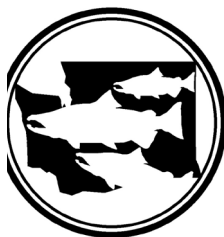




# **REGIONAL ROAD MAINTENANCE FORUM**

## **BEST MANAGEMENT PRACTICE GUIDE**



**This guidebook was created by the Regional Road Maintenance Program to assist with awareness and training staff on implementing the NOAA Fisheries ESA 4d Program. This guidebook may be modified to reflect the roles and responsibilities of individual member organizations in meeting the obligations of the program.**

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## INTRODUCTION

### Purpose

The Regional Road Maintenance Forum (RRMF) is a group of local agencies and WSDOT that have received a letter of approval from NOAA Fisheries covering their road maintenance program under Section 4(d) of the Endangered Species Act (ESA). The ESA 4(d) authorization requires that the road maintenance program monitor the adequacy of BMPs to achieve environmental outcomes. The purpose of this guidebook is to provide a training tool for road maintenance staff to select, install, and maintain BMPs to achieve environmental outcomes – protect water quality, maximize habitat, and contain pollutants. Using BMPs also help achieve permit compliance by avoiding and minimizing impacts.

The Regional Road Maintenance Program (RRMP) is comprised of WSDOT and local agency maintenance programs. Each agency covered by the ESA 4(d) program must provide a representative from the agency with road maintenance knowledge, technical expertise and the authority to implement the program changes and will participate in the RRMP.



## How To Use This Guide












Best Management Practices (BMPs) are applied to road maintenance work activities to protect endangered species and meet environmental outcomes – protect water quality, maximize habitat, and contain pollutants.

This guide identifies common road maintenance activities. Refer to the RRMP Guidelines for a complete description of road maintenance activities covered by the program. Each Work Activity selection below provides tips for performing the work and BMPs for work crews to consider.





<b>ROADWAY SURFACE</b>	<b>pg. 5</b>
<b>STORMWATER INFRASTRUCTURE</b>	<b>pg. 6</b>
<b>NATURAL WATERCOURSES AND STREAMS</b>	<b>pg. 7</b>
<b>BRIDGES</b>	<b>pg. 11</b>
<b>ROAD SHOULDERS</b>	<b>pg. 12</b>
<b>EMERGENCY SLIDE / WASHOUT REPAIR</b>	<b>pg. 13</b>
<b>SPILL PREPAREDNESS AND RESPONSE</b>	<b>pg. 14</b>

Click on any Work Activity to be taken to the page that describes the activity and the BMP considerations thereof.

This guide identifies tips for performing the work and categories of BMPs for work crews to consider for each project. The BMPs identified for Work Activity are linked to the specific categorical BMP description page that identify BMP tools that fit within that category.

Part 1 Operational BMPs:	Icon
<b>Work Crew Instructions:</b> Part 1 BMPs are part of daily operations to control pollution	
<b>Spill Preparedness and Response:</b> Procedures for responding to spills and BMPs to contain and clean up spills.	
Part 2 BMP Outcome Categories:	Icon
<b>In Water Work:</b> BMPs to isolate stormwater or natural water from your work area	
<b>Perimeter Controls:</b> BMPs to protect the perimeter of the maintenance activity	
<b>Stormwater Infrastructure Protection:</b> BMPs for protecting existing subgrade stormwater, ROW infrastructure, and water quality	
<b>Conveyance:</b> BMPs to reduce water velocity, settle out sediment, and move water cleanly through an activity area	
<b>Covering:</b> BMPs for covering and stabilizing exposed soils to prevent erosion	
<b>Revegetation:</b> BMPs to establish long term vegetation upon completion of a maintenance activity	
<b>Habitat Improvement:</b> BMPs that protect or improve habitat as part of the maintenance activity	

**Each individual BMP tool has an icon associated to it as follows:**

-  100% biodegradable and permanent
-  Partially biodegradable and/or there are elements that must be disposed of
-  Must be removed after site stabilization
-  Remove, but can be reused on other maintenance activity projects

Each BMP may fit into one or multiple categories depending on desired function. BMP descriptions include discussion on selection criteria and installation considerations to achieve environmental outcomes.

It is important to remember that each maintenance activity is unique in terms of scale, sensitivities, soil type, and climate. This guidance provides instruction for BMP selection and application for site specific needs. However, each maintenance activity has unique considerations that influence BMP selection based on project specific conditions.



## Part 1 BMPs - Work Crew Instructions

Part 1 BMPs are part of daily operations to meet environmental outcomes

- \* Inspect tools and equipment for leaks or damage
- \* Keep spill kits and cleanup materials available
- \* Keep equipment clean and free of oil and leaks
- \* Plan soil disturbing work during dry weather
- \* Properly dispose of materials and debris from the project

### Part 1 BMP Activity Example

**Sweeping** – Sweeping is done by hand or mechanical means. The purpose is to remove soil particles and debris before entering drainage systems, streams, or watercourses. Inspect and maintain equipment to prevent the spread of noxious weeds or invasive aquatic species.

**Vactoring** – Vactoring is the use of a truck mounted drainage system cleaning device. The purpose of this BMP is to clean drainage systems and/or dewater a work area.

**Handwork** – Handwork is the use of hand tools to remove very small volume of sediments and debris within watercourses and from streams; planting small disturbed areas, and removal of trash and debris at small localized areas. The purpose of this BMP is to minimize impacts to soil and surrounding vegetation by avoiding the use of heavy equipment where practicable.

**Control of Noxious Weeds and Invasive Species** - Follow applicable protocols to control noxious weeds and invasive species (e.g. keep equipment clean prior to and post maintenance work).



Vactoring a culvert to allow for system flow.

**Pre-work Checklist (all work):** each agency may tailor their own checklist and below is an example of key components

- ☐ What is the site like? (e.g. sloped, in water)
- ☐ What is the work activity/activities?
  - Does it require soil disturbance?  
(minimize if possible)
  - Do other factors (e.g. work zone) affect how the work is performed?
- ☐ Is a permit needed?
- ☐ When should work be scheduled?
  - What is the weather forecast?
- ☐ Is equipment in good working order?
- ☐ How will waste be removed?
- ☐ Where will the spill kit(s) be located?
- ☐ BMP Explanations

During Work:

- ☐ Are the BMPs working?
  - Apply adaptive management to BMPs as needed.
  - Maintain and remove built up sediment as needed.

**Work Covered:** Roadway resurfacing and preservation activities such as surface patching, surface removal, repaving, base digout and repair, grading gravel roads, adding gravel, pothole repair, chip seal, slurry seal, shoulder paving, crack sealing, and overlays.

### Tips:

- Where possible prevent roadway surfacing material from leaving the roadway
- Conduct paving work during dry weather
- All materials used in roadway resurfacing should be cured before rain occurs. If a sheen is observed coming off of the roadway, BMPs should be employed to contain and capture contaminated stormwater
- Notify Supervisor if road base is unstable or appears to be damaged
- Identify if BMPs must be removed following site stabilization, and schedule follow-up BMP removal
- Ensure all equipment is properly cleaned at the end of the project and properly dispose of all waste material
- Provide dust control when necessary. Prevent the discharge of roadway surfacing materials to adjacent drainage facilities or critical areas

### Common BMPs:

 [Sweeping](#)

 [Silt fence](#)

 [Inlet Protection](#)

 [Absorbent socks](#), [Drain cover](#), [Spill Pads](#)



Protect drain inlets when repaving.



Conduct overlays during dry weather.



**Maintenance of stormwater facilities are not addressed in this Guide** - Stormwater facilities include a wide variety of stormwater control and treatment features used for meeting National Pollution Discharge Elimination System (NPDES) stormwater requirements. Maintenance work for stormwater facilities and Low Impact Development (LID) is not included in this BMP guide.

### Tips:

- Refer to your Regional Road Maintenance Program Guidelines Part 2 BMPs

and

- If applicable, refer to the  
and  
to determine appropriate maintenance practices and BMPs



Prevent sedimentation to LID infrastructure in right of way (ROW).



Maintaining stormwater facility.

**Work covered:** Repair, replacement, installation and maintenance of enclosed drainage systems which may include: pipes, catch basins (other types of inlets), and other BMP treatment features (vaults, swales and ponds). Includes work using a vacuum/flush “vactor” truck, other equipment and hand work. This work may also be regulated by an MS4 permit.

### Tips:

- Conduct work during dry weather, if possible
- Determine if work requires confined space entry, and follow all safety procedures
- Identify if BMPs must be removed following site stabilization, and schedule follow-up BMP removal
- Properly dispose of all waste material
- Cover temporary stock pile material on the project site to prevent erosion
- Check asset conditions during project planning

### Common BMPs:

 [Vactoring](#)  
 [Drain Cover](#)

 [Dewatering](#)  
 [Inlet Protection](#)



Maintaining stormwater enclosed drainage system.



Traffic control will be necessary for ROW maintenance projects for safety.



**Work covered:** Repair, replacement, installation and maintenance of stormwater conveyance (e.g. roadside ditches), inlets and outlets. This work activity does not include stormwater facilities or LID. Open Drainage Systems do not include [natural watercourses and streams](#). This work may also be regulated by an MS4 permit.

### Tips:

- Notify if a natural watercourse or stream is suspected
- Conduct work during dry weather, if possible
- Identify if BMPs must be removed following site stabilization, and schedule follow-up BMP removal
- Properly disposed of all waste material
- Consider skip ditching where feasible

### Common BMPs:

 [Hand work](#)

 [Dewatering, Sediment Containment, Cofferdam](#)

 [Silt Fence, Wattles](#)

 [Check Dam, Outlet Energy Dissipater](#)

 [Mulch, RECP](#)

 [Seeding](#)



Ditch lining and check dams.



Roadside ditch cleanout and installation of straw wattle checkdam.

**Work covered:** Repair, replacement, installation and maintenance of drainage systems that are watercourses and streams. Work also includes but is not limited to structural repair/replacement, slope stabilization, sediment removal, vegetation management, debris removal, habitat maintenance /improvements and beaver dam management. Some roadside ditches and stormwater facilities can be watercourses or streams.

### Tips:

- Notify  
in advance of maintenance activity
- **Obtain and comply with all required permits**
- Plan and schedule work in dry conditions or when flows are anticipated to be at their lowest when possible, except in emergency situations
- Plan for fish exclusion, if needed
- Identify if BMPs must be removed following site stabilization, and schedule follow-up BMP removal

### Common BMPs:

 [Hand Work](#)

 [Planting, Seeding](#)

 [Wattles](#)

 [Secondary Containment, Spill Kit](#)

 [Mulch, RECP](#)

 [Stream Bypass, Turbidity Curtain, Cofferdam](#)

 [Beaver Dam Management, Large Woody Material, Streambed Gravel](#)



Relocate large woody material (LWM)  
from bridge pier.










Roadside streambank erosion repair.

**Work covered:** Repair, cleaning, maintenance installation or replacement/upgrade of culverts, arch culverts, and box culverts fish ladders, weirs, sediment pools, bridges and beaver dam management.

