Stormwater Management
FOR EASTERN WASHINGTON

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Stormwater Management Manual for Eastern Washington

Chapter 7 – Construction Stormwater Pollution Prevention
Chapter 8 – Source Control
Bibliography

WASHINGTON STATE DEPARTMENT OF ECOLOGY

September 2002
Publication Number 02-10-040C

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Water Quality Program

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Chapter 7 - Construction Stormwater Pollution Prevention

7.1 Introduction

7.1.1 Objective

This chapter provides guidance on planning, design, and implementation of stormwater management practices at construction sites. Runoff from development project sites during the construction phase can contribute to sedimentation of streams and carry other contaminants sufficient to result in water quality violations in receiving waters. Controlling erosion and preventing sediment and other pollutants from leaving the project site during the construction phase is achievable through implementation of selected Best Management Practices (BMPs) that are appropriate both to the site and to the season during which construction activities take place.

The objective of this chapter is to provide guidance for avoiding adverse stormwater impacts from construction activities on downstream resources and on-site stormwater facilities. Minimization of stormwater flows, prevention of soil erosion, capture of water-borne sediment that has been unavoidably released from exposed soils, and protection of water quality from on-site pollutant sources are all readily achievable when the proper BMPs are planned, installed, and properly maintained.

Initial discussions between the project proponents and their designer, contractors, and compliance inspectors can identify approaches to accomplishing a high quality, cost-effective project without compromising environmental protection. Often new ways are found to stage, time, and phase parts of a project to economize a contractor's schedule and use of construction materials. This collaborative planning process can produce methods to minimize or eliminate vulnerability and unnecessary risk associated with some traditional construction practices and techniques.

The construction phase of a project is usually considered a temporary condition, which will be supplanted by the permanent improvements and facilities for the completed project. However, construction work may take place over an extended period of time, including several seasons of multiple years. All management practices and control facilities used in the course of construction should be of sufficient size, strength, and durability to readily outlast the longest possible construction schedule and the worst anticipated rainfall conditions.

Linear projects, such as roadway construction and utility installations, are special cases of construction activities and present their own, unique set of stormwater protection challenges. Many of the BMPs can be adapted and modified to provide the controls needed to adequately address these

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projects. It may by advantageous to segment long, linear projects into a series of separate units that can apply all necessary controls pertinent to that particular unit in a timely manner.

The goal of a Construction Stormwater Pollution Prevention Plan (SWPPP) is to avoid immediate and long-term environmental loss and degradation typically caused by poorly managed construction sites. Prompt implementation of a Construction SWPPP, designed in accordance with this chapter, can provide a number of benefits. These include minimizing construction delays, reducing resources spent on repairing erosion, improving the relationship between the contractor and the permitting authority, and limiting adverse effects on the environment.

Many of the BMPs contained in this chapter can be adapted and modified to provide the erosion and sediment controls needed for other activities such as mining.

7.1.2 Content and Organization of this Chapter

Chapter 7 consists of four sections that address the key considerations and mechanics of preparing and implementing Construction SWPPPs.

- Section 7.1 highlights the importance of construction stormwater management in preventing pollution of surface waters. The section briefly lists the twelve elements of pollution prevention to be considered for all projects. The twelve elements are fully detailed in Section 7.2. Erosion and sedimentation processes and impacts are also described.
- Section 7.2 presents a step-by-step method for developing a Construction SWPPP. It encourages examination of all possible conditions that could reasonably affect a particular project's stormwater control systems during the construction phase of the project. Section 7.2.2 provides detailed descriptions of each of the twelve elements of Construction Stormwater Pollution Prevention. Section 7.2.3 provides a Construction SWPPP checklist.
- Section 7.3 contains BMPs for construction stormwater control and site management. Section 7.3.1 contains BMPs for Source Control. Section 7.3.2 addresses runoff, conveyance, and treatment BMPs. Various combinations of these BMPs should be used in the Construction SWPPP to satisfy each of the twelve elements of construction stormwater management that apply to the project.

7.1.3 How to Use This Chapter

This chapter should be used in developing the Construction Stormwater Pollution Prevention Plan (SWPPP), which is a required component of a Stormwater Site Plan (SSP, see also Chapter 3). Users should refer to this introductory section for an overview of construction stormwater issues, particularly related to erosion and sedimentation. Users should read

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Section 2 to determine the organization and content of the Construction SWPPP. This chapter includes lists of suggested BMPs to meet each element of construction stormwater pollution prevention. Based on these lists, the project proponent should refer to Section 3 to determine which BMPs will be included in the Construction SWPPP, and to design and document application of these BMPs to the project construction site.

7.1.4 Twelve Elements of Construction Stormwater Pollution Prevention

The twelve elements listed below must be considered in the development of the Construction SWPPP unless site conditions render the element unnecessary. If an element is considered unnecessary, the Construction SWPPP must provide the justification. These elements cover the general water quality protection strategies of limiting site impacts, preventing erosion and sedimentation, and managing activities and sources. The twelve elements are:

1. Mark Clearing Limits
2. Establish Construction Access
3. Control Flow Rates
4. Install Sediment Controls
5. Stabilize Soils
6. Protect Slopes
7. Protect Drain Inlets
8. Stabilize Channels And Outlets
9. Control Pollutants
10. Control De-Watering
11. Maintain BMPs
12. Manage the Project

A complete description of each element and associated BMPs is given in Section 7.2.2, under Step 3 of developing a Construction SWPPP.

7.1.5 Erosion and Sedimentation Impacts

Soil erosion and the resulting sedimentation produced by land development impacts the environment, damaging aquatic and recreational resources as well as aesthetic qualities. Erosion and sedimentation ultimately affect everyone.

Common examples of the impacts of erosion and sedimentation are:

- Natural, nutrient rich topsoils are eroded away, making re-establishment of vegetation difficult. Consequently, soil amendments and fertilizers must be applied. A properly functioning soil system is a

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sustained stormwater management mechanism. Vegetation and soil are not effectively sustained unless both are maintained in good condition.

- Siltation fills culverts and storm drains, decreasing capacities and increasing flooding and maintenance frequency.
- Detention facilities fill rapidly with sediment, decreasing storage capacity and increasing flooding.
- Infiltration devices become clogged and fail.
- Streams and harbors must be dredged to remove obstructions caused by sedimentation in order to restore navigability.
- Sediment in lakes builds more rapidly. Resulting shallow areas become covered by aquatic plants, reducing usability. Increased nutrient loading from phosphorus attached to soil particles and transported to lakes and streams can cause a change in the water pH, algal blooms and oxygen depletion that lead to eutrophication and fish kills.
- Treatment of water for domestic uses becomes more difficult and costly.
- Aesthetically pleasing, clear, clean water is replaced with turbid water in streams and lakeshores.
- Eroded soil particles decrease the viability of macro-invertebrates and food-chain organisms, impair the feeding ability of aquatic animals, clog gill passages of fish, and reduce photosynthesis.
- Successful fish spawning is diminished by sediment-clogged gravel. Sedimentation following spawning can smother the eggs or young fry.

Costs associated with these impacts can be obvious or subtle. Some are difficult to quantify, such as the loss of aesthetic values or recreational opportunities. Restoration and management of a single lake can cost millions of dollars. Reductions in spawning habitat, and subsequent reduction in salmon and trout production, cause economic losses to sports fisheries and traditional Native American fisheries. The maintenance costs of man-made structures and harbors are readily quantifiable. Citizens pay repeatedly for these avoidable costs as city, county, state, and federal taxpayers.

Effective erosion and sediment control practices on construction sites can greatly reduce undesirable environmental impacts and costs. Being aware of the erosion and sedimentation process is helpful in understanding the role of BMPs in controlling stormwater runoff.

