Washington State
Department of Transportation

Temporary Erosion and Sediment Control Manual

M 3109.02

May 2019

Engineering and Regional Operations

Development Division, Design Office

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Foreword

The *Temporary Erosion and Sediment Control Manual* (TESCM) replaces Chapter 6 and Appendix 6A of the Washington State Department of Transportation (WSDOT) *Highway Runoff Manual*. It outlines WSDOT's policies for preventing erosion related impacts to waters of the state during construction.

The TESCM is intended for use during the design, permitting, and construction phases of transportation construction projects. It covers:

- Applying for, transferring and terminating Permit coverage
- Temporary erosion and sediment control (TESC) plan design and implementation
- TESC best management practice (BMP) application and installation
- Spill prevention, control and countermeasure (SPCC) plans
- Discharge sampling, site inspections and reporting
- Site management and documentation
- Compliance related issues

For further information, visit WSDOT's Erosion Control Policies & Procedures webpage.

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Contents

Figures

Tables

1-1 Introduction

The *Temporary Erosion and Sediment Control Manual* (TESCM) provides the Washington State Department of Transportation (WSDOT) policy for preventing erosion related impacts to waters of the state during construction and complying with the National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit (Permit), issued by the Washington State Department of Ecology (Ecology). In combination, the TESCM and WSDOT's *Highway Runoff Manual* (HRM) are deemed equivalent to Ecology's Stormwater Management Manuals (SWMMs) for western and eastern Washington.

WSDOT uses the temporary erosion and sediment control (TESC) plan and spill prevention, control and countermeasures (SPCC) plan to manage erosion and spill related risks during construction. Together, the TESC and SPCC plans are designed to meet the Stormwater Pollution Prevention Plan (SWPPP) requirements in Special Condition 9 (S9) of the Permit.

The TESCM is intended for project planning, environmental permitting, design and construction personnel. Construction site erosion and sediment control is specialized work, and depending on the scope of the project, it often intersects with other specialized work and disciplines. Therefore, a comprehensive planning effort and the effective implementation of a TESC plan often necessitates interdisciplinary cross-coordination throughout design and construction. Internal coordination is a critical component of effective policy implementation, compliance assurance and overall project success. Once construction begins, active coordination with the contractor(s) also becomes critically important to these goals. Tips for effective cross-coordination are included throughout this Manual.

The TESCM is written from the transfer of coverage (TOC) perspective because it is WSDOT's standard practice for design-bid-build projects to transfer Permit coverage to the contractor the day after contract execution. The TOC process helps ensure contractors are invested in the TESC planning, implementation and Permit compliance. It may not be appropriate to transfer Permit coverage on all design-bid-build projects (e.g., projects with long winter shutdown or with multiple overlapping phases and contracts); if deemed appropriate, projects may request approval from their Assistant State Construction Engineer (ASCE) to retain Permit coverage through construction (non-transfer). Procedures vary for non-transfer design-bid-build projects and design-build projects in which the contractor obtains Permit coverage, see Section 4-1.6.11 for more information. TOC is addressed in Division 8-01 of WSDOT's Standard Specifications for Road, Bridge, and Municipal Construction (Standard Specifications), and additional TOC guidance is referenced in this Manual and available on the Erosion Control Policies & Procedures webpage.

Division 8-01 of WSDOT's Standard Specifications includes three options for measurement and payment (similar to temporary traffic control) of the erosion control work. While lump sum is the preferred option, the project design team may deem one of the other options appropriate based on project specific factors (e.g., may want to use bid items with potential use of force account for non-transfers). Using lump sum encourages the contractor to think proactively about managing erosion related risks, while also providing project cost predictability for the Project Engineer (PE). The PE is to enforce erosion control contract requirements as they would for any other contract requirement and may need to impose a suspension of work in accordance with Standard Specifications Section 1-08.6 to prevent threats to human health and the environment.

Once WSDOT transfers Permit coverage, the contractor becomes responsible for all Permit requirements and WSDOT's role becomes that of compliance assurance through contract enforcement (WSDOT staff inspect the work to help ensure Permit compliance but do not direct the specific methods of erosion control work). Inspection of erosion control work is a specialized task and it is important that the PE allocates adequate project inspector resources and provides proper training for enforcement of this contract work. Internal training expectations can be found in Section 1-1.2. A detailed list of inspection expectations can be found in Section 4-1.

The contract will be prepared in accordance with the Plans Preparation Manual M 22-01 and administered in accordance with the Construction Manual M 41-01.

1-1.1 Erosion, Sedimentation and AKART

Erosion is the movement of sediment particles from their original location by forces such as water, wind, freeze and thaw cycles, or gravity. Erosion is a natural process but construction activities such as removing vegetation, disturbing soil, and redirecting drainage can increase the natural rates of erosion. The Permit requires erosion related risks be proactively managed through planning, site monitoring, and the implementation and adaptive management of onsite best management practices (BMPs).

The erosion process by water is particularly challenging to manage during construction because the natural protective layers of vegetation and topsoil have been disturbed or removed. Construction activities such as clearing, grubbing and grading expose bare soil and create conditions that encourage stormwater flow volume and velocity to increase. TESC BMPs are used to mimic the erosion and sediment control benefits that natural conditions would otherwise provide.

Water erosion starts at the raindrop or "splash" phase and the erosive energy of the water increases through the subsequent phases:

- **Raindrop or Splash Erosion:** Soil particles are displaced by raindrop impact.
- **Sheet Erosion:** Uniform layer of shallow flow that moves loose soil.

- **Rill Erosion:** Concentrated flows develop and create small eroded channels.
- **Gully Erosion:** High-volume high-velocity concentrated flows displace large amounts of soil quickly, creating large eroded channels.
- **Channel or Streambank Erosion:** Shear stress erodes conveyance sidewalls.

TESC BMPs are most effective at managing erosion in the first two phases. Therefore, protecting bare soil from raindrop impact and maintaining sheet flow by dispersing concentrated flows should be a high priority in every TESC plan and BMP implementation strategy. The effectiveness of BMPs decrease and associated costs increase as concentrated flows develop. Concentrated flows can cause large erosion events and quickly lead to the failure of BMPs designed to manage sheet flow (e.g., silt fence, blankets).

Water erosion is generally the most common and damaging type of erosion on construction sites, and is therefore the primary focus of this Manual. However, erosion related risks associated with other forces must also be considered when designing and implementing a TESC plan.

Wind erosion is hardest to manage in regions of eastern Washington due to soil type and climate factors. However, wind erosion can occur statewide and the associated risks should be considered:

- Settling dust can cause water quality problems.
- Dust can create a health and safety concern.
- Comply with the local clean air agency requirements.

Freeze and thaw cycles will be a seasonal challenge, particularly for projects in higher elevations and regions of eastern Washington. Risks associated with freeze and thaw cycles should be considered:

- The upwards swelling of soil during freezing conditions affects soil aggregate stability making soil more vulnerable to erosion.
- Infiltration rates are commonly reduced when soil is frozen. The risks increase if the rain melts existing snow pack.

Gravity is a constant force pulling sediment and water downhill. Risks associated with the force of gravity should be considered:

- Can lead to mass wasting or slumping (large soil structure failure) events.
- Is of particular concern when soil is saturated, cut/fill slopes, or areas where groundwater seeps or geotechnical concerns are identified.

Turbidity is a measurement of the relative clarity of a liquid and is a simple indicator for suspended sediment and other undissolved matter in a discharge sample. While sediment itself is a pollutant, numerous other pollutants bind to sediment; therefore, less turbid discharges will contribute fewer pollutants to surface waters. This understanding is why the Permit uses a turbidity benchmark to help ensure compliance with the surface water quality standards. For example, construction projects in areas impacted by the Tacoma Smelter Plume or Everett Cleanup Site will likely have elevated amounts of arsenic bound to the sediment. Managing the site as required by the Permit will help ensure surface water quality standards will be met for arsenic in these areas.

Sedimentation is a process that occurs after erosion; it is the gravity-induced settling or the deposition of the eroded soil particles. Sedimentation occurs when the velocity of the water or wind in which soil particles are suspended slows for sufficient time allowing the particles to settle or "drop out". Offsite sedimentation can cause environmental impacts which must be minimized using BMPs. Costs associated with erosion and sedimentation may be finite or extensive and difficult to quantify.

Erosion can lead to turbid discharges, which lead to offsite sedimentation which can have numerous impacts, such as:

- Degradation of habitat, aesthetic, and recreational uses of surface waters.
- Water quality impacts such as nutrient loading and eutrophication.
- Increased stormwater system maintenance and operational costs.
- Loss of nutrient-rich topsoil.

To minimize potential impacts, the Permit requires the implementation of **all known, available, and reasonable methods of prevention, control, and treatment (AKART)** as defined in the Washington Administrative Code (WAC) Chapter 173-218-030 prior to a construction impacted discharge. To meet the AKART requirement, the proper selection, installation, maintenance, and adaptive management of BMPs is required to ensure continued functional performance throughout construction. Adaptive management is described in Section 4-1.4. Approved TESC BMPs can be found in:

- Chapter 5 of this Manual
- Volume II of Ecology's SWMM for Western Washington
- Chapter 2 of Ecology's SWMM for Eastern Washington

TESC BMPs may include schedules of activities, prohibitions of practices, physical, structural or managerial practices and maintenance procedures, used singularly or in combination to prevent or reduce the source and release of pollutants during construction. Most TESC BMPs provide a temporary function during the construction period; they may be designed to degrade in-place or may need to be removed prior to terminating Permit coverage. Some BMPs such as ponds and vegetation, may provide both a temporary function during construction and a permanent function after construction is complete. Using existing permanent stormwater facilities for TESC purposes is covered in Section 4-1.6.14. Permanent stormwater facilities are designed in accordance with WSDOT's HRM. Permanent roadside vegetation policies are implemented in accordance with WSDOT's Roadside Policy Manual.

The following information is intended to clarify how different TESC BMP terminology is commonly used, applicable Permit requirements and functional applications of each category:

Sediment Control (Treatment) BMPs:

- May be referred to as "treatment" BMPs because they work to remove pollutants suspended in water. "Treatment" is a more inclusive term because it applies to other pollutants besides sediment; for example, BMPs used to treat high pH and clean up fuel spills.
- Required to be installed before land disturbing work begins in an area to ensure all construction impacted runoff will receive treatment prior to a discharge.
- Required to be maintained regularly because they fill with sediment or become clogged, which lowers the functional performance.
- Are often used within a site to provide treatment prior (pretreatment) to receiving additional treatment from BMPs nearer the discharge point.
- Are not generally designed to prevent erosion; therefore, erosion control BMPs must be installed in accordance with the soil covering timelines in S9.D.5.d of the Permit.

Erosion Control (Source Control) BMPs:

- May be referred to as "source control" BMPs because they manage the source of pollution. "Source control" is a more inclusive term because it applies to sources of pollution besides bare soil; for example, secondary containment BMPs used to manage the source of fuel spills.
- Required to be installed based on site conditions or work activity. For example, erosion control BMPs must be installed on exposed soil not actively worked in accordance with the soil covering timelines outlined in S9.D.5.d of the Permit and the *Standard Specifications* 8-01.3.
- Not generally designed to hold up against concentrated flows; runoff conveyance BMPs must be used to prevent concentrated flows from developing and leading to the failure of erosion control BMPs like blankets and hydraulically applied mulch products.

Conveyance (Dispersion or Water Management) BMPs:

- Dissipate erosive energy and prevent concentrated flows from developing.
- Collect, route, or otherwise manage different sources of flows.

- Required to be installed to protect adjacent properties and downstream waterways from impacts associated with increased velocity and flow rate of runoff that may develop as a result of the project.

Construction site stormwater runoff is subject to federal, state, and local regulatory requirements. Impacts from polluted discharges can increase project costs through legal fines and repair of site damage that can cause delays to project delivery. Pollution is defined by the federal Clean Water Act (CWA) as any man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of surface water.

Common sources of pollution during construction may include:

- Sediment
- pH modifying substances such as cement and grout
- Fuel, oil, grease, petroleum hydrocarbons
- Chemicals, paints, detergents, solvents, fertilizers, pesticides
- Wastewater, construction waste, contaminated or hazardous material

Chapter 90.48 Revised Code of Washington (RCW) defines “waters of the state” to include underground waters, so the Permit protects groundwater from construction impacts as well as surface waters. To protect waters of the state, S1.D of the Permit prohibits specific types of discharges during construction, some of which are conditionally authorized when managed as required.

Projects must coordinate with local jurisdictions prior to construction. Many local jurisdictions have established their own permits (e.g., clearing and grading, special approved discharges to sewer system), codes, or ordinances, which may be applicable to a project’s TESC related work.

1-1.2 Construction Site Erosion and Sediment Control Training

All WSDOT staff who design, implement, or inspect the implementation of TESC plans during construction must attend WSDOT’s Construction Site Erosion and Sediment Control classroom course every three years to ensure they understand the most current Permit requirements. WSDOT staffs involved in permitting and environmental coordination are encouraged to take this course as well.

The classroom course covers:

- Planning and the Notice of Intent (NOI) permitting process
- TESC plan design and implementation
- The Permit transfer of coverage (TOC) process

- Site inspections, discharge sampling, and reporting procedures
- BMP adaptive management and site documentation requirements
- The Notice of Termination (NOT) process

Check the Learning Management System (LMS) for class availability or contact the Headquarters (HQ) Environmental Services Office (ESO) Erosion Control program. WSDOT consultants may attend the training but may not be able to register in LMS.

This classroom course may be used in WSDOT's internal Certified Erosion and Sediment Control Lead (CESCL) certification program. No WSDOT personnel (including TESC plan designers) are required to be CESCL certified because the Permit required site inspections are performed by the contractor's CESCL. However, construction inspectors responsible for tracking the contractor's TESC related work are encouraged to be CESCL certified as it will improve their confidence in identifying compliance assurance actions.

The following conditions apply for internal CESCL certifications:

- Obtaining a new CESCL requires 16 hours of training (8 hours classroom and 8 hours BMP field course). The BMP field course is organized by WSDOT's Maintenance and Operations program or the Regional Road Maintenance Program and has limited availability for non-maintenance staff. For this reason, staff needing new CESCLs are often encouraged to attend an external CESCL certification program. Individuals are not certified until both classes are completed within 6 months of each other. It does not matter which course is taken first.
- Certifications are valid for 3 years. There is a 6-month renewal window after the expiration date in which the CESCL can be renewed with just the classroom course (the certification is not considered current during the 6-month renewal period).
- The 1-day WSDOT Construction Site Erosion and Sediment Control classroom course will renew certifications not expired for over 6 months. Individuals who do not renew certifications during the 6-month renewal period must obtain a new CESCL. CESCL certification may also be renewed through an Ecology-approved external provider.

1-1.3 Construction Stormwater Permitting

All projects that will disturb 1 acre or more of soil and have the potential to discharge to surface waters of the state (including a storm sewer system that drains to surface waters of the state) are required to apply for coverage under the Permit.

In addition:

- Projects smaller than 1 acre that are part of a larger common plan of development or sale that will ultimately disturb 1 acre or more and discharge stormwater to surface waters of the state, must apply for coverage. The disturbed area of the entire common plan must be used in determining Permit coverage requirements.
- Any sized project deemed by Ecology to be a significant contributor of pollutants or expected to cause a violation of any water quality standard, may be required to apply for Permit coverage.

Exception:

- Based on geographical location and other factors such as construction schedule, projects that will disturb less than 5 acres of soil (including common plan of development) may be eligible for the Erosivity Waiver (waiver for Permit coverage) outlined in S2.C of the Permit.

Chapter 90.48 RCW delegates authority to Ecology to administer the NPDES permit program in Washington State with few exceptions. Projects within Indian Country[1] as defined in 18 U.S.C §1151, are not covered by the Ecology Permit and must seek coverage under the federal NPDES Construction General Permit (CGP) issued by the U.S. Environmental Protection Agency (EPA). If permitting authority is unclear, coordinate with Ecology's regional Permit Administrator. If federal CGP coverage is appropriate, use the EPA electronic Reporting Tool (NeT-CGP) system to apply for coverage.

Coverage under the federal CGP is not transferrable like Ecology's Permit, therefore the transfer of coverage (TOC) process does not apply to federal CGP coverage. Projects that will require federal CGP coverage have two contractual options for managing compliance:

1.) Requiring the contractor to obtain their own CGP. This option does not prevent WSDOT from obtaining coverage because the federal CGP requires all "operators" to obtain coverage. WSDOT is considered an operator because it has the ability to make modifications to contract plans and specifications.

2.) Taking on the liability of allowing the contractor to work under WSDOT's CGP coverage (must be articulated in the contract).

[1] There is an exception for the Puyallup reservation defined in Special Condition S1.E.4 of the Ecology Permit.

Projects should consult with their ASCE to determine the best contractual method for managing federal CGP compliance. Information about how to comply with the federal CGP is not discussed in this Manual because very few WSDOT projects trigger federal coverage, but technical assistance can be provided by the HQ Erosion Control program.

Projects seeking coverage under the Ecology Permit must apply by submitting a Notice of Intent (NOI) through Ecology's Water Quality Web Portal (WQWebPortal) system in accordance with S2 of the Permit. Follow the general instructions in the WQWebPortal page (video tutorials are available) and use the internal guidance bulleted below for specific WSDOT procedures.

The Permit requires the NOI be submitted at least 60 days before discharging stormwater and on or before the date of the first public notice. Additional correspondence between WSDOT and Ecology may become required during the NOI process (e.g., outfalls to impaired waterbodies, existing site contamination) which can delay Permit issuance. Therefore, it is **recommended that projects submit the NOI to Ecology at least 90 days before the project is expected to go to advertisement.** This allows adequate time to address issues that may arise during the permitting process. If existing site contamination (soil and/or groundwater) will be disturbed during construction, it is recommended that early coordination with Ecology begin before the NOI submittal to avoid permitting delays and an Administrative Order (AO) whenever feasible.

Guidance is available on the Erosion Control Policies & Procedures webpage for the following aspects of the NOI process:

- Completing the electronic NOI
- Permitting projects with known existing soil or groundwater contamination
- Completing the Proposed New Discharge to Impaired Waterbody form[2]

All surface waters with the potential to receive a construction related discharge must have at least one outfall location identified on the NOI. For purposes of the NOI submittal, the outfall location is the point at which construction discharges are expected to enter the first receiving surface water (directly or indirectly such as through a storm sewer system). Some outfall locations may be temporary (only active during construction), and some may be permanent outfall locations. Only surface waters with an identified outfall location in the NOI submittal will be permitted to receive discharges during construction. If a receiving surface water is missed (i.e., outfall not identified on the NOI submittal), a new NOI and public notice may be required in accordance with G20 of the Permit prior to a discharge being permitted.

Project staff can prevent permitting delays by identifying construction applicable receiving waterbody impairments and, if needed, including the appropriate form with

[2] Will be sent to permittee by Ecology if the NOI includes temporary outfalls into impaired receiving surface waters. This form can also be found on Ecology's website (see above).

the NOI submittal**.** It is Ecology's process to review outfall locations identified in the NOI and determine whether a waterbody impairment (i.e., 303d listing or approved Total Maximum Daily Load (TMDL)) is applicable to construction (i.e., impairment for turbidity, fine sediment, high pH, and phosphorous). Outfalls in impaired waters applicable to construction will trigger the *Proposed New Discharge to an Impaired Waterbody* form submittal; Ecology will request the form be submitted if it was not included in the NOI submittal (considered an incomplete NOI). Guidance for using the GIS Workbench to identify applicable waterbody impairments and to complete the form is available on the Erosion Control Policies & Procedures webpage. Construction applicable waterbody impairments may also trigger additional TESC planning considerations (see Section 2-1.1.6) and discharge sampling requirements (see Section 4-1.6.7).

Projects must coordinate with local jurisdictions prior to construction to ensure compliance with ordinances, codes or other applicable permits (e.g., clearing and grading, special approved discharges to sewer system) that may be applicable to a project's TESC related work. Local jurisdiction procedures and timelines vary. The Permit covers discharges to storm sewer systems that drain to surface waters of the state. However, jurisdictions covered under the Phase I or Phase II NPDES Municipal Stormwater Permit may want to verify Permit coverage or review a TESC plan prior to authorizing a construction related discharge to their municipal separate storm sewer system (MS4).

The local jurisdiction may also operate a publicly owned treatment works (POTW) often referred to as a sanitary sewer. Sanitary sewer systems provide additional treatment prior to discharging to surface waters of the state and are therefore a good option for discharging water not authorized to be discharged under the Permit (e.g., process wastewater). The local jurisdiction may issue a special approved discharge (SAD) permit for discharges to their sanitary system which may include flow limitations, monitoring and water quality requirements, as well as reporting requirements.

Public notice requirements are outlined in S2.B of the Permit. The eNOI system provides a public notice template but does not submit the public notice to the newspaper selected; the public notice action must be done outside of Ecology's eNOI system. The 30-day public comment period begins on the publication date of the second public notice.

If there are no issues with the NOI submittal, Permit coverage will automatically begin on the 31st day following the receipt by Ecology of a completed NOI. Monthly reporting requirements begin as soon as the Permit is issued, even if construction has not started and no discharge has occurred. Refer to Section 4-1.2 for more information about preconstruction reporting requirements. Permit status can be checked in Ecology's Permit and Reporting Information System (PARIS). WSDOT must pay the Permit fees until coverage is transferred to the contractor.

2-1 Temporary Erosion and Sediment Control (TESC) Plan Design

WSDOT uses the temporary erosion and sediment control (TESC) plan and spill prevention, control and countermeasures (SPCC) plan to manage erosion and spill related risks during construction. Together, the TESC and SPCC plans are designed to meet the Stormwater Pollution Prevention Plan (SWPPP) requirements in Special Condition 9 (S9) of the Permit.

Under the TOC process standard for design-bid-build projects, WSDOT prepares the preliminary TESC plan (narrative and plan sheets) or abbreviated TESC plan for inclusion in the contract. Some required TESC plan content may not be known at the time of preliminary TESC plan development (e.g., discharge sample locations, contractor's CESCL, offsite support activity areas) and must be added by the contractor prior to and throughout construction as needed.

While this Chapter is intended to help designers create a TESC plan, it includes information that may be helpful during construction when adaptively managing the TESC plan and site BMPs. The TESC plan is a living document; it must be continually adapted during construction to ensure compliance. Adaptive management is discussed in Section 4-1.4.

A TESC plan must be prepared if:

- The construction project requires coverage under the Permit (See Section 1-1.1).
- The project will add or replace 2,000 square feet (of existing road surface down to base course)or more of impervious surface or will disturb 7,000 sq. ft. or more of soil (Minimum Requirement 2 in the HRM).
- A TESC plan is required by Ecology or local permitting authority.

Smaller earth disturbing projects that do not meet the above criteria, but have the potential to discharge to surface waters of the state (including a storm sewer system that drains to surface waters of the state) must develop an abbreviated TESC plan, sometimes called a "TESC Memo" to ensure compliance with:

- Applicable codes, ordinances and regulations, including the water quality standards for surface waters; Chapter 173-201A of the Washington Administrative Code (WAC) and water quality standards for groundwater; Chapter 173-200 WAC.

A comprehensive TESC plan will minimize the need for TESC related change orders during construction. TESC plans are required to include specific information (bulleted below), but how that information is organized and formatted is not directed by the Permit. The format for abbreviated TESC plans is even more flexible; they may include a narrative and/or plan sheets but must identify the potential erosion related risks and strategies to manage those risks. TESC plan and abbreviated TESC plan templates are available on the Erosion Control Policies & Procedures webpage. Additionally, Ecology's SWPPP template can be used to develop WSDOT's TESC plan.

TESC plans or abbreviated TESC plans, including a method of payment to cover the work, must be included in the contract. TESC plans are not required to be stamped by a licensed engineer, though regional and project specific requirements may vary. The contract must be prepared in accordance with the *Plans Preparation Manual* M22-01.

TESC plan narratives must include:

- Information about existing site conditions and factors that affect erosion related risks, such as topography, climate, drainage, soil type (see Section 2-1.1).
- Identification of potential erosion problem areas including strategies and contingency plans for managing these areas.
- Risk analysis for the 13 TESC planning elements (see Section 2-1.2.1), and a list of potential BMPs that may be used to manage those risks.
- Engineering calculations for designed stormwater facilities such as ponds or chemical treatment systems.
- A general construction phasing and BMP implementation schedule.
- Onsite CESCL contact information (to be added before construction starts).

TESC plan sheets must include:

- Relevant directional and locational information including the direction of north, property lines, existing structures, roads, and impervious surfaces.
- Cut and fill slopes indicating the top and bottom of slope catch lines.
- Approximate slopes, contours, and direction of stormwater flow before and after major grading activities.
- Areas of soil disturbance and areas that will not be disturbed.
- Locations of BMPs.
- Locations of support activities directly related to the permitted project such as offsite material or borrow areas, stockpiles, waste storage, and equipment storage areas (unless the support activity is a commercial operation serving multiple unrelated construction projects or covered by an existing NPDES Permit).

- Locations of all surface water bodies, including wetlands and protected areas.
- Temporary outfall locations to surface waters of the state (as identified in the NOI).
- Discharge sample location(s) (to be added once construction starts and updated throughout construction).
- Areas where final stabilization (construction complete and soils stabilized with permanent BMPs) has been achieved (to be added as applicable during construction).

2-1.1 TESC Data Collection and Risk Analysis

The first steps in developing a TESC plan include data collection and risk analysis. The time and effort put into a TESC plan should be proportionate to the erosion related risks of the given project. High-to-moderate erosion related risk construction projects necessitate a more detailed risk analysis, thoughtful BMP selection and contingency planning.

Most high-to moderate erosion related risk projects involve more than 1 acre of soil disturbance, discharge to surface waters (including a storm sewer system that drains to surface waters) within 300 feet of the project, and meet at least three of the following four characteristics:

- More than 50% of the site consists of soils in Hydrologic Groups C and D as defined by the Natural Resource Conservation Service (NRCS) soil surveys.
- They involve wet-season (October through April west of the Cascades or October through June east of the Cascades) work or last more than one year.
- Their cut/fill slopes exceed more than 50 feet in length.
- They have active seeps or shallow groundwater.

The TESC plan designer's goal is to provide site-specific information that will help the contractor understand how existing site conditions may affect erosion related risks and identify strategies to minimize environmental impact during construction. Depending on the scope of the project, coordination with additional internal personnel such as the local landscape architect or maintenance staff may become necessary to help ensure a comprehensive TESC planning effort.

Utilize appropriate resources when gathering data to develop a TESC plan, such as:

- Existing project specific documentation such as the Hydraulic and Geotechnical Analysis reports, or NEPA/SEPA documentation.
- Guidance located on the Erosion Control Policies & Procedures webpage.

- Environmental layers in the GIS Workbench.
- Site visits (during a storm event when feasible).
- Consult internal regional stakeholders such as landscape architect or maintenance personnel (topics may include: existing drainage or access issues, implementation of roadside management policies related to erosion control such as Integrated Vegetation Management Plans).

Focus data collection and analysis efforts around the factors that affect erosion related risks on a project (outlined below). Think critically about potential site management challenges and environmental risks during construction. Incorporate relevant information into the TESC plan narrative or show it on the contract plan sheets if appropriate.

In accordance with S9.B.1. a and b of the Permit, the TESC narrative must include information about existing site conditions that can affect erosion related risks and potential erosion problem areas:

2-1.1.1 Soil Type

The proportion and arrangement of sand, silt, clay, and organic matter determines soil texture. Soil texture greatly affects the vulnerability to erosion, cohesiveness of the soil, how quickly the suspended particles will settle due to gravity, and the rate at which infiltration or runoff will occur.

Knowing soil characteristics can help TESC plan designers and implementers select appropriate BMPs. For example, quarry spall check dams may provide adequate sediment control in areas with high proportions of sand because sand particles settle out easily. Quarry spall check dams are not as effective at providing sediment control in areas with high proportions of silt and clay because these smaller particles stay suspended longer and require a longer holding time to settle out. A geotextile or sandbag check dam will work much better at creating the “dam” function so as to provide the holding time required to allow smaller sediments to settle out. Another example is selecting between silt fence or compost sock as a sediment control BMP. Silt fence must be trenched in properly to perform as effective sediment control; if soils are too rocky, trenching in silt fence may not be feasible. In which case, compost socks may be more appropriate because they provide sediment control but do not need to be trenched in. To learn more about each TESC BMP refer to Chapter 5.

Information about soil characteristics can be found from various sources, including geotechnical or hydraulics reports, soil boring logs, Natural Resources Conservation Service soil surveys, and onsite evaluations using soil ribbon or jar testing methods. Additional information about soil characteristics can be found in the HRM and the Hydraulics Manual M 23-03. Additional WSDOT resources include Region

Environmental, Maintenance, and Landscape offices, Region Materials Engineers, and the HQ Erosion Control program.

2-1.1.2 Climate and Precipitation Patterns

Climate and precipitation patterns greatly influence the potential for erosion. Consider the following when evaluating risks for this factor:

- Frequency, intensity, and duration of historic storm events
- Climate

Consider how climate and precipitation patterns influence soil saturation which directly influences how much stormwater will runoff rather than infiltrate. Even soils with high infiltration rates can generate large amounts of runoff during high-intensity rain events. Concentrated flows can develop quickly and must be managed to minimize erosion and damage to slopes, conveyances, drainage features, and downstream properties.

Western and eastern Washington have different climates and precipitation patterns. Those differences coupled with different soil types should lead the designer to different risks and risk management strategies. For example, fugitive dust may be a year-round risk for many eastern Washington projects and may not be a risk for other projects.

Freeze and thaw patterns should also be considered as a potential erosion related risk. When moisture in the ground freezes, it heaves the soil upwards creating voids in the ground that create a vulnerability to erosion. Frozen ground also decreases infiltration rates. Rain falling on snow and frozen ground creates a particularly hard to manage situation.

Additional information about climate and precipitation patterns can be found in the HRM and the Hydraulics Manual. The GIS Workbench also contains information on climate and precipitation patterns. The Western Regional Climate Center (WRCC) website has statistical information on precipitation, temperature, and several other climatic measurements for over 200 sampling stations throughout the state. The WRCC website includes interactive probability-graphing capabilities (🖰 https://wrcc.dri.edu/summary/climsmwa.html).

2-1.1.3 Land Cover and Vegetation

Land cover greatly influences the volume of runoff, peak discharge rates, and the vulnerability to erosion. The volume and velocity of overland flows in cleared and graded areas can increase quickly and generate large amounts of turbid runoff because:

- Absorbent soil horizons (organic layer and topsoil) have been removed and remaining compacted subsoils provide minimal infiltration.

- There is no tree canopy to intercept and dissipate raindrop impact energy.
- There is no surface vegetation to slow and filter overland flows.

Vegetation is the most effective erosion and sediment control BMP because it protects soil from raindrop impact, increases infiltration rates, and root systems hold the soil together. Vegetation also slows and filters sheet flow. Use vegetation wherever feasible to minimize erosion related risks during construction:

- Preserve existing vegetation as much as possible and phase work to limit the amount of vegetation that is removed at one time.
- Set clearing limits to minimize vegetation removal and label any areas of existing vegetation that can be protected on the TESC plan sheets.
- Identify opportunities to incorporate permanent vegetation early.

2-1.1.4 Topography

The three-dimensional surface of the grade (existing, temporary, and permanent) will influence the potential for erosion. The potential for erosion increases with increasing slope length and gradient. However, even low-gradient slopes can generate damaging rill or gully erosion because soil type and climate factors greatly influence topographical risks. All slopes, regardless of soil type, are vulnerable to rapid rill and gully erosion when exposed to concentrated flows.