### Tips:

- Notify in advance of maintenance activity
- **Obtain and comply with all required permits**
- Reduce the potential for contaminants falling into the water
- Plan and schedule work in dry conditions or when flows are anticipated to be at their lowest when possible, except in emergency situations
- Plan for fish exclusion, if needed
- Identify if BMPs must be removed following site stabilization, and schedule follow-up BMP removal

### Common BMPs:

 [Hand Work](#), [Pull dozer](#)    [Secondary Containment](#), [Spill Kit](#)  
 [Stream Bypass](#), [Turbidity Curtain](#), [Cofferdam](#)  
 [Wattles](#)    [Mulch](#), [RECP](#)    [Planting](#)  
 [Beaver Dam Management](#), [Large Woody Material](#), [Streambed Gravel](#)



Gravity bypass with steel plate cofferdam.



Sediment cleanout from bridge using Aqua-barrier® cofferdam.

**Work covered:** Bridge maintenance activities limited to inspecting, testing, repairing, replacing, maintaining, painting or resurfacing the bridge superstructure and approaches. Bridge work occurring below Ordinary High Water Mark (OHM) is covered under [In Water Work](#).

### Tips:

- Notify in advance of maintenance activity
- **Obtain and comply with all required permits**
- Reduce the potential for contaminants falling into the water
- Identify if BMPs must be removed following site stabilization, and schedule follow-up BMP removal
- Properly dispose of all waste material

### Common BMPs:

#### Bridge Containment System

 [Hand Work, Vactoring](#)

 [Concrete Containment, Secondary Containment](#)

 [Inlet Protection](#)



Follow permit requirements when replacing timber piles on bridge structures.



Contain and dispose of concrete material during bridge deck repair.



Install containment to prevent material from falling into sensitive areas.



Bridge containment system for painting work.



**Work covered:** Maintenance tasks performed on shoulders to improve drainage, restore proper grade, restore filtering capability, maintain vegetation to provide adequate site distance, smooth rutting and remove buildup of sediment before entering drainage system.

### Tips:

- Keep work on shoulders
- Compact shoulders when done to prevent erosion and reduce vegetation growth where it could present problems
- Watch for sloughing
- When restoring shoulders use screened material
- Identify and flag any sensitive areas that should not be graded prior to work starting
- Schedule work in dry conditions
- Maintain a vegetation buffer between shoulder and sensitive areas if room allows
- Do not create a secondary ditch when grading shoulders

### Common BMPs:

 **Soil Compaction**

 **Silt Fence, Wattle**



Compact gravel shoulder to prevent erosion and allow for vehicle pull off.



Shoulder grading to ensure sheet flow of road runoff and leave a vegetated strip.

**Work covered:** Emergency activities performed to address immediate threat and protect the public, repair the roadway system, and prevent further damage to the roadway. Activities include removal of slide/washout material from right of way, backfilling, slope stabilization, re-establishment of damaged roadway structures, cleaning and repair of drainage system, revegetation and re-armoring with rock.

### Tips:

- Notify  
if a natural watercourse or stream is identified or suspected in the area of the repair
- Protect public safety and get water off the roadway into the conveyance (e.g. ditch/culvert) Use BMPs when feasible
- **Obtain and comply with all required permits**
- Plan for fish exclusion, if needed
- After repairs - properly dispose of all waste material
- Check and protect inlets down slope from repair
- Install BMPs down slope of the repair, if needed
- Identify if BMPs must be removed following site stabilization, and schedule follow-up BMP removal

### Common BMPs:

 [Vactoring](#)

 [Cofferdam](#)

 [Silt Fence, Wattles](#)

 [Check Dam, Rock, Sediment Containment](#)

 [Mulch, RECP](#)

 [Planting, Seeding](#)

 [Inlet Protection](#)



Obtain and comply with emergency permits and use BMPs when possible.



Emergency response from washout to protect public infrastructure and restore the roadway.



**Work covered:** Mobile fueling and non-emergency incidental spills or discharges that occur during road maintenance work activities. Emergency “uncontrolled” spills or releases where significant safety and health risks could be created **must** be directed to appropriate spill response contact numbers.

### Tips:

- Prepare for spills: develop and train a spill response procedure
- Prevent spills: bringing only what you need to the site, secure chemicals, tightly close lids, use secondary containment
- Have a spill kit and PPE on-site: specific to the activities being performed (e.g. have a non-sparking shovel and pan, if flammable/combustible materials are being used)
- Use non-petroleum based lubricant where possible
- Mobile Fueling: Avoid fueling near stormwater conveyance or sensitive areas, use secondary containment, and have additional spill response supplies available

### Responding to Incidental Spills:

- **YOUR SAFETY COMES FIRST!**
- **Follow**
- Report Spill to
- IF trained AND equipped to do so:
  - o **Assess and Control the situation:**
    - Are you familiar with the material and its hazards?
    - Are there other hazards present? (e.g. traffic control, confined space, sources of ignition, etc...)
    - Do you have the PPE, tools and materials to respond?
  - o **Put on PPE:** specific to the spilled material and hazards.
  - o **Contain the Spill:**
    - Stop the source and spread of the spilled material.
    - Isolate spills from surface and stormwater infrastructure.
  - o **Clean-up the Spill:** Call for disposal of spill response materials
  - o **Post Spill:** Re-stock spill kit.



### Common BMPs:

- Absorbent socks
- Spill Booms
- Spill Pads
- Secondary Containment for pumps, concrete, temporary chemical / fuel storage, and mobile fueling operations
- Drain Cover
- Berms
- Granular or bagged sorbents

### Selection:

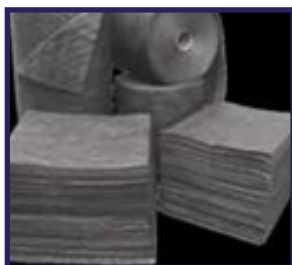
- Use containment booms and petroleum pads when working near water. Universal pads will sink
- Have spill kits with both universal and petroleum sorbents
- Berms may be constructed from onsite materials or socks to contain or direct the spill away from surface or stormwater infrastructure

### Installation:

- Apply sorbents to the downstream point, preventing further spread and work towards the source.



Oil-only, hydrophobic sorbents meant for gas, diesel and oil.



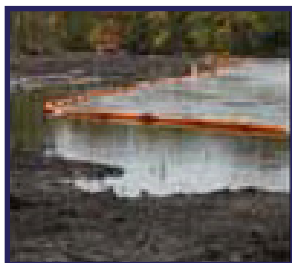
Universal, hydrophilic sorbents for antifreeze and water based chemicals.



Protect stormwater infrastructure using sorbents and earthen berms.



Make sure fluids and appropriate equipment are stored onsite with secondary containment.



Employ spill boom when working near water.



Drain seal to keep spill at the surface.



## In Water Work

**Natural Watercourses** – Roadway features (e.g. culverts, channelized roadside streams, bridges and roadway shoulders) that convey or are adjacent to natural watercourses need to be inspected and maintained to prevent erosion and remove sediment and debris buildup. **Typical BMPs will include: Stream Bypass, Turbidity Curtain, Cofferdam, Outlet Energy Dissipater and Sediment Containment.**

**Stormwater Conveyance System (MS4)** - Roadway maintenance of MS4 systems (e.g. ditches, pipes, catch basins, vaults, swales and ponds) is critical to ensure proper operation of the roadway drainage and protect water quality. **Typical BMPs will include: Cofferdam, Outlet Energy Dissipater, Sediment Containment, Dewatering.**

### BMP Tool Categories

- Stream Bypass
- Cofferdam
- Sediment Containment
- Turbidity Curtain
- Outlet Energy Dissipater
- Dewatering





## Stream Bypass

Working in watercourses typically require flows to be bypassed during work. Bypass flows methods: 1) Gravity pipe bypass 2) Pump bypass.

### BMP Tool Options:

- Plastic sheeting
- Pump inlet screen and pump
- Block net
- [Cofferdam](#)
- Pump
- Secondary containment
- [Outlet Energy Dissipater](#)
- Vegetation removal

**Implementation:** Working in watercourses and streams requires permits; follow your agency's protocols for determining and obtaining all necessary permits and approvals.

#### • Installation:

1. Set block nets, remove aquatic animals.
2. Protect Inlet area.
3. Construct bypass piping/pumps and [outlet energy dissipater](#).
  - o Ensure secondary containment, spill prevention, fuel supply, and back up pump and hoses for continuous operation.
  - o Size the pump and hoses to accommodate increased stream flows from what is anticipated. Monitor the weather forecast.
4. Construct initial diversion structure.
  - o Remove larger boulders and cobble from the bed.
5. Begin bypass, monitor downstream reaches for aquatic animals, maintain stream flow to ensure no stranding of aquatic animals.
6. Construct [cofferdam](#).
7. Install well point as needed. Pump turbid water to upland area for dissipation. Clean water may be pumped to outlet energy dissipater.
8. Complete final dewatering of the site (use pumps with fish screen to remove any remaining water) and aquatic animal removal.



- **Maintenance:** Monitor the following:
  - o Block nets at start and end of each working day and first flush to ensure they are functioning properly. Monitor more frequently during storm events.
  - o Pump inlet.
  - o [Cofferdams](#).
  - o [Outlet Energy Dissipater](#).
- **Removal:**
  - o Slowly return flows to work area, maintaining [cofferdams](#) and flow downstream.
  - o Capture turbid water from work area. This can be accomplished by pumping to an upland area or vactoring.
  - o When site water is within acceptable water quality standards, slowly begin to remove cofferdams and introduce flows downstream. Maintain a partial clean water bypass.
  - o Ramp flows between bypass and work area until bypass can be removed.
  - o Remove nets.



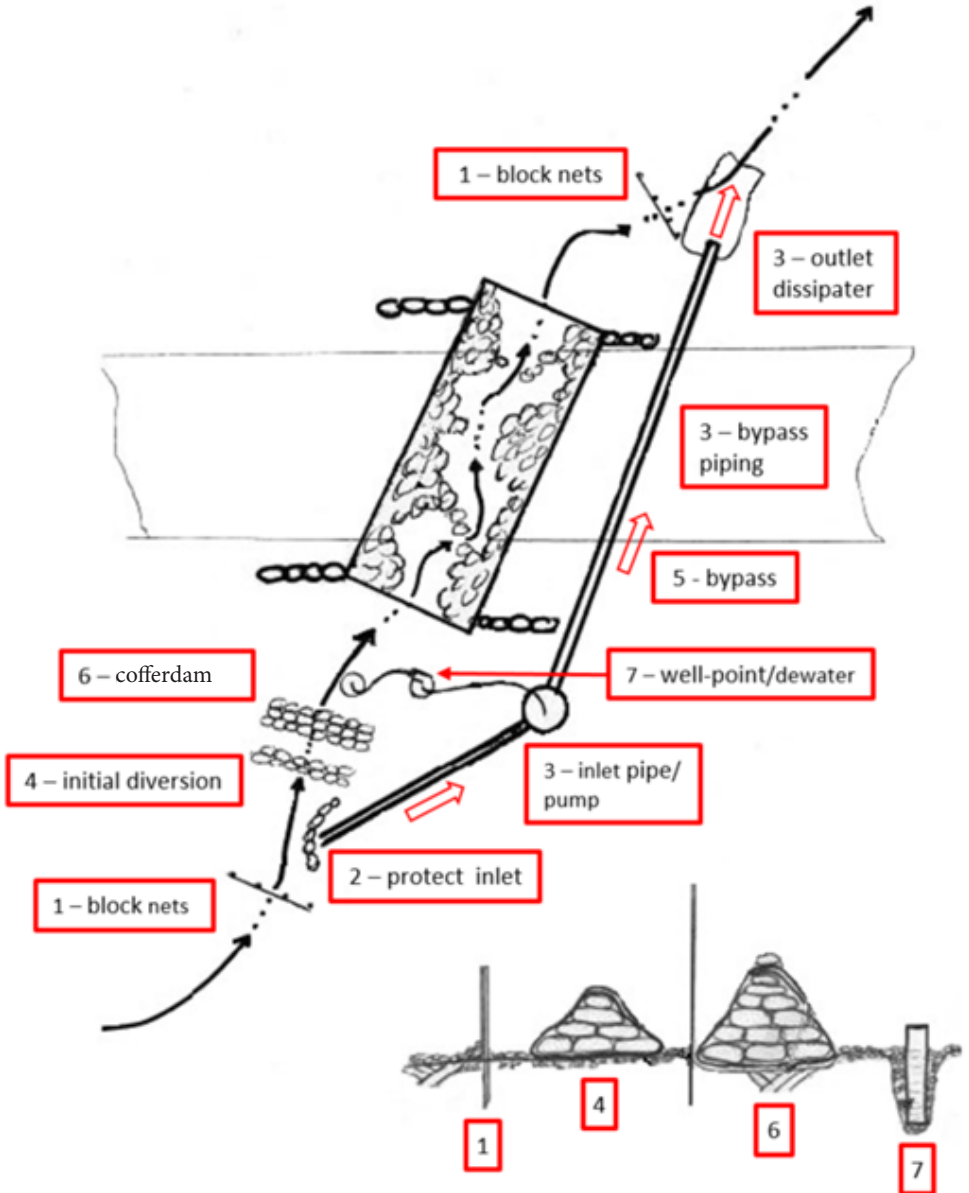
Pump intake fish screen.