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7.1.6 Erosion and Sedimentation Processes

Soil Erosion

Soil erosion is defined as the removal of soil from its original location by the action of water, ice, gravity, or wind. In construction activities, soil erosion is largely caused by the force of falling and flowing water. Erosion by water includes the following processes (see Figure 7.1.1):

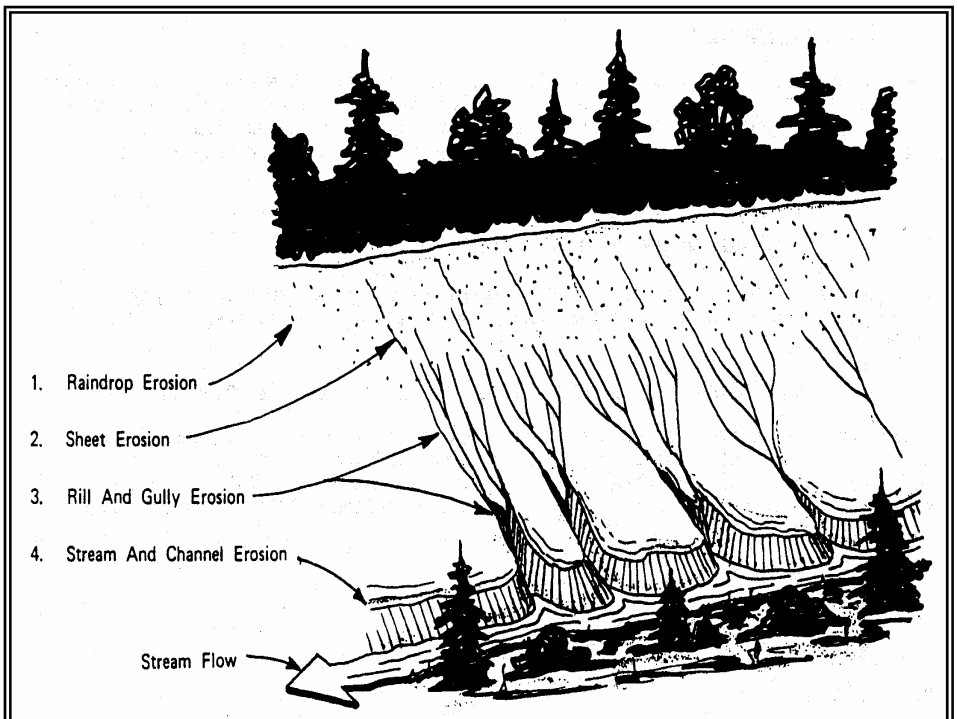

Figure 7.1.1 Types of erosion

- Raindrop Erosion: The direct impact of falling drops of rain on soil dislodges soil particles so that they can then be easily transported by runoff.
- Sheet Erosion: The removal of a layer of exposed soil by the action of raindrop splash and runoff, as water moves in broad sheets over the land and is not confined in small depressions.
- Rill and Gully Erosion: As runoff concentrates in rivulets, it cuts grooves called rills into the soil surface. If the flow of water is sufficient, rills may develop into larger gullies.
- Stream and Channel Erosion: Increased volume and velocity of runoff in an unprotected, confined channel may cause stream meander instability and scouring of significant portions of the stream or channel banks and bottom.
- Soil erosion by wind creates a water quality problem when dust is blown into water. Dust control on paved streets using washdown

waters, if not conducted properly, can also create water quality problems.

Sedimentation

Sedimentation is defined as the gravity-induced settling of soil particles transported by water. The process is accelerated in slower-moving, quiescent stretches of natural waterbodies or in treatment facilities such as sediment ponds and wetponds.

Sedimentation occurs when the velocity of water in which soil particles are suspended is slowed for a sufficient time to allow particles to settle. The settling rate is dependent on the soil particle size. Heavier particles, such as sand and gravel, can settle more rapidly than fine particles such as clay and silt. Sedimentation of clay soil particles is reduced due to clay's relatively low density and electro-charged surfaces, which discourage aggregation. The presence of suspended clay particles in stormwater runoff can result in highly turbid water, which is very difficult to clarify using standard sediment control BMPs. Turbidity, an indirect measure of soil particles in water, is one of the primary water quality standards in Washington State law (WAC 173-201A-030). Turbidity is increased when erosion carries soil particles into receiving waters. Treating stormwater to reduce turbidity can be an expensive, difficult process with limited effectiveness. Any actions or prevention measures that reduce the volume of water needing treatment for turbidity are beneficial.

7.1.7 Factors Influencing Erosion Potential

The erosion potential of soils can be readily determined using various models such as the Flaxman Method or the Revised Universal Soil Loss Equation (RUSLE).

The soil erosion potential of an area, including a construction site, is determined by four interrelated factors (see Figure 7.1.2):

- Soil characteristics;
- Vegetative cover;
- Topography; and
- Climate.

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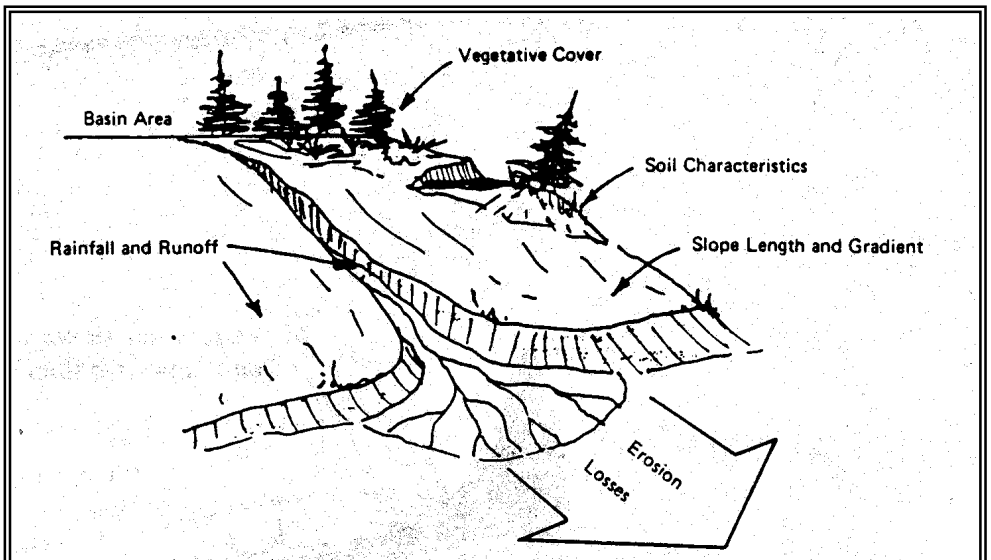

Figure 7.1.2 Factors Influencing Erosion Potential

Collection, analysis, and use of detailed information specific to the construction site for each of these four factors can provide the basis for an effective construction stormwater management system.

The first three factors, soil characteristics, vegetative cover, and topography are constant with respect to time until altered intentionally by construction. The designer, developer, and construction contractor should have a working knowledge about and control over these factors to provide high quality stormwater results.

The fourth factor, climate, is predictable by season, historical record, and probability of occurrence. While predicting a rainfall event is not possible, many of the impacts of construction stormwater runoff can be minimized or avoided by planning appropriate seasonal construction activity and using properly designed BMPs.

Soil Characteristics

The vulnerability of soil to erode is determined by soil characteristics: particle size, organic content, soil structure, and soil permeability.

Particle Size: Soils that contain high proportions of silt and very fine sand are generally the most erodible and are easily detached and carried away. The erodibility of soil decreases as the percentage of clay or organic matter increases; clay acts as a binder and tends to limit erodibility. Most soils with a high clay content are relatively resistant to detachment by rainfall and runoff. Once eroded, however, clays are easily suspended and settle out very slowly.

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Organic Content: Organic matter creates a favorable soil structure, improving its stability and permeability. This increases infiltration capacity, delays the start of erosion, and reduces the amount of runoff.

The addition of organic matter increases infiltration rates (and, therefore, reduces surface flows and erodibility), water retention, pollution control, and pore space for oxygen.