Topographical features such as slope, large rocks or structures such as bridge abutments that influence flow path make certain areas vulnerable erosion. Cut and fill slopes are particularly vulnerable to erosion. BMPs like wattles and compost socks can be used to break up the continuous length of a slope and dissipate flow energy.

Groundwater seepage or ephemeral streams increase the potential for slope failures with all soil types. If geotechnical analysis was done for a project, the report may help you identify areas where these sources of water may occur. Performing site visits in the rainy season during the planning phases of a project can also help you identify such risks.

Topographical features may be used to reduce the risk of erosion and turbid water discharges. Use natural depressions, upland, flat or vegetated areas to disperse or infiltrate runoff. Label dispersion and infiltration areas on the TESC plan sheets like other BMPs.

2-1.1.5 Drainage and Adjacent Areas

Offsite water that runs onto a project (run-on) can cause tremendous damage because it may generate stormwater volumes that far exceed the design capacity of the conveyance system or treatment facility such as a pond. Unidentified offsite sources of water run-on can lead to large erosion related cost overruns and fines.

Identify potential sources of offsite water run-on during the TESC planning phase. Offsite water run-on sources may include: natural sheet flow from neighboring facilities, overland flow from upland areas outside the project boundary, permitted or illicit discharges or connections (e.g., no utility permit) from neighboring buildings and parking lots, groundwater seeps, water from neighboring construction projects, or seasonal drainages.

Division 8-01.3 of the Standard Specifications requires sources of offsite water to be intercepted and piped through or around the construction project to prevent it from coming into contact with construction. If offsite water run-on comes into contact with construction areas, it must be managed in accordance with the Permit.

Take the following actions to identify potential sources of offsite stormwater run-on during the design process:

- Review the Hydraulic Report and Geotechnical Investigation report.
- Consult maintenance personnel about existing drainage patterns.
- Visit the site during a storm event to confirm drainage patterns.

2-1.1.6 Potential Erosion Problem Areas and Contingency Planning

The potential erosion problem areas and contingency plans will be different for every project. The following information includes common examples of problem areas and contingency plans:

Groundwater, Seeps, and Seasonal Springs

Evaluate the risk of intercepting groundwater, seeps, and seasonal springs by reviewing Geotechnical Investigation reports, county soil maps, and wet season site evaluations. There may be helpful information or lessons learned from past projects in the same area.

Groundwater levels fluctuate throughout the year. The presence of high groundwater, seeps, and seasonal springs may impact the BMP selections you make for the project. High groundwater levels affect stormwater infiltration rates, so the timing of certain construction activities may affect the overall risk of that activity.

Sensitive Areas, Existing Contamination, or Impaired Receiving Waters

The location of sensitive areas, site contamination, or impaired receiving waters can have implications for work methods, discharge requirements, and the risk of potential impacts. Review existing environmental documentation to help identify risks applicable to the project.

Identify surface waters, wetlands, buffer zones, and other protected areas within the project site. Always place sediment control BMPs (e.g., silt fence, wattle, compost sock, or vegetated strips) to protect sensitive areas from untreated discharges. Never use sensitive areas as treatment areas.

Existing site contamination is a risk that must be identified as a risk in the TESC plan narrative, but the management details do not need to be included as long as that information is elsewhere in the contract. It can be helpful if the TESC narrative references relevant contract documents used to manage contamination. For more information contact the WSDOT Hazardous Materials Program.

Use the WSDOT GIS Workbench to identify impaired receiving waters that may receive a discharge during construction (this should have been done during the Environmental Review Summary process). Waters impaired for turbidity, fine sediment, high pH and phosphorus will have TESC implications. Depending on the pollutant of concern and the construction activity, additional management strategies may be warranted to prevent impacts to impaired waters. For more information about how to manage impaired receiving waters during construction, refer to Section 4-1.6.7 or the Impaired Water Body section of Erosion Control Policies & Procedures webpage.

Utilities and Existing Encumbrances

Check for existing encumbrances, such as utilities, wells, or drain fields, that may impact risk. Discuss the responsibility for acquisition of any necessary environmental documentation and permitting with the Project Development Engineer, Region Utilities Office, and the utilities as early in the design process as possible. Environmental requirements will vary between projects. Refer to the *Utilities Manual* for more information.

Timing, Duration, Work Sequencing

Consider how timing and duration of the project will impact overall risk. Projects that will have soil disturbing work in the wet season may warrant additional controls and contingency planning to ensure Permit compliance. Timing and duration of construction depends on funding, permitting, weather conditions, fish windows, contractor work schedules, and other issues. The TESC plans should be designed assuming likely worst-case conditions for timing and duration. For example, consider assuming that the risky work planned for September will actually be done in November, which likely means larger volumes of stormwater runoff.

Contingency Planning

Analyzing site conditions and identifying potential erosion problem areas will help the designer prioritize contingency planning efforts in accordance with S9.B.e of the Permit. If erosion and sediment control issues are anticipated, a contingency plan should be developed so it can be implemented quickly if the original management strategy fails to achieve compliance during construction.

Contingency plans may be broad in the sense that they could apply project wide to various construction activity. On the other hand, contingency plans may be location, timing or activity specific. Therefore, contingency plans can be incorporated into the TESC plan wherever they make sense contextually.

Contingency plans may include:

- Materials on hand, such as pumps and inlet plugs to prevent a discharge
- Mobile tanks for temporary containment of water
- Active treatment systems and pH neutralization methods
- Work sequencing or phasing
- Alternative disposal options (e.g., sanitary sewer)

2-1.1.7 Construction Staging Plans and Gutter Flow Analysis

Depending on the contracting method, the WSDOT project office or Design-Builder shall perform a gutter flow analysis for every construction staging plan to identify potential drainage problem areas. The gutter flow analysis shall be included in the TESC Plan, Abbreviated TESC Plan, or Region Equivalent document and requires concurrence by the Region Hydraulics Engineer. Though this issue is not specifically TESC related, it can be tied to the type of change management identified in the TESC Plan. The details of the gutter flow analysis are in the WSDOT Hydraulics Manual 5-4.

2-1.2 BMP Selection and TESC Planning Elements

Once the existing site conditions have been analyzed, the TESC plan designer will be better prepared to evaluate the risks associated with each of the TESC planning elements and select BMPs to manage risks. Selecting BMPs for each TESC planning element is a Permit requirement; it does not necessarily dictate the BMPs that must be used by the contractor during construction. The BMP selections made during the TESC planning process represent the designer’s best professional judgment as to what BMPs may be appropriate to manage specific risks during construction and help develop a cost estimate for the work. Chapter 5 provides detailed information on approved TESC BMPs.

2-1.2.1 TESC Planning Elements

This section will help designers perform the risk analysis for the 13 planning elements and select BMPs to manage risks in accordance with S9.B.c of the Permit. The 13 TESC planning elements are the same as the 13 Stormwater Pollution Prevention Plan (SWPPP) elements outlined in Special Condition S9 of the Permit.

Commonly used BMPs are listed for each element; however, designers can select other approved BMPs. All TESC planning element must be included in every TESC plan narrative, include a justification if an element is not applicable to a project.

Element 1: Preserve Vegetation and Mark Clearing Limits

Risks associated with this element may include the contractor performing work in areas unauthorized for impacts or harming protected vegetation.

The requirements for this element include:

- Retain duff layer, native topsoil, and natural vegetation in an undisturbed state to the maximum degree practicable.
- Prior to land-disturbing activities, mark all clearing limits, sensitive areas and buffers, vegetation and other areas to be protected from impacts.

Additional Information:

Additional guidance about marking clearing limits and protecting sensitive areas can be found on the Environmental Commitments & Compliance webpage.

COMMON BMPS SELECTED FOR ELEMENT 1
➔ Preserving natural vegetation 5-1.1.29
➔ Buffer zones 5-1.1.2
➔ Silt fence 5-1.1.33
➔ High-visibility fencing 5-1.1.18

Element 2: Establish Construction Access

Risks associated with this element may include sediment being tracked offsite and generating turbid runoff during a storm event. The risks vary based on project specific factors like wet season work activity, traffic, soil type, project footprint and access point locations. Sediment track-out is one of the most common, readily visible and hard to manage compliance challenges. Source control (preventing the track-out) is always the goal because street sweeping is not always effective at removing fine sediment particles from the roadway.

The requirements for this element include:

- Limit construction vehicle exit points to the fewest possible to prevent multiple track-out locations.
- Stabilize construction access points to minimize sediment track-out.
- If sediment track-out occurs, clean the affected roadway thoroughly at the end of each day, or more frequently as necessary (e.g. during wet weather).

- Incorporate a tire wash if sediment track-out is an ongoing compliance issue.

Additional Information:

Wherever feasible, slope entrances or haul roads toward the site to prevent discharges offsite or onto the roadway.

COMMON BMPS SELECTED FOR ELEMENT 2	
➔ Stabilized construction entrances 5-1.1.35	➔ Street cleaning 5-1.1.35
➔ Steel rumble plates 5-1.1.35	➔ Tire wash 5-1.1.45
➔ Construction road and parking area stabilization 5-1.1.9	

Element 3: Control Flow Rates

Risks associated with this element may include runoff volumes and velocities that cause erosion damage within the site or to downstream properties or waterways.

The requirements for this element include:

- Protect downstream properties and waterways from erosion by preventing increases in the volume, velocity, and peak flow rate of stormwater leaving the site during construction.
- Implement stormwater retention or detention facilities as one of the first steps in grading.
- Implement temporary flow control measures such as level spreaders or wattles to dissipate erosive energy.
- Outlet structures for permanent ponds may need to be modified during construction to allow adequate settling time for suspended sediments.
- If permanent infiltration ponds are used for flow control during construction, protect the facilities from siltation or rehabilitate prior to the end of construction to original design requirements.
- See section 2-1.1.7 for gutter flow analysis requirements.

Additional Information:

Account for both on- and offsite run-on water sources when designing drainage facilities (the contract requires the contractor to intercept and pipe offsite sources of water run-on around or through the project where feasible).

Minimize soil erosion by controlling stormwater velocity within the site. Maintain sheet flow wherever feasible; use dispersion BMPs to help prevent concentrated flows from developing. Use BMPs such as compost socks and wattles to dissipate flow energy in areas at risk of having concentrated flows develop, such as on slopes, and areas where sheet flows converge.

Temporary BMPs used to cover slope soils, like blankets and hydromulches, protect against raindrop erosion but will not hold up against concentrated flows. Use top-of-slope BMPs to prevent concentrated flows developing or from reaching BMPs not designed to hold up against concentrated flow.

BMPs must be used to minimize erosion in areas designed to manage concentrated flow such as conveyances and pond outlet areas. Use BMPs such as check dams, conveyance channel blankets and rock spillways to dissipate erosive energy and minimize erosion in these areas.

Use upland vegetated areas to disperse and infiltrate stormwater wherever feasible, and mark infiltration areas on the TESC plan sheets.

COMMON BMPS SELECTED FOR ELEMENT 3	
➔ Temporary curbs or water bars 5-1.1.42	➔ Straw wattles 5-1.1.37
➔ Vegetated strips 5-1.1.47	➔ Check dams 5-1.1.4
➔ Outlet protection 5-1.1.25	➔ Compost socks 5-1.1.5
➔ Brush barriers 5-1.1.1	➔ Sediment traps 5-1.1.31
➔ Surface roughening 5-1.1.39	➔ Level spreaders 5-1.1.21
➔ Temporary sediment ponds 5-1.1.44	➔ Filter berms 5-1.1.15
➔ Interceptor dikes and swales 5-1.1.20	➔ Water pumps 5-1.1.49
➔ Vegetative dispersion and infiltration 5-1.1.48	
➔ Temporary or mobile containment 5-1.1.43	
➔ Subsurface drains, French drains, and sump systems 5-1.1.38	

Element 4: Install Sediment Controls

Risks associated with this element may include sediment pollution being discharged from the site.

The requirements for this element include:

- Sediment control BMPs (e.g. silt fence, inlet protection, ponds) are required to be installed before land disturbing work begins in a drainage area to provide treatment prior to a discharge until the drainage area is fully stabilized.
- The design, implementation and maintenance of effective controls to manage site-specific factors and minimize the discharge of pollutants.

- Locate BMPs intended to trap sediment onsite in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages.
- Where feasible, direct stormwater to vegetated areas to maximize stormwater infiltration.
- Wherever feasible, design pond outlet structures that will withdraw or discharge stormwater from the surface of detained water, to avoid discharging sediment that is suspended lower in the detained water column.

Additional Information:

Sediment control BMPs fill with sediment and may require regular maintenance to ensure continued functional performance.

Some sediment control BMP can cause issues if they are not installed properly (e.g. silt fence, check dams). Always enforce applicable BMP installation and maintenance contract requirements.

Wherever feasible, apply for sanitary sewer permits from local jurisdictions. The option of sending discharges to a sanitary system is a huge benefit. It is advisable to apply for coverage before construction starts. Refer to Section 4-1.6.9 for information about reporting discharges to a sanitary sewer system.

COMMON BMPS SELECTED FOR ELEMENT 4	
➔ Silt fences 5-1.1.33	➔ Construction stormwater filtration 5-1.1.11
➔ Check dams 5-1.1.4	➔ Temporary sediment ponds 5-1.1.44
➔ Outlet protection 5-1.1.25	➔ Stabilized construction entrances 5-1.1.35
➔ Sediment traps 5-1.1.31	➔ Storm drain inlet protection 5-1.1.36
➔ Filter berms 5-1.1.15	➔ Temporary or mobile containment 5-1.1.43
➔ Compost socks 5-1.1.5	➔ Sedimentation bags 5-1.1.32
➔ Brush barriers 5-1.1.1	➔ Pond skimmers 5-1.1.28
➔ Straw wattles 5-1.1.37	➔ Stormwater chemical treatment[3] 5-1.1.10
➔ Vegetated strips 5-1.1.47	➔ Surface roughening 5-1.1.39

Element 5: Stabilize Soils

Risks associated with this element may include erosion damage within the site and sediment pollution being discharged from the site.

The requirements for this element include:

[3] Contact Region Environmental when planning to use chemical treatment.

- At a minimum, stabilize all exposed and unworked soils, including stockpiles, by applying erosion control BMPs in accordance with the soil covering timelines listed below. Exposed soils may need to be stabilized more frequently based on the weather forecast to prevent erosion and turbid discharges.
- Control stormwater volumes and velocity within the site to minimize erosion.
- Minimize the amount of exposed soil at one time and the disturbance of slopes.
- Where feasible, locate stockpiles away from storm drains, drainages and surface waters.

Additional Information:

Stockpiles and cut and fill slopes are especially vulnerable to erosion.

Seed laying on soil is not considered a soil stabilizing BMP; about a 70% vegetative cover must be evident before the soil is considered stabilized. Consider using mulch (e.g. compost, HECP) mixed with the seed and fertilizer to temporarily stabilize the soil until the vegetation establishes permanent stabilization.

When selecting erosion control BMPs, consider factors such as the project location and time of year, and site conditions such as climate, slope length and gradient, and soil type. Some erosion control products like biodegradable erosion control blankets and hydraulically-applied mulches come with a wide variety of performance expectations, recommended uses, and installation requirements.

Expose no more soil than can be covered within the soil covering time limits below. Per Division 8-01.3 of the Standard Specifications, exposed soil that is not being worked by hand or machinery must be covered—whether at final grade or not—within the following time limits, using approved soil cover practices:

Western Washington:	
October 1 through April 30	2-day maximum
May 1 through September 30	7-day maximum
Eastern Washington:	
July 1 through September 30	10-day maximum
October 1 through June 30	5-day maximum
Central Basin of eastern Washington (areas with 12 inches or less of annual rainfall):	
July 1 through September 30	30-day maximum
October 1 through June 30	15-day maximum

For precipitation maps: www.wsdot.wa.gov/design/hydraulics/

If any portion of the project lies in areas that receive more than 12 inches of annual precipitation, follow the soil coverage time limits for eastern Washington, not for the Central Basin (contact Region Hydraulics to confirm average annual rainfall).

Walking or driving over exposed soil is not considered working an area. Maximum time limits for all soil cover practices are defined in calendar days. A calendar day is a period of 24 consecutive hours starting at midnight and ending the following midnight.

Construction activities should never expose more erodible earth than the amounts shown below for the specified locations. If the contractor feels that the acreage limitation is too restrictive, they can submit a request for approval to open a larger area and include a plan and schedule for any additional BMPs that may be necessary to manage increased erosion related risks. Evaluate the contractor's request for increased areas in consultation with Region Environmental staff. Work progress is of critical importance and should not be impeded except when clear probability of detrimental erosion potential exists or where permit constraints may be violated (refer to Chapter 8 of the *Construction Manual* for more information).

Area	Date	Location
17 Acres	April 1 – October 31 May 1 – September 30	East of the Summit of the Cascade Range West of the Summit of the Cascade Range
5 Acres	November 1 – March 31 October 1 – April 30	East of the Summit of the Cascade Range West of the Summit of the Cascade Range

COMMON BMPS SELECTED FOR ELEMENT 5	
➔ Preserving natural vegetation 5-1.1.29	➔ Sodding 5-1.1.34
➔ Dust control 5-1.1.13	➔ Check dams[4] 5-1.1.4
➔ Erosion control blankets 5-1.1.14	➔ Topsoiling 5-1.1.46
➔ Mulching 5-1.1.24	➔ Plastic covering 5-1.1.27
➔ Temporary and permanent seeding 5-1.1.41	
➔ Hydraulically-applied erosion control products 5-1.1.19	
➔ Stabilized construction entrances 5-1.1.35	
➔ Construction road and parking area stabilization 5-1.1.9	
➔ Tackifiers and polyacrylamide[5] 5-1.1.40	

[4] Check dams, brush barriers, straw wattles, and compost socks control flow rates and can help stabilize soils, but they are not considered soil-covering BMPs on their own.

[5] Polyacrylamide (PAM) can help stabilize soils, but using it with mulch provides soil covering/additional protection.

Element 6: Protect Slopes

Risks associated with this element may include large erosion events on slopes. Some slopes will be more vulnerable to erosion, depending on factors such as soil type, vegetation, topographical features that influence flow path, slope length and gradient.

The requirements for this element include:

- Design, construct, and manage cut and fill slopes to minimize erosion.
- Use top of slope BMPs, such as interceptor dikes, swales, stabilized channels, or temporary pipe slope drains, to divert flows away from the slope. Place check dams in cut channels on a slope.
- Place excavated material on the uphill side of trenches, consistent with safety and space considerations.
- Where feasible, reduce continuous length or gradient of slopes with terracing or diversions. Add surface texture to slope to slow, disperse, or dissipate flows (e.g., blanket, mulch, compost sock).

Select slope stabilizing BMPs based on soil type, slope length and gradient, and identified geotechnical conditions. In some cases, geotechnical conditions may warrant permanent controls (not temporary or biodegradable) such as rock or turf reinforcement mats to prevent slope failure.

BMPs used to temporarily stabilize slopes (e.g. biodegradable blankets, HECPs) do not hold up to concentrated flows; other BMPs must be used to prevent concentrated flows from developing and causing a failure.

Manage overland flow or offsite water run-on to minimize erosion on slopes. Ensure concentrated flows or drips coming off overhead structures do not create erosion on slopes.

COMMON BMPS USED FOR ELEMENT 6	
➔ Pipe slope drains 5-1.1.26	➔ Subsurface drains 5-1.1.38
➔ Straw wattles[6] 5-1.1.37	➔ Compost socks[6] 5-1.1.5
➔ Mulching 5-1.1.24	➔ Level spreaders 5-1.1.21
➔ Temporary curbs and water bars 5-1.1.42	➔ Brush barriers[5] 5-1.1.1
➔ Interceptor dikes and swales 5-1.1.20	➔ Gradient terraces 5-1.1.16
➔ Erosion control blankets 5-1.1.14	➔ Plastic covering[7] 5-1.1.27

[6] Check dams, brush barriers, straw wattles, and compost socks control flow rates and can help stabilize soils, but they are not considered soil-covering BMPs on their own.
[7] Plastic covering increases flow rates; protect toe of slope areas.

➔ Conveyance channel stabilization 5-1.1.12	
➔ Hydraulically-applied erosion control products 5-1.1.19	
➔ Temporary and permanent seeding 5-1.1.41	

Element 7: Protect Drain Inlets

Risks associated with this element may include sediment pollution being discharged from the site.

The requirements for this element include:

- Use inlet protection devices at all operable storm drain inlets to ensure all discharges receive sediment removal treatment.
- Clean or replace inlet protection devices as needed to ensure continued sediment removal performance.

Additional Information:

Inlet filter socks only provide a minimal level of treatment for discharges and, whenever feasible, should not be relied on as the sole method for minimizing sediment release. Use erosion control BMPs to prevent turbid water from being generated and use diversion BMPs (e.g. temporary curbs) to prevent turbid water from reaching inlets. Wherever feasible, use inlet covers or plugs to prevent turbid discharges, and implement a strategy to manage the resulting ponding water.

COMMON BMPS USED FOR ELEMENT 7	
➔ Storm drain inlet protection 5-1.1.36	➔ Compost socks 5-1.1.5
➔ Silt fences 5-1.1.33	➔ Check dams 5-1.1.4
➔ Temporary curbs or water bars 5-1.1.42	➔ Filter berms 5-1.1.15

Element 8: Stabilize Channels and Outlets

Risks associated with this element may include erosion within channels or outlet areas and sediment pollution being discharged from the site.

The requirements for this element include:

- Design, construct, and stabilize all temporary conveyance channels to minimize erosion.
- Implement stabilization methods, including armoring material, adequate to minimize erosion at the outlets of all conveyance systems.

Additional Information:

Channels and outlet areas are often exposed to concentrated flows which increase erosion related risks. These areas should be stabilized permanently as soon as work allows. Temporary controls must be used to prevent erosion, dissipate erosive energy, and prevent increases in flow rates.

COMMON BMPS USED FOR ELEMENT 8	
➔ Conveyance channel stabilization 5- 1.1.12	➔ Check dams 5-1.1.4
➔ Erosion control blankets 5-1.1.14	➔ Sodding 5-1.1.34
➔ Level spreaders 5-1.1.21	➔ Outlet protection 5-1.1.25
➔ Temporary and permanent seeding 5-1.1.41	

Element 9: Control Pollutants

Risks associated with this element may include the discharge of pollutants.

The requirements for this element include:

- Design, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants.
- Handle and dispose of pollutants, including construction and waste materials, and demolition debris, in a manner that does not cause contamination stormwater.
- Prevent prohibited discharges in accordance with S1.D of the Permit.
- Provide cover, containment, and protection from vandalism for all materials that have the potential to pose a threat to human health or the environment.
- Onsite fueling tanks must include secondary containment capable of containing 110% of the volume in the largest fuel tank. Double-walled tanks do not require additional containment.
- Conduct maintenance, fueling, and repair of heavy equipment and vehicles using spill prevention and control measures.
- Clean contaminated surfaces immediately following a spill incident.
- Discharge tire wash wastewater to a separate onsite treatment system that prevents discharge to surface waters, such as a closed-loop recirculation system.
- Apply fertilizers and other chemicals in a manner and application rate that will not result in loss of chemical to stormwater runoff. Follow manufacturers’ requirements.
- Whenever feasible, use BMPs to prevent the contamination of stormwater by pH-modifying sources such as: bulk cement, cement kiln dust, fly ash, new

concrete and cure water, rubble or waste stockpiles, waste streams generated from concrete resurfacing or demolition, aggregate processes that include recycled concrete, dewatering concrete vaults. Potentially pH affected stormwater (as defined in Division 8-01.1 of the Standard Specifications) must be sampled and potentially neutralized prior to discharge. Stormwater that comingles with cementitious wastewater/concrete wastewater (as defined in Division 8-01.1 of the Standard Specifications) is considered cementitious wastewater/concrete wastewater must be managed to prevent discharge to waters of the State, including groundwater. Refer to Section 4-1.3 and BMP 5-1.1.17 for more information.

- pH affected and conditionally-authorized non-stormwater (as defined in Division 8-01.1 of the Standard Specifications) must be sampled, and potentially neutralized and dechlorinized in accordance with the CSWGP.

- Concrete spillage and concrete wastewater/cementitious wastewater (as defined in Division 8-01.1 of the Standard Specifications) are prohibited to discharge to waters of the state. Do not dump excess concrete onsite, except in designated concrete washout facilities. Do not wash out concrete trucks or handling equipment onto ground, streets, into storm drains, ditches. Refer to BMPs 5-1.1.7, Concrete Handling, and 5-1.1.8, Concrete Washout Areas, for more information.

- Collect concrete slurry generated from cutting or grinding operations from the roadway on a continual basis immediately behind the operations, and dispose of in accordance with Division 5-01.3 of the Standard Specifications. Refer to BMP 5-1.1.6, Concrete Cutting and Grinding Pollution Prevention, for more information.

- Obtain approval from Ecology prior to using any chemical treatment not already authorized by the Permit (e.g. pH neutralization using CO^2, dry ice, or food grade vinegar).

Additional Information:

Known pre-existing site contamination should be identified as a risk in the TESC plan. The TESC plan narrative should reference relevant contract requirements used to manage contamination. The contract must include information about existing site contamination, management strategies or performance expectations for the contractor (contact the WSDOT Hazardous Materials Program).

Control Pollutants: TESC plan

The purpose of the TESC plan is to identify risks and management strategies for controlling nonhazardous sources of pollutants, such as loose soils or turbid stormwater/groundwater, and pH affected stormwater/conditionally authorized non-stormwater (as defined in Division 8-01.1 of the Standard Specifications). Planned work activity may trigger the development of additional plans to manage pollutant-generating work such as hydro-demolition (see Standard Specification 6-09.3) or shaft drilling (see Standard Specification 6-19.3).

Control Pollutants: SPCC plan

The purpose of the contractor's SPCC plan is to identify risks and management strategies that will be used for controlling potentially hazardous materials, such as cementitious materials, petroleum products, and chemicals (defined in Chapter 447 of the *Environmental Procedures Manual)* that the contractor plans to bring onsite. Refer to BMP 5-1.1.22, Materials Handling, Storage, and Containment, for more information.

Ensure the SPCC plan is consistent with Standard Specification 1-07.15 as described in WSDOT SPCC Plan Preparation Instructions and Spill Plan Reviewers Protocols:

www.wsdot.wa.gov/environment/hazmat/spillprevention.htm

COMMON BMPS USED FOR ELEMENT 9	
➔ Concrete washout areas 5-1.1.8	➔ Concrete handling 5-1.1.7
➔ High-pH stormwater neutralization 5-1.1.17	
➔ Concrete cutting and grinding pollution prevention 5-1.1.6	
➔ Materials handling, storage, and containment 5-1.1.22	

Element 10: Control Dewatering

Risks associated with this element include failure to provide appropriate treatment of dewatering prior to a discharge and pollution being discharged from the site.

The requirements for this element include:

- Sources of dewatering water should be kept separate from stormwater unless quality characteristics are similar.
- Dewatering treatment and disposal options include:
  - Onsite Infiltration.
  - Offsite legal disposal facility.
  - Onsite treatment and discharge to surface water in accordance with the discharge sampling requirements.
  - Sanitary or combined sewer discharge with local jurisdiction approval.

Additional Information:

Uncontaminated dewatering water is an authorized non-stormwater discharge under the Permit. If dewatering water comes into contact with pH-modifying substances, such a newly poured concrete foundation, as a result of natural flow, monitor pH levels to ensure high-pH water is not discharged. Follow the pH monitoring protocols outlined in Section 4-1.3.

COMMON BMPS USED FOR ELEMENT 10	
➔ Water pumps 5-1.1.49	➔ Temporary or mobile containment 5-1.1.43

Element 11: Maintain BMPs

Risks associated with this element may include failure to maintain BMPs as required to prevent sediment pollution from being discharged from the site.

The requirements for this element include:

- Maintain or replace all BMPs as needed to ensure continued performance or intended function.
- Remove all non-biodegradable temporary BMPs as soon as they are no longer needed and prior to submitting the Notice of Termination.

Additional Information:

Uncontaminated sediments removed from sediment control BMPs may be stabilized away from drainages in an onsite area approved by the Project Engineer.

COMMON BMPS USED FOR ELEMENT 11	
➔ Materials on hand 5-1.1.23	➔ CESCL 5-1.1.3

Element 12: Manage the Project

Risks associated with this element include the failure to implement procedural requirements (e.g., site inspections, discharge sampling, BMP adaptive management, site documentation, contract requirements etc.).

The requirements for this element include:

- Soil exposure and covering timelines are in accordance with Division 8-01.3 of the Standard Specifications).
- Weekly site inspections are performed in accordance with Division 8-01.3 of the Standard Specifications.
- Weekly discharge sampling is performed in accordance with Section 4-1 and the Permit, and data is being reported to Ecology's WebDMR system on time.

- Onsite BMPs are being maintained and adaptively managed as required to ensure continued performance.
- Maintain a site log book that contains records of the permit requirements (see Section 4-1.5).

COMMON BMPS USED FOR ELEMENT 12	
➔ Materials on hand 5-1.1.23	➔ CESCL 5-1.1.3
➔ Scheduling and coordinating work activity 5-1.1.30	

Element 13: Protect Low-Impact Development BMPs

Risks associated with this element may include the failure to protect LID BMPs from sedimentation or compaction.

The requirements for this element include:

- Protect low-impact development (LID) BMPs during construction activity to prevent impacts from sedimentation and soil compaction.
- If LID BMPs are impacted during construction, restore them to their original condition or design requirements.

Common LID BMPs (existing or installed during construction) that must be protected from construction activity include:

- FC.01 – Natural Dispersion
- FC.02 – Engineered Dispersion
- RT.02 – Compost-Amended Vegetated Filter Strips (CAVFS)
- RT.04 – Continuous Inflow Compost-Amended Biofiltration Swale (CABS)
- RT.07 – Media Filter Drain (MFD)
- RT.08 – Bioretention Area
- IN.01 – Bioinfiltration Pond (E. WA only) Natural Depression Storage
- IN.02 – Infiltration Pond
- IN.03 – Infiltration Trench
- IN.04 – Infiltration Vault
- IN.05 – Dry Well

Design requirements for the above-listed LID BMPs are outlined in Chapter 5 of the *Highway Runoff Manual*.

COMMON BMPS USED FOR ELEMENT 13	
➔ High-visibility fencing 5-1.1.18	➔ Compost socks 5-1.1.5
➔ Silt fences 5-1.1.33	➔ Buffer zones 5-1.1.2
➔ Interceptor dikes and swales 5-1.1.20	➔ Filter berms 5-1.1.15
➔ Temporary curbs or water bars 5-1.1.42	

2-1.3 Reviewing a TESC Plan

TESC plans should be reviewed internally using regional procedures before being included in a contract. TESC plans are not required to be stamped by a licensed engineer, though regional and project specific requirements may vary. A TESC plan review checklist is available on the Erosion Control Policies and Procedures website.

The contractor is required to either adopt and modify the WSDOT TESC plan or develop their own TESC plan in accordance with this Manual. The contractor's TESC plan must be submitted as a Type 2 Working Drawing for review and comment in accordance with the contract. The final TESC plan must include the contractor's schedule, method of construction, TESC implementation schedule, and offsite areas that will be used to directly support construction activity such as equipment staging yards, material storage areas, or borrow areas in accordance with S1.C.2 of the Permit.

3-1 Spill Prevention Control and Countermeasures Plan

A spill prevention control and countermeasures (SPCC) plan is required on all projects to prevent and minimize spills that may contaminate soil or nearby waters of the state. The contractor prepares the SPCC plan in accordance with Standard Specification 1-07.15 and submits the plan to the Project Engineer to be reviewed and accepted before starting onsite construction activities. The Hazardous Materials and Solid Waste Program provides online guidance to contractors for preparing SPCC plans, and provides training to WSDOT staff on reviewing SPCC plans to ensure compliance.

