surface water quality, groundwater quality, or sediment management standards.
3. To control peak volumetric flow rates and velocities of stormwater discharges.

## **B. General Requirements**

1. The SWPPP must include a narrative and drawings. All BMPs must be clearly referenced in the narrative and marked on the drawings. The SWPPP narrative must include documentation to explain and justify the pollution prevention decisions made for the project. Documentation must include:
  - a. Information about existing site conditions (topography, drainage, soils, vegetation, etc.).
  - b. Potential erosion problem areas.
  - c. The 13 elements of a SWPPP in Special Condition S9.D.1-13, including BMPs used to address each element.
  - d. Construction phasing/sequence and general BMP implementation schedule.
  - e. The actions to be taken if BMP performance goals are not achieved—for example, a contingency plan for additional treatment and/or storage of stormwater that would violate the water quality standards if discharged.
  - f. Engineering calculations for ponds, treatment systems, and any other designed structures. When a treatment system requires engineering calculations, these calculations must be included in the SWPPP. Engineering calculations do not need to be included in the SWPPP for treatment systems that do not require such calculations.
2. The Permittee must modify the SWPPP 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, or would be, ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The Permittee must then:
  - a. Review the SWPPP for compliance with Special Condition S9 and make appropriate revisions within 7 days of the inspection or investigation.
  - b. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible, addressing the problems no later than 10 days from the inspection or investigation. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when an extension is requested by a Permittee within the initial 10-day response period.
  - c. Document BMP implementation and maintenance in the site log book.

The Permittee must modify the SWPPP whenever there is a change in design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the State.

## **C. Stormwater Best Management Practices (BMPs)**

BMPs must be consistent with:

1. *Stormwater Management Manual for Western Washington* (most current approved edition at the time this permit was issued), for sites west of the crest of the Cascade Mountains; or

2. *Stormwater Management Manual for Eastern Washington* (most current approved edition at the time this permit was issued), for sites east of the crest of the Cascade Mountains; *or*
3. Revisions to the manuals listed in Special Condition S9.C.1 & 2, or other stormwater management guidance documents or manuals which provide an equivalent level of pollution prevention, that are approved by Ecology and incorporated into this permit in accordance with the permit modification requirements of WAC 173-226-230; *or*
4. Documentation in the SWPPP that the BMPs selected provide an equivalent level of pollution prevention, compared to the applicable stormwater management manuals, including:
  - a. The technical basis for the selection of all stormwater BMPs (scientific, technical studies, and/or modeling) that support the performance claims for the BMPs being selected.
  - b. An assessment of how the selected BMP will satisfy AKART requirements and the applicable federal technology-based treatment requirements under 40 CFR part 125.3.

#### **D. SWPPP – Narrative Contents and Requirements**

The Permittee must include each of the 13 elements below in Special Condition S9.D.1-13 in the narrative of the SWPPP and implement them unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the SWPPP.

1. Preserve Vegetation/Mark Clearing Limits
  - a. Before beginning land-disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area.
  - b. Retain the duff layer, native topsoil, and natural vegetation in an undisturbed state to the maximum degree practicable.
2. Establish Construction Access
  - a. Limit construction vehicle access and exit to one route, if possible.
  - b. Stabilize access points with a pad of quarry spalls, crushed rock, or other equivalent BMPs, to minimize tracking sediment onto roads.
  - c. Locate wheel wash or tire baths on site, if the stabilized construction entrance is not effective in preventing tracking sediment onto roads.
  - d. If sediment is tracked off site, clean the affected roadway thoroughly at the end of each day, or more frequently as necessary (for example, during wet weather). Remove sediment from roads by shoveling, sweeping, or pickup and transport of the sediment to a controlled sediment disposal area.
  - e. Conduct street washing only after sediment removal in accordance with Special Condition S9.D.2.d.
  - f. Control street wash wastewater by pumping back on site or otherwise preventing it from discharging into systems tributary to waters of the State.

### 3. Control Flow Rates

- a. Protect properties and waterways downstream of construction sites from erosion and the associated discharge of turbid waters due to increases in the velocity and peak volumetric flow rate of stormwater runoff from the project site, as required by local plan approval authority.
- b. Where necessary to comply with Special Condition S9.D.3.a, construct stormwater infiltration or detention BMPs as one of the first steps in grading. Assure that detention BMPs function properly before constructing site improvements (for example, impervious surfaces).
- c. If permanent infiltration ponds are used for flow control during construction, protect these facilities from sedimentation during the construction phase.

### 4. Install Sediment Controls

The Permittee must design, install and maintain effective erosion controls and sediment controls to minimize the discharge of pollutants. At a minimum, the Permittee must:

- a. Construct sediment control BMPs (sediment ponds, traps, filters, infiltration facilities, etc.) as one of the first steps in grading. These BMPs must be functional before other land disturbing activities take place.
- b. Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle sizes expected to be present on the site.
- c. Direct stormwater runoff from disturbed areas through a sediment pond or other appropriate sediment removal BMP, before the runoff leaves a construction site or before discharge to an infiltration facility. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of Special Condition S9.D.3.a.
- d. Locate BMPs intended to trap sediment on site in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages.
- e. Provide and maintain natural buffers around surface waters, direct stormwater to vegetated areas to increase sediment removal and maximize stormwater infiltration, unless infeasible.
- f. Where feasible, design outlet structures that withdraw impounded stormwater from the surface to avoid discharging sediment that is still suspended lower in the water column.

### 5. Stabilize Soils

- a. The Permittee must stabilize exposed and unworked soils by application of effective BMPs that prevent erosion. Applicable BMPs include, but are not limited to: temporary and permanent seeding, sodding, mulching, plastic covering, erosion

control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base on areas to be paved, and dust control.

- b. The Permittee must control stormwater volume and velocity within the site to minimize soil erosion.
- c. The Permittee must control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.
- d. Depending on the geographic location of the project, the Permittee must not allow soils to remain exposed and unworked for more than the time periods set forth below to prevent erosion.