Soil Structure: Organic matter, particle size, and gradation affect soil structure, which is the arrangement, orientation, and organization of particles. When the soil system is protected from compaction, the natural decomposition of plant debris on the surface maintains a healthy soil food web. The soil food web in turn maintains the porosity both on and below the surface.

Soil Permeability: Soil permeability refers to the ease with which water passes through a given soil. Well-drained and well-graded gravel and gravel mixtures with little or no silt are the least erodible soils. Their high permeability and infiltration capacity helps prevent or delay runoff.

Vegetative Cover

Vegetative cover plays an extremely important role in controlling erosion by:

- Shielding the soil surface from the impact of falling rain.
- Slowing the velocity of runoff, thereby permitting greater infiltration.
- Maintaining the soil's capacity to absorb water through root zone uptake and evapotranspiration.
- Holding soil particles in place.

Erosion can be significantly reduced by limiting the removal of existing vegetation and by decreasing duration of soil exposure to rainfall events. Give special consideration to the preservation of existing vegetative cover on areas with a high potential for erosion such as erodible soils, steep slopes, drainage ways, and the banks of streams. When it is necessary to remove vegetation, such as for noxious weed eradication, the area should be revegetated at the earliest possible window for successful seeding.

Topography

The size, shape, and slope of a construction site influence the amount and rate of stormwater runoff. Each site's unique dimensions and characteristics provide both opportunities for and limitations on the use of specific control measures to protect vulnerable areas from high runoff amounts and rates. Slope length, steepness, and surface texture are key elements in determining the volume and velocity of runoff. As slope length and/or steepness increase the rate of runoff and the potential for erosion increases. Slope orientation is also a factor in determining erosion potential. For example, a slope that faces south and contains droughty

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soils may provide such poor growing conditions that vegetative cover will be difficult to re-establish.

Climate

Seasonal temperatures and the frequency, intensity, and duration of rainfall are fundamental factors in determining amounts of runoff. As the volume and the velocity of runoff increase, the likelihood of erosion increases. Where storms are frequent, intense, or of long duration, erosion risks are high. Seasonal changes in temperature, as well as variations in rainfall, help to define the period of the year when there is a high erosion risk. When precipitation falls as snow, no erosion occurs. In the spring, melting snow adds to the runoff, and erosion potential will be higher. If the ground is still partially frozen, infiltration capacity is reduced. Eastern Washington is characterized in fall, winter, and spring by storms that are mild and long lasting. The fall and early winter events may saturate the soil profile and fill stormwater detention ponds, increasing the amount of runoff leaving the construction site. Shorter-term, more intense storms occur in the summer. These storms can cause problems if adequate BMPs have not been installed on-site.

7.2 Planning

This section provides an overview of the important components of, and the process for, developing and implementing a Construction Stormwater Pollution Prevention Plan (SWPPP).

- Section 7.2.1 contains general guidelines with which site planners should become familiar. It describes criteria for plan format and content and ideas for improved plan effectiveness.
- Section 7.2.2 outlines and describes a recommended step-by-step procedure for developing a Construction SWPPP from data collection to finished product. This procedure is written in general terms to be applicable to all types of projects.
- Section 7.2.3 includes a checklist for developing a Construction SWPPP.
- Design standards and specifications for Best Management Practices (BMPs) referred to in this section are found in Section 7.3 of this chapter.

The Construction SWPPP may be a subset of the Stormwater Site Plan (SSP) or construction plan set. Full details on how to integrate the Construction SWPPP with the SSP are provided in Chapter 3.

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7.2.1 General SWPPP Guidelines

What is a Construction Stormwater Pollution Prevention Plan?

The Construction SWPPP is a document that describes the potential for pollution problems on a construction project. The Construction SWPPP includes a narrative, drawings and details that explains and illustrates the measures to be taken on the construction site to control those problems. The local permitting authority must review these Construction SWPPPs. The local permitting authority may allow single-family home construction projects to prepare a simpler Construction SWPPP, consisting of a checklist and a plot plan.

While it is a good idea to include standards and specifications from the Construction SWPPP in the contract documents, the Construction SWPPP should be a separate document that can stand alone. The Construction SWPPP must be located on the construction site or within reasonable access to the site for construction and inspection personnel.

As site work progresses, the plan must be modified to reflect changing site conditions, subject to the rules for plan modification by the local permitting authority.

The owner or lessee of the land being developed has the responsibility for Construction SWPPP preparation and submission to local authorities. The owner or lessee may designate someone (i.e., an engineer, architect, contractor, etc.) to prepare the Construction SWPPP, but he/she retains the ultimate responsibility.

What is an Adequate SWPPP?

The Construction SWPPP must contain sufficient information to satisfy the Plan Approval Authority of the local government that the problems of pollution have been adequately addressed for the proposed project. An adequate Construction SWPPP includes a narrative and drawings. The narrative is a written statement to explain and justify the pollution prevention decisions made for a particular project. The narrative contains concise information about existing site conditions, construction schedules, and other pertinent items that are not contained on the drawings. The drawings and notes describe where and when the various BMPs should be installed, the performance the BMPs are expected to achieve, and actions to be taken if the performance goals are not achieved.

On construction sites that discharge to surface water, the primary concern in the preparation of the Construction SWPPP is compliance with Washington State Water Quality Standards. Each of the 12 elements must be included in the Construction SWPPP unless an element is determined not to be applicable to the project and the exemption is justified in the narrative. The step–by-step procedure outlined in Section 7.2.2 is recommended for the development of the Construction SWPPPs. The

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checklists in Section 7.2.3 may be helpful in preparing and reviewing the Construction SWPPP.

On construction sites that infiltrate all stormwater runoff, the primary concern in the preparation of the Construction SWPPP is the protection of the infiltration facilities from fine sediments during the construction phase and protection of ground water from other pollutants. Several of the other elements are very important at these sites as well, such as marking the clearing limits, establishing the construction access, and managing the project.

BMP Standards and Specifications

Chapter 6 contains standards and specifications for the BMPs referred to in this chapter. Wherever any of these BMPs are to be employed on a site, the specific title and number of the BMP should be clearly referenced in the narrative and marked on the drawings.

The standards and specifications in Chapter 6 are not intended to limit any innovative or creative effort to effectively control erosion and sedimentation. In those instances where appropriate BMPs are not in this chapter, experimental management practices can be considered. Minor modifications to standard practices may also be employed. However, such practices must be approved by the plan approval authority of the local government before they may be used. All experimental management practices and modified standard practices are required to achieve the same or better performance than the BMPs listed in Chapter 6.

General Principles

The following general principles should be applied to the development of the Construction SWPPP.

- The duff layer, native topsoil, and natural vegetation should be retained in an undisturbed state to the maximum extent practicable.
- Prevent pollutant release. Select source control BMPs as a first line of defense. Prevent erosion rather than treat turbid runoff.
- Select BMPs depending on site characteristics (topography, drainage, soil type, ground cover, and critical areas) and the construction plan.
- Divert runoff away from exposed areas wherever possible. Keep clean water clean.
- Limit the extent of clearing operations and phase construction operations.
- Before reseeding a disturbed soil area, amend all soils with compost wherever topsoil has been removed.

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- Incorporate natural drainage features whenever possible, using adequate buffers and protecting areas where flow enters the drainage system.
- Minimize slope length and steepness.
- Reduce runoff velocities to prevent channel erosion.
- Prevent the tracking of sediment off-site.
- Select appropriate BMPs for the control of pollutants other than sediment.
- Be realistic about the limitations of controls that you specify and the operation and maintenance of those controls. Anticipate what can go wrong, how you can prevent it from happening, and what will need to be done to fix it.