SPCC plans are required to be project specific, adaptively managed to reflect site conditions, maintained onsite, and must ensure the contractor:

- Handles all pollutants in a manner that does not cause contamination of stormwater.
- Covers, contains, and protects all materials from vandalism so that, if spilled, the materials would not pose an immediate risk to waters of the state.
- Maintains and repairs heavy equipment using spill prevention measures such as drip pans and, if necessary, cover.
- Applies fertilizers and herbicides following manufacturers' recommendations, to protect runoff water quality.
- Manages materials that modify pH, such as cementitious materials that contain Portland cement, fly ash, kiln dust, and bottom ash.

General Special Provisions (GSPs) may be included in a contract for project specific pollution-prevention requirements (e.g., removal, containment, testing, and disposal requirements for contaminated soils or underground storage tanks). For additional SPCC guidance, see: www.wsdot.wa.gov/environment/hazmat/spillprevention.htm

Spill Response on WSDOT Construction Sites

In the event of a hazardous materials spill, release, or encounter by the contractor on a WSDOT construction site, personnel should notify the Project Engineer (PE) and refer to the SPCC plan for response activities. Refer to the Spill Reporting Flow Chart on the Hazardous Materials Investigation, Sampling, & Documentation webpage for contact information and detailed instructions on how to report spills or manage hazardous materials. If the spill may pose a threat to human health or the environment, notify Ecology immediately and submit a written report within 5 days in accordance with S5.f of the Permit.

When contractors encounter unknown preexisting contaminants or underground storage tanks, or cause a spill that may be a threat to human health or the environment, they must stop work in the immediate area and notify the PE. The PE must evaluate the situation and initiate required notifications to regulating authorities and ECAP reporting.

4-1 Managing Compliance

WSDOT staff play a key role in compliance when Permit coverage has been transferred to the contractor. Once Permit coverage has been transferred (specific date of transfer is the day after contract execution) the contractor becomes fully responsible for all Permit requirements. WSDOT's role becomes that of compliance assurance through inspection, documentation, contract enforcement and generally supporting the contractor's compliance efforts by:

- Helping to identify compliance concerns and referencing the applicable Permit requirement(s) and/or contract requirement(s).
- Verifying discharge sampling and reporting is being performed as required (have automatic notifications set up as described in Section 4-1.2 -Step 3).
- Ensuring the contractor is tracking, resolving and documenting TESC adaptive management as required (e.g., using a BMP tracking table as required by the contract to resolve TESC issues within 10 days).
- Ensuring appropriate BMP materials and installation methods are used (e.g., enforce Standard Specifications in Division 9-14 and Standard Plans).
- Ensuring certified contractor personnel perform the weekly site inspections in accordance with Section 4-1.4 and Standard Specification 8-01.3.
- Ensuring the site log book is being maintained as required (Section 4-1.5).
- Documenting and elevating compliance issues (e.g., Inspector's Daily Reports, initiating ECAP).
- Ensuring additional environmental commitments made during the permitting process are being met (e.g., additional sampling requirements associated with outfalls in impaired waterbodies or site contamination).
- Reviewing contractor prepared compliance related documents prior to Ecology submittal as required by the contract (e.g., Request for Chemical Treatment form, Notice of Intent modifications, Notice of Termination).
- Collecting compliance verification discharge samples if appropriate (Section 4-1.6.10).
- Providing insight on site management strategies (do not direct work).

Under the TOC process WSDOT inspectors are not responsible for weekly discharge sampling. However, WSDOT inspectors must continue to monitor construction activity and site conditions to help ensure contractor discharges are compliant, look for:

- Sources of pH modifying substance(s) or pH-affected stormwater.
- New discharge points.
- Sources of prohibited discharges outlined in S1.D of the Permit.
- Potentially hazardous materials onsite not included in the SPCC plan.

4-1.1 Certified Erosion and Sediment Control Lead (CESCL)

All staff can visually monitor construction activities for potential compliance issues and collect discharge samples or compliance verification discharge samples. However, the Permit required site inspections must be performed by a CESCL or a Certified Professional in Erosion and Sediment Control (CPESC). Contractors are required to provide certified personnel to perform the site inspections in accordance with Standard Specification 8-01.3. Refer to Section 4-1.4 for more information about site inspections or BMP 5-1.1.3 for more information about the responsibilities of the CESCL.

4-1.2 Preconstruction Reporting Requirements and Preparation

Monthly Discharge Monitoring Report (DMR) submittal requirements begin as soon as the Permit is issued by Ecology, even if construction has not yet started or a discharge has not occurred. The following steps will help ensure:

- Preconstruction DMR submittals are not missed by WSDOT.
- A smooth transition when Permit coverage is transferred to the contractor.
- Projects are prepared for day one of construction.

Step 1 Track Permit issuance status and submit preconstruction DMRs

Under the TOC process standard for design-bid-build projects, WSDOT applies for Permit coverage and is the permittee until the Permit is transferred to the contractor. Therefore, the project office must track the issuance status of the Permit to determine when coverage begins. Determining the Permit coverage start date usually happens in one of three ways:

- The Ecology Permit Administrator notifies the permittee (as identified on the NOI) that Permit coverage has been issued.
- WSDOT staff use Ecology's PARIS system to search for a project to see if Permit coverage was issued.
- The permittee receives a Permit coverage letter in the mail.

WSDOT project offices must submit the preconstruction DMRs until the Permit has been transferred to the contractor (the day after contract execution). To submit the preconstruction DMRs, delegated WSDOT staff (follow regional procedures) will use Ecology's WebDMR system to prepare, sign and submit a DMR. Refer to WSDOT's internal guidance for the monthly DMR procedures on the Erosion Control internet page, under "Monthly Discharge Monitoring Reports (DMRs)".

Step 2 Permit is transferred to the contractor

WSDOT uses procedural guidance for processing the TOC form, which can be found on the Erosion Control Policies & Procedures webpage under the "Transfer of Coverage (TOC)" section. The construction PE office will receive notification from the Contract Administration and Payment Section (CAPS) office when the TOC form has been finalized and submitted to Ecology. Permit coverage is automatically transferred to the contractor on the specific date of transfer (the day after contract execution) as indicated on the completed TOC form submitted to Ecology. Additional information on how Ecology implements the TOC process can be found in Section 4-1.6.15 for General Condition 9.

The specific date of transfer triggers a change in roles and responsibilities associated with Permit compliance; the contractor becomes responsible for all Permit requirements and WSDOT's role becomes that of compliance assurance through inspection, documentation and contract enforcement.

Contractor staff will need to register for WebDMR and begin submitting DMRs as soon as the Permit is transferred. Depending on the specific date of transfer, timing can be a challenge, so initiating their WebDMR registration effort as soon as possible is important (even before the transfer date if possible). It may be helpful for WSDOT staff to assist contractor staff(s) through the WebDMR registration and electronic signature account processes or connect them with the WebDMR technical support staff at Ecology.

Once contractor staff(s) are registered, WSDOT staff should request they set up automatic notifications in WebDMR to go to appropriate WSDOT staff when DMRs are submitted. This will help WSDOT staff track DMR submittal information to ensure it is occurring as required. This notification step is also covered in the "CSWGP Discharge Monitoring Report Procedures" guidance doc listed under the DMR section of the Erosion Control internet page.

Step 3 Prepare a site log book

The Permit requires a site log book be maintained onsite with specific documents (see Section 4-1.5). The site log book must be available onsite on day one of construction.

4-1.3 Discharge Sampling and Reporting Requirements

Once ground disturbing construction begins discharge sampling becomes required at all discharge points that may be affected by construction. Sampling procedures for in-water work are not covered in this Manual but can be found in WSDOT's *Monitoring Guidance for In-Water Work* document.

The Permit authorizes specific construction-related discharges to waters of the state, including stormwater and conditionally authorizes some uncontaminated non-stormwater sources such as potable water, groundwater, spring water, and dewatering water. Refer to S1.C of the Permit and Standard Specification 8-01.1 for definitions and general guidance on authorized and conditionally-authorized pH-affected discharges.

The Permit prohibits specific construction-related discharges to waters of the state, such as cementitious/concrete wastewater, process wastewater, pollutants and chemicals that may pose a threat to human health or the environment. Refer to S1.D of the Permit and Standard Specification Division 8-01.1 for definitions on prohibited pH-affected discharges.

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 National Toxics Rule (40 CFR Part 131.36). In accordance with Chapter 90.48 RCW, when the permittee fully complies with all Permit requirements, compliance with the above regulations is presumed unless discharge sampling data or other information demonstrates otherwise. **General discharge sampling procedures:**

- Plan sampling efforts around the weather to ensure a sample is collected at every discharge point for each week in which a discharge occurs.
- Use collection devices as needed to collect representative samples (e.g., dust pan to collect sheet flows going into storm drains).
- Do not introduce pollutants (e.g., dirty equipment, sample vials or hands).
- Use appropriate and calibrated equipment. If sample value is suspect, measure it again or verify equipment calibration.
- Record sample values and relevant information about site conditions that may have impacted the sample value(s) in a field notebook (e.g., BMPs in area, weather, work in area, potential adaptive management strategies).
- Be aware of personal safety and changing site conditions such as new discharge locations.

Recommended field equipment:

- Clean collection devices and sample vials
- Calibrated turbidimeter and wide-range pH indicator paper
- Equipment cleaning supplies such as distilled water and glass wipes
- Personal protective equipment, boots, rain gear
- Camera and cell phone
- Weather-proof field notebook and pencil

Discharge sampling equipment:

Appropriate functional discharge sampling equipment for all parameters required to be evaluated must be onsite on day one of construction. Turbidity and pH are the most common parameters that need to be evaluated during construction. If the permitted outfalls (as identified on the NOI) are impaired for fine sediment or phosphorus these parameters are evaluated using turbidity as the surrogate. If site contamination exists, additional parameters may require sample evaluation (if Administrative Order applies).

Turbidimeters must comply with Standard Method 2130 for measuring nephelometric turbidity units (NTUs). Most hand-held turbidimeters that can be calibrated comply with this Method. Wide-range pH paper test strips can be used to sample pH-affected construction site discharges (use a pH meter for in-water work sampling required by a 401 Water Quality Certification).

WSDOT construction staff should periodically verify appropriate sampling equipment is being used by the contractor to ensure quality data is being collected and reported as required. It is recommended that project offices have sampling equipment on hand if there is a need to collect compliance verification discharge samples (see Section 4-1.6.10).

Follow the equipment manufacturers' recommendations for operational and storage procedures. Most turbidimeters have a calibration verification procedure which is a quick way to verify equipment is still calibrated and ready to use. Full calibration may be needed on a regular basis, based on the results of a verification procedure, or if sample data appears suspect.

It is good practice to maintain an equipment calibration log. Keep the log in a convenient location (e.g., in the equipment case) so it can be updated and referred to as needed. General practices for keeping sampling equipment in working order are:

- Using non-expired primary calibration standards to calibrate equipment (note: these commonly expire annually)
- Verify equipment calibration prior to every use
- Cleaning sample vials with distilled water and glass-cleaning wipes
- Using proper storage and housekeeping methods
- Replacing glass sample vials if they appear scratched or damage
- Not exposing equipment or liquid standards to extreme temperatures
- Contacting product manufacturer for technical assistance

Discharge sampling is not required:

- If ground disturbing work has not started in contributing areas draining to the discharge point

- At discharge points that drain fully stabilized areas (construction is complete and soils permanently stabilized). It is recommended that two weeks of discharge samples be collected before sampling is discontinued to verify and document that permanent stabilization methods are effective
- For discharges to a sanitary sewer system (See Section 4-1.6.9)
- When there is no discharge during a calendar week ("no discharge" must be reported in WebDMR)
- Outside normal working hours such as holidays, nights, and weekends
- During frozen or unsafe conditions (reason must be reported in WebDMR)

The following steps outline procedures for Permit required discharge sampling and reporting:

1. Designate Responsible Staff

All staff performing the discharge sampling required by the Permit must be capable of:

- Collecting and recording weekly discharge samples in the field and reporting data as required.
- Following appropriate procedures for quality control including appropriate equipment use and calibration.

2. Discharge sampling frequency and reporting requirements

Discharge samples must be collected at all discharge points at least once every calendar week when stormwater or authorized non-stormwater discharges from the site or enters any onsite surface waters of the state.

Discharge Monitoring Reports (DMRs) for a given month are due the 15th of the following month. For example, January DMRs must be electronically signed and submitted in WebDMR no later than February 15th.

Discharge samples may need to be evaluated for different parameters (turbidity: see step 4, pH: see step 5). Discharge sampling frequency can be reduced to once a month on inactive sites (see Section 4-1.6.4). If discharge sampling is not conducted as required a reason must be provided in the DMR, some reasons are Permit violations (see Section 4-1.6.3). All permit requirements, including discharge sampling and DMRs, must continue until the permit is terminated (see Section 4-1.6).

Additional sampling and/or reporting requirements may be triggered for the following reasons:

- A discharge 250 NTU or more (Special Condition S5.A of the Permit)

- Non-compliance event that may pose a threat to human health or the environment (Special Condition S5.F of the Permit)
- Construction outfalls in waterbodies impaired for turbidity, fine sediment, high pH or phosphorus (See Section 4-1.6.7 for more information)
- Administrative Order associated with site contamination

3. Establish sample location(s) at discharge point(s)

Sample locations must be established at all discharge points where stormwater or authorized non-stormwater may:

- Discharge from the site
- Enter surface waters of the state within the site (e.g., creek running through the site)
- Enter a storm sewer system that drains to surface waters of the state
- The sample location should be established as close to the point of discharge as possible to ensure samples will represent the quality of water leaving the construction site.

WSDOT’s construction projects are often long, linear projects with multiple drainage basins, active storm drains or stream crossings. Most large projects will have multiple discharge points, each of which require a sample location be established.

Establishing a sample location includes:

- Marking it in the field
- Marking it on the TESC plan sheets
- Adding a “monitoring point” to Ecology’s WebDMR system for monthly reporting purposes

Once construction begins and temporary grade changes, discharge points and therefore sample locations often change; they might go away or new ones might develop. Such changes require sample location updates be made in the field, on the TESC plan sheets, and in WebDMR.

All discharges must go to permitted outfalls (as identified on the NOI). If a surface waterbody that may receive a discharge during construction was omitted on the NOI application, a new NOI must be submitted and a new public comment period may be required in accordance with G20 of the Permit before Ecology can permit that surface water to receive a discharge.

4. Evaluate turbidity

All discharge samples of stormwater and authorized non-stormwater must be evaluated for turbidity.

The turbidity benchmark value is 25 nephelometric turbidity units (NTUs), and the phone-reporting trigger value is 250 NTUs. These values are not effluent limits or water quality standards; they are indicators for BMP performance and as triggers for specific actions. Discharge samples are compared to these values to determine the level of required action:

- **Discharges between 0 – 25 NTU** indicate BMPs are functioning well and no additional action is needed beyond collecting and reporting the weekly sample.
- **Discharges between 25.1 and 249.9 NTU** indicate BMPs are not functioning as well as they should be and additional action is required (follow Step A below).
- **Discharges of 250 NTU or greater** indicate BMPs are not functioning and surface water quality impacts may occur and additional action is required (follow Steps A and B below).

A. Required follow-up actions for discharge samples > 25 NTU:

i. Review the TESC plan and make appropriate revisions to strategies or BMPs within 7 calendar days of the discharge that exceeded the benchmark.

ii. Fully implement and maintain BMPs (adaptive management) as soon as possible, but within 10 calendar days of the discharge. If installation of BMPs is not feasible within 10 calendar days, Ecology may approve additional time if an extension is requested within the initial 10-day response period.

iii. Document BMP adaptive management in the site log book.

iv. Report discharge sample data in WebDMR and include notes about adaptive management.

B. Required follow-up actions for discharge samples > 250 NTU:

i. Follow Step A above.

ii. Ensure Ecology is notified via the Environmental Report Tracking System (ERTS) within 24 hours of a discharge that is 250 NTU or more. Failure to call the ERTS hotline is a violation. The person designated to make this call must follow the High Turbidity Reporting instructions on Ecology's website:
www.ecy.wa.gov/programs/wq/stormwater/construction/

iii. Continue to sample (follow-up sampling) the discharge daily until:

1. Turbidity is 25 NTU or lower; or

2. The discharge is confirmed as stopped or eliminated.

3. Compliance with the water quality limit for turbidity is demonstrated:

   a. No more than 5 NTU over background turbidity, if background is less than 50 NTU, or

   b. No more than 10% over background turbidity, if background is 50 NTU or greater.

Note for option 3: A background sample (upstream in-water) may be collected to document compliance with the water quality standard for turbidity, however a discharge point sample is still required to be collected for DMR purposes (the background sample is supplemental information). Demonstrating compliance with the water quality standard for turbidity does not negate follow-up actions triggered by the discharge sample value. Not all projects will have access to the receiving water to collect a background sample – so this option is not applicable to all projects. Lifting a storm drain and sampling the water in the conveyance system does not constitute a background sample. Contact the Erosion Control program for assistance on where and when background sampling may be warranted.

iv. Initiate the internal Environmental Compliance Assurance Procedure (ECAP) so the PE can review the event and determine if a Permit violation occurred. If a Permit violation occurred, the ECAP must be completed. Information about the ECAP can be found in the *Construction Manual*, Section 1-2.2K.

5. Evaluate pH

Discharge samples of stormwater and conditionally authorized non-stormwater must be evaluated for pH if, over the life of the project, construction will:

- incorporate 1,000 cubic yards or more of poured concrete or recycled concrete
- incorporate any amount of engineered soils [e.g. Portland cement-treated base (CTB), cement kiln dust (CKD), or fly ash]

The benchmark value for pH is 8.5 standard units (su). Water outside the range of 6.5 – 8.5 su is not authorized to discharge.

Common pH-modifying substances used during construction include, but are not limited to:

- Portland cement or recycled concrete
- Cementitious materials such as kiln dust, fly ash, bottom ash
- Engineered or amended soils

Begin pH sampling at all potentially pH-impacted discharge points as soon as the pH-modifying substance is being incorporated and is exposed to precipitation.

Continue to evaluate the pH of discharge samples weekly:

- Throughout the concrete pour and curing period (Special Condition S4.D.1).
- Until the recycled concrete or engineered soil is fully stabilized (Special Condition S4.D.2 and 3).

Managing pH affected sources of water:

- Prevent stormwater or authorized non-stormwater outside of the range of 6.5 - 8.5 su from discharging to waters of the state, including groundwater.
- Evaluate potentially pH-affected stormwater or authorized non-stormwater prior to a discharge. Do not report predischarge monitoring data in the DMR; only report discharge sample data.
- Neutralize pH-affected stormwater or authorized non-stormwater using approved methods (BMP 5-1.1.17) prior to a discharge.
- Evaluate and report pH data as required - even if the pH affected stormwater or authorized non-stormwater has been neutralized and is known to be in the range of 6.5 – 8.5 su prior to discharge.
- High pH process wastewater is not the same as pH-affected stormwater or authorized non-stormwater. Process wastewater cannot be discharged to surface waters even if it has been neutralized. Some process wastewater may be infiltrated when managed in accordance with the Permit.

Discharge sample pH evaluation can be discontinued at a discharge point when:

- All pH-modifying substances have been incorporated in the contributing drainage area and are thought to be adequately cured or fully stabilized.
- Two weeks of discharge samples have been collected and the samples are naturally compliant for pH (between 6.5 – 8.5 su without needing to be neutralized).

6. Report all discharge sample data

DMRs for a given month are due the 15th of the following month. A missed reporting deadline is a Permit violation. For every week at every discharge sample location, active construction projects must either:

- Report a discharge sample value, and:

- ☐ If the sample value is over 25 NTU, include a note about BMP adaptive management.
- ☐ If the sample value is 250 NTU or higher, include a note clarifying whether the discharge stopped or was eliminated, or collect and report daily follow-up samples until the discharge is 25 NTU or less.

- Report “no discharge” if no discharge occurred for the week.
- Report a reason why samples were not collected (some reasons are Permit violations - See Section 4-1.6.3).

Monthly DMR procedure guidance is available on the Erosion Control program internet page. Ecology provides periodic training for the WebDMR system.

4-1.4 Site Inspections and TESC Plan Adaptive Management

Permit required site inspections must be performed by a person with a current CESCL or CPESC. Site inspections on active construction projects must be done at a minimum of once per week and within 24 hours of discrete storm events that may have caused onsite erosion or a need to maintain onsite BMPs. Refer to Section 4-1.6 for inspection procedures on temporarily inactive sites.

Site inspections shall be performed in accordance with Standard Specification 8-01.3 and include all:

- Areas disturbed by construction activities
- Onsite BMPs
- Discharge points

TESC Plan Adaptive Management

Adaptive management is a recurring decision making and plan implementation process used to manage changing site conditions and risks. There are three common triggers for TESC plan or BMP adaptive management:

- Visual monitoring or site inspection findings that indicate BMPs are not performing as required (e.g., signs of erosion, sediment filled BMPs)
- A change in work activity, site conditions, schedule, or design that impact erosion related risk(s)
- A discharge sample over 25 NTU (see Section 4-1.3)

The onsite TESC plan must be updated regularly to reflect current site conditions and TESC plan or BMP adaptive management efforts. Adaptive management must be documented onsite in a way that shows identified problems are resolved within 10 days. Ecology may approve additional time if an extension is requested within the initial 10-day timeframe.

4-1.5 Site Log Book

Large projects may need several site log books to contain all of the information required to be kept onsite. Ensure the site log book(s) are organized so information can be located easily. Site log book information may be kept electronically, but must be accessible onsite.

The on-site log book must include the following items:

- Permit coverage issuance letter or completed Transfer of Coverage (TOC) form
- Updated TESC plan, SPCC plan, other related plans (e.g., chemical treatment plan)
- Discharge sampling data
- Site inspection reports
- Documentation of BMP adaptive management
- Contact information for onsite CESCL(s) who perform site inspections
- Other Permit related documents or approvals (e.g., sanitary sewer permit, Administrative Order, approval for use of chemical treatment)

4-1.6 Miscellaneous Procedures and Compliance-Related Issues

4-1.6.1 Non-compliance Events and Permit Violations

Noncompliant events occur when the project fails to meet a law, ordinance, regulation or specific Permit requirement. Even when Permit coverage has been transferred, WSDOT can be held liable for non-compliance events, which is why it is important to inspect the contractor’s TESC related work and document contract enforcement and compliance assurance efforts.

Noncompliant events may include, but are not limited to:

- Failure to collect and report weekly discharge samples as required.
- High-pH discharges (failure to neutralize prior to discharge).
- Failure to perform required follow-up actions based on discharge samples (e.g., BMP adaptive management, daily follow-up sampling).
- Failure to call the ERTS hotline within 24 hours of a discharge > 250 NTU.
- Discharge to a surface water not covered by the issued Permit.
- Prohibited discharges or spills of hazardous material.
- Notification from Ecology that a permit violation has occurred.
- Exceedances of numeric effluent limits for impaired water bodies.
- Unauthorized impacts to a wetland.

If a noncompliant event may pose a threat to human health or the environment, Ecology must be notified immediately (within 24 hours of becoming aware of the event) and a written report must be submitted to Ecology within 5 calendar days unless a report waiver was given (per Special Condition S5.f of the Permit).

An event that may pose a threat to human health or the environment includes, but is not limited to:

- Spills of fuels or toxic materials that cannot be readily cleaned up with the onsite spill kit.
- Large erosion events (e.g. pond or slope failure) that discharge significant amounts of sediment to fish-bearing surface waters or tributaries to fish-bearing surface waters.
- Discharges that cause violations of surface or groundwater quality standards.
- Exceedance of numeric effluent limit to impaired waterbodies.

4-1.6.2 Environmental Compliance Assurance Procedure (ECAP)

The ECAP is an internal procedure for recognizing and rectifying environmental non-compliance events during construction. WSDOT and contractor staffs shall immediately notify the PE when a suspected noncompliant event is identified (i.e., notification trigger observed). Refer to the *Construction Manual*, Section 1-07.5(3), for ECAP procedure information including the complete list of notification triggers.

Initiating ECAP helps determine what happened and why, whether a non-compliance event actually occurred, who needs to be notified and how the issue will be resolved and prevented in the future. Initiating the ECAP process does not necessarily mean a non-compliant event occurred and final ECAP documentation will be required. The PE and Regional Environmental Manager (REM) will work together on an appropriate response to the notification trigger.

When the Permit has been transferred and the ECAP is triggered, the contractor must fill out the ECAP form (WSDOT form #422-011) and provide it to Project Engineer within 48 hours of the non-compliance event. ECAP information should be entered into Commitment Tracking System (CTS) even if Permit coverage has been transferred.

4-1.6.3 Discharge Sampling Not Conducted

If a discharge sample was not collected for a week in which a discharge did occur, the Permit requires that an explanation be provided in the monthly DMR. The Permit defines acceptable reasons for not collecting discharge samples in Special Condition S4.C. (e.g., discharge occurred outside of normal working hours, unsafe or frozen conditions). Reasons attributed to negligence are non-compliance events.

4-1.6.4 Temporarily Stabilized Inactive Sites and Projects in Winter Shutdown

The Permit makes a distinction between temporary stabilization and final stabilization. Construction sites or drainage areas within a site are temporarily stabilized when all erodible soils have been covered with properly installed temporary erosion control BMPs and no soil disturbing work is taking place.

Construction sites or drainage areas within a site that have been temporarily stabilized for winter shutdown or periods of inactivity may reduce site inspections and discharge sampling to once a month instead of weekly per Special Condition S4.B.2 and S4.C.2.g of the Permit respectively. All other Permit requirements remain the same. For example, adaptive management is required if it becomes evident that onsite BMPs have become ineffective at preventing erosion or providing treatment prior to a discharge.

4-1.6.5 Final Stabilization and Notice of Termination

Final stabilization is achieved when all construction is complete, all non-biodegradable temporary BMPs (e.g., fencing, plastic, inlet socks) have been removed, and all erodible soils have been fully stabilized with permanent BMPs (e.g., vegetative cover, rock, concrete). BMPs designed to be left in place and biodegrade do not need to be removed if they will not interfere with WSDOT maintenance activity such as mowing or other land use needs. Some BMP products may be advertised as using “biodegradable plastic” but the science and long-term impact to the environment is debatable. To help ensure products commonly left in place after construction (e.g., compost socks, erosion control blankets) will degrade safely into the environment, several of the Division 9-14 specifications require products be made of natural plant fibers.

Once Physical Completion has been given, the contractor will submit a Notice of Termination (NOT) to the PE for review prior to submitting it to Ecology. WSDOT staff should walk the site to ensure the NOT requirements in Special Condition S10 of the Permit have been met. If requirements have not been met, the NOT should not be submitted to Ecology. Prematurely submitting the NOT is a Permit violation. If the site has not achieved final stabilization, all other contract work is complete, and the project is “waiting for grass to grow”, the contractor may request to transfer the Permit back to WSDOT in accordance with the contract. If the Permit is transferred back to WSDOT (at the PE’s discretion), the project office becomes fully responsible for Permit compliance including site inspections, discharge sampling, and reporting until the Permit is terminated.

Once a NOT is submitted, Ecology may request a site visit or notify the permittee that the termination request is denied. If no contact is made by Ecology, the Permit is considered terminated the 31st calendar day after the date Ecology received the NOT form.

All Permit requirements, including sampling and reporting, must continue until the permit is terminated. Projects should check the status of a Permit (inactive status indicates terminated coverage) in Ecology's PARIS system. If the Permit status is active in PARIS, monthly DMR requirements will continue to generate in WebDMR. Therefore, it is recommended that the permittee (WSDOT or the contractor) follow-up with the Ecology permit administrator as needed to ensure terminated Permits have been inactivated in PARIS.

4-1.6.6 In-Water Work

Upstream and downstream sample data collected during in-water work projects covered by a 401 Individual Water Quality Certification must be reported directly to the certifying agency by the project office staff; do not report in-water work data into the Discharge Monitoring Report (DMR) associated with the Permit.

Division 8-01 includes some contract language for in-water work; however Special Provisions are often necessary to cover project specific work. Check the Index for the General Special Provisions, as the Environmental Services Office Compliance Program is routinely adding contract language for new environmental commitments.

For guidance on in-water work [401 certifications or a Letter of Verification (LOV)] or creating Water Quality Monitoring Pollution Prevention (WQMPP) Plans, refer to WSDOT's *Monitoring Guidance for In-Water Work* document or the Environmental Commitments & Compliance webpage.

4-1.6.7 Impaired Receiving Waters

The federal Clean Water Act (CWA) requires states to prepare a list of impaired water bodies that fail to meet water quality standards for their designated uses (e.g., recreation, drinking, fish spawning etc.). Each waterbody reach (hydrologic segment) that fails to meet water quality standards is added to the Water Quality Assessment list as a Category 5 reach. The list of impaired reaches in Category 5 is known as the 303(d) list. Once 303(d) listed, Ecology must develop a Total Maximum Daily Load (TMDL) or an alternative strategy to address the water quality impairment at the watershed level. In Washington State, Ecology develops the 303(d) list and TMDLs and the Environmental Protection Agency is the approving authority.

TMDLs attempt to calculate the maximum amount of a pollutant (load) that a waterbody can receive and still meet water quality standards. The TMDL allocates the pollutant load among the various sources of the pollutant(s) within the watershed. WSDOT participates in TMDL development when WSDOT facilities have been identified as a potential source of the pollutant.

Impaired waterbodies [303(d) listed or approved TMDL] may have implications for projects from the scoping phase all the way through maintenance and operations. The Environmental Review Summary (ERS) database helps ensure applicable waterbody impairments are identified early in the scoping/planning process. This is important because additional actions or planning procedures may be triggered by waterbody impairments. For example, some TMDLs prohibit construction related discharges (e.g. Wapato Lake and Cottage Lake) which could increase TESC costs substantially.

For the purposes of the Permit, projects with construction outfall location(s) in a surface waterbody (as identified on the NOI) impaired for **turbidity, fine sediment, phosphorus, or high pH** the project will be required to:

- Submit the *Proposed New Discharge to an Impaired Waterbody* form during the NOI permitting process. Any environmental commitments made on this form must be incorporated into the TESC plan or contract. The Permit coverage letter will include information about additional sampling requirements for discharges to impaired receiving waters, but WSDOT staff should help ensure contractors understand impairment discharge sampling requirements prior to construction. Guidance on using the GIS Workbench to identify waterbody impairments and filling out the *Proposed New Discharge to an Impaired Waterbody* form is available on the Erosion Control Policies & Procedures webpage.
- Sample discharges in accordance with Special Condition S8.

4-1.6.8 Construction Projects Not Covered by the Permit

Projects not required to obtain Permit coverage must comply with all Federal, State, tribal, or local laws, ordinances, and regulations that affect work in accordance with Standard Specification 1-07.1. Washington State laws and regulations as codified in the Washington Administrative Code (WAC) and the Revised Code of Washington (RCW) provide specific requirements related to the protection of waters of the state (Chapter 173-201A WAC, Chapter 173-200, and Chapter 90.48 RCW).

An abbreviated TESC plan is required for projects that disturb soil and have the potential to discharge (refer to Section 2-1). While contract plan sheets are not required with an abbreviated TESC plan, they may help ensure the contractor understands where BMP placement is needed to protect waters of the state.

WSDOT project engineers and staff shall enforce contract language that directs contractors on erosion and water pollution control requirements found in Sections 1-07 and 8-01 of the *Standard Specifications*.