Fish block net with pump bypass.



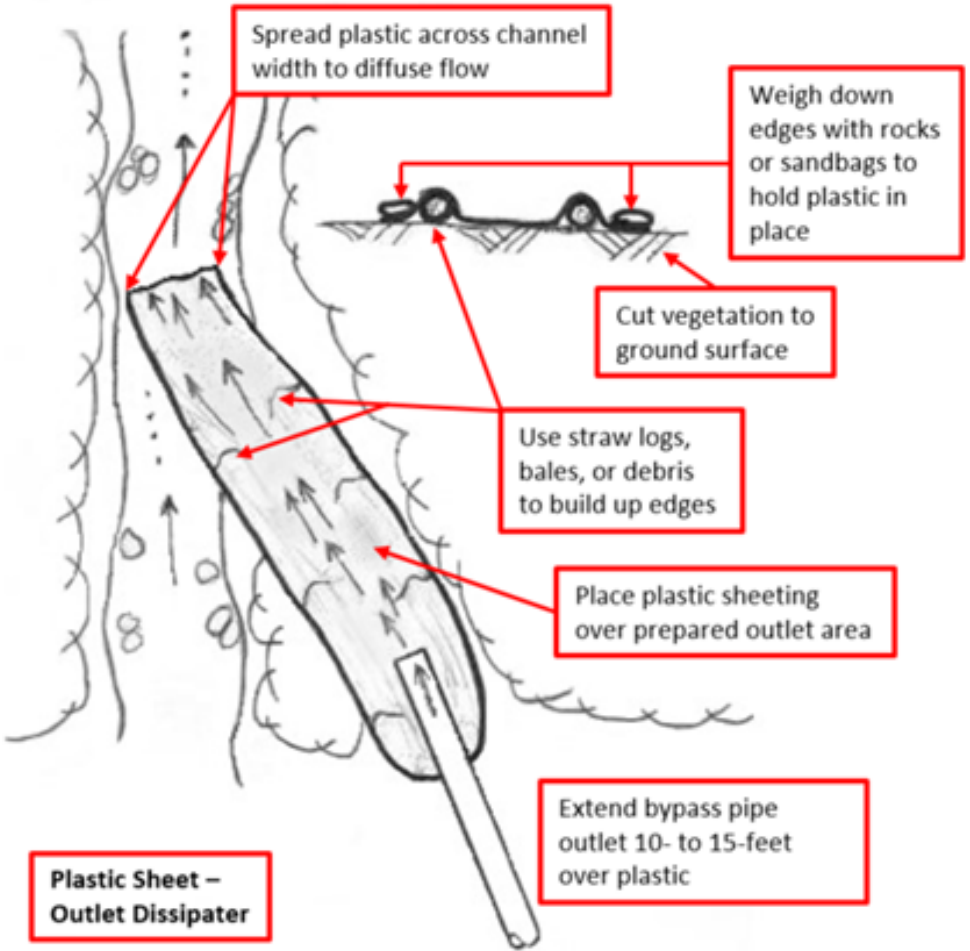
## Stream Bypass Diagram







## Stream Bypass Diagram



Outlet energy dissipater BMP.



Plastic wrapped supersack cofferdam.



## Turbidity Curtain

A turbidity curtain is a pre-manufactured floating geotextile structure which minimizes turbidity transport from a disturbed area adjacent to or within a body of water. This device allows for settling of suspended solids and can be used for both in water work as well as weirs for [Sediment Containment](#).

**BMP Tool Options:** Turbidity curtains come in different lengths, both vertically and horizontally. They can be made longer, horizontally, by attaching multiple curtains to one another.

**Implementation:** Turbidity curtains must be installed according to applicable permit requirements and in accordance with manufacturer recommendations and guidelines for installation and safety measures.

- **Installation:**

- o A watercraft may be needed for deployment. Wear appropriate PPE, consider having a land spotter for emergency situations.
- o A turbidity curtain can be deployed in standing and/or in flowing water, however should not be used where flow volume or water velocity inhibit the BMP's function.
- o Add suitable weight or anchoring system to the bottom of the curtain. Anchor the curtain on the surface to ensure it does not float away.
- o Do not install the curtain across the entire flow of the watercourse or stream.

- **Maintenance:** Inspect the BMP daily during the work week, make any required repairs.

- **Removal:**

- o When curtain is removed, it shall be in such a manner as to minimize turbidity; any soil particles shall be sufficiently settled before removing curtain.
- o Water discharged from turbidity curtain shall meet water quality standards at point of discharge.





Preparing for installation – land spotter, water craft, wearing PPE including life jackets.



Turbidity curtain is installed outside of flowing water, using multiple curtains to ensure entire job length is encompassed. Sign is installed on opposite bank at water point of entry warning summer water enthusiasts to beware of construction site.















## Cofferdam

Working in open drainage systems (e.g. stormwater ponds or ditches) or within natural watercourses (streams or culverts) may require installation of a barrier to isolate a dry work area where work can be performed and protect water quality. This BMP tool works in conjunction with [Stream Bypass](#) or [Dewatering](#).

### BMP Tool Options:

- Sand and gravel bags  
- Super sacks  
- Sheet Pile  
- Proprietary Dams (e.g. Aqua-barrier®, Portadam™, etc.)  
- Culvert Plug - Application is limited to isolating a work area near a culvert inlet  

**Implementation:** Contact permit coordinator to discuss how the work is performed and what permits may be required. **Permits may specify cofferdam materials, and cofferdam materials may trigger permits if work is in a water of the US.**

#### • Installation:

- o Sand and gravel bag cofferdams need to be stacked with a wide base. See construction detail below.
- o Super sacks and steel plates need to be installed with a backhoe or loader. Make sure to follow biodegradable oil protocols.
- o Steel plates and proprietary dams may not trigger Corp permits.
- o Follow manufacturer guidelines for installation of any proprietary cofferdam system.
- o Culvert needs to be clear of debris.

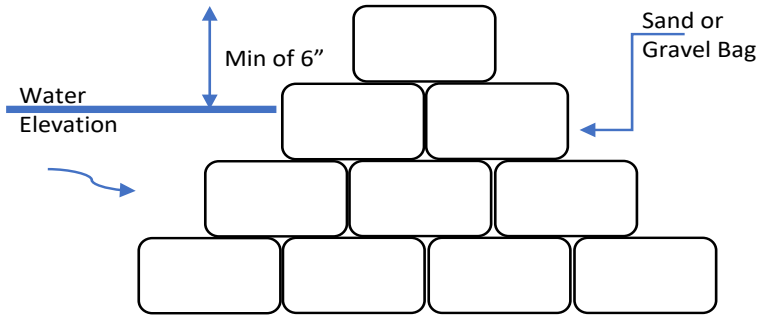
#### • Removal:

- o Slowly return flows to work area, maintaining cofferdams and flow at downstream area.
- o Capture turbid water from work area. This can be accomplished by pumping to an upland area or by vactoring.
- o When site water is within acceptable water quality standards, slowly begin to remove cofferdams and introduce flows downstream.
- o Ramp flows between bypass and work area until bypass can be removed.



## Cofferdam

### Sand or Gravel Bag Cofferdam Detail



HEIGHT AND WIDTH OF COFFERDAM SHALL BE DETERMINED BY THE WATER SURFACE ELEVATION AT THE TIME OF CONSTRUCTION

#### NOTES:

1. BAGS SHALL BE USED IN ACCORDANCE WITH APPLICABLE PERMITS
2. FILL BAGS 2/3 FULL
3. INSTALL COFFERDAM AND DEWATER SITE PRIOR TO CONSTRUCTION
4. PROVIDE ADEQUATE FREEBOARD



Sand bag cofferdam providing a dewatered work space.



Aqua-barrier® cofferdam.



Dewatering a detention pond using culvert plug to bypass water.





## Outlet Energy Dissipater

**Outlet Energy Dissipaters provide erosion protection by preventing scouring that may result from pumped discharge. This BMP tools help reduce water velocity.**

**BMP Tool Options:** Pumped discharge associated with stream bypass or dewatering:

- Slotted or perforated pipe dispersal system ♻️
- Filter Sock Energy Dissipater ♻️
- Plastic with straw bales and sand bags 🗑️ 🌱 ♻️
- Washed Rock 🗑️ 🌱

### **Implementation:**

#### **• Installation:**

- o Ensure BMP is properly sized to accommodate anticipated flow rates.
- o Do not discharge to a slope where dispersed flow could reconcentrate and cause downstream erosion.
- o Check permit conditions when using these BMPs in or near a regulated water.
- o Wrap straw bales with plastic – If placed on a slope, straw should be stabilized with stakes or sand bags to ensure they are secure.
- o If using large pumps with high flows, consider using an elbow at the discharge point to fountain the water upward and scatter water. Ensure enough plastic is present so no scour occurs on streambed or bank.

#### **• Maintenance:**

- o Monitor the BMP to address unanticipated scouring.
- o Filter Sock & Perforated Pipe – Monitor BMPs for proper flow as the BMP may clog with sediment over time.

#### **• Removal:**

- o Evaluate site to determine when BMP is no longer needed
- o Remove BMPs in such a manner to minimize disturbance
- o Revegetate area disturbed by BMP removal



Plastic, silt mat, hose with elbow, sandbags to keep hose stable. Elbow allows extra dissipation through pushing water into air.



Vegetated Spray Field.



Extra large dissipater with plastic and 6-inch hose with elbow.



Dewater bag or filter sock.



Straw bales and wattles covered in plastic to create velocity reduction and dispersal of water.



## Sediment Containment

Sediment containment BMPs are used to manage silt laden water that may be generated from maintenance activities including [Dewatering](#) or [Stream Bypass](#). The water may be discharged to sanitary sewer, storm drainage systems, upland infiltration, or natural watercourses after sufficient settling – contact your environmental coordinator to ensure compliance regarding discharge methods.