**West of the Cascade Mountains Crest**

During the dry season (May 1 - September 30): 7 days

During the wet season (October 1 - April 30): 2 days

**East of the Cascade Mountains Crest, except for Central Basin\***

During the dry season (July 1 - September 30): 10 days

During the wet season (October 1 - June 30): 5 days

**The Central Basin\*, East of the Cascade Mountains Crest**

During the dry Season (July 1 - September 30): 30 days

During the wet season (October 1 - June 30): 15 days

**\*Note: The Central Basin** is defined as the portions of Eastern Washington with mean annual precipitation of less than 12 inches.

- e. The Permittee must stabilize soils at the end of the shift before a holiday or weekend if needed based on the weather forecast.
- f. The Permittee must stabilize soil stockpiles from erosion, protected with sediment trapping measures, and where possible, be located away from storm drain inlets, waterways, and drainage channels.
- g. The Permittee must minimize the amount of soil exposed during construction activity.
- h. The Permittee must minimize the disturbance of steep slopes.
- i. The Permittee must minimize soil compaction and, unless infeasible, preserve topsoil.

6. Protect Slopes

- a. The Permittee must design and construct cut-and-fill slopes in a manner to minimize erosion. Applicable practices include, but are not limited to, reducing continuous length of slope with terracing and diversions, reducing slope steepness, and roughening slope surfaces (for example, track walking).
- b. The Permittee must divert off-site stormwater (run-on) or groundwater away from slopes and disturbed areas with interceptor dikes, pipes, and/or swales. Off-site stormwater should be managed separately from stormwater generated on the site.
- c. At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion.

- i. West of the Cascade Mountains Crest: Temporary pipe slope drains must handle the peak 10-minute flow rate from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate predicted by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model (WWHM) to predict flows, bare soil areas should be modeled as "landscaped area."
    - ii. East of the Cascade Mountains Crest: Temporary pipe slope drains must handle the expected peak flow rate from a 6-month, 3-hour storm for the developed condition, referred to as the short duration storm.
  - d. Place excavated material on the uphill side of trenches, consistent with safety and space considerations.
  - e. Place check dams at regular intervals within constructed channels that are cut down a slope.
7. Protect Drain Inlets
- a. Protect all storm drain inlets made operable during construction so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.
  - b. Clean or remove and replace inlet protection devices when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).
8. Stabilize Channels and Outlets
- a. Design, construct and stabilize all on-site conveyance channels to prevent erosion from the following expected peak flows:
    - i. West of the Cascade Mountains Crest: Channels must handle the peak 10-minute flow rate from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the WWHM to predict flows, bare soil areas should be modeled as "landscaped area."
    - ii. East of the Cascade Mountains Crest: Channels must handle the expected peak flow rate from a 6-month, 3-hour storm for the developed condition, referred to as the short duration storm.
  - b. Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches at the outlets of all conveyance systems.

## 9. Control Pollutants

Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants. The Permittee must:

- a. Handle and dispose of all pollutants, including waste materials and demolition debris that occur on site in a manner that does not cause contamination of stormwater.
- b. Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. Minimize storage of hazardous materials on-site. Safety Data Sheets (SDS) should be supplied for all materials stored. Chemicals should be kept in their original labeled containers. On-site fueling tanks must include secondary containment. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume of the largest tank within the containment structure. Double-walled tanks do not require additional secondary containment.
- c. Conduct maintenance, fueling, and repair of heavy equipment and vehicles using spill prevention and control measures. Clean contaminated surfaces immediately following any spill incident.
- d. Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, such as closed-loop recirculation or upland land application, or to the sanitary sewer with local sewer district approval.
- e. Apply fertilizers and pesticides in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Follow manufacturers' label requirements for application rates and procedures.
- f. Use BMPs to prevent contamination of stormwater runoff by pH-modifying sources. The sources for this contamination include, but are not limited to: bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, recycled concrete stockpiles, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters. (Also refer to the definition for "concrete wastewater" in Appendix A – Definitions.)
- g. Adjust the pH of stormwater or authorized non-stormwater if necessary to prevent an exceedance of groundwater and/or surface water quality standards.
- h. Assure that washout of concrete trucks is performed off-site or in designated concrete washout areas only. Do not wash out concrete truck drums onto the ground, or into storm drains, open ditches, streets, or streams. Washout of small concrete handling equipment may be disposed of in a formed area awaiting concrete where it will not contaminate surface or groundwater. Do not dump excess concrete on site, except in designated concrete washout areas. Concrete spillage or concrete discharge directly to groundwater or surface waters of the State is

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

- i. Obtain written approval from Ecology before using any chemical treatment, with the exception of CO<sub>2</sub>, dry ice or food grade vinegar, to adjust pH.
- j. Uncontaminated water from water-only based shaft drilling for construction of building, road, and bridge foundations may be infiltrated provided the wastewater is managed in a way that prohibits discharge to surface waters. Prior to infiltration, water from water-only based shaft drilling that comes into contact with curing concrete must be neutralized until pH is in the range of 6.5 to 8.5 (su).

#### 10. Control Dewatering

- a. Permittees must discharge foundation, vault, and trench dewatering water, which have characteristics similar to stormwater runoff at the site, in conjunction with BMPs to reduce sedimentation before discharge to a sediment trap or sediment pond.
- b. Permittees may discharge clean, non-turbid dewatering water, such as well-point groundwater, to systems tributary to, or directly into surface waters of the State, as specified in Special Condition S9.D.8, provided the dewatering flow does not cause erosion or flooding of receiving waters. Do not route clean dewatering water through stormwater sediment ponds. Note that "surface waters of the State" may exist on a construction site as well as off site; for example, a creek running through a site.
- c. Other dewatering treatment or disposal options may include:
  - i. Infiltration
  - ii. Transport off site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.
  - iii. Ecology-approved on-site chemical treatment or other suitable treatment technologies (See S9.D.9.i, regarding chemical treatment written approval).
  - iv. Sanitary or combined sewer discharge with local sewer district approval, if there is no other option.
  - v. Use of a sedimentation bag with discharge to a ditch or swale for small volumes of localized dewatering.
- d. Permittees must handle highly turbid or contaminated dewatering water separately from stormwater.