7.2.2 Step-By-Step Procedure

There are three basic steps in producing a Construction SWPPP:

- Step 1 - Data Collection
- Step 2 - Data Analysis
- Step 3 - Construction SWPPP Development and Implementation
- Steps 1 and 2 described below are intended for projects that are disturbing one acre or more. The local permitting authority may allow single-family home construction projects to prepare a simpler Construction SWPPP, consisting of a checklist and a plot plan.

Step 1 - Data Collection

Evaluate existing site conditions and gather information that will help develop the most effective Construction SWPPP. The information gathered should be explained in the narrative and shown on the drawings.

Topography: Prepare a topographic drawing of the site to show the existing contour elevations at intervals of 1 to 5 feet depending upon the slope of the terrain.

Drainage: Locate and clearly mark existing drainage swales and patterns on the drawing, including existing storm drain pipe systems.

Soils: Identify and label soil type(s) and erodibility (low, medium, high or an index value from the NRCS manual) on the drawing. Soils information can be obtained from a soil survey if one has been published for the county. If a soil survey is not available, a request can be made to a district Natural Resource Conservation Service Office.

Soils should be characterized for permeability, percent organic matter, and effective depth by a qualified soil professional or engineer. These qualities should be expressed in averaged or nominal terms for the subject

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site or project. This information is frequently available in published literature.

Ground Cover: Label existing vegetation on the drawing. Such features as tree clusters, grassy areas, and unique or sensitive vegetation should be shown. Unique vegetation may include existing trees above a given diameter. Local requirements regarding tree preservation should be investigated. In addition, existing denuded or exposed soil areas should be indicated.

Critical Areas: Delineate critical areas adjacent to or within the site on the drawing. Such features as steep slopes, streams, floodplains, lakes, wetlands, sole source aquifers, and geologic hazard areas, etc., should be shown. Delineate set backs and buffer limits for these features on the drawings. Other related jurisdictional boundaries such as Shorelines Management and the Federal Emergency Management Agency (FEMA) base floodplain should also be shown on the drawings.

Adjacent Areas: Identify existing buildings, roads, and facilities adjacent to or within the project site on the drawings. Identify existing and proposed utility locations, construction clearing limits and erosion and sediment control BMPs on the drawings.

Existing Encumbrances: Identify wells, existing and abandoned septic drainfield, utilities, and site constraints.

Precipitation Records: Determine the average monthly rainfall and rainfall intensity for the required design storm events. These records may be available from the local permitting agency.

Step 2 - Data Analysis

Consider the data collected in Step 1 to visualize potential problems and limitations of the site. Determine those areas that have critical erosion hazards. The following are some important factors to consider in data analysis:

Topography: The primary topographic considerations are slope steepness and slope length. Because of the effect of runoff, the longer and steeper the slope, the greater the erosion potential. Erosion potential should be determined by a qualified engineer, soil professional, or certified erosion control specialist.

Drainage: Natural drainage patterns that consist of overland flow, swales and depressions should be used to convey runoff through the site to avoid constructing an artificial drainage system. Man-made ditches and waterways will become part of the erosion problem if they are not properly stabilized. Care should also be taken to ensure that increased runoff from the site will not erode or flood the existing natural drainage system. Possible sites for temporary stormwater retention and detention should be considered at this point.

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Direct construction away from areas of saturated soil - areas where ground water may be encountered - and critical areas where drainage will concentrate. Preserve natural drainage patterns on the site.

Soils: Evaluate soil properties such as surface and subsurface runoff characteristics, depth to impermeable layer, depth to seasonal ground water table, permeability, shrink-swell potential, texture, settleability, and erodibility. Develop the Construction SWPPP based on known soil characteristics. Infiltration sites should be properly protected from clay and silt which will reduce infiltration capacities.

Ground Cover: Ground cover is the most important factor in terms of preventing erosion. Existing vegetation that can be saved will prevent erosion better than constructed BMPs. Trees and other vegetation protect the soil structure. If the existing vegetation cannot be saved, consider such practices as phasing construction, temporary seeding, and mulching. Phasing of construction involves stabilizing one part of the site before disturbing another. In this way, the entire site is not disturbed at once.

Critical Areas: Critical areas may include flood hazard areas, mine hazard areas, slide hazard areas, sole source aquifers, wetlands, streambanks, fish-bearing streams, and other water bodies. Any critical areas within or adjacent to the development should exert a strong influence on land development decisions. Critical areas and their buffers shall be delineated on the drawings and clearly flagged in the field. Chain link fencing maybe more useful than flagging to assure that equipment operators stay out of critical areas. Only unavoidable work should take place within critical areas and their buffers. Such unavoidable work will require special BMPs, permit restrictions, and mitigation plans.

Adjacent Areas: An analysis of adjacent properties should focus on areas upslope and downslope from the construction project. Water bodies that will receive direct runoff from the site are a major concern. The types, values, and sensitivities of and risks to downstream resources, such as private property, stormwater facilities, public infrastructure, or aquatic systems, should be evaluated. Erosion and sediment controls should be selected accordingly.

Precipitation Records: Refer to Chapter 4 to determine the required rainfall records and the method of analysis for design of BMPs.

Timing of the Project: An important consideration in selecting BMPs is the timing and duration of the project. Projects that will proceed during the wet season and projects that will last through several seasons must take all necessary precautions to remain in compliance with the water quality standards.

Step 3 - Construction SWPPP Development and Implementation

After collecting and analyzing the data to determine the site limitations, the project proponent can then develop a Construction SWPPP. Each of

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the twelve elements below must be considered and included in the Construction SWPPP unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the narrative of the SWPPP; the project proponent is granted flexibility in selecting appropriate BMPs to implement each element.

Element #1: Mark Clearing Limits

- Prior to beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area. These shall be clearly marked, both in the field and on the plans, to prevent damage and offsite impacts.
- Plastic, metal, or stake wire fence may be used to mark the clearing limits.
- Suggested BMPs:

  BMP C101: Preserving Natural Vegetation
  BMP C102: Buffer Zones
  BMP C103: High Visibility Plastic or Metal Fence
  BMP C104: Stake and Wire Fence

Element #2: Establish Construction Access

- Construction vehicle access and exit shall be limited to one route if possible, or two for linear projects such as roadways where one access is necessary for large equipment maneuvering.
- Access points shall be stabilized with quarry spall or crushed rock to minimize the tracking of sediment onto public roads.
- Wheel wash or tire baths should be located on site, if applicable.
- Roads shall be cleaned thoroughly at the end of each day. Sediment shall be removed from roads by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area. Street washing will be allowed only after sediment is removed in this manner.
- Street wash wastewater shall be controlled by pumping back on site or otherwise be prevented from discharging into systems tributary to state surface waters.
- Construction access restoration shall be equal to or better than the pre-construction condition.
- Suggested BMPs:

  BMP C105: Stabilized Construction Entrance
  BMP C106: Wheel Wash
  BMP C107: Construction Road/Parking Area Stabilization

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Element #3: Control Flow Rates

- Properties and waterways downstream from development sites shall be protected from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site, as required by local plan approval authority.
- Downstream analysis is necessary if changes in offsite flows could impair or alter conveyance systems, streambanks, bed sediment, or aquatic habitat. Refer to Chapter 3 for additional details on how to perform a downstream analysis.
- The local permitting agency may require pond designs that provide additional or different stormwater flow control. This may be necessary to address local conditions or to protect properties and waterways downstream from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site.
- If permanent infiltration ponds are used for flow control during construction, these facilities should be protected from siltation during the construction phase.
- Suggested BMPs:

  BMP C240: Sediment Trap
  BMP C241: Temporary Sediment Pond
  Refer to Chapter 5, Detention, Retention and Infiltration Design

Element #4: Install Sediment Controls

- The duff layer, native top soil, and natural vegetation shall be retained in an undisturbed state to the maximum extent practicable.
- Prior to leaving a construction site or prior to discharge to an infiltration facility, stormwater runoff from disturbed areas shall pass through a sediment pond or other appropriate sediment removal BMP. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of Element #3, bullet #1. Full stabilization means concrete or asphalt paving; quarry spalls used as ditch lining; or the use of rolled erosion products, a bonded fiber matrix product, or vegetative cover in a manner that will fully prevent soil erosion. The Local Permitting Authority shall inspect and approve areas fully stabilized by means other than pavement or quarry spalls.
- BMPs intended to trap sediment on site shall be constructed as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.
- Earthen structures such as dams, dikes, and diversions shall be seeded and mulched according to the timing indicated in Element #5.