### BMP Tool Options:

- Sediment Bag 🌿
- Silt Mat 🌿
- Silt Fence Pond 🗑️
- Vegetated Filtration 🌿
- Vactoring
- Containers/Tanks – steel or poly upright tanks 🌿

**Implementation:** The type and location of sediment containment BMP should be considered before starting the work.

#### • Installation:

- o Be sure to size BMPs to accommodate appropriate flow.
- o Use of these BMPs is limited to the availability of ROW.
- o Sediment Bag – Ensure proper connection between discharge hose and BMP.
- o Silt Mat – Sediment passes through mat layers and is held by the fabric. Install with eco-staples or stakes. Overlap joints according to flow. Install with biodegradable stakes if left onsite.
- o Silt fence Pond – avoid areas where rock or hard surfaces prevent full and uniform anchoring of the foot of the barrier. When BMP is at 3/4 capacity, vector sediment or cease using.
- o Container / Tanks need a level and stable surface. Plan for traffic control if installed on surface.

#### • Maintenance:

- o Monitor BMPs for seepage or undercutting and take corrective action where necessary.
- o Remaining sediment should be removed and disposed of according to applicable permit conditions.

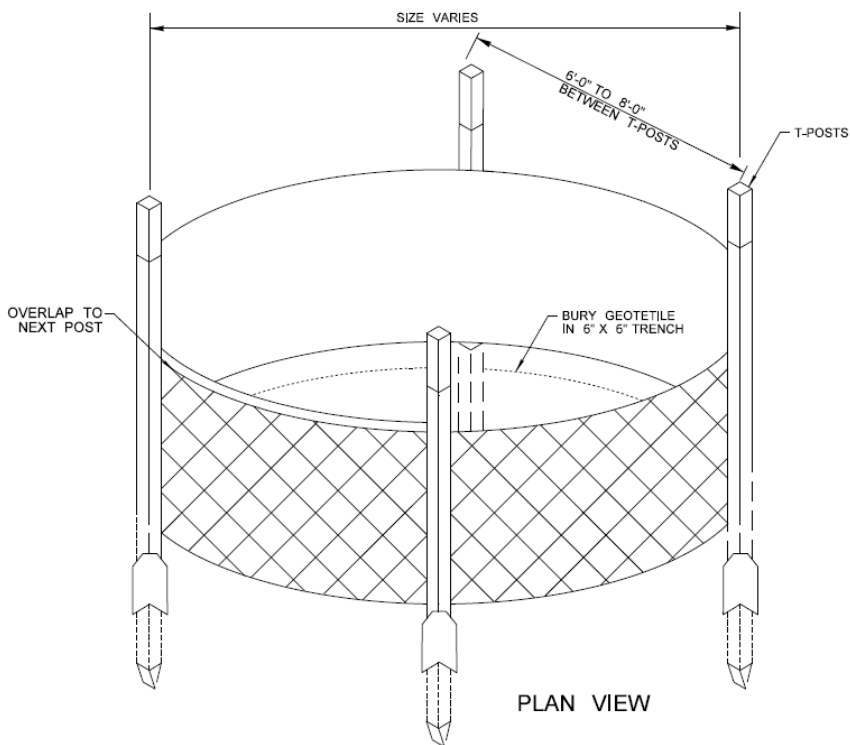


## Sediment Containment

- **Removal:**

- o Evaluate site to determine when BMP is no longer needed.
- o Remove non-biodegradable BMPs in such a manner to minimize disturbance.
- o Revegetate area disturbed by BMP removal.

## WIRE BACKED SILT FENCE SEDIMENT BASIN



Water storage tanks.



Silt fence pond.











## Dewatering

Working in enclosed or open drainage systems (e.g. vaults, stormwater ponds, pipes, culverts and ditches) may require flows to be bypassed during work to protect water quality. This BMP tool is not used in fish bearing waters – see [Stream Bypass](#). There are two methods to bypass flows: 1) Gravity pipe bypass and 2) Pump bypass.

### BMP Tool Options:

- [Cofferdam](#)  
- Pump
- [Outlet Energy Dissipater](#)  
- [Sediment Basin](#)  
- Vactoring

**Implementation:** Contact permit coordinator to determine if the proposed work is located in natural watercourse (permits may apply). Consider whether or not your project is reintroducing upstream water back into the system.

#### • Installation - Reintroducing Water

- o Protect inlet area.
- o Construct bypass piping/pumps and outlet energy dissipater.
- o Construct initial diversion structure.
- o Construct [Outlet Energy Dissipater](#).
- o Begin Bypass, ensure downstream water quality is clean
- o Install well point / sediment pond as needed. Pump turbid water to upland area for dissipation. Clean water may be pumped to [outlet energy dissipater](#).

#### • Installation - Hauling Water

- o Consider if a water diversion is needed prior to performing work.
- o Plan your project with the capacity of gallons that the vactor holds.
- o Ensure proper disposal of processed water.

#### • Maintenance :

- o Monitor pump inlet / [cofferdams](#) / [outlet energy dissipater](#).
- o Monitor water quality of downstream flow.



## Dewatering

- **Removal:**

- o Slowly return flows to work area, maintaining [cofferdams](#) and flow at downstream area.
- o Capture turbid water from work area. This can be accomplished by pumping to an upland area or with a vacator.
- o When site water is within acceptable water quality standards, slowly begin to remove [cofferdams](#) and introduce flows downstream. Maintain a partial clean water bypass.
- o Ramp flows between bypass and work area until bypass can be removed.



Dewatering an enclosed drainage system.



Dewatering to sanitary under an approved permit.



Dewatering from a wellpoint within a maintenance project.



Dewatering a worksite with a pump to bypass flows and work in dry conditions.



## Perimeter Controls

Roadway maintenance work includes soil disturbing work. The purpose of the following BMPs are to protect the perimeter of the project site from run on and run off. These BMPs are often the last line of defense to prevent the turbidity from escaping the maintenance activity area. They should not be relied upon as the only BMP for the activity.

### BMP Tool Categories:

- Silt Fence
- Site Access
- Wattle









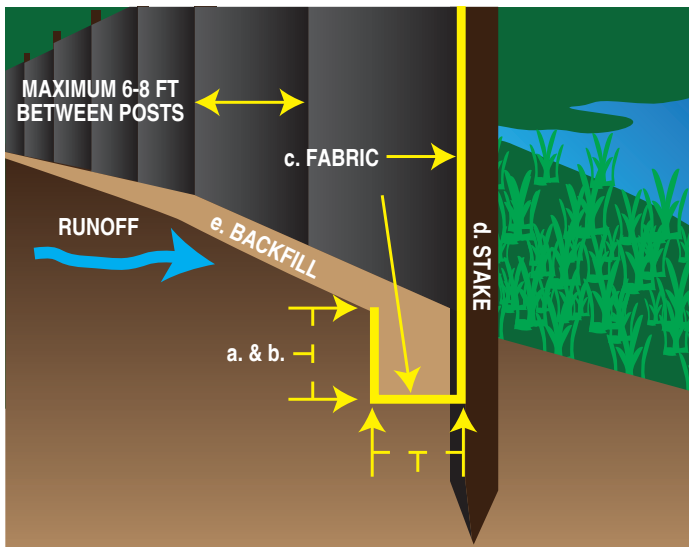
## Silt Fence

Silt fence is a barrier to prevent runoff and runoff and run on from areas. Silt fence is a barrier and not used as a filter unless ordered with a flow through geosynthetic fabric. It can also identify the boundary of disturbance if orange color fence is used.

**BMP Tool Options:** Silt fence comes in different heights, durabilities, and reinforcement. The geosynthetic fabric on a sediment fence ranges from low grade slit-film woven fabric to high tensile woven monofilament and can be either black, white or orange in color.

- 1x1 or 2x2 stake, stapled fence 
- 2x2 stake, pocketed fence 
- T-post, wirebacked fence 
- Proprietary - Smartfence™, Ertec Systems™ 

**Implementation:** Silt fence needs to be dug in so it should be done prior to anticipated rain. Key to all sediment fence is trenching in the bottom of the fence to prevent the water from undercutting. Project plans, duration, anticipated wind and runoff velocity should dictate selection.



- a. Straight, "J" or "U" hook of fabric tail
- b. Depth of backfill may vary
- c. Woven, filter, high visibility geotextile options
- d. Wood or t-post stakes, potentially with wirebacked support
- e. Backfill material can be native fill, compost or pea gravel



- **Installation:**

- o All sediment fence must be installed and in operation prior to excavation. Take the time for proper installation to ensure environmental outcomes.
- o Trench in the desired location, throwing the removed soil on the project or uphill side of the trench.
- o Key in the bottom of the fence (straight tail or “U” hook into the project) and backfill to bury line with soil or pea gravel depending on purpose of the tail (convey water or stop the water).
- o For stapled or wire backed fence the stake is behind the fence. Pocketed fence the stake goes inside the project or uphill and the seam is outside the project. Stakes should be every 8-10’ apart unless you are on the bottom of a slope where staking should be 4-6’ apart (depending on length of slope and anticipated runoff volume and velocity).
- o Join two pieces of wirebacked fence by overlapping the terminal post by 12-18 inches. Roll terminal ends of pocketed or stapled fence together to continue runs.
- o Side sloping applications should have check dams or “J hooks” to step the water slope along the fence. Terminate fence runs with an “L” or “U” shape back into the project.

- **Maintenance:** Routinely inspect and maintain.

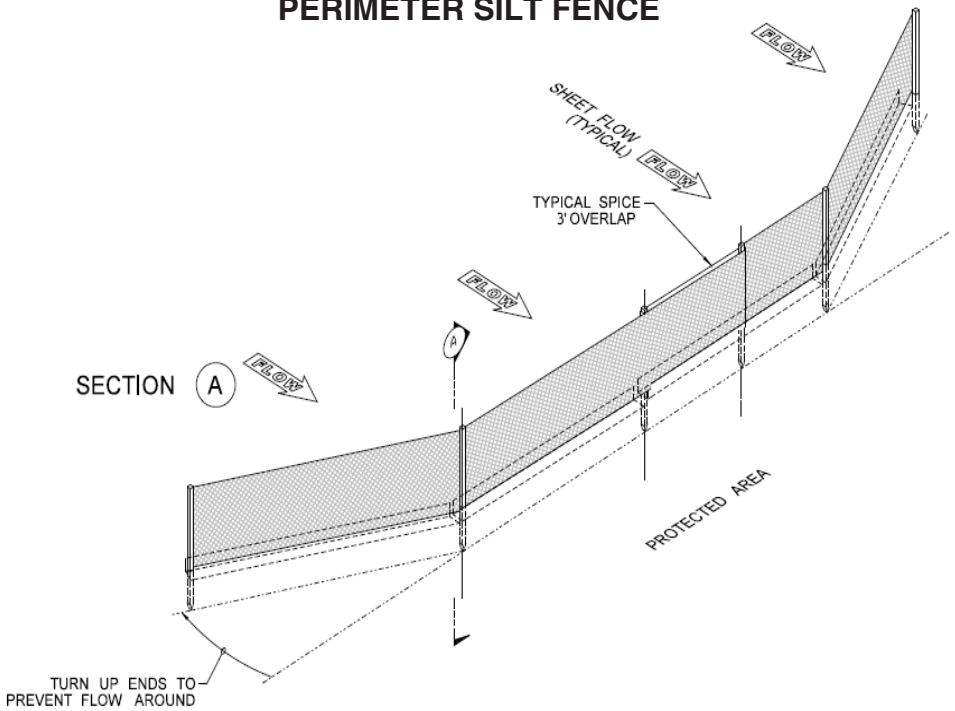
- o Remove sediment when it reaches 1/3 fence height.
- o Maintenance should be minimal. If damaged add new or replace sections as needed.
- o If there is too much flow or sediment build up against the sediment fence, focus upstream to reduce the volume and loading and then repair the fence.