When projects are not covered by a Permit, take measures to minimize discharges and prevent discharges wherever feasible. If discharges cannot be prevented, ensure they are managed to prevent impacts to waters of the state and conduct monitoring. If evidence suggests a compliance issue (e.g. a turbidity plume, oil sheen) in the receiving water, adapt the site controls or management practices immediately to eliminate the source of pollution.

4-1.6.9 Discharges to a Sanitary Sewer

Discharges to a publicly owned treatment works (POTW) commonly referred to as a sanitary sewer system are not covered by the Permit. Approval must be granted by the jurisdictional operator prior to discharging to a sanitary sewer system. The jurisdiction may issue a Special Approved Discharge (SAD) Permit which will likely include discharge sampling and reporting requirements. Report data directly to the jurisdiction as required by the SAD Permit; do not report sanitary sewer discharge data into Ecology's WebDMR system. Jurisdictional procedures vary.

4-1.6.10 Compliance Verification Sampling

WSDOT inspectors shall collect compliance verification discharge samples when non-compliance is suspected and the contractor is not taking required action. For example, if a discharge appears turbid (i.e., > 25 NTU) and the contractor is either reporting non-turbid sample data or not taking required follow-up actions (e.g., BMP adaptive management). Compliance verification discharge samples shall not be used by WSDOT as a reason to direct work but can be used to enforce the contract or initiate ECAP.

4-1.6.11 Non-Transfer of Coverage and Design Build Projects

The Assistant State Construction Engineer (ASCE) may allow a design-bid-build project to forgo the TOC process and for WSDOT to retain Permit coverage during construction (non-transfer). In a non-transfer, WSDOT remains the permittee and is responsible for all Permit requirements including discharge sampling and the monthly DMR submittal to Ecology's WebDMR system. The contractor will identify an ESC Lead in accordance with 8-01.3(1)B to perform the Permit required site inspections.

Design-build projects use Request for Proposals (RFPs) to advertise projects. It is standard practice to require the contractor to obtain the Permit and develop the TESC plan for WSDOT review and acceptance.

4-1.6.12 Permit Coverage on Projects Under an Acre

Some projects may choose to obtain coverage for various reasons including proximity to surface waters and perceived risk. Permit coverage helps define site management expectations that may lower environmental risk. However, the Permit does not require these projects to collect samples or have a CESCL perform weekly site inspections (though weekly site inspections are still required). Because sampling is not required, DMRs are not required, and therefore Ecology will not enter these projects into their WebDMR reporting system. If the WSDOT projects want to require discharge sampling on these projects, those expectations must be included in the contract.

4-1.6.13 Emergency Projects

Ecology uses the federal expectations as outlined in the EPA's Construction General Permit for emergency-related projects. Emergency projects require immediate authorization to avoid imminent endangerment to human health or the environment, public safety, or to reestablish public services. Such projects are authorized to discharge on the condition that a complete and accurate NOI is submitted within 30 calendar days after commencing earth-disturbing activities. Ecology's Regional Permit Administrators should be contacted as soon as possible as their project specific expectations may vary.

WSDOT's emergency projects should operate as if covered under a Permit, including collecting discharge samples as soon as earth-disturbing work begins (document sample data onsite until a Permit is issued and data can be reported in WebDMR). No TESC plan is required; the project shall use the other site log book documentation requirements (e.g. record of implementation of Permit requirements such as the site inspections and adaptive management of BMPs) to meet the pollution prevention intent of a TESC plan.

4-1.6.14 Using Existing Drainage Structures for TESC

Using existing drainage structures for TESC is potentially a capacity issue during construction and Maintenance and Operations concern and after construction. WSDOT's existing conveyance system and permanent stormwater facilities may be used to manage construction stormwater when:

- The flows being managed by the existing system or facility will continue to be managed as required.
- The existing system or facility are not left in worse condition upon final acceptance of the work.

If using WSDOT's existing system and facilities is incorporated into the TESC plan, the project office should include a bid item for cleaning existing drainage structures (Standard Specification 7-07.5) in the contract to ensure structures are cleaned as needed throughout the life of the project and upon final acceptance of the work.

Additionally, 8-01.3 requires the contractor to remove all temporary BMPs (unless made of natural plant fiber), all associated hardware and accumulated sediment deposition from the project limits prior to Physical Completion.

In accordance with Standard Specification 1-07.14, contractors are responsible for damage to completed portions of the project and to property located off the project caused by erosion, siltation (sediment accumulation), runoff or other related items during the construction project. The contractor is required to implement necessary measures to prevent damage to WSDOT property, including siltation in existing drainage structures.

4-1.6.15 Construction Support and Staging Areas

In accordance with S1.C.2, the Permit authorizes stormwater discharges from support activities (e.g., equipment staging, materials storage) solely related to the permitted construction site. These areas are considered part of the land disturbance associated with the construction project and all the Permit requirements are applicable in these areas. Construction support areas can be a big source of pollution and can be mistakenly overlooked during site inspection, discharge sampling and BMP adaptive management efforts.

Site plans may identify areas within the ROW that can be used for support activities, and these areas may move around as construction progresses. WSDOT inspectors should inspect and enforce the contract to ensure Permit compliance in these areas within the ROW. However, due to limitations of the narrow ROW, contractors are often required to find support areas outside the ROW. Division 8-01 of the Standard Specifications includes specific language to ensure the contractor identifies these non-commercial support areas on their TESC plan if they will be covered by the Permit. The contractor may be required to obtain separate Permit coverage for these areas or submit an updated NOI to Ecology to account for the additional land disturbance and cover these areas in accordance with G20 of the Permit.

The contractor may find commercial operations that get used by multiple unrelated construction sites or that provide other services. The owners of these commercial operations are often regulated by other environmental permits and these areas are not covered by the construction project's Permit.

4-1.6.16 General Conditions

The Permit includes General Conditions that include important compliance related information. This section covers General Conditions for which WSDOT:

- Has internal procedures or guidance
- Would like to draw attention to due to potentially required actions triggered by the General Condition

General Condition 2. Signatory Requirements

Permit related documents such as the NOI, NOT and TOC forms and the DMRs must be signed by a person that meets specific criteria or be a duly authorized representative of that person. Related internal procedures and guidance include:

- NOIs and NOTs may be rejected by Ecology if not signed by an authorized person. A 2015 WSDOT memorandum provided regional guidance for formally delegating signature authority for NOIs and NOTs to Regional Environmental Managers or Project Engineers based on regional procedural preference (the signature delegation guidance does not apply to the EPA

CGP). Refer to Section 1-1.3 additional information on the NOI process and the EPA CGP.

- The TOC form must be partially completed, included in the contract for the contractor to complete, returned to WSDOT, routed internally, dated and signed by the State Construction Engineer and then submitted to Ecology in accordance with the internal TOC form guidance, which can be found on the Erosion Control Policies & Procedures webpage.

- Monthly DMRs must be submitted electronically through Ecology's WebDMR system which requires granted access and an electronic signature account. Refer to the DMR Monthly Reporting guidance document for additional information, which can be found on the Erosion Control Policies & Procedures webpage.

General Condition 6. Reporting a Cause for Modification

A new or updated NOI must be submitted if there is a material change in construction activity as identified on the NOI (e.g., significant concrete work) or type of discharge anticipated which is not specifically authorized by the Permit (e.g., inadvertent discovery of site contamination that has the potential to be discharged).

General Condition 8. Duty to Reapply

Once the Permit has been transferred, it is the contractor's responsibility to reapply for Permit renewal and pay the Permit fees (Special Condition 6).

General Condition 9. Transfer of Coverage

Follow WSDOT's guidance for completing the Transfer of Coverage form (which can be found on the Erosion Control Policies & Procedures webpage) for inclusion in the contract. The construction PE office will receive email notification from the Contract Administration and Payments Section (CAPS) office when the completed Transfer of Coverage (TOC) form has been submitted to Ecology. When Ecology receives a completed TOC form, the specific date of transfer as indicated on the form (day after contract execution) is effective immediately and Permit coverage is automatically transferred (do not expect notification from Ecology). Ecology will also automatically transfer any Administrative Order associated with the Permit to the contractor on the specific date of transfer. Ecology will eventually issue the contractor a Permit coverage issuance letter identifying them as the permittee. A copy of the completed TOC form should be kept in the site log book as proof of contractor's Permit coverage until their issuance letter is received.

In accordance with 8-01.3, the contractor may request transferring Permit coverage back to WSDOT. If approved by the PE, the contractor must fill in the TOC form sections applicable to current permittee, and submit the partially completed form to the PE to complete sections applicable to new permittee. Either party can submit the fully completed form to Ecology. Prior to accepting the Permit back from the Contractor, WSDOT staff should perform a site walk-through to ensure all non-biodegradable BMPs have been removed and the site has been stabilized as required. Additional information about the TOC process is available on the Erosion Control Policies & Procedures webpage.

General Condition 20. Reporting Planned Changes

Notify Ecology as soon as possible when there are changes to the planned construction activity identified on the NOI. Depending on the nature of the change, a new NOI and public notice may be required (related to General Condition 6). For example:

- Discharges into additional receiving surface water(s) that was not identified on the NOI.
- A significant change in the nature, or an increase in quantity, of pollutants discharged, including but not limited to: for sites 5 acres or larger, a 20% or greater increase in acreage disturbed by construction activity.
- A change in construction plans and/or activity that affects the Permittee's monitoring requirements (e.g., if a significant amount of concrete will be used (a change from what was identified in the NOI) which triggers pH monitoring and discharge sampling).

5-1 Introduction

The following descriptions are provided to aid in the selection, proper installation, and maintenance of approved best management practices (BMPs) for construction stormwater pollution prevention planning and site management. The Permit requires all known, available, and reasonable methods of pollution prevention, control, and treatment (AKART) to be implemented prior to a discharge. To meet AKART requirements and minimize the release of pollutants, BMPs must be installed to minimize the sources of pollutants and to provide treatment prior to a discharge. Site inspections and discharge sampling are required throughout construction as a way to monitor BMP function. BMPs must be maintained, enhanced, or replaced (adaptive management) to ensure continued BMP functional performance and compliance with the Permit. Refer to Chapter 4 for more information on the BMP adaptive management requirements.

Standard Specifications (from the *Standard Specifications for Road, Bridge, and Municipal Construction*) and Standard Plans exist for some but not all BMPs. General Special Provisions (GSP) and Special Provisions may be used for project specific needs. Prior to writing a Special Provision, check the statewide library for existing GSPs and Special Provisions that can be used to satisfy project needs. Regional GSP libraries may also provide useful provisions. Contact Region Environmental staff or the Assistant Construction Engineer (ASCE) assigned to your project for assistance in identifying resources when preparing Special Provisions.

The Washington State Department of Ecology's (Ecology's) Stormwater Management Manuals for Western Washington (SWMMWW) and Eastern Washington (SWMMEW) also contain information about approved BMPs in Washington State. All BMPs used on construction sites must be consistent with this Manual, the SWMMWW or the SWMMEW. Ecology maintains a list of proprietary BMP products that have been approved as equivalent to the BMPs listed in these manuals. Experimental BMPs must be approved by Ecology before use. The technical basis (e.g., scientific studies, reasoning, or modeling) for the experimental practice must be documented in the TESC plan or site log book.

Linear projects, such as roadway construction and utility installations, present unique challenges (e.g. narrow footprint and right-of-way, offsite water run-on, or multiple drainage basins) that may necessitate adaptive implementation of approved BMPs. The approved BMPs outlined can be modified to ensure functional performance and compliance with the Permit.

5-1.1 TESC BMPs

BMPs are often organized into different categories which may go by different names in different manuals, permits or regulations. Because some BMPs may serve multiple functions, this Manual lists them alphabetically and describes their intended function(s) and associated contract requirements. However, there is value in understanding the commonly used BMP categories and associated terminology.

The highest level of organizational categories includes:

- **Design BMPs:** Design practices that minimize the erosion related risk of a project. For example, minimizing slope length or gradient, phasing earth disturbing work and preserving vegetation are common design BMPs.
- **Operational BMPs:** Procedures or operational practices that minimize the erosion related risk of a project. For example, having a Certified Erosion and Sediment Control Lead (CESCL) onsite during construction is an operational BMP required by the Permit.
- **Structural BMPs:** Practices, materials, or structural measures installed in the field to minimize sources of pollution and/or provide treatment prior to a discharge. Structural BMPs require regular inspection, and may require adaptive management or maintenance to ensure continued functional performance.

Structural TESC BMPs are commonly organized into the following categories:

Source control BMPs work to minimize a source of pollution. In construction stormwater management, the most common pollutant source is sediment. Therefore, TESC source control BMPs are **often called "erosion control" BMPs** because they minimize erosion (the source of sediment). Erosion control BMPs must be installed to stabilize exposed soil not being actively worked in accordance with the timelines in S9.D.5 of the Permit. Some source control BMPs minimize the source of other pollutants common on construction sites such as chemicals, fuels, and pH-modifying materials like concrete (e.g. concrete washout areas, secondary containment).

Treatment BMPs work to remove pollutants. Therefore, TESC treatment BMPs are **often called "sediment control" BMPs**, because they work to remove sediment pollution from water prior to a discharge. Some treatment BMPs are used to neutralize pH or clean up spills. Perimeter control is a term commonly used to describe the sediment control BMPs installed along the project boundary where discharges are anticipated. Sediment control BMPs must be installed as one of the first steps in grading and must be functional before land disturbing construction starts in an area to ensure all runoff will receive treatment prior to a discharge. Regular maintenance is particularly important for the continued performance of sediment control BMPs because they fill with sediment and become less effective at providing the required level of treatment (discharges below 25 NTU). For example, when inlet protection devices fill with sediment, they become clogged and water bypasses treatment through the overflow bypass opening.

Other terms may be used to more specifically describe a BMP's intended function, such as; flow control, runoff conveyance or water management. For example, temporary curbs and pipe slope drains are often used to "convey" runoff to a location where it will receive treatment from additional BMPs.

5-1.1.1 Brush Barriers

No Standard Specification or Standard Plan

SWMM Volume II equivalent: BMP C231 Brush Barrier

Function

Brush barriers are a compacted berm of organic material used to reduce flow velocity and provide coarse sediment control prior to discharge.

Additional Information

- Not intended to treat concentrated flows or to provide treatment for drainage areas over a quarter acre.
- Sediment control function can be enhanced by encasing the brush barrier with filtering fabric such as a geotextile. Filtering fabric must be removed before construction ends unless made from natural plant fibers unaltered by synthetic materials.

Design, Installation and Maintenance

- Install on contours downslope of areas less than a quarter acre.
- Can be made of chipped site vegetation, live cuttings and fascines, composted or wood-based mulch. When site vegetation is used, ensure invasive species are not incorporated.
- Can be held in place with wooden stakes, live cuttings or fascines.
- Sizing (height and width) shall be adequate to provide treatment for flow and prevent flow from going around, or under the brush barrier.
- Monitor for signs of erosion, flows bypassing treatment and sediment buildup. Adapt or maintain the brush barrier as needed to ensure continued functional performance.

5-1.1.2 Buffer Zones

Standard Specifications

1-07.16(2) – Vegetation Protection and Restoration

1-07.16(2)A – Wetland and Sensitive Area Protection

8-01.3(1) – General

SWMM Volume II equivalent: BMP C102 Buffer Zones

Function

Buffer Zones for Wetland and other Sensitive Areas are established by the local permitting authority. Sensitive area buffer zones 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.

Other Buffer Zones may be identified in undisturbed vegetation or managed vegetation for use as:

1. **Buffer Zones for preservation of natural vegetation** Preservation of natural vegetation should be planned in clumps or strips.
2. **Vegetative Buffer Zones** intended to provide an additional area of natural vegetation preserved to provide sediment control and reduce runoff velocities.

Design, Installation and Maintenance

- Critical area buffer zones must be protected with sediment control BMPs to prevent impacts.
- Buffer zones can be incorporated into the landscaping of an area Preservation of natural vegetation should be planned in clumps or strips.
- Mark limits prior to clearing and grubbing to ensure buffer zones are protected from construction activity.
- Sediment Control Buffer zones should be clearly marked.

Maintain delineation and sediment control BMPs as needed to protect critical area buffer zones from construction impacts such as sedimentation, soil disturbance and soil compaction.

5-1.1.3 Certified Erosion and Sediment Control Lead (CESCL)

Standard Specification

8-01.3(1)B – Erosion and Sediment Control (ESC) Lead

SWMM Volume II equivalent: BMP C160 CESCL

Function

A CESCL is a certified person that has received formal training in the procedures required to ensure compliance with the Permit, as well as applicable local, state, and federal water quality requirements. A CESCL is required by personnel performing the Permit required site inspections described in Section 4-1.4. A Certified Professional in Erosion and Sediment Control (CPESC) is functionally equivalent to a CESCL.

The Permit requires a CESCL be available (onsite or on-call) at all times during the construction period. Therefore projects should have a person that can perform as a backup CESCL in the event that the main CESCL is unavailable.

Additional Information

- A CESCL shall be onsite (or available on-call) 24 hours per day during the construction period.
- A CESCL shall perform the Permit required site inspections. The CESCL may perform these duties for multiple construction sites in the same geographic region.
- The onsite CESCL shall have the authority to act on behalf of the contractor or permittee to ensure compliance.
- The onsite TESC plan or site log book shall include contact information for the project CESCL(s).
- Ecology maintains a list of current CESCLs and training providers: https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Certified-erosion-sediment-control
- CESCL certifications are valid for three years. There is a 6-month renewal period after the expiration date. The CESCL certification is not considered current during this renewal period (it is expired on the expiration date). During the renewal period, the CESCL can be renewed with an 8-hour classroom course or an approved online renewal course. If the renewal period passes, a new CESCL certification must be obtained. New CESCL certifications require two 8-hour courses; a classroom course and BMP field course. Both courses must be taken within 6 months of each other (either class can be taken first).

Duties performed or overseen by the CESCL include, but are not limited to:

- Implementing and adaptively managing the TESC plan to ensure continued BMP functional performance and Permit compliance.
- Inspecting the construction site in accordance with S4.B of the Permit and Standard Specification 8-01.3(1)B.

Maintaining onsite documentation in the site log book in accordance with S4.A of the Permit and Division 8-01 of the Standard Specifications.

5-1.1.4 Check Dams

Standard Specifications

8-01.3(6) – Check Dams

9-14.5(4)A – Biodegradable Check Dam

9-14.5(4)B – Non-biodegradable Check Dam

Standard Plan

I-50.20 – Check Dams on Channels

SWMM Volume II equivalent: BMP C207

Function

Check dams are small dams across a swale or channel used to reduce the velocity of concentrated flow and dissipate erosive energy, thereby encouraging suspended sediment to settle out prior to discharge.

Additional Information

- Use in temporary or permanent conveyance areas where concentrated flow may cause erosion.
- Should be used in conjunction with an erosion control blanket or other conveyance stabilization BMP in channel areas with highly concentrated flow.
- Can be used in conjunction with an upstream sump to enhance flow and sediment control function.

Design, Installation and Maintenance

- Check dams shall slow and filter flow and not create erosion.
- Check dams can be created with various materials (e.g. sand bags, compost socks, rock, and reusable proprietary products). Rock check dams can be wrapped in fabric or plastic to enhance the "damming" function. Do not use silt fence for check dams. Material used shall not contribute turbidity. Prefabricated products, such as water bladders and geotextile products must be installed in accordance with manufacturer's recommendations.
- Geotextile fabric, plastic or erosion control blanket may be needed under the check dam to minimize scouring.
- Do not install checks dams in a stream unless approved by the Department of Fish and Wildlife. Do not install check dams in wetlands without approval from a permitting authority. Do not place check dams below the expected backwater from any salmonid-bearing water between October 1 and May 31.
- Effective dam height, width, sloped side walls, and spillway design vary depending on flow rate, channel shape, and material used. Install in accordance with Standard Plan or modify as needed to ensure functional performance.
- Install the dam in a way that minimizes undercutting at the downstream toe of the check dam (spillway erosion). For example, triangle shaped check dams (when viewed from the side) allow water to flow over the face of the check dam rather than spilling directly onto the soil at the toe. Other practices may include using rock or fabric to protect the soil at the toe below the spillway.
- Keep the center of the check dam lower than the outer edges at natural ground elevation to prevent flooding of roads, dikes, or other structures.
- If erosion occurs between check dams, additional check dams or channel armoring BMPs (e.g. erosion control blanket, rock, and vegetation) are required.
- In many cases (considerations include: potential wildlife impacts such as fish trapping, land use needs such as maintenance access, and the type of material used), check dams can be left in place after construction ends. All nonbiodegradable materials (besides rock) must be removed prior to Permit termination.
- Monitor for signs of erosion, flows bypassing treatment and sediment buildup. Adapt or maintain check dams as needed to ensure continued functional performance.

5-1.1.4 Compost Socks

Standard Specifications

8-01.3(12) – Compost Sock

9-14.5(6) – Compost Socks

Standard Plan

I-30.40 – Compost Sock

SWMM Volume II equivalent: BMP C235 Wattle

Function

Compost socks are tubular barriers made of compost encased in a natural, plant-based biodegradable sock that provide sediment control prior to a discharge and dissipate erosive energy to prevent concentrated flow from developing.

Additional Information

Compost socks for WSDOT projects are usually filled in place (compost shot into sock at installation location) because they are long and heavy. However, smaller readymade compost socks are available for BMP 5-1.1.23 Materials On Hand purposes. Compost socks are one of the best BMP materials to have on hand for urgent adaptive management needs because they can serve multiple functions:

- To prevent concentrated flows from developing by dissipating erosive energy and dispersing flows on a slope or along the edge of pavement.
- Instead of silt fence to provide sediment control when soils are too rocky to effectively trench in silt fence.
- In paved areas around inlets to enhance sediment control performance of inlet protection device.
- As a check dam.

Design, Installation and Maintenance

- Install in accordance with Standard Plan.
- Install compost socks perpendicular to flows.
- Maintenance may be needed depending on how the compost sock is being used. If for example, the compost sock is being used as sediment control (e.g. as a check dam, inlet protection, perimeter control instead of silt fence), it must be maintained as functional in that regard (remove sediment build up). Compost socks used to dissipate flow velocity on slopes or edge of pavement do not usually require maintenance.

- Compost socks that are not performing their intended function must be maintained to improve performance.
- Biodegradable compost socks are designed to be left in place after construction ends (consider maintenance access needs).
- Monitor for signs of erosion, flows bypassing treatment and sediment buildup. Adapt or maintain compost socks as needed to ensure continued functional performance.

5-1.1.5 Concrete Cutting and Surfacing Pollution Prevention

Standard Specifications

1-07.5 – Environmental Regulations

5-01.3(11) – Concrete Slurry

8-01.1 – Definitions

SWMM Volume II equivalent: BMP C152 Sawcutting and Surfacing Pollution Prevention

Function

Concrete cutting and surfacing operations generate high pH concrete slurry. Concrete cutting and surfacing pollution prevention BMPs are a set of practices used to prevent discharges of concrete slurry to waters of the state.

Additional Information

- Concrete resurfacing operations such as saw cutting, coring, roughening, hydro-demolition, and grinding generate high-pH concrete slurry (fine particles of cementitious waste and process wastewater) that can violate water quality standards. Discharge of concrete resurfacing waste to waters of the state is prohibited.
- Vacuum or otherwise remove slurry and cuttings from the roadway as they are generated during the resurfacing operations. Do not allow concrete resurfacing waste to remain on the roadway overnight.
- Do not allow concrete resurfacing waste, including process wastewater to drain to any natural or constructed conveyance system or discharge point. Catch basins may need to be temporarily plugged to prevent a discharge.
- Dispose of concrete resurfacing waste in a manner that will not violate water quality standards.
- Store and dispose of waste material removed from the roadway in a manner that does not cause the contamination of stormwater.

Design, Installation, and Maintenance

- Monitor work during resurfacing operations to ensure resurfacing wastes are removed from the roadway as required and discharges do not occur. If potential impacts to surface water or groundwater quality standards develop, stop work immediately and install additional controls.

5-1.1.6 Concrete Handling

Standard Specifications

1-07.5 – Environmental Regulations

8-01.1 – Definitions

SWMM Volume II equivalent: BMP C151 Concrete Handling

Function

Concrete work can generate various types of high pH waste and wastewater that can violate water quality standards. Concrete spillage, waste and wastewater discharge to waters of the state is prohibited. Concrete handling BMPs are a set of practices used to prevent concrete work related impacts to waters of the state.

Additional Information

- Concrete equipment washout must be performed in accordance with Concrete Washout Facilities (5-1.1.8).
- When feasible, return excess concrete to the originating batch plant for recycling. Small amounts of excess concrete (for example, from hand tools, shovels, and rakes) may be dumped into a formed area awaiting a concrete pour or a Concrete Washout Facility – do not dump excess concrete onto the ground.
- Do not allow washdown from areas where concrete aggregate has been incorporated to drain directly to natural or constructed stormwater conveyances.
- Use forms or solid barriers, such as pilings, for concrete pours within 15 feet of surface waters.
- When feasible use BMPs to prevent contamination of stormwater by pH-modifying sources. For example:
  - Schedule larger concrete pours for the dry season.
  - Remove, cover or contain ongoing sources of contamination.

- ☐ Monitor for elevating pH levels in stormwater runoff as required in the Permit.
- ☐ Refer to related BMPs, including: Concrete Cutting and Grinding Pollution Prevention (5-1.1.6), Concrete Washout Facilities (5-1.1.8), and High-pH Stormwater Neutralization (5-1.1.17).

Design, Installation and Maintenance

- Monitor all concrete pollution prevention BMPs regularly to ensure continued functional performance.

5-1.1.7 Concrete Washout Facilities

Standard Specification

1-07.5 – Environmental Regulations

8-01.1 - Definitions

SWMM Volume II equivalent: BMP C154 Concrete Washout Area

Function

Washing of equipment used to perform concrete work can generate high pH waste and wastewater that can violate water quality standards. Concrete washout waste and wastewater discharge to waters of the state is prohibited. A concrete washout facility contains waste and wastewater and prevents impacts to waters of the state.

Additional Information

- Whenever feasible, excess concrete should be taken to the originating concrete batch plant to be recycled.
- Onsite concrete washout must occur in leak-free concrete washout facility that effectively contains cementitious washout waste and wastewater.
- Small amounts of concrete washout (for example, hand tools shovels, rakes, and trowels) may be performed and disposed of in a formed area awaiting a concrete pour.
- Do not wash out concrete truck drums, handling equipment or excess concrete onto the ground, streets, near storm drains, surface waters, ditches, or LID facilities.
- Do not drain concrete washout areas to surface waters or natural or constructed stormwater conveyances.

- Dispose of hardened concrete washout waste regularly in accordance with solid waste regulations.
- Use other related BMPs as needed to prevent impacts to waters of the state, including: Concrete Handling (5-1.1.7) and Concrete Cutting and Grinding Pollution Prevention (5-1.1.6).

Design, Installation and Maintenance

- Locate concrete washout facilities at least 50 feet from storm drains, ditches, and surface waters including wetlands.
- Concrete washout facilities must be installed prior to starting concrete work and be capable of containing all cementitious waste and wastewater generated from washout activity.
- Self-installed below-grade washout facilities are preferred when a project involves significant concrete work because below-grade facilities are larger and less prone to spills and sidewall failures than above-grade facilities.
- Plastic lining material should be a minimum of 10-mil polyethylene sheeting and free of holes or other defects that compromise the impermeability.
- Prefabricated washout facilities and pans are designed to be leak-free and can be utilized as mobile washout facilities but they are small and require regular maintenance to prevent overflow and contamination of stormwater.
- During concrete work, concrete washout areas must be monitored daily to ensure continued functional performance and adequate holding capacity for active concrete work needs:
  - Maintain as leak-free containment.
  - Clean washout facilities when 75% full or less than 12” of freeboard.
  - Cover washout facilities when not in use to prevent stormwater contamination and containment overflow.
- When concrete washout facilities are no longer required for concrete work, they must be removed. The decommissioning waste (cementitious waste and materials used to construct the facility) and recycled or disposed of in accordance with solid waste regulations. Ground disturbance left by the facility shall be filled in and stabilized as needed to prevent erosion.

5-1.1.8 Construction Road and Parking Area Stabilization

No Standard Specification or Standard Plan

SWMM Volume II equivalent: BMP C107 Construction Road/Parking Area Stabilization

Function

Construction road and parking area stabilization are practices used to reduce erosion of temporary roadbeds or parking areas.

Additional Information

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

Design, Installation and Maintenance

- Whenever feasible, place construction roads and parking areas on a firm, compacted subgrade.
- Install High Visibility Fence if necessary to limit vehicle access to unstabilized roads or parking areas.
- Install the first lift as soon as possible on areas that will receive asphalt.
- Apply crushed rock, gravel base, or crushed surfacing base course immediately after grading or utility installation. Asphalt-treated base (ATB) may also be used, or the road/parking area may be paved. It may also be possible to use calcium chloride for soil stabilization. If the area will not be used for permanent roads, parking areas, or structures, hog fuel/wood chips may also be used. Recycled concrete and other cementitious materials may not be used for construction road or parking area stabilization.
- Grade roadways to drain effectively. Drainage shall be directed through sediment control BMP(s) prior to discharge.
- Protect storm drain inlets that receive runoff from temporary construction roadways to prevent sediment-laden water from entering the storm drain system.
- Add stabilizing material as needed to maintain a stable driving surface and to stabilize any areas that have eroded.

5-1.1.9 Construction Stormwater Chemical Treatment

No Standard Specification or Standard Plan

SWMM Volume II equivalent: BMP C250

Function

Construction stormwater chemical treatment (sometimes called “active” or “advanced” treatment) can quickly remove fine suspended sediments, such as clay and silt. These often take a long time to gravity settle out in ponds or do not filter out in passive sediment control BMPs like compost socks or inlet protection devices. Depending on design, chemical treatment systems may also provide treatment for other pollutants such as pH, hydrocarbons and metals.

Conditions of Use

Chemical treatment may be warranted when:

- Large volumes of highly turbid water cannot be prevented due to site or work specific circumstances (e.g., large earthwork projects) and there is low possibility of effectively employing passive sediment control BMPs, dispersal/infiltration, or use of sanitary sewer permit to maintain compliance.
- Enables the recovery of costs by accelerating construction schedule.
- High risk earthwork near sensitive areas, or surface waters impaired for turbidity, fine sediment, or phosphorus.
- Earthwork will result in the disturbance of contaminated soils or the discharge of contaminated stormwater or groundwater.

Only approved chemicals and technologies can be used. Systems must be designed and operated in accordance with the Use Designation document for the technology selected. Use the guidance in Appendix 3 for additional information about designing and operating chemical treatment systems.

Ecology must be notified prior to the discharge from a chemical treatment system (submit a *Request for Chemical Treatment* form).

Additional Information

- Operators of chemical treatment systems need to have additional certifications or training.
- Use of other chemicals, such as tackifiers or PAM on soil, may affect the treatability and performance of chemical treatment systems.

- Chemical treatment systems may require automated measuring or shutoff systems, calibrated dose rate mechanisms, extra containment, designed bypass, residual testing, and daily monitoring information.

5-1.1.10 Construction Stormwater Filtration

No Standard Specification or Standard Plan

SWMM Volume II equivalent: BMP C251

Function

Construction stormwater filtration uses sand media or other filtration methods to remove suspended sediment.

Conditions of Use

- Treatment chemicals are not employed therefore the use of construction stormwater filtration does not require pre-approval from Ecology. Additionally, because no treatment chemicals are employed, there is no system operator certification required.