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- BMPs intended to trap sediment on site shall be located in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages, often during non-storm events, in response to rain event changes in stream elevation or wetted area.
- Suggested BMPs:

  BMP C230: Straw Bale Barrier
  BMP C231: Brush Barrier
  BMP C232: Gravel Filter Berm
  BMP C233: Silt Fence
  BMP C234: Vegetated Strip
  BMP C235: Straw Wattles
  BMP C240: Sediment Trap
  BMP C241: Temporary Sediment Pond
  BMP C250: Construction Stormwater Chemical Treatment
  BMP C251: Construction Stormwater Filtration

Element #5: Stabilize Soils

- Exposed and unworked soils shall be temporarily or permanently stabilized as soon as practicable by application of effective BMPs that protect the soil from the erosive forces of raindrops, flowing water, and wind.
- No soils should remain exposed and unworked for more than the time periods set forth below to prevent wind and water erosion. This stabilization requirement applies to all soils on site, whether at final grade or not. This time limit may be adjusted by the local permitting authority if it can be shown that local precipitation data justifies a different standard.

  All of eastern Washington, except for the Central Basin (Region 2, see Figure 1.B or Figure 4.3.1):

  - During the regional dry season (June 1 through September 30): 14 days
  - During the regional wet season (October 1 through May 31): 7 days

  Central Basin (Region 2, see Figure 1.B or Figure 4.3.1):

  - During the regional dry season (June 1 through September 30): 30 days
  - During the regional wet season (October 1 through May 31): 14 days
- Wind erosion/dust control measures shall be implemented and maintained immediately following initial disturbance or exposure of all soils on site, whether at final grade or not.

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- Fugitive dust from construction activity shall be controlled in accordance with the requirements of state and/or local air quality authorities with jurisdiction over the project area.
- In arid and semi-arid regions with an average annual rainfall of 20 inches or less, the operator shall initiate soil stabilization measures on inactive areas as soon as practicable. This stabilization requirement applies to all soils on site, whether at final grade or not.
- In regions with an average annual rainfall of more than 20 inches, the operator shall initiate soil stabilization measures on inactive areas as soon as practicable, but in no case more than 14 days after the construction activity has temporarily or permanently ceased. This stabilization requirement applies to all soils on site, whether at final grade or not. This time limit may be adjusted by the local permitting authority if it can be shown that the average time between storm events justifies a different standard.
- Applicable practices include, but are not limited to, temporary and permanent seeding, sodding, mulching, plastic covering, erosion control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base on areas to be paved, and dust control.
- Selected soil stabilization measures shall be appropriate for the time of year, site conditions, estimated duration of use, and the water quality impacts that stabilization agents may have on downstream waters or ground water.
- Soil stockpiles shall be stabilized and protected with sediment trapping measures.
- Linear construction activities such as right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities, shall be conducted to meet the soil stabilization requirement. Contractors shall install the bedding materials, roadbeds, structures, pipelines, or utilities and re-stabilize the disturbed soils in accordance with bullet #2 above.
- Suggested BMPs:

  BMP C120: Temporary and Permanent Seeding
  BMP C121: Mulching
  BMP C122: Nets and Blankets
  BMP C123: Plastic Covering
  BMP C124: Sodding
  BMP C125: Topsoiling
  BMP C126: Polyacrylamide for Soil Erosion Protection
  BMP C130: Surface Roughening
  BMP C131: Gradient Terraces

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BMP C140: Dust Control
BMP C180: Small Project Construction Stormwater Pollution Prevention

Element #6: Protect Slopes

- Design, construct, and phase cut and fill slopes in a manner that will minimize erosion.
- Consider soil type and its potential for erosion.
- Reduce slope runoff velocities by reducing continuous length of slope with terracing and diversions, reduce slope steepness, and roughen slope surface.
- Divert upslope drainage and run-on waters with interceptors at top of slope. Stormwater from off site should be handled separately from stormwater generated on the site. Diversion of off-site stormwater around the site may be a viable option. Diverted flows shall be redirected to the natural drainage location at or before the property boundary.
- Contain downslope collected flows in pipes, slope drains, or protected channels. Check dams shall be used within channels that are cut down a slope.
- Provide drainage to remove ground water intersecting the slope surface of exposed soil areas.
- Excavated material shall be placed on the uphill side of trenches, consistent with safety and space considerations.
- Stabilize soils on slopes, as specified in Element #5.
- Suggested BMPs:

  BMP C120: Temporary and Permanent Seeding
  BMP C130: Surface Roughening
  BMP C131: Gradient Terraces
  BMP C200: Interceptor Dike and Swale
  BMP C201: Grass-Lined Channels
  BMP C204: Pipe Slope Drains
  BMP C205: Subsurface Drains
  BMP C206: Level Spreader
  BMP C207: Check Dams
  BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam)

Element #7: Protect Drain Inlets

- Storm drain inlets operable during construction shall be protected so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.

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- Approach roads shall be kept clean. Sediment and street wash water shall not be allowed to enter storm drains without prior and adequate treatment unless treatment is provided before the storm drain discharges to waters of the state.
- Inlets should be inspected weekly at a minimum and daily during storm events. Inlet protection devices shall be cleaned or removed and replaced before six inches of sediment can accumulate.
- Suggested BMP:

  BMP C220: Storm Drain Inlet Protection

Element #8: Stabilize Channels and Outlets

- Temporary on-site conveyance channels shall be designed, constructed, and stabilized to prevent erosion from the expected flow velocity of a 2-year, 24-hour frequency storm for the developed condition.
- Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent streambanks, slopes, and downstream reaches shall be provided at the outlets of all conveyance systems.
- Suggested BMPs:

  BMP C202: Channel Lining
  BMP C209: Outlet Protection

Element #9: Control Pollutants

- All pollutants, including waste materials and demolition debris, that occur on site during construction shall be handled and disposed of in a manner that does not cause contamination of stormwater. Woody debris may be chopped and spread on site.
- Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site (see Chapter 173-304 WAC for the definition of inert waste).
- Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.
- Wheel wash or tire bath wastewater shall be discharged to a separate on-site treatment system or to the sanitary sewer.

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- Application of agricultural chemicals including fertilizers and pesticides shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations for application rates and procedures shall be followed.
- BMPs shall be used to prevent or treat contamination of stormwater runoff by pH modifying sources. These sources include bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, and concrete pumping and mixer washout waters. Stormwater discharges shall not cause a violation of the water quality standard for pH in the receiving water.
- Suggested BMPs: See also Chapter 8 – Source Control

  BMP C151: Concrete Handling
  BMP C152: Sawcutting and Surfacing Pollution Prevention

Element #10: Control De-Watering

- Foundation, vault, and trench de-watering water shall be discharged into a controlled conveyance system prior to discharge to a sediment pond. Channels shall be stabilized, as specified in Element #8.
- Clean, non-turbid de-watering water, such as well-point ground water, can be discharged to systems tributary to state surface waters, as specified in Element #8, provided the de-watering flow does not cause erosion or flooding of receiving waters. These clean waters should not be routed through stormwater sediment ponds.
- Highly turbid or contaminated dewatering water from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam shall be handled separately from stormwater.
- Other disposal options, depending on site constraints, may include:
  - Infiltration,
  - transport off site in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters,
  - on-site treatment using chemical treatment or other suitable treatment technologies,
  - sanitary sewer discharge with local sewer district approval, or use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

Element #11: Maintain BMPs

- Temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance

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of their intended function. Maintenance and repair shall be conducted in accordance with BMPs.