- **Removal:**

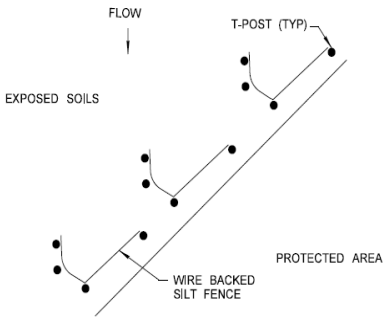
- o Most sediment fences are one time use and are thrown away at the end of the project. Some components of wire back fence such as T-posts and wire fence can be reused if not damaged.



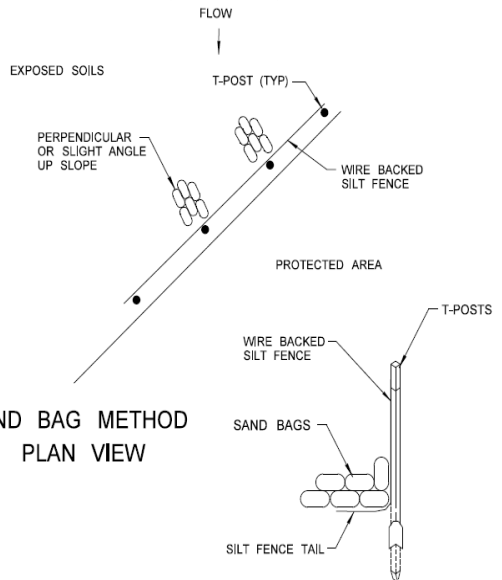
# PERIMETER SILT FENCE



## SIDE SLOPE PERIMETER PROTECTION



J HOOK METHOD  
PLAN VIEW



SAND BAG METHOD  
PLAN VIEW

T-POST ANCHOR DETAIL



Orange fence can also act as project delineation or define protection areas such as wetlands, historical buildings, or tree preservation.



Sediment fence is a barrier not a filter and must be installed properly.



Undercutting of the fence can occur if not trenched in appropriately.



Correctly installed pocketed fence.









Silt fence is often the last line of defense for the site. Make sure it is installed correctly.



**Maintenance activities may install temporary or permanent access roads to provide ingress and egress from work sites. This also includes areas necessary to stage equipment to perform maintenance work. Avoid locating access roads and staging areas within sensitive areas and buffers where practicable. The BMP tool provides stability for vehicles and equipment to access maintenance sites and prevents mud and debris from being deposited on roadways or adjacent sensitive areas.**

**BMP Tool Options:** Determining whether it is a short term temporary entrance or will remain in perpetuity (such as detention pond access ramp) will influence which type you will utilize.

- Permanent
  - [Rock](#) 
  - Turf and gravel reinforcement system – These systems promote infiltration and still meet load bearing requirements [ex. cellular confinement systems, plastic pavers (ex Bodpave™, GeoBlock™, etc.) or permeable pavers]. 
- Temporary
  - [Rock](#) 
  - Steel plate – Either flat surface or rumble strip. 
  - Geotextile mat – Either hard plates or rolled (ex. MudMat™). 
  - High strength plastic or rubber mats – (ex. ExtremePlates™, FODS™) 

### Installation:

- For permanent access roads check with your permit coordinator to ensure applicable permit approvals. Consider LID product options wherever geotechnically feasible.
- Be aware of unstable slopes and disturbance of vegetation.
- Ensure vehicles are free of weeds.
- Access roads and staging areas should include other [perimeter control BMPs](#).
- [Rock](#) - Unsuitable material should be excavated prior to placement of rock. Install geotextile fabric under rock.
- Geotextile mats, plates and infiltrative access roads – Follow manufacturers specifications for expected load bearing.



## Maintenance:

- Inspect BMPs during storm events and make any necessary repairs.
- Dirt spilled, dropped, or tracked from vehicles onto roadways should be swept or removed.

## Removal:

- Revegetate the site post maintenance, unless the access road is permanent.



Make sure geotextile fabric goes down before the rock to ensure the earth will not pump up through the rock.



Permeable pavers installed for access road.



Placing steel plate entrance.



Geotextile mat plate.



Rolled geotextile MudMat™.



FODS™ high strength plastic pad.



## Wattle

**Tubular shaped, lower profile perimeter control to slow the water velocities and provide containment. They also often serve as [check dam](#) devices.**

**BMP Tool Options:** Wattles come in different diameters, lengths and netting. Some are completely biodegradable and some are reusable. Most are barriers and only some provide filtration.

- Straw – Barrier, different types of netting (photodegradable plastic, biodegradable plastic, cotton, burlap). 🍏 🗑️
- Coir logs – Barrier, long term (12-36 months). 🍏
- Compost sock and berm – Filtration, no trenching required. 🍏 🗑️
- Gravel sock – Filtration, no trenching required, stands up to higher flow velocities. ♻️ 🗑️
- Synthetic – Barrier, reuseable, hard surface capability, Ex. Gatorguard™, Durawattle™. ♻️

**Implementation:** All wattles must be installed and in operation prior to excavation. Take the time for proper installation to ensure environmental outcomes. Trenching in the wattles (those without flaps) is key to prevent the water from undercutting. Wattles with flaps can be used on hard surfaces. Project duration, soil type, biodegradability and runoff velocity should dictate selection.

- **Installation:**

- o Trench in 1/3 of the height or bury the flap (if they have one) and backfill uphill or project side to prevent undercutting. Keep the trench depth even so as not to have low spots on the surface.
- o Create an overlap in direction of flow when joining two wattles. Do not butt joint.
- o Consider that if placed on a slope the wattle will store a lot of the water weight on the slope. Create controlled release points.
- o Staking patterns vary depending on soil type, slope steepness and velocity of runoff.

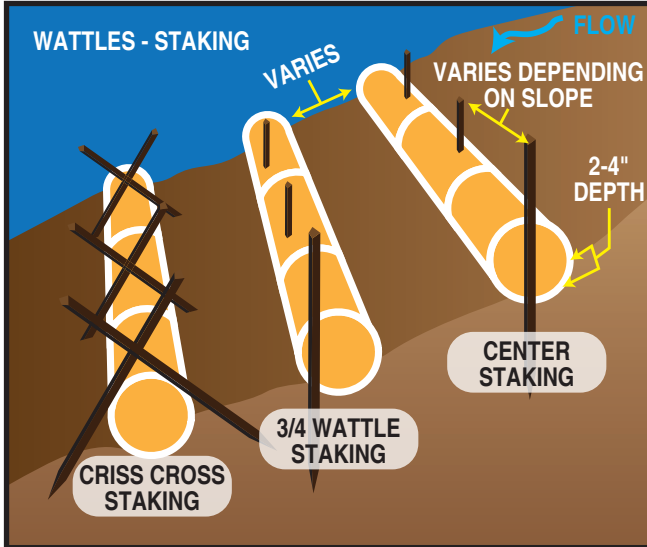
- **Maintenance:**

- o Remove sediment when it reaches 2/3 of the BMP freeboard.
- o Undercutting is most likely evident at the staking.



- **Removal:**

o Most wattles are biodegradable and left on site. However, you may be required to retrieve the netting surrounding the wattle at the end of the project.



There should be good overlapping when joining wattles.



Compost sock with safety fence acting as project delineation and perimeter filtration.



Coir logs can provide long term biodegradable perimeter control.



Gravel socks are often more robust to snow melt or high flow conditions.



Wattles laid down directly on hard surfaces do not provide much protection.



## Stormwater Infrastructure Protection

Roadway maintenance work may generate turbid water or material within the project area that must be contained and prevented from entering stormwater facilities and natural waterbodies downstream. These BMPs minimize pollutant loading to the infrastructure and minimize future maintenance requirements of MS4 facilities, while protecting water quality.

Effective MS4 protection is a combination of BMPs working together to reduce impacts on future maintenance and protection of water quality.

### BMP Tool Categories

- Inlet Protection
- [Spill Preparedness and Response](#)
- [Vactoring](#)
- [Sweeping](#)
- BMPs in [Perimeter Controls](#), [Conveyance](#), [Covering](#) and [Revegetation](#) can also be used to protect stormwater quality

















## Inlet Protection

**Inlet protection is the last line of defense before stormwater enters the subgrade infrastructure. These BMPs should not be receiving a heavy load of sediment or turbid water due to upstream source control effort. These BMPs will provide some filtration, but as a stand alone, are not likely to achieve environmental outcomes.**

**BMP Tool Options:** There are many different styles of inlet protection devices. There are below and above grate options and often are used in conjunction to achieve the environmental outcome. They have differing support mechanism, from straps to ridge basket-like structures. Some are designed to only fit Type I structures, others can be round or even expandable to meet both square and rectangular shapes. The materials vary from non woven geotextiles to woven monofilament for the desired purpose. Some have overflow opening to minimize flooding potential, others do not. Some fabrics are different color than black to allow for easier maintenance inspections.

- Drop in filters – fabric sock inserts, wire rimmed, framed with media (ex. FlexStorm™)  
- Curb cut inlet – rock sock, curb inlet dams, GatorGuard™  
- Drain cover – heavy mil plastic bag, drain seals, Blocksum™  
- Culvert/drain plug – rubber, air inflated  
- Above grate barriers – sand bags, Grate guards, Ertec™  
- Sorbent materials – spill socks, filter pillows 
- Media amendments – many inlet protection devices have amendments such as sorbent pillows, screens or other features to address particular conditions or pollutants of concern 

**Implementation:** Along with [Perimeter Controls](#), inlet protection should be one of the first BMPs implemented on the project. Some may require confined space access for installation. These BMPs may also serve as part of a Spill Response effort. Size and shape of structure, along with the depth of sump may determine which BMP is selected. Always follow confined space protocols when installing and maintaining subgrade filters or plugs.



## Inlet Protection

- **Installation:**

- o You may need 1/2" allen wrench grate key, grate pick and heavy hammer to remove grate.
- o Fabric filters with no frame need to be secured to the grate with straps by either hooking the straps over the corners of the grate or pushing the straps from bottom up through the grate and sliding a piece of rebar through the loops.
- o Often subgrade and above grate filters are used in combination to prevent having to replace subgrade filter multiple times over the project life.
- o DO NOT use straw bales or unconfined compost as an above grate barrier.
- o Do not obstruct the outlet pipe of sump with the filter.

- **Maintenance:**

- o If there is no water going into the basin but there is standing water in the filter it needs to be replaced.
- o Some filters have a maintenance line installed in them. If that is not visible it needs to be replaced. Rule of thumb: if there is sediment accumulated in 1/3 of the sock or freeboard of inlet protection, the sediment/debris needs to be removed.
- o Sweeping with push broom or vacuum equipment at the surface is an important source control BMP to prevent loading to the filters.
- o Monitor and clean as needed during high leaf litter and snow melt periods to prevent flooding.
- o When replacing the grate, make sure it is oriented correctly to the flow if the grate pattern requires that.

- **Removal:**

- o When removing the grate make sure the filter will not fall into the sump.
- o Filters that have been saturated with hydrocarbons or other pollutants other than sediment or debris will need to be treated as saturated [Spill Response](#) materials for disposal.