Additional Information

- Two types of filtration systems may be applied to construction stormwater treatment:
  - Rapid sand filters can achieve relatively high hydraulic flow rates, on the order of 2 to 20 gallons per minute per square foot of filter area (gpm/sf), because they have automatic backwash systems to remove accumulated solids.
  - Slow sand filters have very low hydraulic flow rates, on the order of 0.02 gpm/sf, because they do not have backwash systems. Slow sand filtration is mechanically simple in comparison to rapid sand filtration, but requires a much larger filter area.
- 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 is related to particle size distribution in the stormwater.
- The treatment process (e.g., collection and routing of water) is similar to that described in Appendix 3 (except treatment chemicals are not used). Use the design criteria (e.g., sizing and flow control criteria) in Appendix 3.

5-1.1.11 Conveyance Channel Stabilization

Multiple BMPs can be used to stabilize a channel, some of which have Standard Specifications or Standard Plans:

- Flexible liners such as erosion control blankets and vegetation
- Rock lining
- Check dams
- Temporary pipe slope drain

SWMM Volume II equivalent: BMP C201 Grass-Lined channels or C202 Channel Lining

Function

Conveyance channel stabilization consists of various practices used to prevent erosion within a channel or ditch. Selecting the best practice for the channel may involve considerations such as the gradient and soil type in the channel.

Additional Information

- Bare soil has very little resistance to erosion when subjected to concentrated flows. Protect channels to withstand expected erosive forces.
- Limit flow velocities with BMPs such as check dams, if necessary, to prevent damage to channel liners.
- Flexible liners are able to conform to changes in channel shape while protecting the soil.

Design, Installation and Maintenance

Temporary channels should be sized to convey expected flows as follows:

- Eastern Washington should be designed to handle the 6-month, 3-hour peak flow rate using a single-event model. The designer should consult the Region Hydraulics staff to determine whether a higher level of protection is needed beyond the 6-month, 3-hour storm due to the time of year for construction (freezing conditions and snowmelt), the downstream conditions, or the expectation that the project will last several construction seasons.
- Western Washington should be designed to handle peak flows generated by the 10-year storm event using 15-minute time steps predicted by MGSFlood.

Note: The following guidance comes from the Hydraulic Engineering Circular No. 15 – Design of Roadside Channels with Flexible Linings, Federal Highways Department publication No. FHWA-IP-87-7.

Consider the following principles when designing stable channels:

The potential for erosion is based on the shear stress of flow, which is the force required to pull or peel (erode) material off the bottom or sides of a ditch. Calculate shear stress using the following formula:

Shear Stress = WHG

where: W = Weight of water (62.4 lb/ft^3)

H = Height of water in feet

G = Channel gradient in ft/ft

Note: Channel gradient and water height in this formula assume an unobstructed flow of water in the ditch.

- Using shear stress to determine effective liner material:

  Table 5-1 indicates the maximum shear stresses that several types of flexible liner materials can withstand. As a general guideline when rock lining is used, multiply the expected maximum shear stress by 3 to apply a 30% safety factor, to obtain the mean diameter of rock or riprap needed to stabilize the ditch. Manufacturers provide the shear strength ratings for erosion control blankets.

  Base the selection of liner material on the maximum shear stress that products or specified rock sizes can withstand.

- Sample calculation and product selection process:

  What flexible liner materials are adequate to stabilize a ditch with a 3% slope and an expected flow depth of 1.5 feet?

  Shear stress = (62.4 lb/ft^3)(1.5 ft)(.03) = 2.81 lb/ft^2

  If rock is used, stone size should be a minimum mean stone size of at least 8.4 inches, because (2.81)(3.0 conversion factor) = 8.4.

  Numerous erosion control blankets made of coir and synthetic turf reinforcement products could be substituted for rock with potentially significant cost savings. A well-established healthy stand of grass could also withstand the expected shear stresses in the ditch and help purify the runoff.

Consider coupling other BMPs with the channel lining to ensure channel stability. Check dams can greatly reduce the velocity of flowing water, thereby reducing shear stress. Check dams can prevent erosion until the permanent grass liner is established.

Table 5-1 Maximum permissible shear stresses for flexible liners

Liner Category	Liner Type	Permissible Shear Stress (lbs/ft^2)
Bare soil – No liner	Noncohesive soil Cohesive soil	0.01–0.04 up to 0.1 (noncompacted) up to 0.8 (compacted)
Erosion control blankets (temporary/permanent)*	Jute Curlex wood or straw Coir Organic, synthetic, or mix	0.45–1.0 1.0-2.5 2.0-4.0 10.0-12.0
Vegetative**	Uncut stand Cut grass	2.1–3.7 0.6–1.0
Gravel/riprap	1-inch 2-inch 6-inch 12-inch	0.33 0.67 2.0 4.0

*Permissible shear stresses based on products chosen at random to give a general idea of blanket strengths by material type. This table does not reflect the full range of permissible shear stresses for each product type.
**Varies with type and density of grass stand.

- Monitor for signs of erosion, flows bypassing treatment and sediment buildup. Adapt the conveyance channel stabilization BMP as needed to ensure continued functional performance.

5-1.1.12 Dust Control

Standard Specifications

1-07.5(4) – Air Quality

2-07.3 – Construction Requirements

8-01.3(2)E –Tackifiers

9-14.4(7) – Tackifier

9-14.5(1) – Polyacrylamide

SWMM Volume II equivalent: BMP C140 Dust Control

Function

Dust control is a set of practices used to minimize the creation or movement of fugitive dust generated during construction.

Conditions of Use

- Compliance with the local clean air agency constitutes compliance with this BMP.

Additional Information

All erosion control BMPs used to cover or stabilize soil will also minimize the creation of fugitive dust. Practices that minimize fugitive dust during construction include:

- Spray dust generating areas with water until the surface is wetted, but do not create a discharge.
- Cover and/or wet materials transported by trucks, or provide adequate freeboard (space from the top of the material to the top of the truck) to reduce particulate emissions during transport.
- Limit clearing to areas where immediate activity will take place. Preserve vegetation wherever feasible.
- Cover stockpiles and bare soils as soon as possible.
- Construct natural or artificial windbreaks or windscreens or limit dust-generating work on windy days if feasible.
- Lower speed limits or use paved routes. Restrict use by tracked vehicles and heavy trucks to prevent damage to the road surface and base.
- Incorporate permanent vegetative cover as soon as possible (see BMP 5-1.1.41).
- Add surface gravel to reduce the source of dust emission. Limit the amount of fine particles (those passing a #200 screen) to 10% to 20%.
- Remove mud and other dirt promptly from wheels so it does not dry and turn into dust. Implement tire wash facilities to prevent sediment track-out (see BMP 5-1.1.45).
- Implement stabilized construction access to prevent sediment track-out from exit points. Perform street sweeping on paved areas on which sediment track-out occurred (see BMP 5-1.1.35).

- Use PAM or other approved dust palliative or suppression products (see BMP 5-1.1.40). Local governments may approve dust palliatives (such as calcium chloride). Used oil is prohibited as a dust suppressant. Dust suppressant and palliative products and materials used near surface or groundwater shall have no aquatic toxicity.

Design, Installation and Maintenance

- Contact your local clean air agency for guidance on local requirements.
- Monitor for fugitive dust during dust generating activity and implement or maintain dust control BMPs as needed.

5-1.1.13 Erosion Control Blankets and Nets

Standard Specifications

8-01.3(3) – Placing Erosion Control Blanket

9-14.5(2) – Biodegradable Erosion Control Blanket

Standard Plans

I-60.10 – Biodegradable Erosion Control Blanket Placement for Slopes

I-60.20 – Biodegradable Erosion Control Blanket Placement for Ditches

SWMM Volume II equivalent: BMP C122 Nets and Blankets

Function

Erosion control blankets (sometimes called rolled erosion control products) temporarily protect soil from raindrop and sheet erosion and hold seed in place until permanent vegetation is established. Blankets are often used to minimize erosion on slopes and in areas with channelized flow. Thick or textured blankets and nets can capture small amounts of sediment, but are not considered sediment control.

Additional Information

Biodegradable erosion control blankets are designed to fully cover soil. Biodegradable blankets and netting, if present, should effectively perform their intended erosion control function until permanent vegetation has been established, or for a minimum of 6 months (whichever comes first), and may remain intact for longer, depending on the material composition and environmental conditions. Biodegradable erosion control blankets and nets are designed to be left in place and degrade as vegetation grows through the blanket and permanently stabilizes the soil.

Biodegradable blankets/nets are made of natural plant fibers such as jute, straw, wood strands, coconut fiber (coir), or various combinations of each. Some blanket products are held together with a biodegradable netting also made of natural plant material. Netting can trap ground-dwelling wildlife such as birds and snakes. Some blankets are woven together, so netting is not needed to hold the blanket together. Avoid using a netted blanket if endangered species are present that are vulnerable to this type of entrapment. **Biodegradable erosion control blankets, and netting (if present), should never contain any form of synthetic materials, such as plastics.**

Synthetic blankets, often called turf reinforcement mats, contain materials that resist ultraviolet light, last more than 5 years, and should not be used under most circumstance for temporary erosion control (may be suggested for permanent soil stabilization based on geotechnical analysis).

Design, Installation and Maintenance

Installation is the key to success with blankets. Improperly installed blankets can cause big erosion events because problems go unseen (erosion under the blanket). Follow the manufacturers' recommendations for product placement and stapling, and:

- Prepare slopes (smooth, uniform surface) prior to blanket installation so the blanket will make contact with the entire soil surface.
- Apply seed before the blanket is installed unless an open weave netting is used (with 60% or more open area so seed can contact soil).
- Always consider the directional flow of water before installing a blanket. Anchor-trench blankets at the top of the slope to prevent water from undercutting the blanket. Place upslope sections over downslope sections like shingles on a roof.
- Manually unroll blankets down the slope to prevent stretching or pulling out of the anchor trench. Do not walk on the installed blanket.
- Note that typical staples are 6 inches long, metal, and U-shaped. Use longer, coiled, or barbed staples in sandy soils. Biodegradable staples are also available.
- Follow the manufacturer's recommendations for overlapping, staple, and check slot placement. If manufacturer's recommendations are not provided with the product, follow Standard Plan I-60.10 for slopes or Standard Plan I-60.20 for ditches.

- Sources of high velocity concentrated flow should be managed to prevent erosion under the blanket. Use flow dispersal BMPs (e.g. compost socks on slopes, check dams in channels) to prevent high velocity concentrated flow from developing in blanketed areas.
- Monitor for signs of erosion, flows bypassing treatment and sediment buildup. Adapt the conveyance channel stabilization BMP as needed to ensure continued functional performance.

5-1.1.14 Filter Berms

Standard Specification

8-01.3(9)B – Gravel Filter, Wood Chips, or Compost Berm

Standard Plan

I-80.10 – Miscellaneous Erosion Control Details

SWMM Volume II equivalent: BMP C232 Gravel Filter Berm

Function

Filter berms are temporary barriers that allow water to pass through while providing some larger particle sediment control.

Additional Information

- Functional performance is dependent on material used.
- Rock material should be ¾ to 3 inches in size and shall not contribute to turbidity (crushed rock shall be washed and have less than 5% fines).
- Route construction vehicles and equipment around filter berms, because they are easily damaged.
- Note that you may need pipe slope drains to convey water that accumulates along the filter berm to prevent blowouts.

Design, Installation and Maintenance

- Dimensions shall be adequate to provide sediment control for runoff.
- Berms are highly susceptible to failure and must be inspected regularly when used in actively worked areas to ensure continued performance.
- Monitor for signs of erosion, flows bypassing treatment and sediment buildup. Adapt the conveyance channel stabilization BMP as needed to ensure continued functional performance.

5-1.1.15 Gradient Terraces

No Standard Specification or Standard Plan

SWMM Volume II equivalent: BMP C131 Gradient Terraces

Function

Gradient terraces reduce erosion by intercepting surface runoff and conducting it to a stable outlet that dissipates erosive energy.

Additional Information

Do not construct gradient terraces on deep sands or soils that are too stony, steep, or shallow to allow practical installation and maintenance. Use gradient terraces only when suitable outlets are available or will be made.

Determine the maximum vertical spacing of gradient terraces by the following method:

$$VI = (0.8)s + y$$

where: VI = vertical interval in feet

s = land rise per 100 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 soil covering is on the surface.

Design gradient terraces in the following ways:

- Increase vertical spacing determined by the above method as much as 0.5 feet or 10%, whichever is greater, to: provide better alignment or location, avoid obstacles, adjust for equipment size, or reach a satisfactory outlet. In the drainage area above the terrace, do not exceed the area that would be drained by a terrace with normal spacing.
- Ensure the top of the constructed ridge is not lower at any point than the design elevation plus the specified overfill for settlement. The ridge height should include a reasonable settlement factor with a minimum top width of 3 feet at the design height.
- Note that 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, you may increase the grades to improve alignment. Ensure the channel velocity does not create erosion.
- Include adequate outlets that prevent erosion.

- Note that terraces should be able to handle the peak runoff expected from a 2-year, 24-hour design storm without overtopping.
- Proportion the cross-section to fit the land slope.

Design, Installation and Maintenance

- Inspect gradient terraces after large storm events and maintain as needed to ensure continued function.

5-1.1.16 High pH Water Management

Standard Specifications

1-07.5 – Environmental Regulations

8-01.1(1) - Definitions

8-01.3(1)C – Water Management

SWMM Volume II equivalent: BMP C252 High pH Neutralization Using CO_2 and C253 pH Control for High pH Water

Function

Sources of high pH water must be managed to prevent violations of water quality standards. Different sources of high pH water must be managed differently under the Permit depending on whether they are an authorized or prohibited discharge.

Additional Information

Sources of high pH water on construction sites are commonly created by contact with cementitious materials such as concrete, Portland cement, recycled concrete, amended or engineered soils, mortars, grouts, materials that contain lime, fly ash, kiln dust, or bottom ash. The primary acidic agent in cement is calcium hydroxide (free lime).

The Permit designates specific sources of authorized discharges (Special Condition 1.C) and prohibited discharges (Special Condition 1.D) that dictate what can be discharged to waters of the state (surface and groundwater). WSDOT Standard Specification 8-01.1 provides definitions and general guidance for the treatment and/or disposal of:

1. **pH-Affected Stormwater**
2. **pH-Affected Non-Stormwater, and**
3. **Cementitious Wastewater/Concrete Wastewater.**

Sources of cementitious wastewater/concrete wastewater (including pH-affected process wastewater) and other prohibited discharges that cannot be discharge to surface water or infiltrated may be able to be discharged to a sanitary sewer system if approved by the local jurisdiction. If a sanitary sewer is not an option, alternative disposal options will need to be identified (contact Region Environmental or the Hazardous Materials Program).

Cementitious wastewater/concrete wastewater (as defined in Standard Specification 8-01.1), and process wastewater (including pH impacted process wastewater) generated as part of a construction process, cannot be discharged to surface waters of the state even if the pH has been neutralized. Stormwater, conditionally authorized non-stormwater, and groundwater becomes a process wastewater if it's used as part of a construction process, and therefore cannot be discharged to surface waters even if it is neutralized.

BMPs must be used to minimize contamination of authorized discharges by pH-modifying substances. When stormwater comes into contact with pH-modifying substances as a natural course of work (e.g., rain hitting freshly poured concrete) runoff must be monitored in accordance with the Permit and may require neutralization prior to being discharged to surface waters. Neutralization is a process used to lower the pH levels of authorized discharges to the range of 6.5 to 8.5 standard units (su). Any water, including stormwater conditionally-authorized non-stormwater, and groundwater that comes in to contact with fine cementitious particles becomes a cementitious wastewater/concrete wastewater and cannot be neutralized and discharged or infiltrated.

Design, Installation and Maintenance

Dry ice, CO_2, and food grade vinegar are the approved methods for neutralizing authorized discharges under the Permit. General neutralization procedures include:

- Identify a treatment strategy for the source and quantity of water (e.g., using a tank and dry ice for single batch treatment).
- Isolate the high pH water as much as possible to treat it separately from sources of water that do not need to be neutralized.
- Sample the pH of the water. As a general rule, less CO_2 is needed for clearer water. Add dry ice or compressed CO_2 using a diffusing device (to create gas flushing or sparging effect) until the pH drops as close to 7 as practicable.
- Release water in a controlled manner to prevent the resuspension of settled sediment and downstream erosion. Implement flow control if required by surface water being discharged into.

- Maintain operational records in the site log book: Include a description of the treatment strategy being implemented, estimated volume of water treated daily, pH of untreated water, amount of CO_2 needed to adjust water, pH of treated water, outfall location and discharge sample values.
- Obtain written approval from Ecology before using forms of chemical treatment other than dry ice or CO_2.
- Implement related BMPs as required, including: Concrete Washout Areas (5-1.1.8) and Concrete Handling (5-1.1.7).

5-1.1.17 High-Visibility Fencing

Standard Specifications

1-07.16(2) – Vegetation Protection and Restoration

8-01.3(1) – General

8-01.3(9)A – Fencing

9-14.5(8) – High Visibility Fencing

Standard Plan

I-10.10 – High Visibility Fence

SWMM Volume II equivalent: BMP C103 High Visibility Fence

Function

Use High-visibility fencing (HVF) to delineate areas to be protected from construction activity.

Additional Information

Install HVF in advance of clearing and grubbing to delineate sensitive or protected areas. The high-visibility orange color is intended to draw attention to a protected area. Use high-visibility (orange) silt fence only in sensitive or protected areas where turbid runoff is a concern; ensure it is trenched in to provide sediment control (Standard Plan I-30.16 or I-30.17).

Where High Visibility Fencing cannot be effectively placed and maintained due to tidal water fluctuation or seasonal high water, or is in a position with low risk for accidental equipment entry and where staking can prevent temporary impacts to sensitive areas and natural vegetation associated with High Visibility Fence installation, the Engineer may approve use of High Visibility Staking (HVS). HVS shall be placed to identify limits of areas for preservation as identified in the approved

TESC plans and as approved by the Engineer. HVS is not a substitute for High Visibility Silt Fence. Where HVS is used, active erosion control measures will also be required if there is potential for surface erosion to result in violation of State Water Quality standards.

Design, Installation and Maintenance

- Maintain HVF or HVS as needed to ensure effective delineation.

5-1.1.18 Hydraulically-Applied Erosion Control Products (HECPs)

Standard Specifications

8-01.3(2) – Temporary Seeding and Mulching

8-01.3(2)E – Tackifiers

8-02.3(11) - Mulch

9-14.4(2)C – Hydraulically Applied Erosion Control Products (HECPs)

SWMM Volume II equivalent: BMP C121 Mulching

Function

Hydraulically-applied erosion control products (HECPs), often referred to as hydromulch, adhere to the top layer of soil and create a permeable crust holding soil in place while allowing water to infiltrate.

Additional Information

All HECP products are different; they have different ingredients, different hydration rates (amount of water needed to hydrate the product so it can be sprayed) and look different on the soil once applied. Generally, HECPs are a combination of organic fiber and tackifier (and usually seed and fertilizer), which are sprayed onto soil to provide temporary stabilizing cover until permanent stabilizing vegetation establishes. HECPs do not prevent erosion in areas with channelized or concentrated flows and therefore BMPs must be used to prevent concentrated flows from hitting HECP installations.

Most HECP products require some cure time (no heavy rain) before they effectively adhere to the top layer of soil and create a permeable crust. They must dry to fully cure. WSDOT's Qualified Products List (QPL) contains approved HECP products.

Proper application is the key to success with HECPs. The soil onto which the product is applied is a big factor. Like painting a wall, the texture of the soil will influence that amount of mulch needed to achieve full coverage. Generally soils that have been prepared for application [8-01.3(2)A)] will take the least amount of mulch product. Unprepared soils with large rocks, mounds of soil or stumps will require mulch and may lead to shadow areas (areas where the mulch application is blocked and soil is not covered). Shadow areas are a common problem for WSDOT projects because mulch is generally only able to be sprayed from the roadway (from above or below area to be mulched) rather than from multiple directions (from above and below area to be mulched). To minimize shadow areas, the installer should spray the mulch from multiple angles or in multiple passes. Full coverage (no visible soil) is necessary to ensure the product doesn't fail as a temporary stabilization method.

Design, Installation and Maintenance

Table 5-2 Hydromulch standard specifications and general remarks

Material	Application Rates	Remarks
Short-Term Mulch 9-14.4(2)C	Approx. 1,500–2,000 lbs per acre: Apply per the manufacturer's recommendations	Applied with a hydromulcher or hydroseeder, often combined with seed and fertilizer. Contains a tackifier and requires a typical cure time of 24–48 hours before rain. Soil must be completely and uniformly covered, without shadow areas where soil shows through. These mulches do not hold up to concentrated flows. Under normal conditions, will last 3–6 months.
Moderate-Term Mulch 9-14.4(2)B	Approx. 3,000–4,000 lbs per acre: Apply per the manufacturer's recommendations	Applied with a hydromulcher or hydroseeder, often combined with seed and fertilizer. Contains a tackifier and requires a typical cure time of 24–48 hours before rain. Soil must be completely and uniformly covered, without shadow areas where soil shows through. Moderate-Term Mulch needs to be applied in more than one layer with no more than 2,000 pounds per acre in any one layer. These mulches do not hold up to concentrated flows. Under normal circumstances, will last 6–12 months.
Long-Term Mulch 9-14.4(2)A	Approx. 3,000–4,000 lbs per acre: Apply per the manufacturer's recommendations	Applied with a hydromulcher or hydroseeder, often combined with seed and fertilizer. May only require 2–4 hours of cure time. Soil must be completely and uniformly covered, without shadow areas where soil shows through. Long-Term Mulch needs to be applied in more than one layer with no more than 2,000 pounds per acre in any one layer. These mulches do not hold up to concentrated flows. Under normal circumstances, will last 12–18 months. Cellulose fiber, or paper-based mulches, are not permitted for long-term applications.

Whenever feasible, construction inspectors should be present when the HECP is being sprayed to ensure:

- The hydromulcher or hydroseeder equipment tank (usually 3,000 gallons) is filled with the appropriate quantity of bags of mulch for the product specific hydration rate.
- The appropriate pound per acre application rate is used.
- The HECP is sprayed from multiple angles to prevent shadow areas.
- No more than 2,000 pounds per acre are applied in any single layer (unless the product is short term mulch). This allows the first layer to dry before a second layer is applied and prevents slumping of the mulch and proper curing.

- Covered areas are not walked on after installation. Breaks in crust coverage will lead to product failure.
- The products are not used on saturated soils, areas with groundwater seeps or seasonal springs, or soils dominated by rock larger than 1-inch in diameter.
- The product are not applied within the Ordinary High Water Mark (OHWM)
- Employ BMPs to ensure concentrated flows do not reach areas covered by HECPs – HECPs do not hold up against channelized or concentrated flow.
- The manufacturers' recommendations for installation are followed. There are many different HECP products on the market, so following recommendations is very important.

5-1.1.19 Interceptor Dikes and Swales

No Standard Specification or Standard Plan

SWMM Volume II equivalent: BMP C200 Interceptor Dike and Swale

Function

Use interceptor dikes and swales to intercept runoff and/or groundwater from drainage areas on slopes and direct it to a stabilized outlet.

Additional Information

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 runoff from entering the work area or sediment-laden runoff from leaving the construction site.

- Note that, when placed horizontally across a disturbed slope, the dike and swale reduces the amount and velocity of runoff flowing down the slope.
- Stabilization of the dike and swale with temporary or permanent vegetation depends on soil characteristics and gradient. You may not need to apply a higher level of protection to low-gradient highly porous soils, because much of the water infiltrates the ground, reducing erosion potential.
- Use swale protection, check dams, or level spreaders on steeper grades.
- Provide energy dissipation measures at the swale outlet.
- Release sediment-laden runoff to a sediment-trapping facility.
- Minimize construction traffic over temporary dikes. Use temporary cross culverts for channel crossing.

Design, Installation and Maintenance

Size interceptor dikes and swales (see Table 5-3) to handle expected flows:

- Eastern Washington should be designed to handle the 6-month, 3-hour peak flow rate using a single-event model. The designer should consult the Region Hydraulics staff to determine whether a higher level of protection is needed beyond the 6-month, 3-hour storm due to the time of year for construction (freezing conditions and snowmelt), the downstream conditions, or the expectation that the project will last several construction seasons.
- Western Washington should be designed to handle peak flows generated by the 10-year storm event using 15-minute time steps predicted by MGSFlood.

Table 5-3 Dike and swale design criteria

Interceptor dikes meet the following criteria:	
Top width	2 feet (600 mm) minimum.
Height	18 inches (450 mm) minimum. Measured from upslope toe and at a compaction of 90% ASTM D698 standard proctor.
Side slopes	2H:1V or flatter.
Grade	Topography dependent, except that dike is limited to grades between 0.5-1.0%.
Horizontal spacing of interceptor dikes	Slopes <5% = 300 feet (90 m) Slopes 5–10% = 200 feet (60 m) Slopes 10-25% = 100 feet (30 m) Slopes 25–50% = 50 feet (15 m)
Stabilization	Slopes = <5%. Seed and mulch applied within 5 days of dike construction. Slopes = 5–40%. Dependent on runoff velocities and dike materials. Stabilization, using either sod or riprap, should be done immediately to avoid erosion.
Outlet	The upslope side of the dike must provide positive drainage to the dike outlet. No erosion can occur at the outlet. Provide energy dissipation measures as necessary. Sediment-laden runoff must be released through a sediment-trapping facility.
Other	Minimize construction traffic over temporary dikes.
Interceptor swales meet the following criteria:	
Bottom width	2 feet (600 mm) minimum; the bottom is level.
Depth	1 foot (300 mm) minimum.
Side slope	≤ 2H: 1V or flatter.
Grade	Maximum 5%, with positive drainage to a suitable outlet (such as a sediment trap).
Stabilization of swale bottom and side slopes	Seed per Standard Specification 8-01.3(2). Temporary seeding, or riprap 12 inches (300 mm) thick, pressed into the bank and extending at least 8 inches (200 mm) vertical from the bottom.
Swale spacing	Slope of disturbed area: <5% = 300 feet (90 m) 5–10% = 200 feet (60 m) 10–40% = 100 feet (30 m)
Outlet	Level spreader or riprap to stabilized outlet/sedimentation pond.

5-1.1.20 Level Spreaders

No Standard Specification or Standard Plan

SWMM Volume II equivalent: BMP C206 Level Spreader

Function

A level spreader is used to convert concentrated runoff to sheet flow and release it onto areas stabilized by existing vegetation or engineered filter strips; provide a temporary outlet for dikes and diversions consisting of an excavated depression constructed at zero grade across a slope.

Additional Information

Use above areas that are stabilized by vegetation. If the level spreader has any low points, flow will concentrate, creating channels and possibly causing erosion.

- Use 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 absorb most of the low-flow events.
- Use above areas that are stabilized by vegetation.
- Note that, if the level spreader has any low points, flow will concentrate, creating channels and possibly causing erosion.
- Design the level spreader so that runoff does not reconcentrate after release unless intercepted by another downstream measure.
- Ensure level spreaders consisting of gravel or organic material have a minimal amount of fine particles that could negatively influence turbidity.
- Ensure the spreader spans the full width of the channel. Use multiple spreaders for higher flows.
- Ensure the depth of the spreader, as measured from the lip, is uniform across the entire width.
- Set level spreaders back from the property line unless there is an easement for flow.

Design, Installation and Maintenance

- If concentrated flow or erosion becomes evident the level spreader must be adapted to improve functional performance.

5-1.1.21 Materials Handling, Storage and Containment

Standard Specifications

1-06.4 – Handling and Storing Materials

1-07.5 – Environmental Regulations

1-07.15(1) – Spill Prevention, Control, and Countermeasures (SPCC) Plan

SWMM Volume II equivalent: BMP C153 Materials Delivery, Storage and Containment

Function

Materials handling, storage and containment procedures include various methods to prevent a discharge of hazardous pollutants.

Additional Information

Handle the following common construction site materials with extra precautions to prevent contamination:

- Petroleum products such as fuel, oil and grease
- Soil stabilizers and binders (e.g., Polyacrylamide)
- Fertilizers, pesticides, and herbicides
- Detergents, soaps, and solvents
- Cementitious materials such as Portland cement or grouts
- Hazardous chemicals such as acids, lime, adhesives, paints, and curing compounds
- Any other material that may be detrimental if released to the environment

Take the following steps to minimize risk:

- Minimize the storage of hazardous materials onsite whenever feasible, and store materials in designated areas.
- Locate storage of hazardous materials away from waterways or discharge points such as storm drains.
- Supply Safety Data Sheets (SDS) for all materials stored, and keep chemicals in their original labeled containers.

- Minimize long-term storage of hazardous materials whenever feasible, and handle as infrequently as possible.
- Store materials in a covered area during the wet season.
- Do not store hazardous materials directly on the ground; always use appropriately-sized secondary containment.

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.
- Be impervious to the materials stored therein for a minimum contact time of 72 hours.
- Be maintained as leak free and be covered during nonworking days in the wet season. If containment devices fill with rainwater, the water shall be collected or removed so the required storage capacity is maintained. Removed or collected liquids shall be handled as hazardous waste unless testing determines otherwise.
- Be placed in the field to allow for easy access and responsive cleanup times.

Spill kits should contain materials appropriate for the work being done and the potential spill-related risks. Contents for a typical spill kit include:

- 1 – Water-resistant nylon bag
- 3 – Oil-absorbent socks 3” x 4’
- 2 – Oil-absorbent socks 3” x 10’
- 12 – Oil-absorbent pads 17” x 19”
- 3 – Pairs of nitrile gloves
- 1 – Pair of splash – resistant goggles
- 10 – Disposable bags with ties
- Instructions

5-1.1.22 Materials On Hand

No Standard Specification or Standard Plan

SWMM Volume II equivalent: BMP C150 Materials On Hand

Function

Materials on hand is a procedural BMP to ensure the project is prepared to quickly employ BMP adaptive management when required.

Additional Information

Provide cover or appropriate storage methods for BMP materials that may break down when exposed to the elements or generate contaminated runoff.

The following BMPs can be implemented quickly, fulfill multiple needs, or require regular maintenance throughout construction and therefore make sense to keep on hand in extra quantities dependent on the project:

- Compost socks or wattles and stakes
- Inlet protection devices
- Weed-free straw
- Plastic covering
- Rock material
- Silt fence and posts
- Sandbags
- Pumps and pipe

5-1.1.23 Mulching

Standard Specifications

8-01.3(2)D – Temporary Mulching

8-02.3(11) 0 Mulching

9-14.4 – Mulch and Amendments

SWMM Volume II equivalent: BMP C121 Mulching

Function

Mulching is organic material used to protect bare soil from raindrop erosion. Mulch also enhances seed germination and plant establishment by conserving moisture; holding fertilizer, seed, and topsoil in place; and moderating soil temperatures.

Additional Information

Table 5-4 provides additional information on some types of mulch material.

Design, Installation and Maintenance

Mulch covering must be maintained when erosion becomes evident. Reapplication of mulch to cover soils that have been eroded due to concentrated flows will not prevent reoccurrence of erosion – employ BMPs that prevent concentrated flows from developing of eroding mulched areas.