- Sediment control BMPs shall be inspected by project personnel (preferably by the designated Erosion and Sediment Control Lead) weekly or after a runoff-producing storm event during the dry season; and daily during the wet season. The inspection frequency for stabilized, inactive sites shall be determined by the local permitting authority based on the level of soil stability and potential for adverse environmental impacts.
- Temporary erosion and sediment control BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

Element #12: Manage the Project

- Phasing of Construction

  Development projects shall be phased where feasible in order to prevent, to the maximum extent practicable, the transport of sediment from the development site during construction. Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase.

  Clearing and grading activities for developments will be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. When establishing these permitted clearing and grading areas, consideration shall be given to minimizing removal of existing trees and minimizing disturbance and compaction of native soils except as needed for building purposes. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas as may be required by local jurisdictions, shall be delineated on the site plans and the development site.

- Seasonal Work Limitations

  The local permitting authority may impose a seasonal limitation on site disturbance. This decision may be based upon local weather conditions and/or other information provided including site conditions, the extent and nature of the construction activity, and the proposed erosion and sediment control measures.

  The local permitting authority may take enforcement action - such as a notice of violation, administrative order, penalty, or stop-work order under the following circumstances:

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- If, during the course of any construction activity or soil disturbance during the seasonal limitation period, sediment leaves the construction site causing a violation of the surface water quality standard; or
- If clearing and grading limits or erosion and sediment control measures shown in the approved plan are not maintained.

The following activities are exempt from the seasonal clearing and grading limitations:

- Routine maintenance and necessary repair of erosion and sediment control BMPs;
- Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil; and
- Activities where there is one hundred percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

- Coordination with Utilities and Other Contractors

  The primary project proponent shall evaluate, with input from utilities and other contractors, the stormwater management requirements for the entire project, including the utilities, when preparing the Construction SWPPP.

- Inspection and Monitoring

  All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function.

  A Qualified Professional in Erosion and Sediment Control shall be identified in the Construction SWPPP and shall be on-site or on-call at all times. See BMP C160 for qualifications.

  Sampling and analysis of the stormwater discharges from a construction site may be necessary on a case-by-case basis to ensure compliance with standards. The local permitting authority may establish monitoring and reporting requirements when necessary.

  Whenever inspection and/or monitoring reveals that the BMPs identified in the Construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, the SWPPP shall be modified, as appropriate, in a timely manner.

- Maintenance of the Construction SWPPP

  The Construction SWPPP shall be retained on-site or within reasonable access to the site. The Construction SWPPP shall be

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modified whenever there is a significant change in the design, construction, operation, or maintenance of any BMP.

7.2.3 Checklists for Construction SWPPPs

The Construction SWPPP consists of two parts: a narrative and the drawings. The two checklists in this section can be used to determine if all the major items are included in the Construction SWPPP.

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Construction Stormwater Pollution Prevention Plan Checklist

Project Name: _____

City/County Reference No. _____

Review Date: _____

On-site Inspection Review Date: _____

Construction SWPPP Reviewer: _____

Section I – Construction SWPPP Narrative

1. Construction Stormwater Pollution Prevention Elements

___ a. Describe how each of the Construction Stormwater Pollution Prevention Elements has been addressed though the Construction SWPPP.
___ b. Identify the type and location of BMPs used to satisfy the required element.
___ c. Written justification identifying the reason an element is not applicable to the proposal.

> 12 Required Elements – Construction Stormwater Pollution Prevention Plan:

___ 1. Mark Clearing Limits.
___ 2. Establish Construction Access.
___ 3. Control Flow Rates.
___ 4. Install Sediment Controls.
___ 5. Stabilize Soils.
___ 6. Protect Slopes.
___ 7. Protect Drain Inlets.
___ 8. Stabilize Channels and Outlets.
___ 9. Control Pollutants.
___10. Control De-Watering.
___11. Maintain BMPs
___12. Manage the Project.

2. Project Description

___ a. Total Project Area.
___ b. Total proposed impervious area.
___ c. Total proposed area to be disturbed.
___ d. Total volumes of proposed cuts/fill.

3. Existing Site Conditions

___ a. Description of the existing topography.
___ b. Description of the existing vegetation.
___ c. Description of the existing drainage.

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Construction Stormwater Pollution Prevention Plan Checklist

Project Name: _____

City/County Reference No. _____

4. Adjacent Areas

___ I. Description of adjacent areas which may be affected by site disturbance

___ a. Streams
___ b. Lakes
___ c. Wetlands
___ d. Residential Areas
___ e. Roads
___ f. Other

___ II. Description of the downstream drainage path leading from the site to the receiving body of water. (Minimum distance of 400 yards.)

5. Critical Areas

___ a. Description of critical areas that are on or adjacent to the site.
___ b. Description of special requirements for working in or near critical areas.

6. Soils

___ Description of on-site soils.

___ a. Soil name(s)
___ b. Soil mapping unit
___ c. Erodibility
___ d. Settleability
___ e. Permeability
___ f. Depth
___ g. Texture
___ h. Soil Structure

7. Erosion Problem Areas

___ Description of potential erosion problems on site.

8. Construction Phasing

___ a. Construction sequence
___ b. Construction phasing (if proposed)

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Construction Stormwater Pollution Prevention Plan Checklist

Project Name: _____

City/County Reference No. _____

9. Construction Schedule

___ I. Provide a proposed construction schedule.

___ II. Wet Season Construction Activities

___ a. Proposed wet season construction activities.
___ b. Proposed wet season construction restraints for environmentally sensitive/critical areas.

10. Financial/Ownership Responsibilities

___ a. Identify the property owner responsible for the initiation of bonds and/or other financial securities.
___ b. Describe bonds and/or other evidence of financial responsibility for liability associated with erosion and sedimentation impacts.

11. Engineering Calculations

___ 1. Provide Design Calculations.

___ a. Sediment Ponds/Traps
___ b. Diversions
___ c. Waterways
___ d. Runoff/Stormwater Detention Calculations

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Construction Stormwater Pollution Prevention Plan Checklist

Project Name: _____

City Reference No. _____

Section II - Erosion and Sediment Control Plans

1. General

___ a. Vicinity Map
___ b. City/County of _____ Clearing and Grading Approval Block
___ c. Erosion and Sediment Control Notes

2. Site Plan

___ a. Legal description of subject property.
___ b. North Arrow
___ c. Indicate boundaries of existing vegetation, e.g. tree lines, pasture areas, etc.
___ d. Identify and label areas of potential erosion problems.
___ e. Identify any on-site or adjacent critical areas and associated buffers.
___ f. Identify FEMA base flood boundaries and Shoreline Management boundaries (if applicable)
___ g. Show existing and proposed contours.
___ h. Indicate drainage basins and direction of flow for individual drainage areas.
___ i. Label final grade contours and identify developed condition drainage basins.
___ j. Delineate areas that are to be cleared and graded.
___ k. Show all cut and fill slopes indicating top and bottom of slope catch lines.

3. Conveyance Systems

___ a. Designate locations for swales, interceptor trenches, or ditches.
___ b. Show all temporary and permanent drainage pipes, ditches, or cut-off trenches required for erosion and sediment control.
___ c. Provide minimum slope and cover for all temporary pipes or call out pipe inverts.
___ d. Show grades, dimensions, and direction of flow in all ditches, swales, culverts and pipes.
___ e. Provide details for bypassing off-site runoff around disturbed areas.
___ f. Indicate locations and outlets of any dewatering systems.