Gravel sock as prefilter in high flow environments.



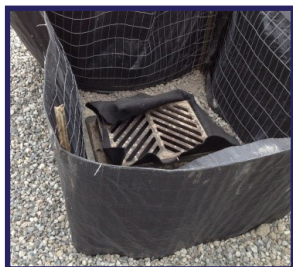
Sediment fence fabric does not filter and causes ponding at the surface.



Inlet filter with additional sorbent media for sensitive maintenance project.



Blocksom™ grate cover with filter underneath.



Combination of filter and above grate protection offers the easiest maintenance and protection of inlets.

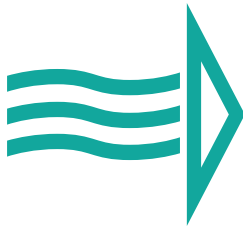


Recessed curb inlet dam to remove coarse material prior to filter.



Filters require inspection and maintenance.





## Conveyance

The purpose of roadway maintenance work located in open conveyances (e.g. roadside ditches, culverts and pipes) is to remove sediment and debris to prevent flooding and ensure proper function. This work will use BMPs to move water cleanly through the conveyance.

Velocity reduction of the water through the maintenance activity is not only important in reducing erosion in the project area, but also to prevent scouring or flooding to the downstream receiving water.

### BMP Tool Categories

- Check Dam
- Rock
- [Outlet Energy Dissipater](#)
- [RECP](#)












## Check Dam

**Check dams are used for velocity reduction of flowing water in ditches and channels to allow for settlement of turbidity.**

**BMP Tool Options:** Check dams can be both temporary and permanent installations. Some are fully or partially biodegradable and some can be reused. Some act as a dam to slow water velocity and provide settling. Others allow the water to pass through the center and provide filtration, not just settlement of sediment.

- [Rock](#) – sand bags, gravel sock  angular rock 
- [Wattles](#) – straw, compost sock, compost berm, coir log  
- Fiber rolls – RECP that has been rolled or bound to create a tube or filter devices or TerraTube™  
- Synthetic and reuseable – Triangular silt dike, spring berm, GatorGuard™ 

**Implementation:-** Other than rock and compost, check dams need to be dug into the channel whether burying 2-3 inches of the freeboard of the BMP or a flap of the BMP. Check dams should be installed prior to anticipated rain. Some check dams such as compost socks, compost berms, spring berm and TerraTube also provide filtration of sediment along with velocity reduction. NOTE: The use of compost may produce an initial spike of turbidity due to the rinsing out of “compost tea” which will stain the water a dark color.

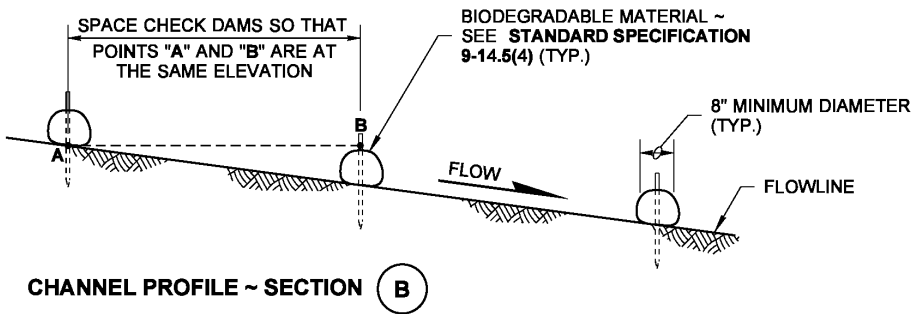
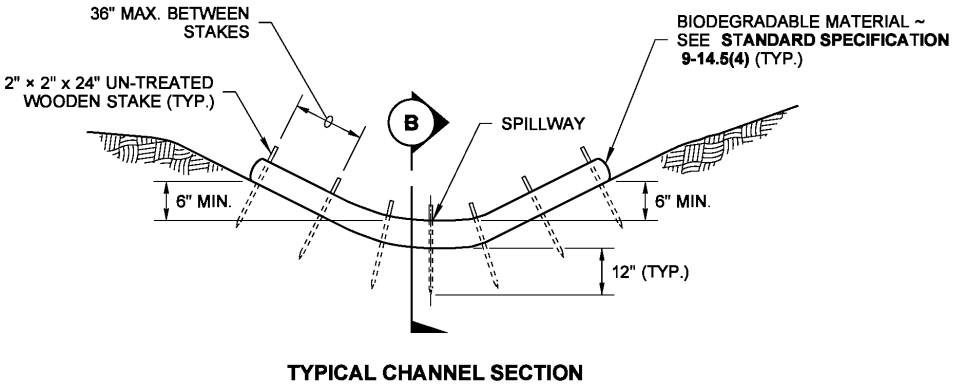
- **Installation:**

- o Silt dikes don't require the entire flap buried, just the bury the front end of the flap in the trench.
- o Trench in the desired location, throwing the removed soil on uphill side of the trench to back fill against the dam. Those BMPs with flaps need to have the entire upstream flap stapled and buried.
- o Staking of straw wattles and fiber rolls should be done frequent enough to handle the flow velocity (see staking diagram on [Wattle](#) page). Rope or twine may also be used to tie down the wattle or coir log in place.
- o Select different product diameters to meet conditions on site.



## Check Dam

- o Install low spot near center of the channel to prevent water from scouring the shoulders of the ditch or channel.



**BIODEGRADABLE CHECK DAM  
NOTE**

- **Maintenance:**
  - o Remove sediment when it reaches 2/3 of product freeboard.
  - o Look for undercutting of the dam and repair if necessary.
- **Removal:**
  - o Other than permanent installations, all or part (product sock or netting) of the check dam must be removed at the end of the project.



Compost socks allow for three dimensional filtration and can be placed right on the ground.



TerraTubes™ profile should be stood up.



Spring berms are six feet wide and can be clipped together.



Rock check dam.



Coir log wattles can be left on site and will biodegrade in 24-48 months.



Combination of check dams can achieve better results.



## Rock

Rock is used for many different applications and in combination with other BMPs. It can be used for emergency related work to stabilize steep slopes, control downstream turbidity and prevent roadway or shoulder failure. It can be used to protect soils from concentrated runoff and strengthen shoulders. It is also used as a [check dam](#) and [Outlet Energy Dissipater](#) to reduce flow velocity and settle out sediments.

**BMP Tool Options:** Rock size will vary based on the flows through the conveyance structure with higher flows requiring larger sized rock. It is recommended that when selecting rock size, staff should consult with an Engineer to make sure rock size meets specifications. Before installing rock in a conveyance structure, staff should also consult with Environmental staff to determine what permits if any are needed.

- **Rock** Additional BMP options may include: sand, gravel (with and without 'minus'), rip rap, armorment bolders. 🍏

Additional BMP options may include:

- **Ecology Blocks and Sheet Pile** -used in similar applications as rock to provide structural stability and support for road infrastructure or [cofferdam](#). 🍏 🍏

**Implementation:** Rock varies depending on flow velocities. Rock used for check dams or erosion control will require regular inspections and maintenance. Please consult your agencies Stormwater Manual or Regional Road Maintenance Guidelines for maintenance inspection guidelines.

- **Erosion Protection**

- o Rock should be clean and free of sediments.
- o Rock should be sufficiently buried to prevent undermining.
- o In locations where permits are required, rock must be placed in accordance with design and/or permit conditions.

- **Maintenance** – Inspect for undermining and scour holes.

- o Check for signs of erosion and undermining of rock.
- o Repair any scoured areas with like sized rock.
- o Maintain in accordance with permits and local ordinance.





## Rock



Repairing shoulder erosion with rock.



Rock protection at bridge abutment.



Ecology block to protect bridge abutment.



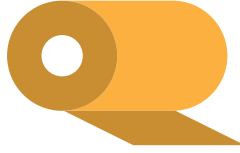
Rock outlet energy dissipater.



Rock to stabilize roadside slope.



Rock and large woody material (LWM)  
used for roadside streambank repair.



## Covering

Roadway maintenance work may involve soil disturbing work within the road prism or ROW. The purpose of covering BMPs is to cover exposed soil and minimize the erosive force of raindrops. They also serve to protect seed and plantings that are placed under them from washing away, freezing or drying out.

Covering BMPs aid in retaining channel integrity and can provide reinforcement for slope structural integrity. Cover BMPs are generally rolled products, hand dispersed or sprayed/blown on.

### **BMP Tool Categories:**

- **Mulch**
- **Rolled Erosion Control Products (RECP)**







## Mulch

**Covering the exposed soils with hand broadcasting or blown in mulch.**

### **BMP Tool Options:**

- Straw – Hand dispersed or straw blower 🌱
- Wood straw – Hand dispersed 🌱
- Hog Fuel – Chipped up grubbed 🌱
- Compost – Blown in compost as a blanket 🌱

**Implementation:** Make sure mulch covers over 90% of exposed soil.

#### • **Installation:**

- o Make sure the coverage is over 90%.
- o Attempt to incorporate straw mulch into the top layer of soil by stabbing it in with tools or running over it with equipment. May require tackifier if in high wind areas.
- o Incorporate [RECP](#) over mulch when needed due to slope or wind conditions or as a thermal protection for seed.
- o Coordinate the use of compost with your permit or NPDES coordinator.
- o Seed should have direct contact with soil then hand mulch applied over the top except when using compost mulch.
- o **Ensure mulch (particularly straw) is certified or labeled as weed free.**

#### • **Maintenance:**

- o Reapply if material is moved by wind or concentrated flow.
- o Monitor to prevent invasive species.



Compost being blown.







Make sure to apply over 90% coverage when utilize straw mulch.



## Rolled Erosion Control Products (RECP)

**RECP are mats and blankets used for covering exposed soils, in channels/ditches and slopes/temporary stockpiles as a covering BMP.**

**BMP Tool Options:** RECP come in many materials and have different square footage coverage per roll.

- Plastic Sheeting – An impervious surface used for short term protection of soil. It will create high velocity runoff and therefore velocity reduction BMPs such as Perimeter Controls must be used at the bottom of the sheeting to prevent downstream erosion. Plastic MUST be anchored well especially near right of ways so as not to blow off exposed soils.  
- Biodegradable Blankets (jute, straw, coconut, excelsior, coir or combinations thereof) – Used as a temporary covering while the seeding underneath has a chance to establish.  

**Implementation:** RECP selection depends on how long the media needs to last (3 – 18 months) to provide protection for the seed to establish, shear stress expectations over the top of it, what wildlife sensitivities exist, and how much coverage will be required. The netting holding the media should be biodegradable unless utilizing a turf reinforced mat (TRM) for permanent structural engineering purposes.

- **Installation:**

- o Keeping contact with the soil is critical – no tenting.
- o The slope should be groomed by trackwalking up and down the slope to create micro check dams and allow for good contact with soil surface.
- o Check permits when installing near watercourses.
- o Key in blankets at the top of the slope to prevent water running underneath and wind blowing it back.
- o Overlap the up hill blanket over the downslope or down channel blanket like shingles on a roof.
- o Overlap joining blankets by 4-6”.
- o Follow manufacturers recommendations for staple placement, (a rule of thumb is staple every 3’ on center in the field and every 16” on edges and overlap areas.)
- o Choose staples based on soil texture, slope, and removal requirements. Wood or biodegradable staples are preferred.

- **Maintenance:**

- o Monitor until the site is revegetated.
- o Products that are not sacrificial need to be removed.