Table 5-4 Mulch standard specifications and guidelines

Material	Application Rates	Remarks
Straw 9-14.4(1)	Approx. 2"–3" thick	Hand-spread straw generally requires greater thickness than blown straw. Hand-spread straw is less likely to be displaced by wind or runoff because of its weight and length. Blown straw should be held in place with a netting or tackifier to prevent displacement of mulch by wind and rain. Straw often introduces weed species. Certified Weed-Free Straw is required by 9-14.4(1). It should also not be used within the ordinary high-water elevation or in areas with concentrated flow (due to flotation). Straw mulch needs to be maintained often to be an effective soil cover and it may need to be removed for soil compaction purposes.
Hydromulch		See BMP 5-1.1.19
Compost 9-14.4(8)	2" minimum thickness Approx. 100 tons per acre (approx.. 750 lb per cubic yard)	A “compost blanket” is often used to protect soils at final grades until permanent vegetation is planted because it can be directly seeded or tilled into soil as an amendment. Compost applied too thickly (over 3") on slopes may slide down as it becomes heavy when it absorbs water. If slopes are composted, it is best to till in the first lift or roughen the soil surface by cat-tracking or other means. Compost should not be applied in areas where water will sit for long periods of time because it will create a compost leachate that can elevate turbidity readings and nutrient levels in runoff. Do not use composted mulch near wetlands or nutrient-impaired waters. Must be produced per Chapter 173-350 WAC, Solid Waste Handling Standards, but may have up to 35% biosolids if not applied on stormwater BMPs.
Chipped Site Vegetation 2-01.2(3)	2" minimum thickness	A cost-effective way to dispose of debris from clearing and grubbing. If seeding is expected shortly after mulch, the decomposition of the chipped vegetation can create a nitrogen deficiency in the soil, making it difficult for grass to grow. It can be used where woody native vegetation will be planted. It is not recommended within 200 feet of surface waters. Wood chip mulch is also a suitable material for stabilizing entrances and haul roads that are not heavily used by construction vehicles. Special attention is needed to ensure invasive species are not being spread through this method.
Bark or Wood Chips 9-14.4(3) Wood Strand Mulch 9-14.4(4)	2" minimum thickness Approx. 100 tons per acre (approx. 800 lbs per cubic yard)	May be a suitable material for stabilizing entrances and haul roads that are not heavily used by construction vehicles. Wood material may need to be removed for compaction purposes and the structural integrity of roadways. The use of wood chip mulch ultimately improves the organic matter in the soil. However, if seeding is immediately expected, the decomposition of bark or wood chips can create a nitrogen deficiency, making it difficult for grass to grow. Wood chips can be used where native woody vegetation will be planted. Special attention is needed to ensure invasive species are not being spread through this method.

5-1.1.24 Outlet Protection

Standard Specification

8-01.3(11) – Outlet Protection

SWMM Volume II equivalent: BMP C209 Outlet Protection

Function

Outlet protection prevents scour at temporary outlets and minimizes the potential for downstream erosion by reducing the velocity of concentrated flow.

Additional Information

Outlet protection is required at the outlets of all ponds, pipes, ditches or other conveyances, and where runoff is conveyed to a natural or manmade drainage feature such as a stream, wetland, lake or ditch. WSDOT incorporates permanent outfall protection into the design process for permanent BMPs and stormwater conveyance facilities. This BMP is only intended to address temporary outlet protection needs during construction (e.g., outlets from temporary pipe slope drains, temporary channels).

- Common locations for outlet protection include discharge points for ponds, pipes, ditches, or spillways with erosive concentrated flow.

Design, Installation and Maintenance

- Size the scale of the outlet protection based on expected flow volumes and velocities. Refer to the *Hydraulics Manual* for guidance in choosing appropriately-sized rock outlet protection or alternative materials.
- Outlet structures designed for permanent facilities may not be installed yet, or if installed, may not provide adequate holding time to treat construction stormwater. The outlet structure may need to be adapted during construction to provide adequate holding time allowing sediment to settle.
- Inspect outlet areas regularly for signs of erosion or concentrated flows.
- Maintain or adapt as needed to improve functional performance.

5-1.1.25 Pipe Slope Drains

Standard Specification

8-01.3(14) – Temporary Pipe Slope Drain

SWMM Volume II equivalent: BMP C204 Pipe Slope Drains

Function

Pipe slope drains are used to collect runoff and route concentrated flow down a slope or structure without causing erosion or to minimize saturation of slide-prone soils. Also used to collect and route different sources of water.

Additional Information

Pipe slope drains are often used at bridge ends to collect runoff and pipe it to the base of the fill slopes along bridge approaches. Another use is to collect runoff from pavement and pipe it away from side slopes. This is useful because there is often a time lag between installation of the first lift of asphalt and installation of curbs, gutters, and permanent drainage. Water can be collected and channeled to pipe slope drain inlets with sand bags, triangular silt dikes, berms, or other material.

- Use pipe slope drains when a temporary or permanent stormwater conveyance is needed to move the water down a slope to prevent erosion.
- Use pipe slope drains at bridge ends to collect runoff and pipe it to the base of the fill slopes along bridge approaches. You can design these into a project and include them as bid items.
- Use on road projects to collect runoff from pavement and pipe it away from side slopes.
- Use temporary drains on new slopes.

Design, Installation and Maintenance

Temporary pipe slope drains should be sized to handle expected flows:

- Eastern Washington should be designed to handle the 6-month, 3-hour peak flow rate using a single-event model. The designer should consult the Region Hydraulics staff to determine whether a higher level of protection is needed beyond the 6-month, 3-hour storm due to the time of year for construction (freezing conditions and snowmelt), the downstream conditions, or the expectation that the project will last several construction seasons.

- Western Washington should be designed to the 10-year handle peak flow rate (using15-minute time step) predicted by MGSFlood.
- If flow is exclusively surface water, use the design criteria contained in HRM Section 4-3.3 for western Washington or Section 4-4.3 for eastern Washington.
- If flow is from seeps or groundwater, use best professional judgment in consultation with the Region Materials Engineer (RME) when sizing slope drains.
- Collect water and channel it to pipe slope drain inlets with sand bags, triangular silt dikes, berms, or other material.
- Compact the soil around and under the pipe and entrance section to prevent undercutting.
- Securely connect prefabricated flared inlet sections to the slope drain pipe.
- Securely fasten multiple slope drain sections together, or use gasketed watertight fittings.
- If 90° bends cannot be avoided in the drain pipe, install thrust blocks constructed from sandbags, “t” posts and wire, or ecology blocks to anchor the bends. For pipe slope drains that are to remain as permanent features, ensure the thrust block materials are capable of lasting for the expected life of the pipe.
- Secure pipe along its full length to prevent movement (this can be done with steel “t” posts and wire). Install posts on each side of the pipe and wire the pipe to them. Do this approximately every 10–20 feet of pipe length, depending on the size of the pipe and quantity of water to be diverted.
- Use pipe slope drains to convey water collected by interceptor dikes. Ensure the height of the dike is at least 1 foot higher at all points than the top of the inlet pipe.
- Stabilize the area at the outlet with an energy-dissipating material (such as riprap).
- If the pipe slope drain is conveying sediment-laden water, direct all flows into a sediment-trapping facility.
- Inspect inlet area of pipe slope drain regularly to ensure continued function of collection point strategy. Inspect outlet area of pipe slope drain to ensure erosion is not being created. Maintain and adapt pipe slope drain as needed to ensure continued function.

5-1.1.26 Plastic Covering

Standard Specifications

8-01.3(5) – Placing Plastic Covering

9-14.5(3) – Clear Plastic Covering

SWMM Volume II equivalent: BMP C 123 Plastic Covering

Function

Plastic provides immediate soil coverage and prevents soil saturation.

Additional Information

The primary uses for plastic are:

- Coverage of temporary grade cut/fill slopes and stockpiles.
- Temporary coverage of active work areas.
- Protection of areas vulnerable to saturation.
- Temporary liner for concrete washout areas or secondary containment.

Plastic prevents infiltration, which means 100% of rainfall is transferred to somewhere else. Preventing infiltration and soil saturation may be the goal in some cases; however, you must plan for the large volumes and velocities of clean water coming off the plastic. Unmanaged runoff from plastic covering can quickly create erosion issues. Make a plan for managing the water coming off the plastic.

Design, Installation and Maintenance

Key factors to remember when installing plastic:

- Plastic will increase flow velocity, so use soil stabilization and energy dissipation BMPs to minimize the erosive energy of flows coming off sloped areas of plastic (e.g., toe of slope).
- When feasible, prevent the clean runoff from plastic from hitting bare soil. Direct flows from plastic to stabilized outlet areas.
- Anchor plastic at the top of the slope and along seams to prevent water from going under the plastic. Place upslope sheets over downslope sheets like shingles on a roof.
- Secure overlapping edges and terminal ends. Plastic can easily be blown off in wind and become a safety hazard for the traveling public.

- Plastic covering is maintenance intensive, and it becomes brittle over time and develops holes and tears. The average cost per square yard of installed plastic is often greater than the cost of many erosion control blankets, especially when maintenance, removal, and disposal costs are added.

5-1.1.27 Pond Skimmers

No Standard Specification or Standard Plan

No SWMM Volume II equivalent

Function

Pond skimmers withdraw temporarily detained water from the top part of the water column to avoid sediment that may be suspended lower in the water column.

Additional Information

Pond skimmers are used to pump down water levels in sedimentation ponds to maintain storage capacity in a way that ensures the cleanest water is discharged in a controlled manner. Skimmer products can be purchased or made using floats and centrifugal pumps (submersible pumps create a vortex that can suck up settled sediments at the bottom of the pond or tank).

All discharges shall comply with the Permit and shall be controlled in a manner that will protect downstream properties and waterways from sedimentation and erosion related to increased velocity and peak volumetric flow rates.

Design, Installation and Maintenance

- Operate and maintain pond skimmers to maintain function. Trash or other debris can clog skimmers and impair function.

5-1.1.28 Preserving Natural Vegetation

Standard Specifications

1-07.16(2) – Vegetation Protection and Restoration

1-07.16(2)A – Wetland Sensitive Area Protection

8-01.3(1) – General

SWMM Volume II equivalent: BMP C101 Preserving Natural Vegetation

Function

Provides multiple erosion and sediment control related benefits.

Additional Information

Existing vegetation is the most effective and cheapest BMP available. Phasing work or minimizing exposed soils by clearing only where construction will occur will minimize erosion related risks. Vegetation provides the following erosion control benefits:

- Rainfall impact (energy) absorption
- Reduction of runoff volumes and velocities
- Sediment trapping
- Root stabilization of soil

Install high-visibility fencing (HVF) in advance of clearing and grubbing to delineate sensitive or protected areas.

Vegetation may be protected because it does not need to be removed as part of construction or because it is in a sensitive area or buffer zone. Do not use sensitive areas and buffer zones as treatment or infiltration areas. Check with the local jurisdiction or WSDOT environmental permitting staff.

Design, Installation and Maintenance

- Inspect protected areas regularly to ensure intended protection is being achieved.
- Maintain delineation marking BMPs such as HVF is maintained as needed.

5-1.1.29 Scheduling and Coordinating Work Activity

Standard Specifications

1-08.3 – Progress Schedule

8-01.3(1) – General

8-01.3(1)A – Submittals

SWMM Volume II equivalent: BMP C162 Scheduling

Function

Minimize environmental risks that may arise due to scheduling conflicts.

Additional Information

Managing a large construction project with multiple contractors is a major coordination challenge. Weekly meetings, progress reports and schedules, or other methods of consistent communication are vital. Developing and following a specified work schedule that coordinates the timing of land-disturbing activity with the installation of appropriate BMPs requires effective communication between environmental site inspectors, CESCLs, contractors, subcontractors, and the Project Engineer.

Construction practices that limit or phase land-clearing activity and provide timely installation of erosion and sediment control BMPs can significantly reduce potential environmental impacts. Sediment control (treatment) BMPs must be installed to protect potential discharge points prior to land-disturbing activity in an area. Whenever feasible:

- Minimize grading or excavation work during the rainy season.
- Phase work to minimize the total area of exposed soil at any one time.
- Install sedimentation ponds or detention facilities, stabilized construction, and sediment control BMPs prior to work in an area.
- Practice staged seeding in order to revegetate areas as soon as possible.

5-1.1.30 Sediment Traps

No Standard Specification

Standard Plan

I-80.10 – Miscellaneous Erosion Control Details

SWMM Volume II equivalent: BMP C240 Sediment Trap

Function

Sediment traps are used to aid in the settling of suspended sediments from concentrated flows.

Additional Information

- Intended for use on sites where the tributary drainage area is less than 3 acres, with no unusual drainage features and with a projected build-out time of 6 months or less. If the tributary drainage area is more than 3 acres, use a temporary sediment pond.
- Trap efficiency is enhanced when runoff is passed through multiple sediment control BMPs.
- Sediment traps are limited to removing silt/larger-sized sediment particles.
- Trap effectiveness increases with trap size.

Design, Installation and Maintenance

1. Sizing Procedure

- 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:

$$SA = FS(Q/V_s)$$

where: Q = Design inflow based on criteria below.
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^3 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 surface area becomes:

SA = 2 x Q/0.00096 or
2,080 square feet per cfs of inflow

Note: Even if permanent facilities are used, they must still have a surface area that is at least as large as that derived from the above formula. If they do not, the pond must be enlarged.

- Design *Q* for sizing:
    - Eastern Washington should be designed to handle the 2-year peak flow rate from the appropriate long duration storm event using a single event model. See HRM Appendix 4C to determine the Climatic Region and appropriate long duration storm event for the project. The designer should consult with Region Hydraulics staff to determine whether a higher level of protection is needed beyond the 2-year peak flow due to the time of year for construction (freezing conditions and snowmelt), the downstream conditions, or the expectation that the project will last several construction seasons.
    - Western Washington should be designed to handle peak flows generated by the 2-year storm event using 15-minute time steps predicted by MGSFlood for the developed site condition without flow control. The designer should consult Region Hydraulics staff to determine if downstream conditions warrant a higher level of protection. The 10-year peak flow using 15-minute time steps should be used if the project is expected to last several construction seasons.
- Note that sediment traps may not be feasible on utility projects due to the limited work space or the short-term nature of the work. Use portable tanks in place of sediment traps for utility projects.
- Remove sediment from the trap when it reaches 1 foot in depth.
- Repair any damage to the pond embankments or slopes.

5-1.1.31 Sedimentation Bags

No Standard Specification or Standard Plan

No SWMM Volume II equivalent

Function

Sedimentation bags are considered pre-treatment BMPs because they work to remove coarse sediment from turbid water before it receives additional treatment.

Additional Information

Sedimentation or filtration dewatering bags are a pretreatment BMP, meaning the water that filters through the bag must receive additional treatment prior to discharging to surface waters.

Base the selection of the bag product on pump flow rate, the amount and type of suspended sediment in the water, and permittivity of the bag. As the bag fills with sediment, take measures to prevent bag failure or bursting (e.g., reduce pump flow rate, maintain or replace bag). Stabilize uncontaminated dewatered sediment from the bag in a controlled upland location away from drainages.

- Products should be made from nonwoven, needle-punched polypropylene geotextile.

Design, Installation and Maintenance

Filter bags require the following:

- Place at least 50 feet away from potential discharge locations.
- Never place on slopes or on surfaces that may puncture the bag.
- Filtered water from the bag must not cause onsite erosion.
- Water that filters through the bag must receive additional sediment control treatment (e.g., vegetative dispersion) prior to discharging to surface waters.
- Install and maintain in accordance with manufacturers' instructions, including recommended pump flow rates, sediment loading rates, and hose connections.

5-1.1.32 Silt Fence

Standard Specification

8-01.3(9)A – Fencing

Standard Plans

I-30.10 – Silt Fence with Backup Support

I-30.15 – Silt Fence

I-30.20 – Erosion Control at Culvert Ends

I-40.10 – Temporary Silt Fence for Inlet Protection in Unpaved Areas

SWMM Volume II equivalent: BMP C233 Silt Fence

Function

Silt fences reduce the transport of coarse sediment from a construction site by providing a geotextile barrier that reduces velocities of sheet flow or shallow overland flow.

Additional Information

Silt fence can create serious erosion problems quickly if not properly installed. Though sometimes referred to as “filter fence”, silt fence is not intended to provide an ongoing filtering function. The geotextile fabric quickly becomes clogged with sediment creating a dam like BMP in which sediment can drop out of the standing water behind the silt fence.

- Place fence below disturbed areas subject to shallow overland flow (sheet erosion) as a sediment control BMP.
- Never install silt fence in streams or in areas with concentrated flows.

Design, Installation and Maintenance

- Place fence on contour to maximize sediment-trapping performance and prevent concentrated flows and scouring from developing along fence.
- Silt fence must be trenched in accordance with the Standard Plan to be considered effective sediment control. If trenching is infeasible due to rocky soil consider using a compost sock as sediment control because they do not need to be trenched in.
- Do not install silt fence in areas that receive concentrated flows (over 0.5 cfs). Concentrated flows will overtop silt fence or collapse it altogether.
- Monitor for signs of erosion, flows bypassing treatment and sediment buildup. Adapt or maintain the silt fence as needed to ensure continued functional performance.

5-1.1.33 Sodding

Standard Specification

9-14.6(8) – Sod

SWMM Volume II equivalent: BMP C124 Sodding

Function

Sodding is used to establish permanent turf for immediate erosion protection or to stabilize areas where concentrated flow will occur (roots must be attached to underlying soil before erosion can be prevented in areas with concentrated flows).

Additional Information

- Place sod on soil areas where roots can penetrate and keep the sod healthy. Any sod that either does not attach to the soil or dies must be removed, because water can flow under the dead sod mats and create unseen erosion issues.
- Note that sod provides instant soil coverage, and permanent stabilization should be achieved if the roots successfully attach to the soil.
- In swales, place sod strips perpendicular to the flow of water to increase the ability to resist shear stress.
- Stagger sod strips to produce a more stable soil cover.

Design, Installation and Maintenance

- Ongoing care such as irrigation may be required to ensure sod establishment.
- Inspect regularly to ensure sod remains healthy and erosion does not develop.
- If the sod is unhealthy, the cause shall be determined and appropriate action taken to reestablish a healthy groundcover.

5-1.1.34 Stabilized Construction Entrances

Standard Specification

8-01.3(7) – Stabilized Construction Entrance

Standard Plan

I-80.10 – Miscellaneous Erosion Control Details

SWMM Volume II equivalent: BMP C105 Stabilized Construction Entrance/Exit

Function

Stabilized construction entrances are used to stabilize entrance and exit areas to reduce the amount of sediment track-out onto roadways that may generate a turbid discharge.

Additional Information

- Paved areas and steel rumble plates can be used in conjunction with this BMP. Care must be used when placing rumble plates because they are impervious and fill with sediment (i.e., can create a turbid discharge if placed adjacent to drainage areas).
- Manage construction traffic with signage or fencing to minimize track-out locations and unintended exit points (e.g., restrict use of access points for exit or entrance only).
- Limit planned access points.
- Include extra materials in the contract for large projects or projects with a lot of grading and hauling activity to maintain the entrance/exit areas.
- Source control (preventing track-out) is the goal, because relying on street sweeping is not a substitute for a stabilized construction entrance. If sediment is tracked offsite, street sweeping is required at a minimum at the end of each day, and more frequently if necessary to prevent turbid discharges. However, most street sweeping equipment does not remove fine sediments from the roadway; therefore, a rain event can still cause a turbid discharge. High-efficiency sweepers remove sediment track-out and prevent fugitive dust more effectively than standard broom sweepers. High-efficiency sweepers use water and brooms to clean the roadway, vacuums to remove the sediment and wash water, and a filter to minimize fugitive dust. Verify the performance of contractor equipment during construction to ensure effective sediment removal and containment.
- Street washing may only be used after sweeping to remove the fine sediments. Street wash wastewater cannot be discharged to surface waters of the state.

Design, Installation and Maintenance

- Where possible, stabilized entrances should be constructed on a firm compacted subgrade.
- Inspect all exit points regularly to ensure sediment track-out is being prevented.
- If a stabilized construction entrance/exit fails to prevent sediment track-out or transport, the stabilization methods must be maintained or enhanced (e.g., rock cleaned or added, stabilized entrance lengthened).
- If sediment is tracked offsite, effective street sweeping must occur at the end of each day, or more frequently as needed (e.g., during wet weather) to prevent a turbid discharge.
- A tire wash facility may be required if BMPs are not preventing sediment track-out.

5-1.1.35 Storm Drain Inlet Protection

Standard Specification

8-01.3(9)D – Inlet Protection (below inlet grate, above inlet grate, and inlet grate cover)

Standard Plans

I-30.40 – Compost Sock

I-40.10 – Temporary Silt Fence for Inlet Protection in Unpaved Areas

I-40.20 – Storm Drain Inlet Protection

SWMM Volume II equivalent: BMP C220 Storm Drain Inlet Protection

Function

Storm drain inlet protection is used to prevent coarse sediment from entering an operational drainage system. Inlet protection is often the last opportunity to treat runoff prior to a discharge.

Additional Information

Tucking geotextile fabric under or over storm drains is not an acceptable practice. Inlet protection BMPs must meet materials requirements to ensure no sediment or geotextile fabric is lost down the catch basin during maintenance or removal of the inlet protection device.

Inlet filter socks clog quickly and water simply bypasses the filter area and overflows without treatment. If the inlet filter sock appears clogged or the water is discharging through the overflow bypass as shown in Standard Plan I-40.20, replace or maintain the inlet device.

Inlet protection devices vary widely in their ability to capture sediment. In general, these devices clog quickly and do not provide a high level of treatment. They should not be relied on to clean up dirty water. Other BMPs must be used to minimize the turbidity of water going to inlets.

- There is a difference in how internal and external inlet protection devices function.

- Internal devices tend to consist of a nonwoven material that is semiporous. Larger sediments are trapped, but silt and clay-sized particles pass through. They are most appropriate in situations where roadway flooding is a concern or construction traffic will damage an external device. Filtering devices, sometimes called “witches hats” clog quickly and need to be replaced often.
- External devices may be prefabricated or assembled in the field using silt fence. Both types trap sediment by creating a ponding area surrounding the inlet. The reduced velocities allow sediment to settle. This process allows external devices to be more efficient at trapping greater volumes of smaller-sized sediment.
- In an emergency, berms of sand bags or washed gravel can be placed around the inlet.

Design, Installation and Maintenance

- Inspect devices regularly to ensure continued function. Devices full of sediment or other debris that impairs filtering ability must be cleaned or replaced to ensure water doesn’t bypass treatment.

5-1.1.36 Straw Wattles

Standard Specifications

8-01.3(10) – Wattles

9-14.5(5) – Wattles

Standard Plan

I-30.30 – Wattle Installation on Slope

SWMM Volume II equivalent: BMP C235 Wattles

Function

The two main purposes of wattles are to reduce flow velocity and to trap sediment.

Additional Information

Wattles are used to break up the continuous length of a slope and to prevent concentrated flows from developing. They are also used as a sediment control device. Wattles, including netting, must be made of natural plant fibers unaltered by synthetic materials, such as plastic.

- Trench in straw wattles to prevent flows from going under them. The lightweight springy nature of the straw material makes the staking and trenching installation absolutely necessary for performance.
- Install wattles perpendicular to flows and parallel to slope contours.
- Do not use straw wattles as check dams because straw wattles are designed to be trenched in to prevent flows from going under them. However, it is not a good idea to trench anything into a conveyance area because those areas will become vulnerable to erosion from the concentrated flows.

Design, Installation and Maintenance

- Inspect regularly to ensure continued performance. If flows are going under, over or around wattles, adapt the installation to ensure functional performance.

5-1.1.37 Subsurface Drains

No Standard Specification or Standard Plan

SWMM Volume II equivalent: BMP C205 Subsurface Drains

Function

Subsurface drains intercept, collect and convey water to a desired location.

Additional Information

Subsurface drains, also known as french drains, provide a mechanism for dewatering excessively wet soils, provide a stable base for construction, improve stability of structures with shallow foundations, or reduce hydrostatic pressure. Subsurface drains can also be used to collect and convey stormwater runoff. Common types of subsurface drains include relief or interceptor drains used to temporarily intercept and collect runoff or excessive groundwater and convey it in an underground conduit to a stabilized outlet, infiltration area, collection area, or an area where additional treatment will occur.

- Determine the capacity of underground drainage systems by calculating the maximum rate of groundwater or overland flow to be intercepted. Ensure the drainage system has an adequate capacity and a stabilized outlet (e.g., by gravity or pumping) to manage flows.

Design, Installation and Maintenance

- The trench shall be constructed on a continuous grade with no reverse grades or low spots.
- Soft or yielding soils under the drain shall be stabilized with gravel or other suitable material.
- Monitor and maintain collection points and outlet areas to ensure the drainage system is functioning as intended. Ensure the discharges from drainage systems do not cause polluted discharges, erosion, or a danger to the public.

5-1.1.38 Surface Roughening

Standard Specification

8-02.3(5) – Roadside Seeding, Lawn and Planting Preparation

SWMM Volume II equivalent: BMP C130 Surface Roughening

Function

Surface roughening adds texture to the soil surface that will aid in the establishment of vegetation, reduce runoff velocity, encourage infiltration, and may trap sediment.

Additional Information

Roughening methods include stairstep grading, grooving, contour furrows, and track walking. Factors to be considered in choosing a method are slope steepness, mowing requirements, and whether the slope is formed by cutting or filling. Surface roughening should be used in conjunction with other practices such as seeding, composting, mulching, planting or sodding.

- Select the surface roughening method based on site specific factors such as slope gradient, soil type and future mowing requirements.
- Stairstep 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.
- All areas to be seeded shall be prepared for seeding to provide a firm but friable seedbed.

Design, Installation and Maintenance

- Track walking texture must be parallel to slope contour.
- Additional soil covering BMPs should occur as quickly as possible after surface preparation. Inspect the area regularly for signs of erosion and seed loss. If rill erosion develops, the area should be regraded and reseeded as soon as possible.

5-1.1.39 Tackifiers and Polyacrylamide

Standard Specifications

8-01.3(2)E – Tackifier

9-14.5(1) – Polyacrylamide

SWMM Volume II equivalent: BMP C126 Polyacrylamide for Soil Erosion Protection

Function

Tacking agents such as Polyacrylamide (PAM) are used to hold soil, seed and/ or mulch in place and may provide other benefits. PAM is a synthetic polymer used in temporary erosion and sediment control applications for several reasons:

- Binds soil particles (encouraging sediment to gravity settle if suspended)
- Increases soil porosity (improves infiltration rates)
- Reduces soil compaction, dust, and water runoff

Conditions of Use

Never apply PAM directly to water without prior approval from Ecology (considered chemical treatment). You may apply PAM to soil without prior approval from Ecology in accordance with these guidelines. The use of PAM may be restricted in a 401 Water Quality Certification.

PAM products must meet the ANSI/NSF Standard 60 for drinking water treatment and be anionic and linear (non-cross-linked). Never use cationic PAM, because it is known to cause aquatic toxicity. Approved PAM products are listed on the Qualified Product List in accordance with Standard Specification 9-14.5(1).

Design, Installation and Maintenance

- Measure the area where PAM is to be applied and calculate the amount of product and mixing water necessary to provide coverage at the specified application rate. Always add PAM to the mixing water; never add mixing water to PAM. Use mechanical mixing to help the PAM dissolve completely.
- PAM works best when applied to dry soil, so apply PAM to bare soil in accordance with Standard Specification 8-01.3(2)E.
- Ensure runoff from PAM-treated areas passes through sediment control devices that provide adequate opportunity for PAM-treated sediments to drop out before water discharges to surface waters:
    - If less than 5 acres of soil are treated with PAM, all runoff from treated areas must drain to sediment control BMP(s) that will allow enough time for sediment to settle out. For example, three check dams per acre treated, prior to discharge.
    - If 5 acres or more of soil have been treated with PAM, all of the runoff from the treated area must drain to a pond prior to discharge.
- Use PAM in conjunction with, not as a replacement for, other BMPs. It also works well when used in conjunction with mulches.
- Do not apply PAM to areas that flow directly into a surface water, including wetlands.
- For small areas that need coverage, apply PAM at the dry application rate using a hand-held seed spreader.
- Note that, depending on site conditions, PAM remains in the soil 3 to 6 months from the date of application. Extreme weather and heavy traffic (if used on haul roads) shorten the lifespan. These conditions require more frequent re-application.
- Reapply PAM, if necessary, on actively worked areas after a 48-hour period.
- PAM breaks down and loses its effectiveness when exposed to climatic conditions such as high or low temperatures and sunlight. Store PAM in an airtight container in secondary containment and out of the sun.

5-1.1.40 Temporary and Permanent Seeding

Standard Specifications

8-01.3 – Temporary Seeding and Mulching (Temporary)

8-02.3 – Seeding, Fertilizing, and Mulching (Permanent)

9-14.2 – Seed

SWMM Volume II equivalent: BMP C120 Temporary and Permanent Seeding

Function

A well-established vegetative cover is one of the most effective methods of erosion and sediment control. Vegetation protects bare soil from raindrop impact, binds the soil with roots, encourages infiltration, and slows and filters sheet flows. Temporary seeding can be used in areas where permanent cover is not necessary (such as stockpiles or over-wintering of incomplete grades).

Additional Information

Seed laying on soil is not a stabilizing cover. A healthy stand of vegetation must be established before soil is considered covered and stabilized (green should dominate brown, approximately 70% coverage in western Washington and 50% in eastern Washington). Mulch should be used with seeding to achieve immediate soil coverage and temporary stabilization until the vegetation can establish. Getting vegetation established can be difficult if site soils are of poor quality or weather conditions are not conducive to seed germination.

Additional methods such as soil amendments and/or irrigation may be used to improve conditions. Related specifications for seeding include:

- Prepare soil surfaces prior to seeding in accordance with Standard Specification 8-02.3(5)
- Use soil binders and tacking agents in accordance with Standard Specification 8-01.3(2).
- Perform seeding and fertilizing in accordance with Standard Specification 8-01.3(2)B (for temporary seeding) and 8-02.3(5) (for permanent seeding)
- Unless otherwise approved, place seeding during the seeding windows in Standard. Seeding outside of the seeding window will likely require additional care through the seed germination phase, such as cover in the cold season or irrigation in the dry season.
- Protect, care, inspect, and mow seeded areas in accordance with Standard.

Conduct the application of agricultural chemicals to promote grass establishment in a manner and at application rates that will not result in loss of chemicals to stormwater runoff. Contact the Region Landscape Architect for fertilizer specifications and follow manufacturers' procedures.

To determine the optimal seed/fertilizer/mulch mixes and application specifications for a project, contact the Region Landscape Architect, or the Headquarters (HQ) Roadside and Site Development Section. Additional information can be found in the *Roadside Manual*, Chapter 800 – Vegetation ~ Seed, Fertilizer, and Mulch.

Design, Installation and Maintenance

- Whenever feasible, enforce the contract to ensure a healthy stand of grass is established.

5-1.1.41 Temporary Curbs

Standard Specification

8-01.3(13) – Temporary Curb

SWMM Volume II equivalent: BMP C203 Water Bars

Function

A small ridge of material, sometimes in conjunction with an upstream depression, used to disperse or direct stormwater runoff.

Additional Information

Temporary curbs or water bars used along the edge of a roadway must not create ponding or a potential danger to the traveling public. As with other BMPs, temporary curbs can create more problems than they solve if they are installed without considering the high flow scenarios. Do not install temporary curbs in a way that will create concentrated flow. Ensure curbs direct flows to a stabilized area capable of dealing with the expected flow rates.

Common uses for temporary curbs and water bars include:

- Top of slope areas to prevent overland flows from hitting vulnerable slope.
- Edge of pavement or edge of right of way to prevent offsite water from entering construction site.
- Around inlets to prevent discharges.
- To divert overland flows to vegetated or otherwise stabilized area.

Design, Installation and Maintenance

- Inspect temporary curbs regularly to ensure continued function and ponding conditions are not created that may pose a threat to the traveling public.

5-1.1.42 Temporary or Mobile Containment

No Standard Specification or Standard Plan

No SWMM Volume II equivalent

Function

Temporary or mobile containment provides supplemental containment of stormwater or construction waste materials, spoils, or wastewater. This BMP can be used as containment or as part of a treatment strategy.

Additional Information

Large tanks can be delivered to a construction site and moved around within a site as needed to contain stormwater or wastewater. Tanks are often used as part of a treatment system or as temporary storage for wastewaters or contaminated soils.