4. Location of Detention BMPs

___ a. Identify location of detention BMPs.

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Construction Stormwater Pollution Prevention Plan Checklist

Project Name: _____

City/County Reference No. _____

5. Erosion and Sediment Control Facilities

___ a. Show the locations of sediment trap(s), pond(s), pipes and structures.
___ b. Dimension pond berm widths and inside and outside pond slopes.
___ c. Indicate the trap/pond storage required and the depth, length, and width dimensions.
___ d. Provide typical section views through pond and outlet structure.
___ e. Provide typical details of gravel cone and standpipe, and/or other filtering devices.
___ f. Detail stabilization techniques for outlet/inlet.
___ g. Detail control/restrictor device location and details.
___ h. Specify mulch and/or recommended cover of berms and slopes.
___ i. Provide rock specifications and detail for rock check dam(s), if applicable.
___ j. Specify spacing for rock check dams as required.
___ k. Provide front and side sections of typical rock check dams.
___ l. Indicate the locations and provide details and specifications for silt fabric.
___ m. Locate the construction entrance and provide a detail.

6. Detailed Drawings

___ a. Any structural practices used that are not referenced in the Ecology Manual should be explained and illustrated with detailed drawings.

7. Other Pollutant BMPs

___ a. Indicate on the site plan the location of BMPs to be used for the control of pollutants other than sediment, e.g. concrete wash water.

8. Monitoring Locations

___ a. Indicate on the site plan the water quality sampling locations to be used for monitoring water quality on the construction site. Sampling stations shall be located upstream and downstream of the project site.

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7.3 Standards and Specifications for Best Management Practices

Best Management Practices (BMPs) are defined as schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices, that when used singly or in combination, prevent or reduce the release of pollutants to waters of Washington State. This section contains standards and specifications for temporary BMPs to be used as applicable during the construction phase of a project.

- Section 7.3.1 contains the standards and specifications for Source Control BMPs.
- Section 7.3.2 contains the standards and specifications for Runoff Conveyance and Treatment BMPs.

The standards for each individual BMP are divided into four sections:

1. Purpose
2. Conditions of Use
3. Design and Installation Specifications
4. Maintenance Standards

Note that the "Conditions of Use" always refers to site conditions. As site conditions change, BMPs must be changed to remain in compliance.

Information on streambank stabilization is available in the Integrated Streambank Protection Guidelines, Washington State Department of Fish and Wildlife, 2000.

It has been suggested that a listing of the construction stormwater BMPs, included in this chapter, be added here for the final document.

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7.3.1 Source Control BMPs

BMP C101: Preserving Natural Vegetation Purpose

Purpose: The purpose of preserving natural vegetation is to reduce erosion wherever practicable. Limiting site disturbance is the single most effective method for reducing erosion. For example, conifers can hold up to about 50 percent of all rain that falls during a storm. Up to 20-30 percent of this rain may never reach the ground but is taken up by the tree or evaporates. Another benefit is that the rain held in the tree can be released slowly to the ground after the storm.

Conditions of Use:

- Natural vegetation should be preserved on steep slopes, near perennial and intermittent watercourses or swales, and on building sites in wooded areas.
- As required by local governments.

Design and Installation Specifications: Natural vegetation can be preserved in natural clumps or as individual trees, shrubs and vines.

The preservation of individual plants is more difficult because heavy equipment is generally used to remove unwanted vegetation. The points to remember when attempting to save individual plants are:

- Is the plant worth saving? Consider the location, species, size, age, vigor, and the work involved. Local governments may also have ordinances to save natural vegetation and trees.
- Fence or clearly mark areas around trees that are to be saved. It is preferable to keep ground disturbance away from the trees at least as far out as the dripline.

Plants need protection from three kinds of injuries:

- Construction Equipment - This injury can be above or below the ground level. Damage results from scarring, cutting of roots, and compaction of the soil. Placing a fenced buffer zone around plants to be saved prior to construction can prevent construction equipment injuries.
- Grade Changes - Changing the natural ground level will alter grades, which affects the plant's ability to obtain the necessary air, water, and minerals. Minor fills usually do not cause problems although sensitivity between species does vary and should be checked. Trees can tolerate fill of 6 inches or less. For shrubs and other plants, the fill should be less.

  When there are major changes in grade, it may become necessary to supply air to the roots of plants. This can be done by placing a layer of gravel and a tile system over the roots before the fill is made. A tile system protects a tree from a raised grade. The tile system should be laid out on the original grade leading from a dry well around the tree trunk. The system should then be covered with small stones to allow air to circulate over the root area.

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Lowering the natural ground level can seriously damage trees and shrubs. The highest percentage of the plant roots are in the upper 12 inches of the soil and cuts of only 2-3 inches can cause serious injury. To protect the roots it may be necessary to terrace the immediate area around the plants to be saved. If roots are exposed, construction of retaining walls may be needed to keep the soil in place. Plants can also be preserved by leaving them on an undisturbed, gently sloping mound. To increase the chances for survival, it is best to limit grade changes and other soil disturbances to areas outside the dripline of the plant.

- Excavations - Protect trees and other plants when excavating for drainfields, power, water, and sewer lines. Where possible, the trenches should be routed around trees and large shrubs. When this is not possible, it is best to tunnel under them. This can be done with hand tools or with power augers. If it is not possible to route the trench around plants to be saved, then the following should be observed:
    - Cut as few roots as possible. When you have to cut, cut clean. Paint cut root ends with a wood dressing like asphalt base paint.
    - Backfill the trench as soon as possible.
    - Tunnel beneath root systems as close to the center of the main trunk to preserve most of the important feeder roots.

Some problems that can be encountered are:

- In general, most trees native to Eastern Washington do not readily adjust to major changes in environment and special care should be taken to protect these trees.
- The danger of windthrow increases where dense stands of coniferous trees have been thinned.
- Cottonwoods, maples, and willows have water-seeking roots. These can cause trouble in sewer lines and infiltration fields. On the other hand, they thrive in high moisture conditions that other trees would not.
- Thinning operations in pure or mixed stands of Grand fir, Pacific silver fir, Noble fir, Sitka spruce, Western red cedar, Western hemlock, Pacific dogwood, and Red alder can cause serious disease problems. Disease can become established through damaged limbs, trunks, roots, and freshly cut stumps. Diseased and weakened trees are also susceptible to insect attack.

Maintenance Standards:

- Inspect flagged and/or fenced areas regularly to make sure flagging or fencing has not been removed or damaged. If the flagging or fencing has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.
- If tree roots have been exposed or injured, “prune” cleanly with an appropriate pruning saw or loppers directly above the damaged roots and

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recover with native soils.

BMP C102: Buffer Zones

Purpose: An undisturbed area or strip of natural vegetation or an established suitable planting that will provide a living filter to reduce soil erosion and runoff velocities.

Conditions of Use: Natural buffer zones are used along streams, wetlands and other bodies of water that need protection from erosion and sedimentation. Vegetative buffer zones can be used to protect natural swales and can be incorporated into the natural landscaping of an area.

Critical-areas buffer zones should not be used as sediment treatment areas. These areas shall remain completely undisturbed. The local permitting authority may expand the buffer widths temporarily to allow the use of the expanded area for removal of sediment.

Design and Installation Specifications

- Preserving natural vegetation or plantings in clumps, blocks, or strips is generally the easiest and most successful method.
- Leave all unstable steep slopes in natural vegetation.
- Mark clearing limits and keep all equipment and construction debris out of the natural areas. Steel construction fencing is the most effective method in protecting sensitive areas and buffers. Alternatively, wire-backed silt fence on steel posts is marginally effective. Flagging alone is typically not effective.
- Keep all excavations outside the dripline of trees and shrubs.
- Do not push debris or extra soil into the buffer zone area because it will cause damage from burying and smothering.
- Vegetative buffer zones for streams, lakes or other waterways shall be established by the local permitting authority or other state or federal permits or approvals.

Maintenance Standards:

- Inspect the area frequently to make sure flagging remains in place and the area remains undisturbed.