The steeper the slope, the more robust the RECP needs to be.



Select RECP in higher flow environments that have high erosion potential.



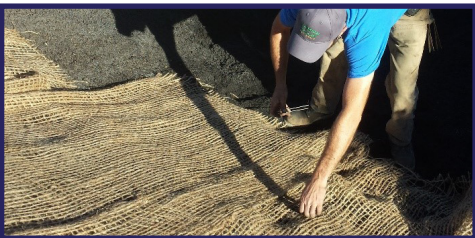
Make sure plastic is anchored well and a velocity reduction BMP is placed at the bottom of the slope or stockpile.



TRM used for permanent shoulder stabilization.



Plantings through RECP for revegetation and slope stabilization.

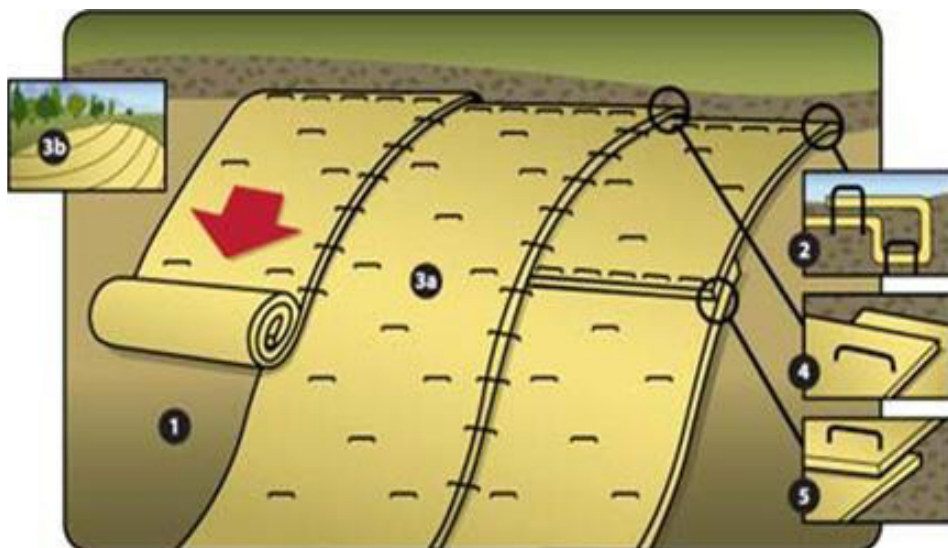
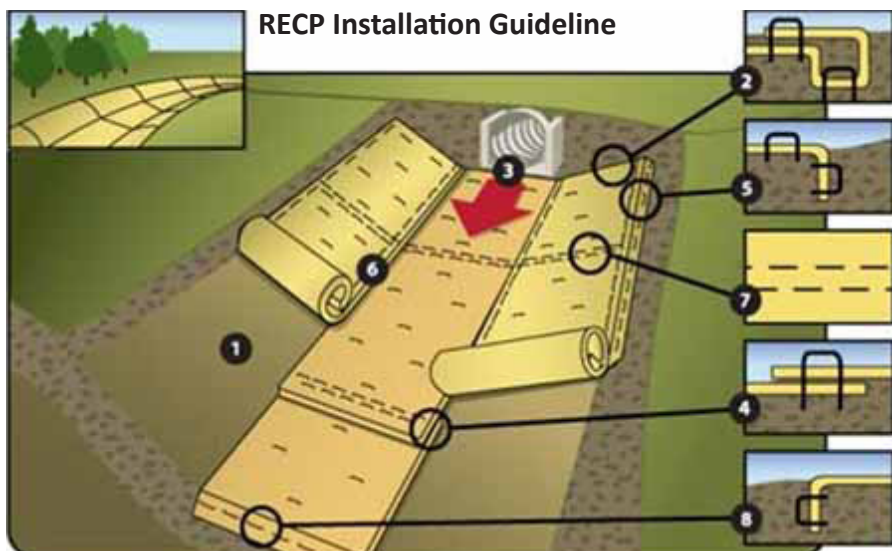


Follow manufacturer stapling recommendation for slope and soil type.



Trackwalking is important to groom slopes for RECP to have good soil contact.





1. Grade and groom the slope or channel
2. Key in the top of the slope or blanket at the head of the channel
3. Roll out and shingle in direction of flow
4. Anchor the field and edges with staple size and frequency based on slope and soil type
5. Key in edges of the blanket on the top of the channel shoulder
6. Overlap should be 4 - 6 inches
7. Increase staple frequency on seams
8. Key in or staple the tail of the blanket



## Revegetation

Plants need both sun and water to grow and often need support to establish. It takes time for seeds to grow, so for revegetation to be effective, it needs to be timed correctly as part of the project management.

Vegetation is the most effective erosion control BMP. The more that can be left on a project, the less erosion potential there will be. Once established, the plants create a network of roots that hold soil together preventing erosion, promoting infiltration and creating habitat.

### BMP Tool Categories:

- Plantings
- Seeding





## Planting

**Vegetation is the most effective erosion control BMP. Once established the plants create a network of roots that hold soil together. Plantings are also part of habitat restoration efforts to provide shade over water and create habitat.**

### **BMP Tool Options:**

- Livestaking 🌱
- Potted plants 🪴

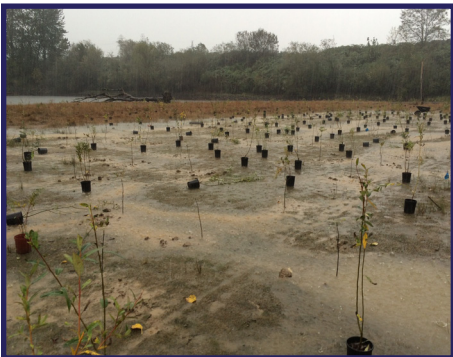
**Implementation:** It takes time for the plants to grow and establish, so make sure they are protected over that time.

#### • **Installation:**

- o Make a fresh cut before embedding a live stake.
- o Store cut live stakes in water until planting.
- o Break up root ball of potted plant before planting and bury completely under the soil (see page [57](#) for schematic).
- o Plants should be installed during the spring or fall or should be watered if installed during the summer.
- o If using RECP over the exposed soil, cut through blanket to plant.
- o Protect plants from animal browsing where that is a problem.
- o Provide plant shading needs when necessary.

#### • **Maintenance:**

- o Irrigation may be required to achieve establishment.



Potted plants with jute mat covering.



Live staking between lifts with coir blanket.

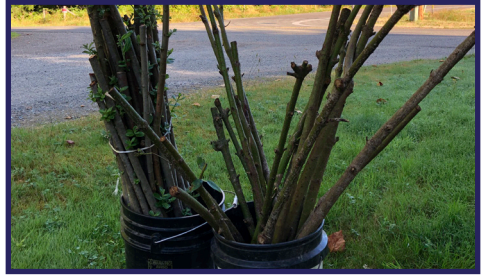




## Planting



Live staking through jute.



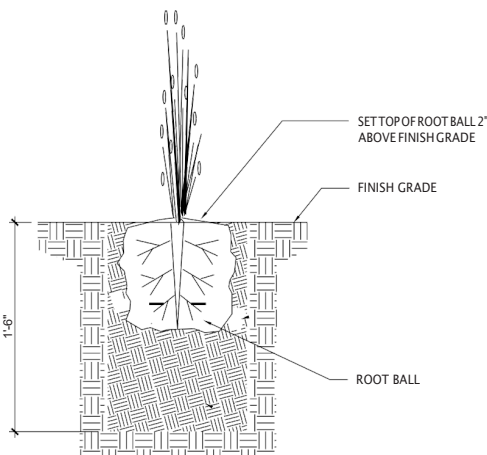
Willow and dogwood stakes ready for planting.



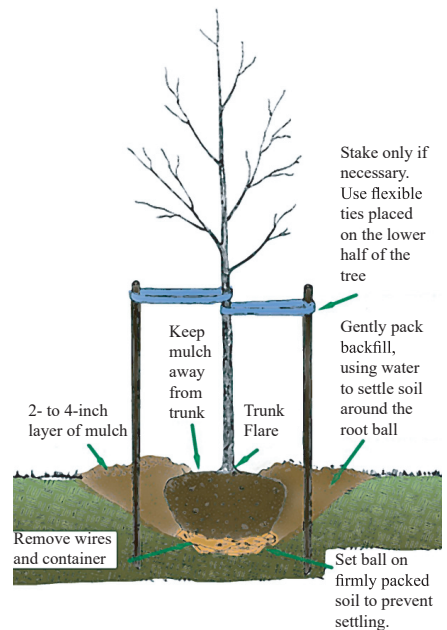
Planting, live potted dogwood, on streambank geogrid multi-layer wrap repair.



Slope checks help retain soil for plantings in tidally influenced areas.



Non-woody planting schematic.



Tree planting schematic.






## Seeding

**Vegetation is the most effective erosion control BMP. Seeding exposed areas will become a permanent BMP once established.**

### **BMP Tool Options:**

- Hand seeding 
- Hydroseeding 

**Implementation:** All work needs to be conducted during the seeding window. It takes time for the grass to grow and establish, so make sure it is protected over that time. Use only specified seed mixes. “Hydroseed” is a broad definition. Make sure you get the appropriate mulch to protect the seed until it establishes and follow manufacturers installation guidance. If the project soil is very rocky and void of nutrient, soil amendments may be required to achieve establishment.

#### **• Installation:**

- o Exposed soils need to have texture or be track walked to prevent seed loss – don’t back blade slopes.
- o If seeding in a ditch or on a slope, where velocities of water may wash seed away, the seed needs to be installed under the blanket.
- o Make sure to get good coverage of seed. If hydroseeding make sure shadowing is minimized.
- o Install [RECP](#) or [mulch](#) (hand dispersed, blown or sprayed) over the top, if needed, to prevent washing seed away, for thermal protection, or in shadowed areas to achieve establishment.

#### **• Maintenance:**

- o Irrigation may be required to achieve establishment.
- o Monitor site to control for noxious weeds.



## Planting & Seeding



Make sure to get good coverage of exposed soils.



Trackwalking the slope allows for the mulch to adhere to the exposed soil and provides good protection for the seed.



Some hydromulches can act as an erosion control blanket and provide up to nine months of protection.



Revegetation provide stabilization and habitat.



Soil amendments can be hydraulically applied and are less weight on a slope than topsoil.



Spray mulches need reinforcement to remain in high flow areas like the toe of the slope.



## Habitat Improvement

Roadway maintenance work involving soil disturbing or in water work will use BMPs to improve habitat upon completion of the project. Habitat for salmonids and other wildlife is improved by restoring native plant communities and improving in stream habitat for fish life.

Revegetation improves habitat by cooling the water temperature, providing resting areas, creation of a food source or food web, and improving water quality.

### BMP Tool Categories:

- Beaver Dam Management
- Large Woody Material (LWM)
- Streambed Gravel
- [Planting](#)





## Beaver Dam Management

North American beavers provide many ecological benefits, though beaver activity may conflict with road structures in some locations. The purpose of this BMP is to provide road maintenance crews tools, tips and possible solutions to protect roadway infrastructure while allowing beaver to continue to provide ecological benefits to the surrounding environment.

### BMP Tool Options:

- [Cofferdam](#)
- Pump
- [Outlet Energy Dissipater](#)
- Vactoring
- Hand Tools
- Specialty Structures

**Implementation:** Contact local environmental staff to determine if the work is located in a natural watercourse and comply with all required permits.