#### 11. Maintain BMPs

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

## 12. Manage the Project

- a. Phase development projects to the maximum degree practicable and take into account seasonal work limitations.
- b. Inspect, maintain and repair all BMPs as needed to assure continued performance of their intended function. Conduct site inspections and monitoring in accordance with Special Condition S4.
- c. Maintain, update, and implement the SWPPP in accordance with Special Conditions S3, S4, and S9.

## 13. Protect Low Impact Development (LID) BMPs

The primary purpose of on-site LID Stormwater Management is to reduce the disruption of the natural site hydrology through infiltration. LID BMPs are permanent facilities.

- a. Permittees must protect all LID BMPs (including, but not limited to, Bioretention and Rain Garden facilities) from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into the Bioretention and/or Rain Garden facilities. Restore the BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the facility must include removal of sediment and any sediment-laden bioretention/ rain garden soils, and replacing the removed soils with soils meeting the design specification.
- b. Permittees must maintain the infiltration capabilities of LID BMPs by protecting against compaction by construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction due to construction equipment.
- c. Permittees must control erosion and avoid introducing sediment from surrounding land uses onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-laden runoff onto permeable pavements or base materials.
- d. Permittees must clean permeable pavements fouled with sediments or no longer passing an initial infiltration test using local stormwater manual methodology or the manufacturer's procedures.
- e. Permittees must keep all heavy equipment off existing soils under LID BMPs that have been excavated to final grade to retain the infiltration rate of the soils.

### **E. SWPPP – Map Contents and Requirements**

The Permittee's SWPPP must also include a vicinity map or general location map (for example, a USGS quadrangle map, a portion of a county or city map, or other appropriate map) with enough detail to identify the location of the construction site and receiving waters within one mile of the site.

The SWPPP must also include a legible site map (or maps) showing the entire construction site. The following features must be identified, unless not applicable due to site conditions.

1. The direction of north, property lines, and existing structures and roads.
2. Cut and fill slopes indicating the top and bottom of slope catch lines.

3. Approximate slopes, contours, and direction of stormwater flow before and after major grading activities.
4. Areas of soil disturbance and areas that will not be disturbed.
5. Locations of structural and nonstructural controls (BMPs) identified in the SWPPP.
6. Locations of off-site material, stockpiles, waste storage, borrow areas, and vehicle/equipment storage areas.
7. Locations of all surface water bodies, including wetlands.
8. Locations where stormwater or non-stormwater discharges off-site and/or to a surface waterbody, including wetlands.
9. Location of water quality sampling station(s), if sampling is required by state or local permitting authority.
10. Areas where final stabilization has been accomplished and no further construction-phase permit requirements apply.
11. Location or proposed location of LID facilities.

## **S10. NOTICE OF TERMINATION**

Partial terminations of permit coverage are not authorized.

- A.** The site is eligible for termination of coverage when it has met any of the following conditions:
  1. The site has undergone final stabilization, the Permittee has removed all temporary BMPs (except biodegradable BMPs clearly manufactured with the intention for the material to be left in place and not interfere with maintenance or land use), and all stormwater discharges associated with construction activity have been eliminated; *or*
  2. All portions of the site that have not undergone final stabilization per Special Condition S10.A.1 have been sold and/or transferred (per Special Condition S2.A), and the Permittee no longer has operational control of the construction activity; *or*
  3. For residential construction only, the Permittee has completed temporary stabilization and the homeowners have taken possession of the residences.
- B.** When the site is eligible for termination, the Permittee must submit a complete and accurate Notice of Termination (NOT) form, signed in accordance with General Condition G2, to:

Department of Ecology  
Water Quality Program - Construction Stormwater  
PO Box 47696  
Olympia, WA 98504-7696

When an electronic termination form is available, the Permittee may choose to submit a complete and accurate Notice of Termination (NOT) form through the Water Quality Permitting Portal rather than mailing a hardcopy as noted above.

The termination is effective on the 31st calendar day following the date Ecology receives a complete NOT form, unless Ecology notifies the Permittee that termination request is denied because the Permittee has not met the eligibility requirements in Special Condition S10.A.

Permittees are required to comply with all conditions and effluent limitations in the permit until the permit has been terminated.

Permittees transferring the property to a new property owner or operator/Permittee are required to complete and submit the Notice of Transfer form to Ecology, but are not required to submit a Notice of Termination form for this type of transaction.

# GENERAL CONDITIONS

## G1. DISCHARGE VIOLATIONS

All discharges and activities authorized by this general permit must be consistent with the terms and conditions of this general permit. Any discharge of any pollutant more frequent than or at a level in excess of that identified and authorized by the general permit must constitute a violation of the terms and conditions of this permit.