Design, Installation and Maintenance

- Inspect temporary and mobile containments regularly to ensure continued function and capacity.

5-1.1.43 Temporary Sediment Ponds

Standard Specification

8-01.3(1)E – Detention/Retention Pond Construction

SWMM Volume II equivalent: BMP C241 Temporary Sediment Pond

Function

Collect stormwater runoff and detain it long enough to trap sediment.

Additional Information

They are typically used for tributary drainage areas that are greater than or equal to 3 acres. Bioretention areas should not be used for temporary sediment ponds. If these areas will be used for sediment ponds, they must be rehabilitated before placement of the final bioretention soils to restore infiltration rates. Contact the HQ Hydraulics Office for guidance.

- The use of a permanent infiltration facility as a temporary sediment pond may clog the soils and reduce the long term infiltration capacity. The project must restore the infiltration capacity to those specified in the permanent infiltration facility design per the project's hydraulics report.
- Use sediment traps as pretreatment devices to minimize the need for pond maintenance and prevent soil clogging. If pretreatment is not possible, install a permeable rock divider within the pond.
- Design pond outlets to provide flow control. Design outlets in accordance with Figure 5-3 and the dewatering orifice design guidance. Contact the Region Hydraulics Office if site conditions warrant any modification of the figures.
- Structures having a maximum storage capacity at the top of the dam of 10 acre-ft (435,600 ft^3) or more are subject to the Washington Dam Safety Regulations (Chapter 173-175 WAC).
- If a permanent detention pond is a part of the project, consider using it as a temporary sediment pond during construction, if possible. You must meet the surface area and minimum depth requirements of the temporary sediment pond design. This may require enlarging the permanent detention pond to comply with the surface area requirements and minimum depth requirements. If a permanent control structure is used, it may be advisable to partially restrict the lower orifice with gravel to increase residence time while still allowing dewatering of the temporary sediment pond.

1. Sizing Procedure

- Determine the surface area (*SA*) of the sediment pond at the top of the riser pipe. Use the equation:

$$SA = 2 \times Q/0.00096 \text{ or}$$
$$2{,}080 \text{ square feet per cfs of inflow}$$

For more information on the derivation of the surface area calculation, see Section 5-1.1.31. Design inflow (*Q*) based on criteria below.

  - Eastern Washington should be designed to handle the 2-year peak flow rate from the appropriate long duration storm event using a single event model. See HRM Appendix 4C to determine the Climatic Region and appropriate long duration storm event for the project. The designer should consult with Region Hydraulics staff to determine whether a higher level of protection is needed beyond the 2-year peak flow due to the time of year for construction (freezing conditions and snowmelt), the downstream conditions, or the expectation that the project will last several construction seasons.

   - Western Washington should be designed to handle peak flows generated by the 2-year storm event using 15-minute time steps predicted by MGSFlood for the developed site condition without flow control. The designer should consult Region Hydraulics staff to determine if downstream conditions warrant a higher level of protection. The 10-year peak flow using 15-minute time steps should be used if the project is expected to last several construction seasons.

- Determine the basic geometry of the pond using the following design criteria:
   - Minimum 3.5-foot depth from top of riser to bottom of 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.
- Sizing of Discharge Mechanisms:
   - The outlet for the temporary sediment 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 pond 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. The runoff calculations should be based 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 should result in some reduction in the peak rate of runoff.

- ☐ The size of the tributary drainage basin flowing to the temporary sediment pond, 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 of additional discharge control. (See HRM Figure 5-56 Overflow structure sizing for riser inflow curves.)

Principal Spillway: Determine the required diameter for the principal spillway (riser pipe). For Western Washington, the diameter shall be the minimum necessary to pass the tributary area's 10-year flow rate using 15-minute time steps (Q_{10}) for developed conditions using a continuous simulation model (MGSFLood). For eastern Washington, the diameter shall be the minimum necessary to pass the tributary area's 10-year peak flow rate using the appropriate long duration storm (Q_{10}) for developed conditions using a single event model. See HRM Appendix 4C to determine the Climatic Region and appropriate long duration storm event for the project. Use the Primary Overflow guidance in HRM FC.03 Detention Pond and Figure 5-56 to determine the riser diameter (h = 1 foot). ***Note:*** A permanent control structure may be used instead of a temporary riser.

Emergency Overflow Spillway: Determine the required size for the Emergency Overflow Spillway. For western Washington, the emergency overflow spillway will be the minimum necessary to pass the tributary area's peak 100-year flow rate using 15-minute time steps (Q_{100}) for developed conditions using a continuous simulation model (MGSFlood). For eastern Washington, the emergency overflow spillway shall be the minimum necessary to pass the tributary area's 100-year peak flow rate using the appropriate long duration storm (Q_{100}) for developed conditions using a single event model. See HRM Appendix 4C to determine the Climatic Region and appropriate long duration storm event for the project. See the emergency overflow spillway design guidance contained in the HRM FC.03 Detention Pond.

Dewatering Orifice: Determine the 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:

$$A_o = \frac{A_s (2h)^{0.5}}{0.6\text{x}3600Tg^{0.5}}$$

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^2)

Convert the required surface area to the required diameter D of the orifice:

$$D = 24\text{x}\sqrt{\frac{A_o}{\pi}} = 13.54\text{x}\sqrt{A_o}$$

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.

- Additional Design Specifications:
  - The temporary sediment pond shall be divided into two roughly equal volume cells by a permeable divider that will reduce turbulence while allowing movement of water between cells. The divider shall be at least one-half the height of the riser and a minimum of 1 foot below the top of the riser. Wire-backed, 2- to 3-foot-high, extra-strength filter fabric supported by treated 4x4s can be used as a divider. If the pond is more than 6 feet deep, a different mechanism 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 or around the barrier.

- ◻ To aid in determining sediment depth, 1-foot intervals shall be prominently marked on the riser.

- ◻ If an embankment of more than 6 feet is proposed, the temporary sediment pond must comply with the criteria contained in HRM BMP FC.03 regarding dam safety for detention BMPs.

- The most common structural failure of a temporary sediment pond is caused by piping. Piping refers to: (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 sequences to prevent piping will be:

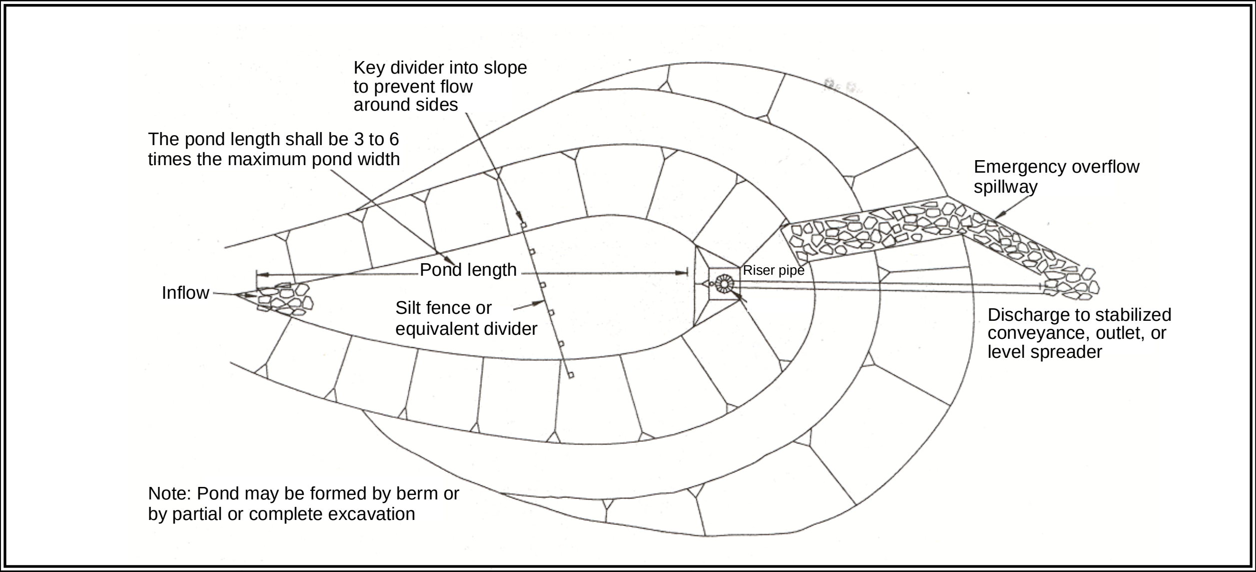
  - ◻ Tight connections between riser and barrel and other pipe connections.

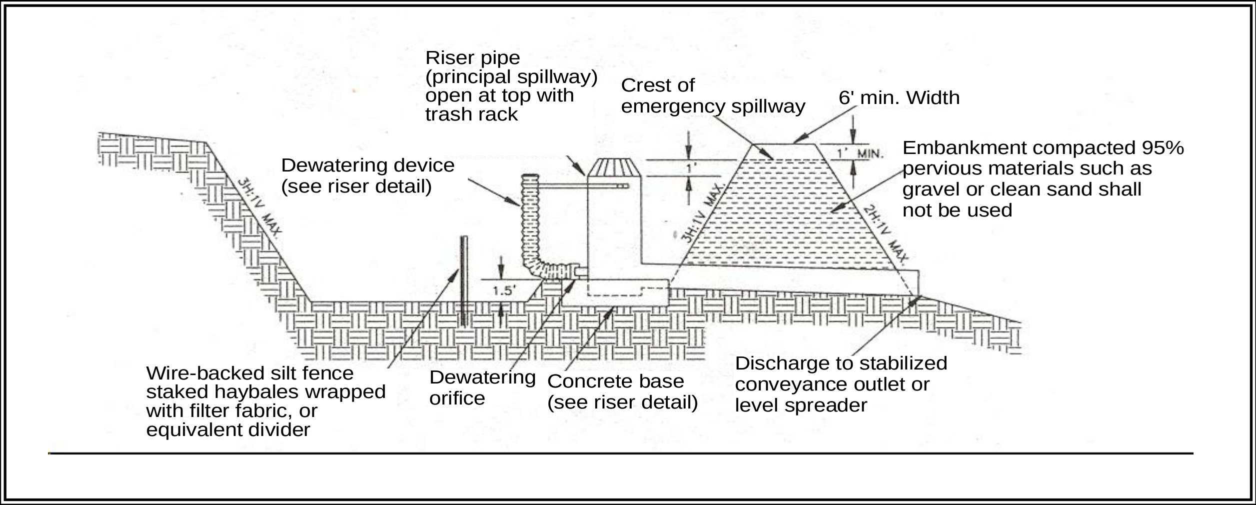
  - ◻ Adequate anchoring of riser.

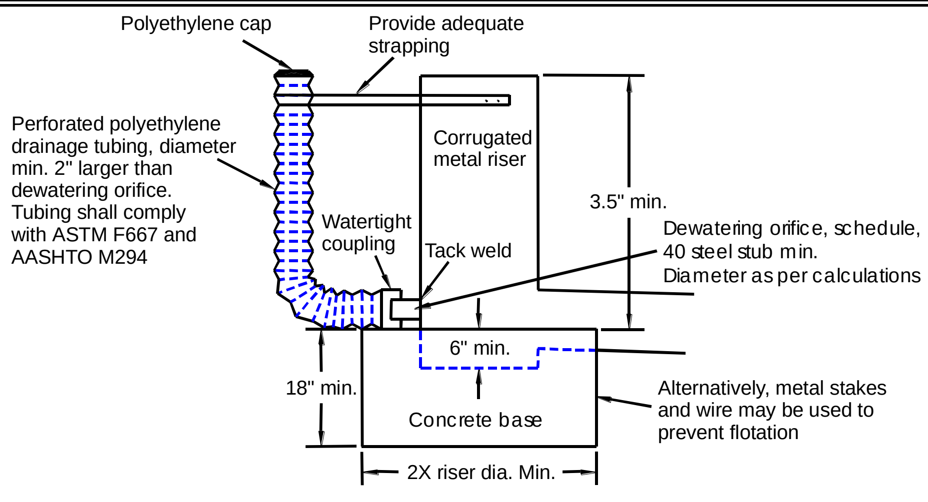
  - ◻ Proper soil compaction of the embankment and riser footing.

  - ◻ Proper construction of antiseep devices.

Figure 5-1: Temporary sediment pond details







Sediment Pond Riser Detail

5-1.1.44 Tire Wash

Standard Specification

8-01.3(7) – Stabilized Construction Entrance

SWMM Volume II equivalent: BMP C106 Wheel Wash

Function

When a stabilized construction entrance does not prevent sediment from being tracked onto offsite, a tire wash will prevent sediment track-out.

Additional Information

- A tire wash is required if sediment track-out cannot be prevented with a stabilized entrance.
- Effective function requires participation by and communication with vehicle drivers to ensure all vehicles leaving the site pass through the tire wash at a slow enough speed to fully remove sediment.
- Washwater shall be discharged to a separate onsite treatment system, such as closed-loop recirculation or upland application, or discharged to a sanitary sewer if permitted by local jurisdiction.
- Local jurisdictions may require a tire wash as a permit condition.

Design, Installation and Maintenance

Effective tire washes will include the following features:

- Stabilized approach (paved, permeable ballast pad, or rumble plates) that is maintained clear of excess soil.
- Appropriately sized wash deck based on soil type (minimum of one complete tire revolution; more revolutions will be required for more cohesive soil types).
- Multiple angled spray patterns (must reach all tires and undercarriage).
- High-volume, moderate-pressure spray.
- Rinse water maintained at reasonable clarity.
- Collection of overspray and drip out.
- Stabilized egress (paved, permeable ballast pad, or rumble plates) that is maintained clear of excess soil.

5-1.1.45 Topsoiling

Standard Specifications

8-02.3(4) – Topsoil

9-14.1 – Soil

SWMM Volume II equivalent: BMP C125 Topsoiling/Composting

Function

Topsoiling creates a suitable growth medium for vegetation and permanent site stabilization.

Additional Information

Topsoil, often called tilth, includes the top layers of soil and the organic material. Native topsoil often contains mycorrhizal bacteria that are acclimated to the site and will provide optimum growing conditions. Amending or importing topsoil promotes vegetation establishment in areas with poor topsoil. While topsoiling itself is not a stabilizing cover, it is an important part of achieving a permanent vegetated cover. Topsoiling should be used in conjunction with other practices such as composting, seeding, mulching, planting or sodding.

- Restore, to the maximum extent practical, native soils disturbed during construction. Use onsite native topsoil whenever feasible, incorporate amendments, or import blended topsoil to ensure sufficient quality for vegetation establishment.
- Ensure landscaped areas contain healthy topsoil with 8% to 15% organic matter so the need for fertilizer is minimized.
- Preserve existing soil systems in undisturbed and uncompacted conditions whenever feasible.
- Native topsoil may contain seeds from invasive species that will cause plant establishment problems.

Design, Installation and Maintenance

- Stockpile topsoil onsite in a designated, controlled area, not adjacent to public resources and critical areas. Stabilize soil stockpiles from erosion, protected with sediment trapping measures, and where possible, be located away from storm drain inlets, waterways, and drainage channels. Locate the topsoil stockpile so that it meets specifications and does not interfere with work on the site.
- Inspect stockpiles regularly, especially after large storm events. Stabilize any areas that have eroded.
- Biotic benefits of stockpiled topsoil degrade overtime. Incorporate stockpiled topsoil as soon as possible.

5-1.1.46 Vegetated Strips

No WSDOT Standard Specification or Standard Plan

SWMM Volume II equivalent: BMP C234 Vegetated Strip

Function

Vegetated strips reduce the transport of coarse sediment and runoff velocities.

Additional Information

- 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. Concentrated flows must be conveyed to a flow control BMP.

Design, Installation and Maintenance

Table 5-5 Contributing area for vegetated strips

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

5-1.1.47 Vegetative Dispersion and Infiltration

Standard Specification

8-01.3(1)D – Dispersion/Infiltration

SWMM Volume II equivalent: BMP C236 Vegetative Filtration

Function

Vegetative dispersion and infiltration can be used separately or in conjunction with each other or other BMPs. Sheet flow dispersion through vegetation filters out sediment, some amount of infiltration will occur during dispersion. Infiltration rates are dependent on soil type; compacted till soils may not infiltrate much at all.

Additional Information

- Never use ditched stream channels, sensitive or critical areas, or areas with high groundwater for dispersion and infiltration.
- Always obtain prior written authorization from adjacent landowners before dispersing water onto adjacent non-WSDOT properties.
- Silt and clay deposits reduce infiltration capacity. Upslope erosion and sediment control BMPs must be used to help ensure continued performance of infiltration facilities.

Design, Installation and Maintenance

- As a general rule of thumb, every five acres of disturbed soil use will need one acre of vegetated area to disperse and infiltrate (numerous factors can increase or decrease this ratio).
- Maximize infiltration by spreading water over the largest possible area, discharging water at a slow and constant rate. Disperse flows so as not to cause erosion during dispersion.

Table 5-6 Flowpath guidelines for vegetative dispersion filtration

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

- Control discharge rates to infiltration areas to encourage complete infiltration and avoid discharges whenever possible. Use pumps, distribution manifold and branches, perforated pipe, sprinklers, wattles, compost socks, level spreaders, or other BMPs where necessary to enhance the effectiveness of the dispersion and infiltration areas. If an area becomes saturated, give it a rest period and try again later.
- Label dispersion and infiltration areas on the TESC plan sheets so they can be inspected as any other BMP would be.
- Inspect manifold, branches, pipes or other components for unintended leaks and repair as needed.
- Inspect dispersion and infiltration areas regularly to verify that the areas continue to function as intended. If surface water discharges occur, sample runoff at the discharge point in accordance with the Permit. Stop discharging water to the dispersion or infiltration area if standing water or erosion occurs.

5-1.1.48 Water Pumps

No Standard Specification or Standard Plan

No SWMM Volume II equivalent

Function

Water pumps are used to collect and move temporary or continual sources of surface or groundwater. Pumps do not provide erosion or sediment control function but are often part of the water management strategy.

Additional Information

There are numerous types and sizes of pumps available; select a pump based on the job that needs to be done. Pumps commonly used to manage water on construction sites include:

- Submersible pumps are most commonly used to remove water from confined areas such as ponds. These pumps can include a float switch which detect the water level and automatically turn on.
- Centrifugal pumps can be very high-powered, but they should be used only when water is fairly clear.
- Trash pumps are rugged and dependable in situations where there are suspended solids. This type of pump can also be submersible and is often used for dewatering.

- Diaphragm pumps work well for slow seepage applications where centrifugal pumps would lose their prime or when the material is muddy or has suspended solids.

Design, Installation and Maintenance

- Use and maintain pump based on manufacturers recommendations to ensure continued function.

Appendix A Definitions

Refer to the definitions in the Permit.

AKART - All Known, Available and Reasonable Methods of Prevention, Control and Treatment

BMP - Best Management Practice

CESCL - Certified Erosion and Sediment Control Lead

CPESC - Certified Professional in Erosion and Sediment Control

CTS - Commitment Tracking System

CWA - Clean Water Act

DMR - Discharge Monitoring Report

ECAP - Environmental Compliance Assurance Procedure

EPA - Environmental Protection Agency

ERTS - Ecology's Environmental Regional Tracking System

HECP - Hydraulically Applied Erosion Control Product

HRM - Highway Runoff Manual

HVF - High Visibility Fence

LID - Low Impact Development

MS4 - Municipal Separate Storm Sewer System

NOI - Notice of Intent

NOT - Notice of Termination

NTU – Nephelometric Turbidity Unit

NPDES - National Pollutant Discharge Elimination System

RCW – Revised Code of Washington

SPCC - Spill Prevention Control and Countermeasures

SWMM - Stormwater Management Manual

SWPPP - Stormwater Pollution Prevention Plan

TESC - Temporary Erosion and Sediment Control

TMDL - Total Maximum Daily Load

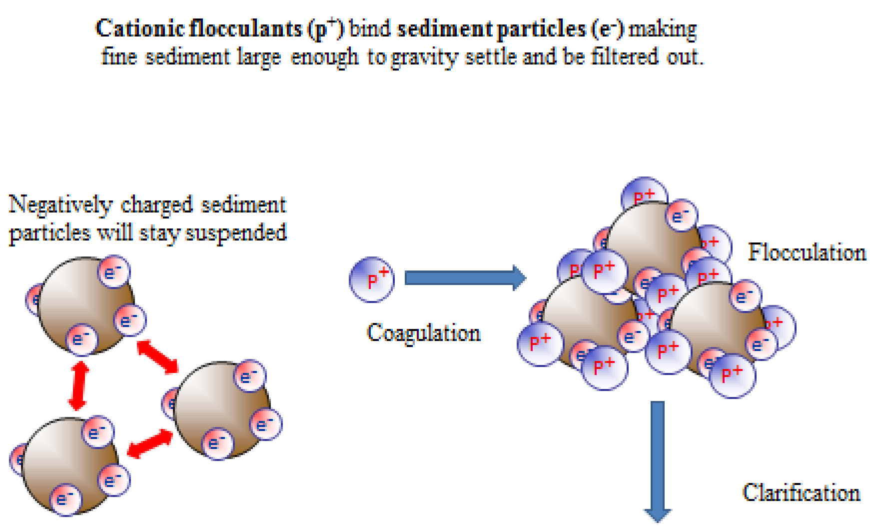
TOC - Transfer of Coverage

WAC – Washington Administrative Code

Section 1 Introduction

Chitosan is a cationic (positively charged ion) biopolymer derived from chitin, found in crustacean exoskeletons, that encourages the coagulation and flocculation of suspended sediment. Chitosan comes in various forms and grades, and has various applications, including treating polluted construction stormwater. Chitosan Enhanced Sand Filtration (CESF) stormwater treatment systems use chitosan and pressurized media filtration pods to rapidly clean stormwater. CESF systems are considered "active" or "advanced" stormwater chemical treatment systems because they require a power source and the chemical additive chitosan. These systems can be designed to treat for additional pollutants such as high pH, hydrocarbons and heavy metals. Various types of chitosan products and systems as well as other types of other active chemical treatment systems, such as electrocoagulation, are approved for use in Washington State by the Department of Ecology.

Figure 2: Chemistry of chitosan



Active chemical treatment may be necessary in order to ensure compliance with environmental commitments such as discharge limits associated with waterbody impairments and/or site contamination. This guidance is intended to provide additional information for WSDOT projects that will use CESF; it can be used in place of or as a supplement to BMP C250 Construction Stormwater Chemical Treatment, as found in Ecology's Stormwater Management Manual for Western Washington: Volume II.

Section 2 Understanding the CESF Treatment Process

Flow-through CESF systems are typically used on projects with more than 5 acres of soil disturbance because they are designed to treat large volumes of influent water with minimal system down time. Alternatively, chitosan can be used as part of a batch treatment process (not flow-through) - this guidance does not cover that process because they are not common on WSDOT projects. Batch treatment systems must be designed and operated in accordance with the requirements listed in Ecology's Stormwater Management Manual: Volume II for BMP C250.

While CESF system design may vary depending on site needs and constraints, the main components of a typical CESF flow-through system include:

- stormwater collection and conveyance facilities
- an untreated stormwater storage facility
- at least one pre-treatment cell
- pump(s), generator(s), interconnecting pipes
- lockable operational trailer
- programmable water quality control unit
- metered chemical injection system
- in-line meters and automated valves
- sand-pods and appropriate filter media
- flow control equipment may be needed

Additional components, such as a monitoring tank with viewing window, may be required by a local jurisdiction or permitting authority. If the project will discharge to a jurisdictional storm sewer system, ensure the jurisdiction is properly notified prior to a discharge as there may be additional requirements.

Untreated runoff

For a typical CESF system, onsite stormwater runoff is collected and diverted to an untreated (no chitosan introduced) stormwater storage facility, usually a pond or tank. **Temporary erosion and sediment control (TESC) best management practices (BMPs) must be used to minimize the turbidity of the stormwater going to the untreated storage facility.** Stormwater in the untreated storage facility can either be sent through the CESF treatment system or be discharged without active treatment if it already meets the 25 Nephelometric Turbidity Units (NTUs) or less benchmark listed in the NPDES Construction Stormwater General Permit (permit). **The untreated storage facility is a very important component of the CESF system.** Additional information and sizing requirements for the untreated stormwater facility is discussed in Section 3.

Chitosan acetate is most effective on water that has a pH between 6.5 – 8.5. Therefore, stormwater may need to be neutralized prior to be being sent to the CESF system or being discharged. Neutralization must be performed using approved methods; CO2 or dry ice. Increasing pH or increasing water conductivity can be done using sodium bicarbonate (baking soda). Neutralizing pH can occur in the untreated storage facility or in the pre-treatment cells.

Chemical treatment can be negatively impacted by external chemical inputs. Even if the CESF system has been enhanced with activated carbon filter to treat for existing hydrocarbon contamination, the Spill Prevention, Control and Countermeasures (SPCC) plan must be implemented to minimize additional sources of pollution inputs. Minimize the amount of organics that get introduced to the stormwater runoff; organics introduced by mulches or compost can negatively affect treatability. Polyacrylamide (PAM) either applied directly to soils or indirectly through hydraulically applied mulches, can also negatively affect treatability or clog filters. Avoid the use of such products in areas that will drain to storage facilities used to feed the CESF system. Other work activity or chemicals used in the runoff treatment area may also negatively impact treatability.

Chitosan dosing and mixing

Stormwater that needs active treatment prior to discharge is pumped from the untreated storage facility through an operational trailer. As the untreated incoming flow (influent) passes through the operational trailer it is measured by the in-line pH, turbidity, and flow meters, and chitosan can be added to the stormwater through a metered chemical injection device. The metered chemical injection device must be calibrated upon every system start-up and throughout the day either every 4 hours, or when influent characteristics change (i.e. average influent characteristics change by > 20% including flow rate or turbidity levels). Calibrations are intended to prevent chemical overdosing. **Chitosan acetate does exhibit toxicity for rainbow trout; chemical dosing limits as well as other design and operational requirements are developed to prevent discharges with free chitosan (not attached to sediment).** Dosing limits can be found in the Use Designation document for each chitosan product.

After chitosan is injected into the stormwater, a rapid mixing process must occur to ensure adequate dispersal of the chitosan. Some CESF systems include an internal mixing device; other systems may rely on another method, like gravity or flow turbulence, to perform the necessary mixing. **Adequate dispersal of chitosan is very important because inadequate mixing leads to inadequate flocculation.**

Pre-treatment

Once chitosan dosing and mixing occurs, stormwater is sent to a cell where the coagulation and flocculation process can begin. This process is referred to as "pre-treatment" because it takes place before the sand filtration process. **Pre-treatment is an important step because some of the suspended solids will flocculate to the point of being able to gravity settle out of the stormwater in the pre-treatment cell so cleaner water can be sent to the sand filtration pods.** Effective pre-treatment increases the overall efficiency of the CESF system because the sand pods will need to backwash less often (less sediment will have built up on the filtration media in the sand pods).

The chitosan dosed stormwater is then pumped from the top of the water column (cleanest water) in the treatment cell back through the operational trailer to be monitored by the in-line meters and then (if water meets a system specific quality standard – usually about 600 NTU or less) it is routed to the pressurized filtration pods, where the water is forced through the filtration media. Specific filtration media requirements can be found in the Use Designation document for each chitosan product.

Filtered stormwater from the pods (effluent) is then routed back through the operational trailer where it is again measured by the in-line meters for pH, turbidity, and flow rate, and it will discharge if it meets requirements. **Discharges from CESF systems must have turbidity values of < 10 nephelometric turbidity units (NTU) and pH values must be between 6.5 - 8.5.** Effluent water cannot be discharged if it does not meet this criteria; it must be recirculated back through the system for additional treatment.

In-line monitoring and recirculation

Some CESF systems may be fully or almost fully automated, but all CESF systems must include some specific automated features to ensure compliance with discharge requirements (to minimize human error). **All CESF systems must include a programmable device used to set discharge limits (pH range from 6.5 - 8.5 and turbidity of 10 NTU or less).** The in-line meters help prevent non-compliant discharges because they control automated valves that allow stormwater to discharge or prevent a discharge and route it back through the system for additional treatment (called recirculation). To ensure compliance, the in-line pH and turbidity meters must be calibrated prior to every startup, and as needed if inaccurate readings become apparent.

If the in-line pH and turbidity meters detect that effluent water is out of compliance, the out-flow valve automatically closes and a recirculation valve opens, thereby routing out of compliance water back to a treatment cell for additional treatment or settling time. An audible and visual alarm must alert the operator when effluent water outside the acceptable discharge limits has been detected so the operator can confirm the out-flow valve has closed and water is being recirculated as required. System operators may be required to make note of such occurrences in the daily operations paperwork (refer to the Use Designation document for each chitosan product).