#### • Installation:

##### • Notching / Dismantling a dam:

- o Full dam removal is discouraged when the dam is older than one year to avoid wetland impacts and because beavers will often rebuild them.
- o Notch or remove the dam gradually to allow water to release slowly to prevent scour and downstream sedimentation. The breach in the beaver dam should not be wider than the original streambed.
- o Use hand tools, winch, or excavator to slowly dismantle dam.
- o Monitor upstream and downstream for stranded fish in isolated pools.

##### • Tools for active beavers:

- o Exclusion Devices and Levelers: Allow the beaver to stay on location while water levels are kept at a preferred maximum height. Consult WDFW for latest guidelines. Fence opening should be 6"X6" minimum.
  - Fencing / Cages/ Perma-notches
    - Prior to installing device, remove debris from within culvert or notch dam to desired height.
    - Ensure cages/fences have a bottom or are fully seated to the ground to decrease possibility of beaver intrusion.





- Consider installing on inlet and outlet at culverts.
  - Levelers, if allowed under permit conditions.
- **Trapping:** Consider hiring a trapper to remove the current beaver family. Beavers will typically re-inhabit the area unless conditions change and therefore is a temporary solution. This option may not be available during certain times of the year.
  - Live vs Other Trapping Resources:
    - [WDFW](#)
    - [Tulalip Tribes](#)
    - United States Department of Agriculture.
- **Crew safety** - Waters used by beavers and other wildlife may contain giardia, cryptosporidium, leptospirosis and other hazards.
  - o PPE and Sanitation may include but is not limited to: gloves, eye wear, washing hands.
  - o Be aware and avoid (if possible) wildlife in your surrounding area.
  - o Maintain situational awareness. Swift and dangerous currents may develop while beaver management actions are performed.
- **Maintenance:**
  - o Monitor exclusion and leveler devices for damage and effectiveness.
    - Remove/reposition debris as needed or required.
    - Repair structure as necessary.



Cleaning beaver debris from a box culvert. Follow safety precautions.



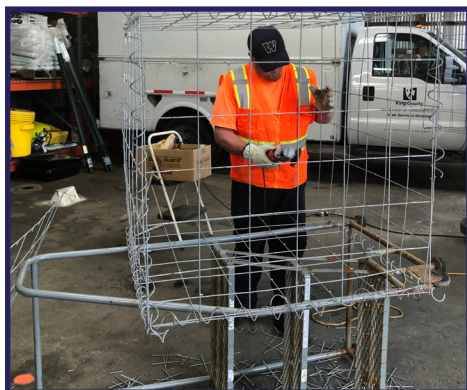
## Example of Culvert Cage:



Example of cage system with tube.



Cages connected with tube.



Cage fabrication.



Final field assembly.



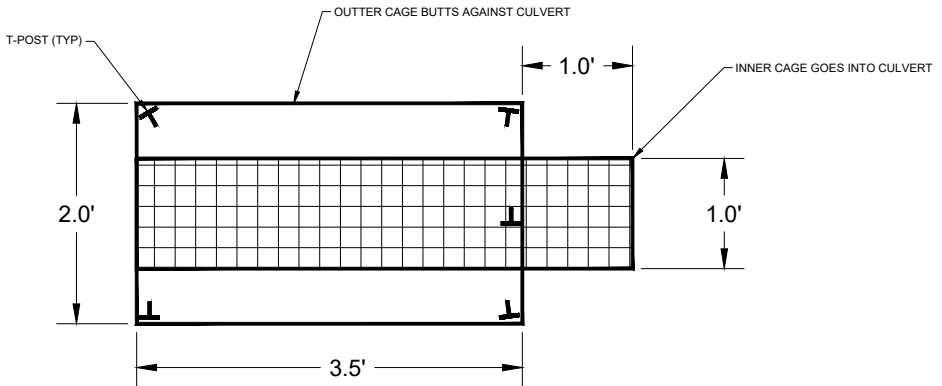
Installation of the culvert cage.



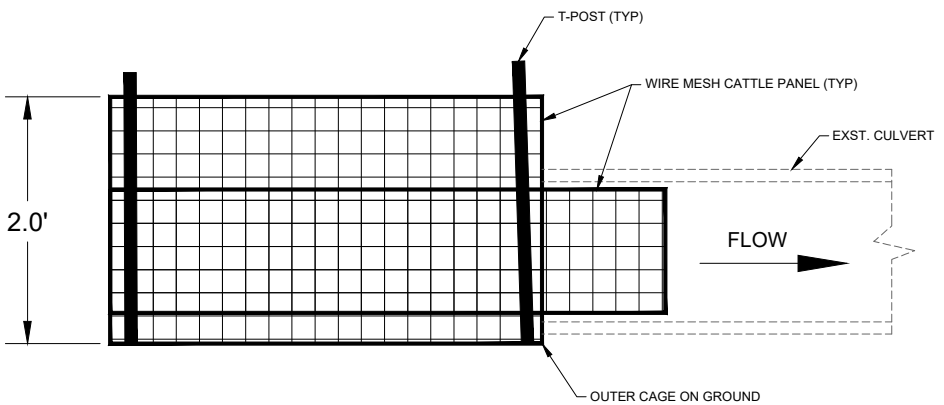
Example of culvert cage set in open water environment. Cages may be designed with hinged access for easy cleaning.

# Culvert Cage Detail:

## INNER CAGE GOES INTO CULVERT



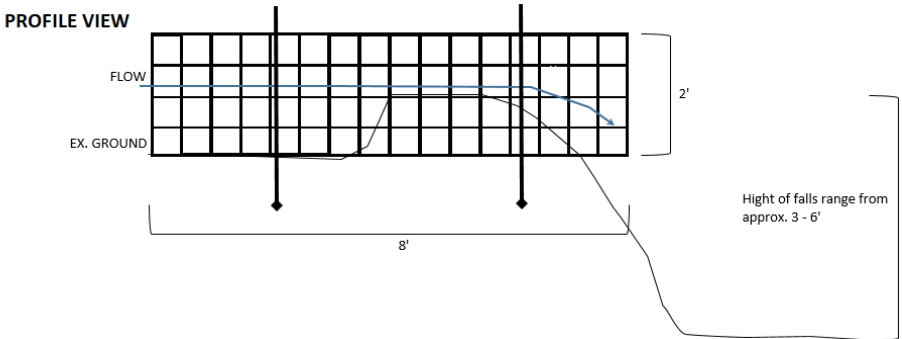
Plan view - Dimensions vary depending on culvert size.



## Profile VIEW



## Perma-Notch:



Notch beaver dam to desired height, install perma-notch at notched location to allow dam building around the notch, but water flow at a specified height. Monitor cage and remove new debris as needed.

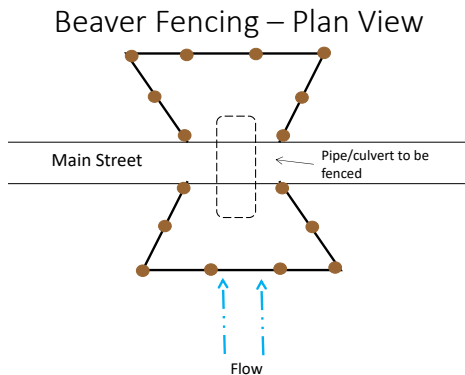


Perma-notch.



Perma-notch.

## Fencing:



Example of fencing: Trapezoidal fencing decreases maintenance of the fencing. Add top and bottom to fence as necessary.





## Large Woody Material - (LWM)

Large woody material is defined in WAC 220-660-030 as "trees or tree parts larger than four inches in diameter and longer than six feet, or rootwads, wholly or partially waterward of the ordinary high water line." Woody material affects local flow velocities, streambed and streambank stability, and local stream characteristics. The purpose of this BMP includes but is not limited to:

- Improving aquatic habitat by protecting eroding banks, providing cover and hydraulic diversity, creating pools and storing sediment
- Providing stream bed and bank stabilization

**BMP Tool Options:** LWM typically requires design specifications and permits, when incorporating LWM into maintenance activities. 🌱

**Implementation Considerations:** Each LWM placement should be tailored to meet engineering, habitat and target species objectives.

Considerations include:

- Conifer species (fir and cedar) are preferred for their longevity.
- Determine the method of anchoring LWM if necessary.
- In some cases LWM may be placed loosely on the bank.
- The use of LWM in combination with other BMPs.

### Maintenance:

- Follow any inspection and maintenance practices identified in applicable maintenance plans.
- Long-term maintenance may require permits.
- Consult a qualified biologist for specific repairs.





Consider perimeter controls when installing LWD installations.



Plantings with LWD installations can significantly improve habitat.



Engineered log jam.




LWD being embedded in bank and anchored with chain and deadman anchors.





## Streambed Gravel

**Rounded “river” rock of various sizes used to mimic the bed of natural watercourses. Streambed gravel is used to provide habitat and maintain the grade of stream channels conveyed by roadway infrastructure (e.g. culverts, bridges, and channelized streams).**

**BMP Tool Options:** Streambed gravel typically requires design specification and permits. 

Streambed gravel may be:

- *Various rock sizes* in order to maintain the grade of the stream channel conveyed by roadway infrastructure, mimic the natural bed of nearby streams, or selected to create specific types of habitat;
- *New or reused* from maintenance activities at other locations, recycled streambed gravel should be free from invasive species; and
- Refer to current WSDOT standard specifications. If stockpiled on site, install BMPs as necessary to avoid runoff.

**Implementation:** Streambed gravel should only be used when it meets specifications for roadway infrastructure and all appropriate permits have been secured.

- **Installation:** Streambed gravel is typically placed near the end of maintenance activities, prior to returning water to the work area.
  - o Haul material in a clean truck bed on the day of installation or store on a tarped area onsite. If stored onsite, then appropriate stockpile BMPs should be selected.
  - o Install in a dry work area ([see Stream Bypass](#))
  - o Install streambed gravel in accordance with design specifications and permit requirements.
  - o Consult the plans for placement of larger rock. Rock may be required to be precisely placed in groupings or with wood ([see Large Woody Material](#)) to create habitat features.
  - o Create a low flow channel as may be required by permits (see latest guidance from WDFW).
  - o For maintenance of stream crossings – streambed gravel should be installed prior to placing the “lid” on box culverts or in culvert sections as they are installed. Follow confined space protocols.
  - o Check grade of the watercourse to ensure design specifications are met prior to returning water to the work area.



- o The new stream bed material may be washed down in situ with a pump using stream water, well water or ground water to help drive the fines into the gravel interstitial spaces to seal the bed and reduce the "first flush" turbid discharge that could occur during site re-watering.
- o The site should be rewatered using ramped flows to avoid dewatering downstream reaches.

- **Maintenance:** Inspect and Maintain

- o Inspect water flow. Contact if surface flow is not present once water has been returned to the work area.
- o Follow any inspection and maintenance practices identified in applicable maintenance plans (these may be permit required).
- o Long-term maintenance may require permits.



Installing streambed gravel.



Streambed gravel with LWM.



Inspecting streambed gravel at the gravel pit.



Installing streambed gravel.



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BMP - Best Management Practices

ESA - Endangered Species Act

LID - Low Impact Development

LWM - Large Woody Material

MS4 - Municipal Separate Storm and Sewer System

OHM - Ordinary High Water Mark

PPE - Personal Protective Equipment

RECP - Rolled Erosion Control Product

ROW - Right of Way

RRMP - Regional Road Maintenance Program