## G2. SIGNATORY REQUIREMENTS

- A.** All permit applications must bear a certification of correctness to be signed:
1. In the case of corporations, by a responsible corporate officer.
  2. In the case of a partnership, by a general partner of a partnership.
  3. In the case of sole proprietorship, by the proprietor.
  4. In the case of a municipal, state, or other public facility, by either a principal executive officer or ranking elected official.
- B.** All reports required by this permit and other information requested by Ecology (including NOIs, NOTs, and Transfer of Coverage forms) must be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:
1. The authorization is made in writing by a person described above and submitted to Ecology.
  2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters.
- C.** Changes to authorization. If an authorization under paragraph G2.B.2 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph G2.B.2 above must be submitted to Ecology prior to or together with any reports, information, or applications to be signed by an authorized representative.
- D.** Certification. Any person signing a document under this section must make the following certification:

*I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.*

### **G3. RIGHT OF INSPECTION AND ENTRY**

The Permittee must allow an authorized representative of Ecology, upon the presentation of credentials and such other documents as may be required by law:

- A.** To enter upon the premises where a discharge is located or where any records are kept under the terms and conditions of this permit.
- B.** To have access to and copy, at reasonable times and at reasonable cost, any records required to be kept under the terms and conditions of this permit.
- C.** To inspect, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.
- D.** To sample or monitor, at reasonable times, any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

### **G4. GENERAL PERMIT MODIFICATION AND REVOCATION**

This permit may be modified, revoked and reissued, or terminated in accordance with the provisions of Chapter 173-226 WAC. Grounds for modification, revocation and reissuance, or termination include, but are not limited to, the following:

- A.** When a change occurs in the technology or practices for control or abatement of pollutants applicable to the category of dischargers covered under this permit.
- B.** When effluent limitation guidelines or standards are promulgated pursuant to the CWA or Chapter 90.48 RCW, for the category of dischargers covered under this permit.
- C.** When a water quality management plan containing requirements applicable to the category of dischargers covered under this permit is approved, or
- D.** When information is obtained that indicates cumulative effects on the environment from dischargers covered under this permit are unacceptable.

### **G5. REVOCATION OF COVERAGE UNDER THE PERMIT**

Pursuant to Chapter 43.21B RCW and Chapter 173-226 WAC, the Director may terminate coverage for any discharger under this permit for cause. Cases where coverage may be terminated include, but are not limited to, the following:

- A.** Violation of any term or condition of this permit.
- B.** Obtaining coverage under this permit by misrepresentation or failure to disclose fully all relevant facts.
- C.** A change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge.
- D.** Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.
- E.** A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations.
- F.** Nonpayment of permit fees or penalties assessed pursuant to RCW 90.48.465 and Chapter 173-224 WAC.

- G.** Failure of the Permittee to satisfy the public notice requirements of WAC 173-226-130(5), when applicable.

The Director may require any discharger under this permit to apply for and obtain coverage under an individual permit or another more specific general permit. Permittees who have their coverage revoked for cause according to WAC 173-226-240 may request temporary coverage under this permit during the time an individual permit is being developed, provided the request is made within ninety (90) days from the time of revocation and is submitted along with a complete individual permit application form.

## **G6. REPORTING A CAUSE FOR MODIFICATION**

The Permittee must submit a new application, or a supplement to the previous application, whenever a material change to the construction activity or in the quantity or type of discharge is anticipated which is not specifically authorized by this permit. This application must be submitted at least sixty (60) days prior to any proposed changes. Filing a request for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not relieve the Permittee of the duty to comply with the existing permit until it is modified or reissued.

## **G7. COMPLIANCE WITH OTHER LAWS AND STATUTES**

Nothing in this permit will be construed as excusing the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

## **G8. DUTY TO REAPPLY**

The Permittee must apply for permit renewal at least 180 days prior to the specified expiration date of this permit. The Permittee must reapply using the electronic application form (NOI) available on Ecology's website. Permittees unable to submit electronically (for example, those who do not have an internet connection) must contact Ecology to request a waiver and obtain instructions on how to obtain a paper NOI.

Department of Ecology  
Water Quality Program - Construction Stormwater  
PO Box 47696  
Olympia, WA 98504-7696

## **G9. REMOVED SUBSTANCE**

The Permittee must not re-suspend or reintroduce collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of stormwater to the final effluent stream for discharge to state waters.

## **G10. DUTY TO PROVIDE INFORMATION**

The Permittee must submit to Ecology, within a reasonable time, all information that Ecology may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee must also submit to Ecology, upon request, copies of records required to be kept by this permit [40 CFR 122.41(h)].

## **G11. OTHER REQUIREMENTS OF 40 CFR**

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

## **G12. ADDITIONAL MONITORING**

Ecology may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

## **G13. PENALTIES FOR VIOLATING PERMIT CONDITIONS**

Any person who is found guilty of willfully violating the terms and conditions of this permit shall be deemed guilty of a crime, and upon conviction thereof shall be punished by a fine of up to ten thousand dollars (\$10,000) and costs of prosecution, or by imprisonment at the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit shall incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to ten thousand dollars (\$10,000) for every such violation. Each and every such violation shall be a separate and distinct offense, and in case of a continuing violation, every day's continuance shall be deemed to be a separate and distinct violation.

## **G14. UPSET**

Definition – "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed, contemporaneous operating logs or other relevant evidence that: 1) an upset occurred and that the Permittee can identify the cause(s) of the upset; 2) the permitted facility was being properly operated at the time of the upset; 3) the Permittee submitted notice of the upset as required in Special Condition S5.F, and; 4) the Permittee complied with any remedial measures required under this permit.

In any enforcement proceeding, the Permittee seeking to establish the occurrence of an upset has the burden of proof.

## **G15. PROPERTY RIGHTS**

This permit does not convey any property rights of any sort, or any exclusive privilege.

## **G16. DUTY TO COMPLY**

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

## **G17. TOXIC POLLUTANTS**

The Permittee must comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

## **G18. PENALTIES FOR TAMPERING**

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than \$10,000 per violation, or by imprisonment for not more than two years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this condition, punishment shall be a fine of not more than \$20,000 per day of violation, or imprisonment of not more than four (4) years, or both.

## **G19. REPORTING PLANNED CHANGES**

The Permittee must, as soon as possible, give notice to Ecology of planned physical alterations, modifications or additions to the permitted construction activity. The Permittee should be aware that, depending on the nature and size of the changes to the original permit, a new public notice and other permit process requirements may be required. Changes in activities that require reporting to Ecology include those that will result in:

- A.** The permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b).
- B.** A significant change in the nature or an increase in quantity of pollutants discharged, including but not limited to: a 20% or greater increase in acreage disturbed by construction activity.
- C.** A change in or addition of surface water(s) receiving stormwater or non-stormwater from the construction activity.
- D.** A change in the construction plans and/or activity that affects the Permittee's monitoring requirements in Special Condition S4.