Figure 3. Generalized treatment process of a flow-through CESF system

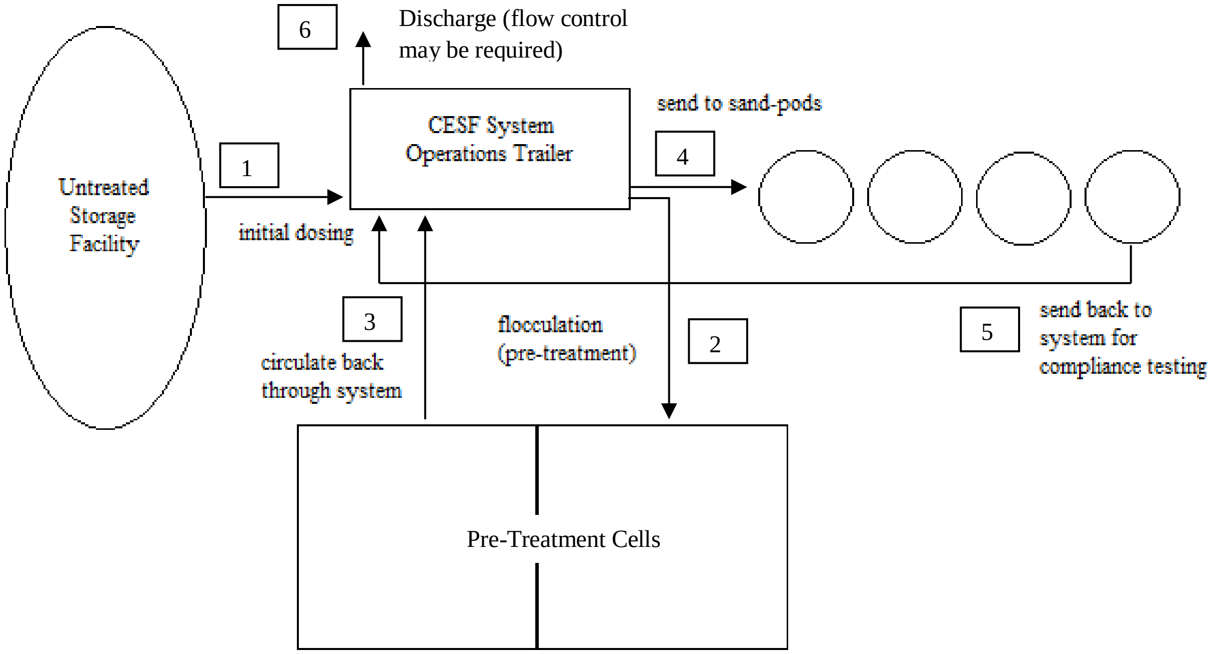


Figure 4. Normal flow

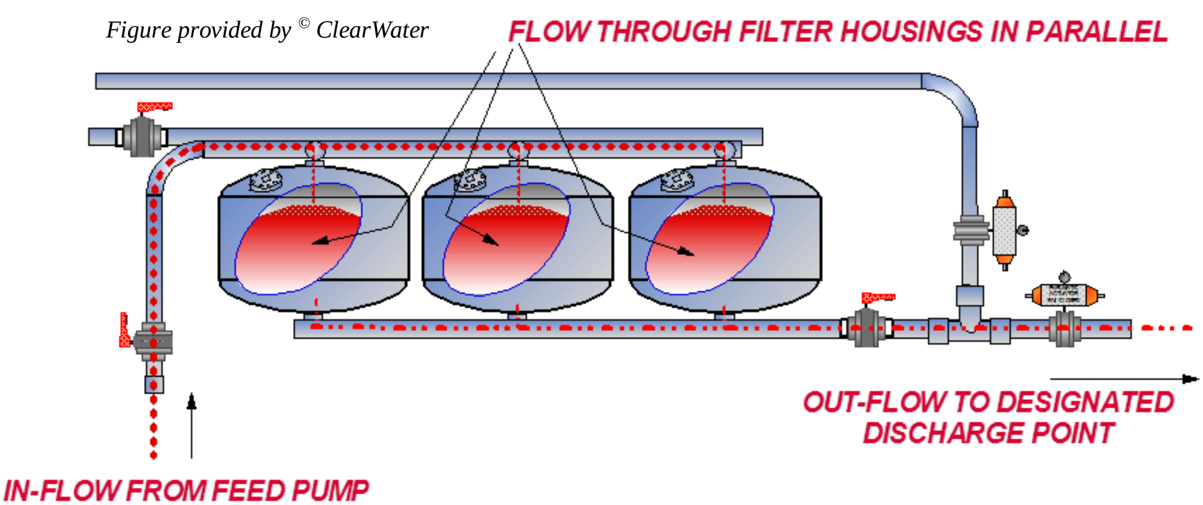
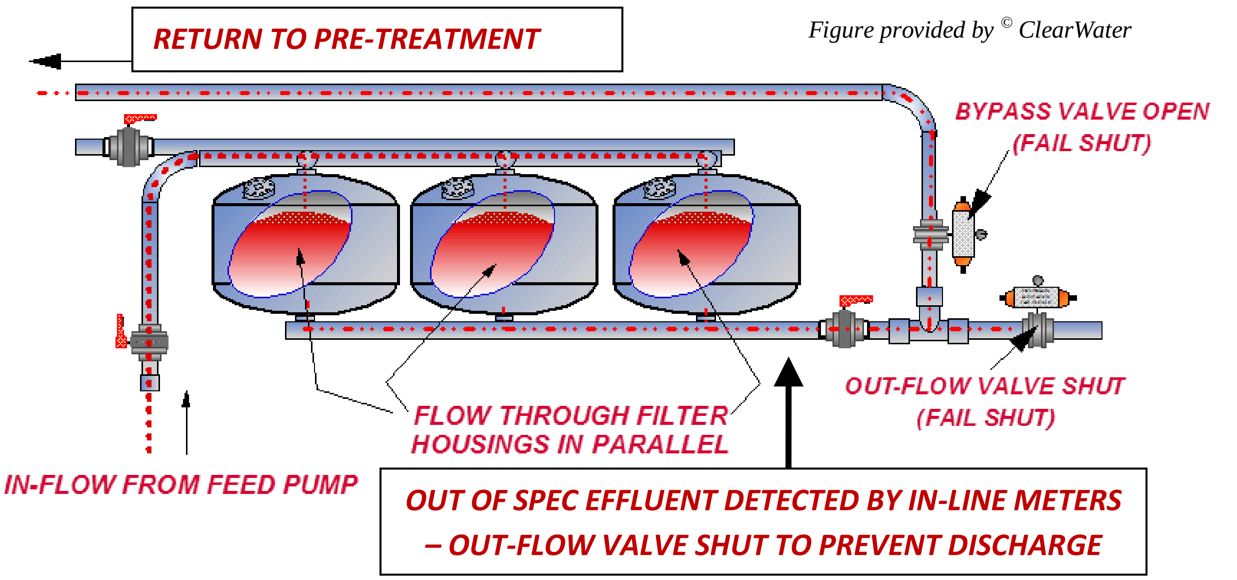


Figure 5. Flow during system start-up and when effluent does not meet discharge requirements



Backwash cycle

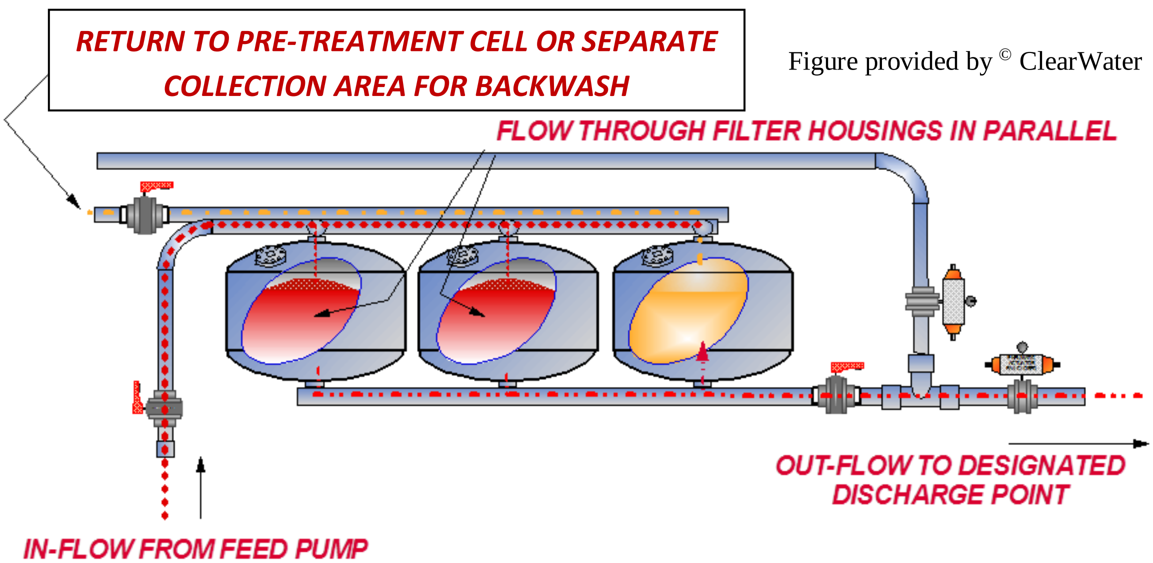
As described earlier, an effective pre-treatment means cleaner water can be sent to the sand pods, which makes the CESF system more efficient in two important ways: 1.) reduces or eliminates the need to employ additional chitosan and pre-treatment time, and 2.) reduces the amount of sediment that builds up at the top of the filtration media.

Sediment buildup on filtration media eventually triggers a backwash cycle that works to remove buildup and clean the filter media. A backwash cycle moves one-by-one through each sand-pod; each sand pod is backwashed for several minutes before the next pod's backwash cycle begins. Each sand pod will backwash before the entire backwash cycle is complete. When a pod is backwashing, that pod is not filtering water, and therefore not contributing to the system discharge flow rate (out-flow). However, the entire filtration system may continue to discharge because the non-backwashing pods are still filtering water. It is important to remember that the expected gallon per minute (GPM) out-flow rate for the system is reduced during the backwash cycle. A turbidity "spike" in the effluent could trigger the out-flow valve to close periodically during a backwash cycle. An experienced operator may be able to increase or decrease sand pod pressure differentials to minimize turbidity spikes during backwash cycles.

For example, a four pod system designed to discharge 500 GPM that is consistently receiving 450 NTU water might go into a backwash cycle every 15 minutes. The length of a backwash cycle can be manually set on some systems but must be an adequate amount of time to clean the filter media (usually 2-4 backwash minutes per pod) or the pods will fail. A typical backwash cycle on a four pod system might take 13 minutes total (just over 3 minutes per pod). In this example system, the GPM out-flow rate may be reduced by about 25% (1 out of 4 pods in backwash) about 50% of the time (2 times per hour, 13 minutes for each cycle).

Backwash exits through the top of the pod and is kept separate from the treated effluent water. Backwash is routed to either a treatment cell or separate holding area. Backwash can be routed back to a treatment cell because it has already been dosed with chitosan and the sediments in the backwash will settle out quickly (do not send backwash to the untreated facility). Introduce backwash flows to a treatment cell in a manner that will minimize the disturbance of settled sediments – avoid creating an upwelling of settled sediments. Treatment cell(s) may need to be cleaned periodically to prevent capacity problems, especially if the system will be used for multiple rainy seasons. Uncontaminated sediments removed from a treatment cell or backwash holding area can be incorporated into the site away from drainage areas.

Figure 6. Flow in backwash cycle



Discharges from a CESF system (effluent or out-flow)

Discharges from CESF systems must have turbidity values of < 10 NTU and pH values must be between 6.5 - 8.5 (unless more stringent standards are required based on the receiving water). Effluent water cannot be discharged if it does not meet this criteria, it must be recirculated back through the system. It is important to know where the CESF discharges will outfall (permitted location in the receiving surface water). Different receiving waters or city systems may have different flow control or discharge requirements. The outfall location may also dictate the chitosan product that is used (e.g., not all chitosan products can be used when discharging to marine waters).

Section 3 outlines design requirements for flow control water bodies or discharges sent to a municipal separate storm sewer system (MS4s).

Section 4 of this document outlines how CESF systems and effluent must be monitored during construction to ensure operational compliance occurs and is documented properly.

Section 3 Designing a CESF System

This guidance shall be used for WSDOT projects; it can be used in place of or in conjunction with BMP C250 Construction Stormwater Chemical Treatment, as found in Ecology's Stormwater Management Manual for Western Washington: Volume II.

Every chitosan product has its own Use Designation document that may include product specific requirements that may not be included in this guidance. A Use Designation document is associated with every approved chitosan product: https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

WSDOT does not have standard contract language for CESF because there are simply too many site specific variables that need to be considered when designing and writing contract language for a CESF system. Contract language should include site specific requirements to ensure properly sized systems and performance expectations (e.g., additional treatment needs beyond sediment) and to limit the need for change orders.

Identifying treatment needs

A site specific analysis should be performed to help identify treatment needs. Relevant site-specific factors to evaluate include:

- Soil type (e.g., percentages of fine silts, clays, and organic content)
- Climate (e.g., frequency, intensity, and duration of storm events)
- Proximity to impaired waters, sensitive areas and endangered species
- Construction phasing schedule, duration of project, and clearing and grubbing footprint
- Existing conditions (e.g., impervious surface or existing contamination)
- Receiving water bodies or city system (e.g., flow control exempt or flow control requirements)
- Footprint available for treatment system and required storage facilities (often a limiting factor for linear projects)

Evaluating site specific factors may help determine that CESF is not necessary or not the right treatment option. For example, electrocoagulation may be more effective treatment option if the runoff has a high level of organics. Alternatives to advanced chemical treatment include:

- Dispersion and infiltration
- Infiltrate on neighboring properties (requires written approval)
- Limiting risky earthwork to the dry season
- Preserving vegetation and phasing construction to limit the amount of open soil at any given time
- Discharging to a sanitary sewer system

In cases where the site specific analysis identifies risks that are best minimized with a CESF system, specific treatment needs should be determined. This can be difficult, especially on multi-phased linear construction project, because many factors need to be considered before construction begins. The following questions can help guide the process:

- How much runoff is expected to need treatment?
- Where can the runoff be routed and collected?
- Are there flow control limitations?
- Is there onsite contamination?

Determine how much runoff is expected to need treatment

Many factors must be considered when sizing a CESF system. The most important factors are how much water will be coming into the system and how much can be discharged. Some water bodies have flow control requirements that limit the volume of water that can be continuously discharge. Large water bodies are usually flow control exempt, but if discharges will be going to a small creek or city system, the CESF system will need to be designed with a discharge flow control system.

Offsite water run-on sources must also be considered when designing a system. Wherever feasible, offsite water that runs onto or through project boundaries must be diverted around or tight-lined through the project to its existing discharge location in accordance with the contract. If diversion or tight-lining cannot be done, offsite water run-on must be accounted for in the CESF system sizing calculations. Once the drainage basin(s) are identified, each project must calculate expected runoff volumes and design a treatment system capable of managing those volumes.

The designer shall use the 10yr, 24hr volume calculated by the Santa Barbara Urban Hydrograph (SBUH) method. WSDOT prefers to use the computer software program Stormshed 3G to run the SBUH analysis. Stormshed will calculate the volume of water in cubic feet per 24 hour period. To get the volume of water (G) in equation 1 below, multiply the number of cubic feet by 7.48052 to get gallons. See the WSDOT Hydraulics Manual Section 2-5 for more on the SBUH method.

Sizing the filtration system and storage facilities

Once expected runoff volumes are calculated, the next step is designing a system that can adequately store and effectively treat expected volumes. Sizing systems for long linear projects can be a challenge; there may be overlapping phases of work resulting in different volumes and quality of runoff at different times during construction. A balance must be found between the size of the untreated storage facility, the pre-treatment cells, and the number and size of the sand pods used to filter the treated water.

Total system capacity

The total system capacity includes all storage capacities (i.e., untreated and pre-treatment) and the treatment rate of the system within an operational period (e.g., 8 hours – 24 hours). **The capacity of the total system serving each drainage area must be sized to manage runoff volumes of 1.5 times the 10yr, 24hr storm event:**

$$1.5 \times G = U + P + (QCESF \times M) \qquad \text{EQ-1}$$

Where:

G = 10-yr, 24 hr runoff volume (gallons)

U = untreated storage volume (gallons); minimum of 50% of the 10-yr, 24hr runoff volume = 0.5 x G

P = pre-treatment storage cells volume (gallons)

QCESF = CESF system treatment rate (gallons per minute) – the hydraulic loading rate should be 15 GPM or less following the specific CESF system's use level designation document requirements for that specific technology. (See Figure 6 and Figure 8)

M = Operational period (minutes)

Generally, the designer knows (G) in EQ-1. The designer varies U, P, and QCESF, and M so that EQ-1 balances. For the operational period (M), some projects may choose to require extended operational periods (up to 24 hours) based on weather conditions or as a way to minimize the storage facility footprint. Projects can use the expected operational period in the sizing calculation above.

Untreated storage facility (U) and system bypass

CESF systems are required to have an untreated storage facility (where no chitosan has been introduced) with a bypass system. Untreated storage facilities are typically ponds or tanks and are an important part of the system design for several reasons. First, in the event of an extreme storm event, the treatment system may not be able to keep up and incoming runoff will have to bypass the system and discharge without treatment. The bypassed stormwater must not have chitosan in it – hence the need for an untreated storage facility. Never allow water that has been dosed with chitosan to discharge without treatment. The bypass system must be stabilized to prevent erosion and water must pass through sediment control BMPs. If bypass discharges occur they must be sampled and reported in accordance with the permit. Second, having enough storage "upstream" from the treatment system allows flexible operational hours and increases response time and treatment efficiency. Thirdly, if the incoming stormwater is clean (meets benchmarks in the permit), it can be discharged without chemical treatment (system bypass).

The larger the untreated storage facility, the better the operational efficiency will be, unfortunately the narrow right of way on our projects are a limiting factor. Ecology recognizes that a "one size fits all" system design is not practical, but the system must be designed with adequate treatment facilities to ensure discharges remain in compliance. **The rule of thumb is the untreated stormwater facility be designed to hold 50% of the runoff volume from a 10 yr, 24hr storm event**.

If the project does not have the footprint for the storage capacities needed after doing initial design calculations, a common solution is to increase the amount of water that can be treated in an operational period by using larger diameter pods, more pods per system, or a higher hydraulic loading rate (HLR).

Pre-treatment cells (P)

There are no sizing requirements for the pre-treatment storage facility; however a minimum of one pre-treatment facility is a necessary component for the flocculation process to occur before the chitosan dosed water is sent to the sand pods. Consider two things when designing the pre-treatment facility:

1.) Different flows entering the pre-treatment facility (e.g., chitosan dosed water, recirculated water, backwash water) should not cause interfering water turbulence that may disturb the flocculation process or resuspend settled solids at the bottom of the pre-treatment facility. Using split cell ponds, weir tanks, or energy dispersal BMPs is a good way of minimizing interfering turbulence resulting from incoming flows.

2.) A smaller pre-treatment facility means less flow-through operational efficiency. For example, a 1000 GPM system can empty a 18,000 gal. weir tank very quickly. A system with a high GPM out-flow rate and a small pre-treatment facility will likely have a lot of operational down-time (stopping the system).

For these reasons, a 18,000 gal. weir tank should be considered as the minimum requirement for a pre-treatment facility. Larger split cell ponds are preferable if the footprint is available.

How the hydraulic loading rate and backwash cycles affect the effluent rate

System flow rates should be sized using a hydraulic loading rate (HLR) usually between 8 – 13 GPM/ft2 (10 GPM/ft2 is most common). HLRs may vary based on pod size, pressure differentials within the pods, and the influent water quality. In general, larger diameter pods and cleaner influent can allow higher HLRs. The Use Designation document for the chitosan product that will be used may also include specific HLR requirements. The HLR will affect the treatment effluent (out-flow) rates (more water in = more water out). However, if incoming influent is really turbid (~450 NTU or higher), a high HLR (over 10 GPM/ft2) may "crash the pod", meaning the filtering media or function of the pod(s) will fail and blow-out the filtration media.

The following table shows how sand pod diameter and quantity changes to the estimated effluent rate. The GPM effluent rates in the table assume a HLR of 10 GPM/ft^2 which is an average rate. However the values below are high end estimates because they do not represent how backwash cycles may impact the GPM out-flow rates.

Figure 6. Pod size and estimated effluent out-flow rates using a HLR of 10 GPM/ft^2

Sand Filter Pod Diameter (inches)	4-pod system (GPM)	5-pod system (GPM)	6-pod system (GPM)	7-pod system (GPM)	8-pod system (GPM)
48	503	628	754	880	1005
54	636	795	954	1113	1272
60	785	982	1178	1374	1571

The estimated effluent rates in the above table are high-end estimates because they do not account for the time each pods will be in a backwash cycle. Recall from Section 2, that during a backwash cycle, one pod backwashes at a time, and when a pod is backwashing it is not contributing to the out-flow rate. Meaning the above estimated out-flow rates will decrease depending on the amount of time the pods are in the backwash cycle.

Unfortunately, the time that a system will be in backwash is hard to estimate. It depends on the system design, the influent water quality, and the treatability of the stormwater. If appropriate erosion control BMPs are used as required to minimize incoming stormwater turbidity, a well-designed system should be in a backwash cycle less than 40% of the time (about 40% of the time the system is operating, one pod will be backwashing).

Using the 4-pod system column in the above table as an example, the table below represents a more realistic expectation for the GPM out-flow rate using a 4-pod system with a HLR of 10 GPM/Ft^2:

Figure 7. Example of how effluent flow rates may decrease by 40% due to backwash

Sand Filter Pod Diameter (inches)	4-pod system (GPM)	4-pod system estimated (GPM) decreased for backwash time
48	503	452
54	636	573
60	785	707

System placement and mobility

System design and placement varies based on treatment needs, project footprint, construction phasing and schedule. To minimize logistical complication during construction, projects should preemptively identify appropriate stormwater collection areas, develop a plan for routing stormwater during construction, and locate appropriate areas for the physical placement of the CESF operational trailer and sand pods.

Linear projects often require complex conveyances for routing stormwater to the CESF system(s). For example, if the project is proposing one stationary system, there will need to be a plan for routing runoff to that system. There may be multiple flows from different drainage basins combining into one central treatment location. In some cases, it may be more efficient and cost effective to have multiple stationary systems or a mobile system (CESF system on a trailer along with storage or weir tanks) that can be moved throughout the construction based on where treatment is needed.

Flow control requirements

Sites that must implement flow control for the developed site condition must also control stormwater release rates during construction. Construction site stormwater discharges shall not exceed the discharge durations of the pre-developed condition for the range of pre-developed discharge rates from ½ of the 2-year flow through the 10-year flow as predicted by an approved continuous runoff model. The pre-developed condition to be matched shall be the land cover condition immediately prior to the development project. This restriction on release rates can affect the size of the untreated storage pond and pre-treatment cells.

The following is how Western Washington Hydraulic Model (WWHM) can be used to determine the release rates to a flow control waterbody from the chemical treatment systems. The same design steps can generally be used for MGSFlood:

1.) Determine the pre-developed flow durations to be matched by entering the existing land use area under the “Pre-developed” scenario in WWHM. The default flow range is from ½ of the 2-year flow through the 10-year flow.

2.) Enter the post developed land use area in the "Developed Unmitigated" scenario in WWHM.

3.) Copy the land use information from the "Developed Unmitigated" to "Developed Mitigated" scenario.

4.) While in the "Developed Mitigated" scenario, add a pond element under the basin element containing the post-developed land use areas. This pond element represents information on the available untreated stormwater storage and discharge from the chemical treatment system. In cases where the discharge from the chemical treatment system is controlled by a pump, a stage/storage/discharge (SSD) table representing the pond must be generated outside WWHM and imported into WWHM. WWHM can route the runoff from the post-developed condition through this SSD table (the pond) and determine compliance with the flow duration standard. This would be an iterative design procedure where if the initial SSD table proved to be inadequate, the designer would have to modify the SSD table outside WWHM and re-import in WWHM and route the runoff through it again. The iteration will continue until a pond that complies with the flow duration standard is correctly sized.

Notes on SSD table characteristics:

The pump discharge rate would likely be initially set at just below ½ of the 2-year flow from the pre-developed condition. As runoff coming into the untreated stormwater storage pond increases and the available untreated stormwater storage volume gets used up, it would be necessary to increase the pump discharge rate above ½ of the 2-year. The increase(s) above ½ of the 2-year must be such that they provide some relief to the untreated stormwater storage needs but at the same time will not cause violations of the flow duration standard at the higher flows. The final design SSD table will identify the appropriate pumping rates and the corresponding stage and storages.

5.) When building such a flow control system, the design must ensure that any automatic adjustments to the pumping rates will be as a result of changes to the available storage in accordance with the final design SSD table.

6.) It should be noted that the above procedures would be used to meet the flow control requirements. The chemical treatment system must be able to meet the runoff treatment requirements. It is likely that the discharge flow rate of ½ of the 2-year or more may exceed the treatment capacity of the system. If that is the case, the untreated stormwater discharge rate(s) (i.e., influent to the treatment system) must be reduced to allow proper treatment. Any reduction in the flows would likely result in the need for a larger untreated stormwater storage volume.

If the discharge is to a municipal storm drainage system, the allowable discharge rate may be limited by the capacity of the public system. It may be necessary to clean the municipal storm drainage system prior to the start of the discharge to prevent scouring solids from the drainage system. If the municipal storm drainage system discharges to a waterbody not on the flow control exempt list, the project site is subject to flow control requirements. Obtain permission from the owner of the collection system before discharging to it.

If system design does not allow you to discharge at the slower rates as described above and if the site has a retention or detention pond that will serve the planned development, the discharge from the treatment system may be directed to the permanent retention/detention pond to comply with the flow control requirement. In this case, the untreated stormwater storage pond and treatment system will be sized according to the sizing criteria for flow-through treatment systems for flow control exempt water bodies described earlier except all discharge (water passing through the treatment system and stormwater bypassing the treatment system) will be directed into the permanent retention/detention pond. If site constraints make locating the untreated stormwater storage pond difficult, the permanent retention/detention pond may be divided to serve as the untreated stormwater storage pond and the post-treatment 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 post-treatment flow control pond's revised dimensions must be entered into the WWHM and the WWHM must be run to confirm compliance with the flow control requirement.

Stormwater Chemical Treatment Plan

Once the system sizing has been completed and a chitosan product has been selected, the Stormwater Chemical Treatment Plan (SCTP) can be finalized. WSDOT requires the contractor to develop and submit this document for review prior to construction. **There is no specific format for this document but it must include the design and operational information specific to the system that is required to be onsite.** WSDOT project staff should review this document to ensure the system proposed by the contractor meets the contract requirements. The SCTP must be updated as needed as it is considered part of the Temporary Erosion and Sediment Control (TESC) plan.

Existing site contamination

Existing site contamination may trigger additional environmental commitments related to construction stormwater discharges (refer to the Permitting on Contaminated Sites guidance on the Erosion Control Policies & Procedures webpage). Known existing soil or groundwater contamination must be identified during the NOI application process for the permit. Existing contamination may trigger the need for an Administrative Order to be issued with the permit which may include additional discharge sampling, testing and effluent limits. CESF systems can be enhanced to treat some types of contamination. A "treatment train" can be designed to include additional treatment methods. For example, activated carbon filters can be added to remove hydrocarbons. Contaminated sediments removed from stormwater treatment cannot be incorporated back into the site and must be disposed of in accordance with applicable regulations.

If contamination does not become evident until after construction has begun, the CESF system may require additional treatment components be added to enhance performance. Contact the Hazardous Materials Program for additional information about contamination issues.

Getting approval to use chitosan on a project

Ecology must be properly notified prior to any discharge from a CESF system. The permittee must submit a Request for Chemical Treatment Form to Ecology. The permittee must know several things before the Request for Chemical Treatment Form can be completed (e.g., what chitosan product will be used and who will be operating the system). Therefore, this form is usually filled out a week or two before the system will be ready to start discharging. If filled out correctly, this form has a very quick turnaround time once submitted to Ecology (several hours up to a week). Ecology may not send a formal approval; they will likely just send an email giving the project the go-ahead to start discharging. This email should be a printed and kept onsite with the system design and operational information.

Ecology keeps a list of approved chitosan products at: https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

Only chemicals approved by the Chemical Technology Assessment Protocol – Ecology (C-TAPE) may be used. Each product is accompanied by a Use Level Designation and a Use Designation document. Most chitosan products have been given a General Use Level Designation (GULD) so the Ecology's review of the Request for Chemical Treatment Form is quick. Some products have only been given a Conditional Use Level Designation (CULD), which may require additional submittals and/or a system inspection prior to system discharges.

Section 4 Operational Requirements

Every chitosan product has its own Use Designation document that may include product specific operational requirements. Therefore all individuals responsible for operating, inspecting, or monitoring CESF operations must be familiar with the Use Designation document for the chitosan product(s) being used to ensure all product specific operational requirements are also being met.

CESF operators must be monitoring the treatment system (unless the system is approved by Ecology as automated and capable of being monitored remotely) when discharges are occurring to confirm all operational requirements are being met and documented appropriately. WSDOT inspectors should ensure the CESF operators are meeting these requirements.

The following information is a summary of the common operational requirements outlined in each Use Designation document:

- **BMPs must be implemented to minimize the suspended sediment in runoff coming to the system.** Erosion and sediment control BMPs must be implemented to minimize the need for chemical dosing.
- **All system operators must have a CESF certification from an approved provider.** CESF certification is not the same as a CESCL certification.
- **When feasible, daily background pH and turbidity measurements must be collected for receiving waters.** When discharging directly to waters of the state.
- **Jar tests or bench-scale tests must be conducted daily upon startup to determine appropriate initial chemical dosing levels.** Additional tests must be conducted if the influent turbidity changes by 20% or greater.
- **Record total volume treated and discharged during an operational period.** Influent and effluent flow rates should be continuously metered and recorded at the end of the day. Influent and effluent volumes may vary due to backwash and recirculation events.
- **Influent and effluent flows must be continually monitored for pH and turbidity and data must be recorded at 15 minute intervals.**
- **Effluent must be continuously monitored prior to discharge to ensure it is in compliance with pH (6.5 – 8.5 su) and turbidity (10 ntu or less).** Automated shut-off valves must prevent out of compliance discharges.
- **Record amount and concentration of chitosan used for treatment (chemical metering, pump dosing levels and daily calibration information).** The daily operating log shall include information about the chemical being used (for example, 3% chitosan acetate solution). In addition, the chemical injection metering device must be calibrated at system start-up and then as needed throughout the day if influent average flow rate or water quality changes by 20% or greater.
- **Only approved methods can be used for pH adjustment.**
- **Effluent shall be monitored for residual chitosan or aquatic toxicity (One test within the first 30 minutes of operation, the second within the first 2 hours of operation, and additional tests when dosing rates or average flow rates change).** Additional toxicity testing may be required by Ecology for discharges to non-stream waterbodies (e.g., wetlands, estuaries, lakes).
- **Secondary containment must be provided for acidic or caustic material, buffering compounds, and treatment chemicals.**

- **An emergency shower and eyewash must be available in the operational trailer.**
- **Specific system operations monitoring must be performed during every operational period (startup, operation, and shutdown) and documented in an onsite daily operating log.** The operating forms or operating log shall be reviewed weekly and signed by an operating supervisor to confirm operations are meeting requirements and performance expectations. At a minimum the form(s) must include:
    - A record of each recirculation event and backwash cycle
    - Actions taken to remedy excessive recirculation and/or backwashing
    - A record of chemical metering pump calibrations
    - A record of chitosan use for pre-treatment
    - A record of chitosan dosage immediately prior to filters
    - A record of test results for residual chitosan and/or toxicity testing

Treatability issues

The CESF operator may encounter “treatability issues”. This can mean anything from the treatment system or the chitosan product itself is not treating the water as expected. Treatability issues can lead to capacity problems because the system cannot treat and discharge water fast enough to prevent an overflow. Common treatability issues may result from:

- Improper design, installation, or operation of a system (e.g., inadequate mixing of chitosan into stormwater)
- High or lower pH water (chitosan works best between 6.5 – 8.5)
- High level of organics in runoff (e.g., wetland soils, mulches, compost)
- Introduced chemicals (e.g., PAM, rock blasting fluids)
- Low conductivity in runoff (baking soda can increase conductivity)

In some cases, treatability issues may be resolved easily (e.g., neutralize pH, increase conductivity, use higher dose of chitosan). Never dose water with a higher rate of chitosan than is allowed by the Use Designation document. Many treatability issues are harder to resolve and may trigger the CESF operator to first try a different chitosan product. **Ecology must be notified if a different chitosan product must be used than was identified in the Request for Chemical Treatment Form.** Other solutions may come in the form of system design modifications or excluding specific sources of influent.

When treatability issues persist, treatment costs often increase or alternative disposal costs may become required to prevent ongoing bypassing of the system (e.g., water hauled to an offsite disposal location). Depending on the contract language or whether WSDOT directed the contractor to do something that led to the treatability issue, WSDOT may be responsible for the additional costs.

Tips for managing the contract

Prior to 2009, designing, installing and operating CESF systems was the realm of specialty sub-contractors who specialized in CESF dynamics. The systems were capable of treating water at about $0.01 – 0.03 per gallons discharged. Of course after mark-ups, the contracting agency always paid a higher price per gallon. In 2009, Ecology began approving certain chitosan products for 'General Use' which led to more contractors providing CESF services. Ecology currently has no training requirements for designing and installing CESF systems and the training requirements to operate a system is minimal and does not guarantee a skilled operator.

Beware of the following operational red flags:

- Contractor using more chitosan than expected
- Incoming runoff is over 600 NTU
- Undefined treatability issues
- Systems that recirculate or are back flushing more than 25% of the time
- CESF operators that cannot explain how the system works or the onsite documentation
- Systems that overflow (water bypasses treatment) outside of extreme storm events
- New operators that are not familiar with the specific system

Contractors must provide a Stormwater Chemical Treatment Plan (SCTP), which is considered part of the TESC plan. Always confirm that the system the contractor installs meets the performance or design requirements in the contract and the SCTP. The SCTP must contain system information including design and operational details. The plan must also include contingency plans for how the system will bypass in overflow events. This plan must be kept onsite along with the chemical treatment system approval from Ecology (may just be a printed email).

If pre-treatment and/or operation of the system are bid low by the contractor, this may be a sign they will be reluctant to actually operate the system because they have front loaded costs to prepare the SCTP and install the system.