Following such notice, permit coverage may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation.

## **G20. REPORTING OTHER INFORMATION**

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to Ecology, it must promptly submit such facts or information.

## **G21. REPORTING ANTICIPATED NON-COMPLIANCE**

The Permittee must give advance notice to Ecology by submission of a new application or supplement thereto at least forty-five (45) days prior to commencement of such discharges, of any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility or activity which may result in noncompliance with permit limits or conditions. Any maintenance of facilities, which might necessitate unavoidable interruption of

operation and degradation of effluent quality, must be scheduled during non-critical water quality periods and carried out in a manner approved by Ecology.

## **G22. REQUESTS TO BE EXCLUDED FROM COVERAGE UNDER THE PERMIT**

Any discharger authorized by this permit may request to be excluded from coverage under the general permit by applying for an individual permit. The discharger must submit to the Director an application as described in WAC 173-220-040 or WAC 173-216-070, whichever is applicable, with reasons supporting the request. These reasons will fully document how an individual permit will apply to the applicant in a way that the general permit cannot. Ecology may make specific requests for information to support the request. The Director will either issue an individual permit or deny the request with a statement explaining the reason for the denial. When an individual permit is issued to a discharger otherwise subject to the construction stormwater general permit, the applicability of the construction stormwater general permit to that Permittee is automatically terminated on the effective date of the individual permit.

## **G23. APPEALS**

- A.** The terms and conditions of this general permit, as they apply to the appropriate class of dischargers, are subject to appeal by any person within 30 days of issuance of this general permit, in accordance with Chapter 43.21B RCW, and Chapter 173-226 WAC.
- B.** The terms and conditions of this general permit, as they apply to an individual discharger, are appealable in accordance with Chapter 43.21B RCW within 30 days of the effective date of coverage of that discharger. Consideration of an appeal of general permit coverage of an individual discharger is limited to the general permit's applicability or nonapplicability to that individual discharger.
- C.** The appeal of general permit coverage of an individual discharger does not affect any other dischargers covered under this general permit. If the terms and conditions of this general permit are found to be inapplicable to any individual discharger(s), the matter shall be remanded to Ecology for consideration of issuance of an individual permit or permits.

## **G24. SEVERABILITY**

The provisions of this permit are severable, and if any provision of this permit, or application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

## **G25. BYPASS PROHIBITED**

### **A. Bypass Procedures**

Bypass, which is the intentional diversion of waste streams from any portion of a treatment facility, is prohibited for stormwater events below the design criteria for stormwater management. Ecology may take enforcement action against a Permittee for bypass unless one of the following circumstances (1, 2, 3 or 4) is applicable.

- 1. Bypass of stormwater is consistent with the design criteria and part of an approved management practice in the applicable stormwater management manual.
- 2. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions.

Bypass is authorized if it is for essential maintenance and does not have the potential to cause violations of limitations or other conditions of this permit, or adversely impact public health.

3. Bypass of stormwater is unavoidable, unanticipated, and results in noncompliance of this permit.

This bypass is permitted only if:

- a. Bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.
  - b. There are no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, maintenance during normal periods of equipment downtime (but not if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance), or transport of untreated wastes to another treatment facility.
  - c. Ecology is properly notified of the bypass as required in Special Condition S5.F of this permit.
4. A planned action that would cause bypass of stormwater and has the potential to result in noncompliance of this permit during a storm event.

The Permittee must notify Ecology at least thirty (30) days before the planned date of bypass. The notice must contain:

- a. A description of the bypass and its cause
  - b. An analysis of all known alternatives which would eliminate, reduce, or mitigate the need for bypassing.
  - c. A cost-effectiveness analysis of alternatives including comparative resource damage assessment.
  - d. The minimum and maximum duration of bypass under each alternative.
  - e. A recommendation as to the preferred alternative for conducting the bypass.
  - f. The projected date of bypass initiation.
  - g. A statement of compliance with SEPA.
  - h. A request for modification of water quality standards as provided for in WAC 173-201A-110, if an exceedance of any water quality standard is anticipated.
  - i. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.
5. For probable construction bypasses, the need to bypass is to be identified as early in the planning process as possible. The analysis required above must be considered during

preparation of the Stormwater Pollution Prevention Plan (SWPPP) and must be included to the extent practical. In cases where the probable need to bypass is determined early, continued analysis is necessary up to and including the construction period in an effort to minimize or eliminate the bypass.

Ecology will consider the following before issuing an administrative order for this type bypass:

- a. If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.
- b. If there are feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment down time, or transport of untreated wastes to another treatment facility.
- c. If the bypass is planned and scheduled to minimize adverse effects on the public and the environment.

After consideration of the above and the adverse effects of the proposed bypass and any other relevant factors, Ecology will approve, conditionally approve, or deny the request. The public must be notified and given an opportunity to comment on bypass incidents of significant duration, to the extent feasible. Approval of a request to bypass will be by administrative order issued by Ecology under RCW 90.48.120.

#### **B. Duty to Mitigate**

The Permittee is required to take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

## APPENDIX A – DEFINITIONS

**AKART** is an acronym for “All Known, Available, and Reasonable methods of prevention, control, and Treatment.” AKART represents the most current methodology that can be reasonably required for preventing, controlling, or abating the pollutants and controlling pollution associated with a discharge.

**Applicable TMDL** means a TMDL for turbidity, fine sediment, high pH, or phosphorus, which was completed and approved by EPA before January 1, 2021, or before the date the operator’s complete permit application is received by Ecology, whichever is later. TMDLs completed after a complete permit application is received by Ecology become applicable to the Permittee only if they are imposed through an administrative order by Ecology, or through a modification of permit coverage.

**Applicant** means an *operator* seeking coverage under this permit.

**Benchmark** means a pollutant concentration used as a permit threshold, below which a pollutant is considered unlikely to cause a water quality violation, and above which it may. When pollutant concentrations exceed benchmarks, corrective action requirements take effect. Benchmark values are not water quality standards and are not numeric effluent limitations; they are indicator values.

**Best Management Practices (BMPs)** means schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the State. BMPs include treatment systems, operating procedures, and practices to control stormwater associated with construction activity, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

**Buffer** means an area designated by a local jurisdiction that is contiguous to and intended to protect a sensitive area.

**Bypass** means the intentional diversion of waste streams from any portion of a treatment facility.

**Calendar Day** A period of 24 consecutive hours starting at 12:00 midnight and ending the following 12:00 midnight.

**Calendar Week** (same as **Week**) means a period of seven consecutive days starting at 12:01 a.m. (0:01 hours) on Sunday.

**Certified Erosion and Sediment Control Lead (CESCL)** means a person who has current certification through an approved erosion and sediment control training program that meets the minimum training standards established by Ecology (See BMP C160 in the SWMM).

**Chemical Treatment** means the addition of chemicals to stormwater and/or authorized non-stormwater prior to filtration and discharge to surface waters.

**Clean Water Act (CWA)** means the Federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217, 95-576, 96-483, and 97-117; USC 1251 et seq.

**Combined Sewer** means a sewer which has been designed to serve as a sanitary sewer and a storm sewer, and into which inflow is allowed by local ordinance.

**Common Plan of Development or Sale** means a site where multiple separate and distinct construction activities may be taking place at different times on different schedules and/or by different contractors, but still under a single plan. Examples include: 1) phased projects and projects with multiple filings or lots, even if the separate phases or filings/lots will be constructed under separate contract or by separate owners (e.g., a development where lots are sold to separate builders); 2) a development plan that may be phased over multiple years, but is still under a consistent plan for long-term development; 3) projects in a contiguous area that may be unrelated but still under the same contract, such as construction of a building extension and a new parking lot at the same facility; and 4) linear projects such as roads, pipelines, or utilities. If the project is part of a common plan of development or sale, the disturbed area of the entire plan must be used in determining permit requirements.

**Composite Sample** means a mixture of grab samples collected at the same sampling point at different times, formed either by continuous sampling or by mixing discrete samples. May be "time-composite" (collected at constant time intervals) or "flow-proportional" (collected either as a constant sample volume at time intervals proportional to stream flow, or collected by increasing the volume of each aliquot as the flow increases while maintaining a constant time interval between the aliquots).

**Concrete Wastewater** means any water used in the production, pouring and/or clean-up of concrete or concrete products, and any water used to cut, grind, wash, or otherwise modify concrete or concrete products. Examples include water used for or resulting from concrete truck/mixer/pumper/tool/chute rinsing or washing, concrete saw cutting and surfacing (sawing, coring, grinding, roughening, hydro-demolition, bridge and road surfacing). When stormwater combines with concrete wastewater, the resulting water is considered concrete wastewater and must be managed to prevent discharge to waters of the State, including groundwater.

**Construction Activity** means land disturbing operations including clearing, grading or excavation which disturbs the surface of the land (including off-site disturbance acreage related to construction-support activity). Such activities may include road construction, construction of residential houses, office buildings, or industrial buildings, site preparation, soil compaction, movement and stockpiling of topsoils, and demolition activity.

**Construction Support Activity** means off-site acreage that will be disturbed as a direct result of the construction project and will discharge stormwater. For example, off-site equipment staging yards, material storage areas, borrow areas, and parking areas.

**Contaminant** means any hazardous substance that does not occur naturally or occurs at greater than natural background levels. See definition of "hazardous substance" and WAC 173-340-200.

**Contaminated soil** means soil which contains contaminants, pollutants, or hazardous substances that do not occur naturally or occur at levels greater than natural background.

**Contaminated groundwater** means groundwater which contains contaminants, pollutants, or hazardous substances that do not occur naturally or occur at levels greater than natural background.

**Demonstrably Equivalent** means that the technical basis for the selection of all stormwater BMPs is documented within a SWPPP, including:

1. The method and reasons for choosing the stormwater BMPs selected.
2. The pollutant removal performance expected from the BMPs selected.

3. The technical basis supporting the performance claims for the BMPs selected, including any available data concerning field performance of the BMPs selected.
4. An assessment of how the selected BMPs will comply with state water quality standards.
5. An assessment of how the selected BMPs will satisfy both applicable federal technology-based treatment requirements and state requirements to use all known, available, and reasonable methods of prevention, control, and treatment (AKART).

**Department** means the Washington State Department of Ecology.

**Detention** means the temporary storage of stormwater to improve quality and/or to reduce the mass flow rate of discharge.

**Dewatering** means the act of pumping groundwater or stormwater away from an active construction site.

**Director** means the Director of the Washington State Department of Ecology or his/her authorized representative.

**Discharger** means an owner or operator of any facility or activity subject to regulation under Chapter 90.48 RCW or the Federal Clean Water Act.

**Domestic Wastewater** means water carrying human wastes, including kitchen, bath, and laundry wastes from residences, buildings, industrial establishments, or other places, together with such groundwater infiltration or surface waters as may be present.

**Ecology** means the Washington State Department of Ecology.

**Engineered Soils** means the use of soil amendments including, but not limited, to Portland cement treated base (CTB), cement kiln dust (CKD), or fly ash to achieve certain desirable soil characteristics.

**Equivalent BMPs** means operational, source control, treatment, or innovative BMPs which result in equal or better quality of stormwater discharge to surface water or to groundwater than BMPs selected from the SWMM.

**Erosion** means the wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep.

**Erosion and Sediment Control BMPs** means BMPs intended to prevent erosion and sedimentation, such as preserving natural vegetation, seeding, mulching and matting, plastic covering, filter fences, sediment traps, and ponds. Erosion and sediment control BMPs are synonymous with stabilization and structural BMPs.

**Federal Operator** is an entity that meets the definition of "Operator" in this permit and is either any department, agency or instrumentality of the executive, legislative, and judicial branches of the Federal government of the United States, or another entity, such as a private contractor, performing construction activity for any such department, agency, or instrumentality.

**Final Stabilization** (same as **fully stabilized** or **full stabilization**) means the completion of all soil disturbing activities at the site and the establishment of permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions, or geotextiles) which will prevent erosion. See the applicable Stormwater Management Manual for more information on vegetative cover expectations and equivalent permanent stabilization measures.

**Groundwater** means water in a saturated zone or stratum beneath the land surface or a surface waterbody.

**Hazardous Substance** means any dangerous or extremely hazardous waste as defined in RCW 70.105.010 (5) and (6), or any dangerous or extremely dangerous waste as designated by rule under chapter 70.105 RCW; any hazardous sub-stance as defined in RCW 70.105.010(14) or any hazardous substance as defined by rule under chapter 70.105 RCW; any substance that, on the effective date of this section, is a hazardous substance under section 101(14) of the federal cleanup law, 42U.S.C., Sec. 9601(14); petroleum or petroleum products; and any substance or category of substances, including solid waste decomposition products, determined by the director by rule to present a threat to human health or the environment if released into the environment. The term hazardous substance does not include any of the following when contained in an underground storage tank from which there is not a release: crude oil or any fraction thereof or petroleum, if the tank is in compliance with all applicable federal, state, and local law.

**Injection Well** means a well that is used for the subsurface emplacement of fluids. (See **Well**.)

**Jurisdiction** means a political unit such as a city, town or county; incorporated for local self-government.

**National Pollutant Discharge Elimination System (NPDES)** means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Federal Clean Water Act, for the discharge of pollutants to surface waters of the State from point sources. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington State Department of Ecology.

**Notice of Intent (NOI)** means the application for, or a request for coverage under this general permit pursuant to WAC 173-226-200.

**Notice of Termination (NOT)** means a request for termination of coverage under this general permit as specified by Special Condition S10 of this permit.

**Operator** means any party associated with a construction project that meets either of the following two criteria:

- The party has operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications; or
- The party has day-to-day operational control of those activities at a project that are necessary to ensure compliance with a SWPPP for the site or other permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the SWPPP or comply with other permit conditions).

**Permittee** means individual or entity that receives notice of coverage under this general permit.

**pH** means a liquid's measure of acidity or alkalinity. A pH of 7 is defined as neutral. Large variations above or below this value are considered harmful to most aquatic life.

**pH Monitoring Period** means the time period in which the pH of stormwater runoff from a site must be tested a minimum of once every seven days to determine if stormwater pH is between 6.5 and 8.5.

**Point Source** means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, and container from which pollutants are or may be discharged to surface waters of the State. This term does not include return flows from irrigated agriculture. (See the Fact Sheet for further explanation)

**Pollutant** means dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, domestic sewage sludge (biosolids), munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste. This term does not include sewage from vessels within the meaning of section 312 of the CWA, nor does it include dredged or fill material discharged in accordance with a permit issued under section 404 of the CWA.

**Pollution** means contamination or other alteration of the physical, chemical, or biological properties of waters of the State; including change in temperature, taste, color, turbidity, or odor of the waters; or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the State as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare; or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses; or to livestock, wild animals, birds, fish or other aquatic life.

**Process Wastewater** means any non-stormwater which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product. If stormwater commingles with process wastewater, the commingled water is considered process wastewater.

**Receiving Water** means the waterbody at the point of discharge. If the discharge is to a storm sewer system, either surface or subsurface, the receiving water is the waterbody to which the storm system discharges. Systems designed primarily for other purposes such as for groundwater drainage, redirecting stream natural flows, or for conveyance of irrigation water/return flows that coincidentally convey stormwater are considered the receiving water.

**Representative** means a stormwater or wastewater sample which represents the flow and characteristics of the discharge. Representative samples may be a grab sample, a time-proportionate *composite sample*, or a flow proportionate sample. Ecology's Construction Stormwater Monitoring Manual provides guidance on representative sampling.

**Responsible Corporate Officer** for the purpose of signatory authority means: (i) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or (ii) the manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures (40 CFR 122.22).

**Sanitary Sewer** means a sewer which is designed to convey domestic wastewater.

**Sediment** means the fragmented material that originates from the weathering and erosion of rocks or unconsolidated deposits, and is transported by, suspended in, or deposited by water.

**Sedimentation** means the depositing or formation of sediment.

**Sensitive Area** means a waterbody, wetland, stream, aquifer recharge area, or channel migration zone.

**SEPA** (State Environmental Policy Act) means the Washington State Law, RCW 43.21C.020, intended to prevent or eliminate damage to the environment.

**Significant Amount** means an amount of a pollutant in a discharge that is amenable to available and reasonable methods of prevention or treatment; or an amount of a pollutant that has a reasonable potential to cause a violation of surface or groundwater quality or sediment management standards.

**Significant Concrete Work** means greater than 1000 cubic yards placed or poured concrete or recycled concrete used over the life of a project.

**Significant Contributor of Pollutants** means a facility determined by Ecology to be a contributor of a significant amount(s) of a pollutant(s) to waters of the State of Washington.

**Site** means the land or water area where any "facility or activity" is physically located or conducted.

**Source Control BMPs** means physical, structural or mechanical devices or facilities that are intended to prevent pollutants from entering stormwater. A few examples of source control BMPs are erosion control practices, maintenance of stormwater facilities, constructing roofs over storage and working areas, and directing wash water and similar discharges to the sanitary sewer or a dead end sump.

**Stabilization** means the application of appropriate BMPs to prevent the erosion of soils, such as, temporary and permanent seeding, vegetative covers, mulching and matting, plastic covering and sodding. See also the definition of Erosion and Sediment Control BMPs.

**Storm Drain** means any drain which drains directly into a *storm sewer system*, usually found along roadways or in parking lots.

**Storm Sewer System** means a means a conveyance, or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains designed or used for collecting or conveying stormwater. This does not include systems which are part of a *combined sewer* or Publicly Owned Treatment Works (POTW), as defined at 40 CFR 122.2.

**Stormwater** means that portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a stormwater drainage system into a defined surface waterbody, or a constructed infiltration facility.

**Stormwater Management Manual (SWMM) or Manual** means the technical Manual published by Ecology for use by local governments that contain descriptions of and design criteria for BMPs to prevent, control, or treat pollutants in stormwater.

**Stormwater Pollution Prevention Plan (SWPPP)** means a documented plan to implement measures to identify, prevent, and control the contamination of point source discharges of stormwater.

**Surface Waters of the State** includes lakes, rivers, ponds, streams, inland waters, salt waters, and all other surface waters and water courses within the jurisdiction of the state of Washington.

**Temporary Stabilization** means the exposed ground surface has been covered with appropriate materials to provide temporary stabilization of the surface from water or wind erosion. Materials include, but are not limited to, mulch, riprap, erosion control mats or blankets and temporary cover crops. Seeding alone is not considered stabilization. Temporary stabilization is not a substitute for the more permanent "final stabilization."

**Total Maximum Daily Load (TMDL)** means a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet state water quality standards. Percentages of the total maximum daily load are allocated to the various pollutant sources. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The TMDL calculations must include a "margin of safety" to ensure that the waterbody can be protected in case there are unforeseen events or unknown sources of the pollutant. The calculation must also account for seasonable variation in water quality.

**Transfer of Coverage (TOC)** means a request for transfer of coverage under this general permit as specified by Special Condition S2.A of this permit.

**Treatment BMPs** means BMPs that are intended to remove pollutants from stormwater. A few examples of treatment BMPs are detention ponds, oil/water separators, biofiltration, and constructed wetlands.

**Transparency** means a measurement of water clarity in centimeters (cm), using a 60 cm transparency tube. The transparency tube is used to estimate the relative clarity or transparency of water by noting the depth at which a black and white Secchi disc becomes visible when water is released from a value in the bottom of the tube. A transparency tube is sometimes referred to as a "turbidity tube."

**Turbidity** means the clarity of water expressed as nephelometric turbidity units (NTUs) and measured with a calibrated turbidimeter.

**Untaminated** means free from any contaminant. See definition of "contaminant" and WAC 173-340-200.

**Upset** means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

**Waste Load Allocation (WLA)** means the portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality based effluent limitation (40 CFR 130.2[h]).

**Water-Only Based Shaft Drilling** is a shaft drilling process that uses water only and no additives are involved in the drilling of shafts for construction of building, road, or bridge foundations.

**Water Quality** means the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose.

**Waters of the State** includes those waters as defined as "waters of the United States" in 40 CFR Subpart 122.2 within the geographic boundaries of Washington State and "waters of the State" as defined in Chapter 90.48 RCW, which include lakes, rivers, ponds, streams, inland waters, underground waters, salt

waters, and all other surface waters and water courses within the jurisdiction of the state of Washington.

**Well** means a bored, drilled or driven shaft, or dug hole whose depth is greater than the largest surface dimension. (See **Injection Well**.)

**Wheel Wash Wastewater** means any water used in, or resulting from the operation of, a tire bath or wheel wash (BMP C106: Wheel Wash), or other structure or practice that uses water to physically remove mud and debris from vehicles leaving a construction site and prevent track-out onto roads. When stormwater combines with wheel wash wastewater, the resulting water is considered wheel wash wastewater and must be managed according to Special Condition S9.D.9.

## APPENDIX B – ACRONYMS

|              |  |
|--------------|--|
| <b>AKART</b> | All Known, Available, and Reasonable Methods of Prevention, Control, and Treatment |
| <b>BMP</b>   | Best Management Practice   |
| <b>CESCL</b> | Certified Erosion and Sediment Control Lead  |
| <b>CFR</b>   | Code of Federal Regulations  |
| <b>CKD</b>   | Cement Kiln Dust   |
| <b>cm</b>    | Centimeters  |
| <b>CPD</b>   | Common Plan of Development   |
| <b>CTB</b>   | Cement-Treated Base  |
| <b>CWA</b>   | Clean Water Act  |
| <b>DMR</b>   | Discharge Monitoring Report  |
| <b>EPA</b>   | Environmental Protection Agency  |
| <b>ERTS</b>  | Environmental Report Tracking System   |
| <b>ESC</b>   | Erosion and Sediment Control   |
| <b>FR</b>    | Federal Register   |
| <b>LID</b>   | Low Impact Development   |
| <b>NOI</b>   | Notice of Intent   |
| <b>NOT</b>   | Notice of Termination  |
| <b>NPDES</b> | National Pollutant Discharge Elimination System                                    |
| <b>NTU</b>   | Nephelometric Turbidity Unit   |
| <b>RCW</b>   | Revised Code of Washington   |
| <b>SEPA</b>  | State Environmental Policy Act   |
| <b>SWMM</b>  | Stormwater Management Manual   |
| <b>SWPPP</b> | Stormwater Pollution Prevention Plan   |
| <b>TMDL</b>  | Total Maximum Daily Load   |
| <b>UIC</b>   | Underground Injection Control  |
| <b>USC</b>   | United States Code   |
| <b>USEPA</b> | United States Environmental Protection Agency                                      |
| <b>WAC</b>   | Washington Administrative Code   |
| <b>WQ</b>    | Water Quality  |
| <b>WWHM</b>  | Western Washington Hydrology Model   |