BMP C103: High Visibility Plastic or Metal Fence

Purpose: Fencing is intended to: (1) restrict clearing to approved limits; (2) prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed; (3) limit construction traffic to designated construction entrances or roads; and, (4) protect areas where marking with survey tape may not provide adequate protection.

Conditions of Use: To establish clearing limits, plastic or metal fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left uncleared.

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- As necessary to control vehicle access to and on the site.

Design and Installation Specifications:

- High visibility plastic fence shall be composed of a high-density polyethylene material and shall be at least four feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every six inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stringer to prevent sagging between posts. The fence color shall be high visibility orange. The fence tensile strength shall be 360 lbs./ft. using the ASTM D4595 testing method.
- Metal fences shall be designed and installed according to the manufacturer's specifications.
- Metal fences shall be at least 3 feet high and must be highly visible.
- Fences shall not be wired or stapled to trees.

Maintenance Standards:

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

BMP C104: Stake and Wire Fence

Purpose: Fencing is intended to: (1) restrict clearing to approved limits; (2) prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed; (3) limit construction traffic to designated construction entrances or roads; and, (4) protect any areas where marking with survey tape may not provide adequate protection.

Conditions of Use: To establish clearing limits, stake or wire fence may be used:

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

Design and Installation Specifications:

- See Figure 7.3.1 for details.
- More substantial fencing shall be used if the fence does not prevent encroachment into those areas that are not to be disturbed.

Maintenance Standards:

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

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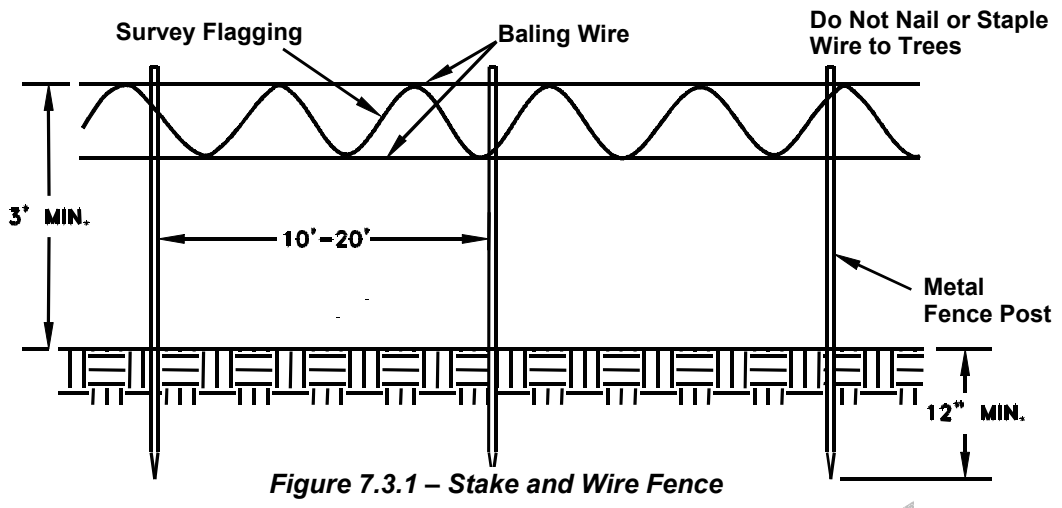

Figure 7.3.1 – Stake and Wire Fence

BMP C105: Stabilized Construction Entrance

Purpose: Construction entrances are stabilized to reduce the amount of sediment transported onto paved roads by vehicles or equipment by constructing a stabilized pad of quarry spalls at entrances to construction sites.

Conditions of Use:

- Construction entrances shall be stabilized wherever traffic will be leaving a construction site and traveling on paved roads or other paved areas within 1,000 feet of the site.
- On large commercial, highway, and road projects, the designer should include enough extra materials in the contract to allow for additional stabilized entrances not shown in the initial Construction SWPPP. It is difficult to determine exactly where access to these projects will take place; additional materials will enable the contractor to install them where needed.

Design and Installation:

- See Figure 7.3.2 for details.
- A separation geotextile shall be placed under the spalls to prevent fine sediment from pumping up into the rock pad. The geotextile shall meet the following standards:

Grab Tensile Strength (ASTM D4751)	200 psi min.
Grab Tensile Elongation (ASTM D4632)	30% max.
Mullen Burst Strength (ASTM D3786-80a)	400 psi min.
AOS (ASTM D4751)	20-45 (U.S. standard sieve size)

Maintenance Standards: Quarry spalls (or hog fuel) shall be added if the pad is no longer in accordance with the specifications.

- If the entrance is not preventing sediment from being tracked onto pavement,

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then alternative measures to keep the streets free of sediment shall be used. This may include street sweeping, an increase in the dimensions of the entrance, or the installation of a wheel wash.

- Any sediment that is tracked onto pavement shall be removed by shoveling or street sweeping. The sediment collected by sweeping shall be removed or stabilized on site. The pavement shall not be cleaned by washing down the street, except when sweeping is ineffective and there is a threat to public safety. If it is necessary to wash the streets, the construction of a small sump shall be considered. The sediment would then be washed into the sump where it can be controlled.
- Any quarry spalls that are loosened from the pad, which end up on the roadway shall be removed immediately.
- If vehicles are entering or exiting the site at points other than the construction entrance(s), fencing (see BMPs C103 and C104) shall be installed to control traffic.
- Upon project completion and site stabilization, all construction accesses intended as permanent access for maintenance shall be permanently stabilized.

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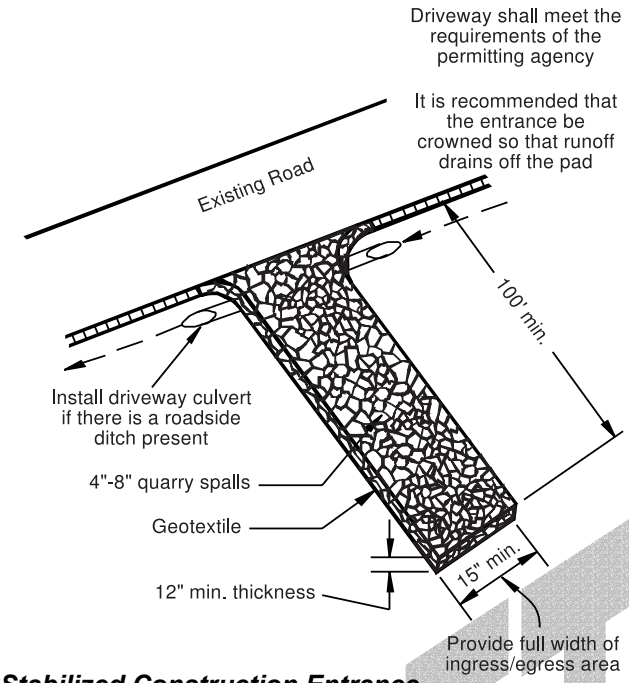

Figure 7.3.2 - Stabilized Construction Entrance

BMP C106: Wheel Wash

Purpose: Wheel washes reduce the amount of sediment transported onto paved roads by motor vehicles.

Conditions of Use:

- When a stabilized construction entrance (see BMP C105) is not preventing sediment from being tracked onto pavement.
- Wheel washing is generally an effective BMP when installed with careful attention to topography. For example, a wheel wash can be detrimental if installed at the top of a slope abutting a right-of-way where the water from the dripping truck can run unimpeded into the street.
- Pressure washing combined with an adequately sized and surfaced pad with direct drainage to a large 10-foot x 10-foot sump can be very effective.

Design and Installation Specifications: Suggested details are shown in Figure 7.3.3. The Local Permitting Authority may allow other designs. A minimum of 6 inches of asphalt treated base (ATB) over crushed base material or 8 inches over a good subgrade is recommended to pave the wheel wash.

Maintenance Standards:

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

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- Wheel wash or tire bath wastewater shall be discharged to a separate on-site treatment system, such as closed-loop recirculation or land application, or to the sanitary sewer with proper local sewer district approval.

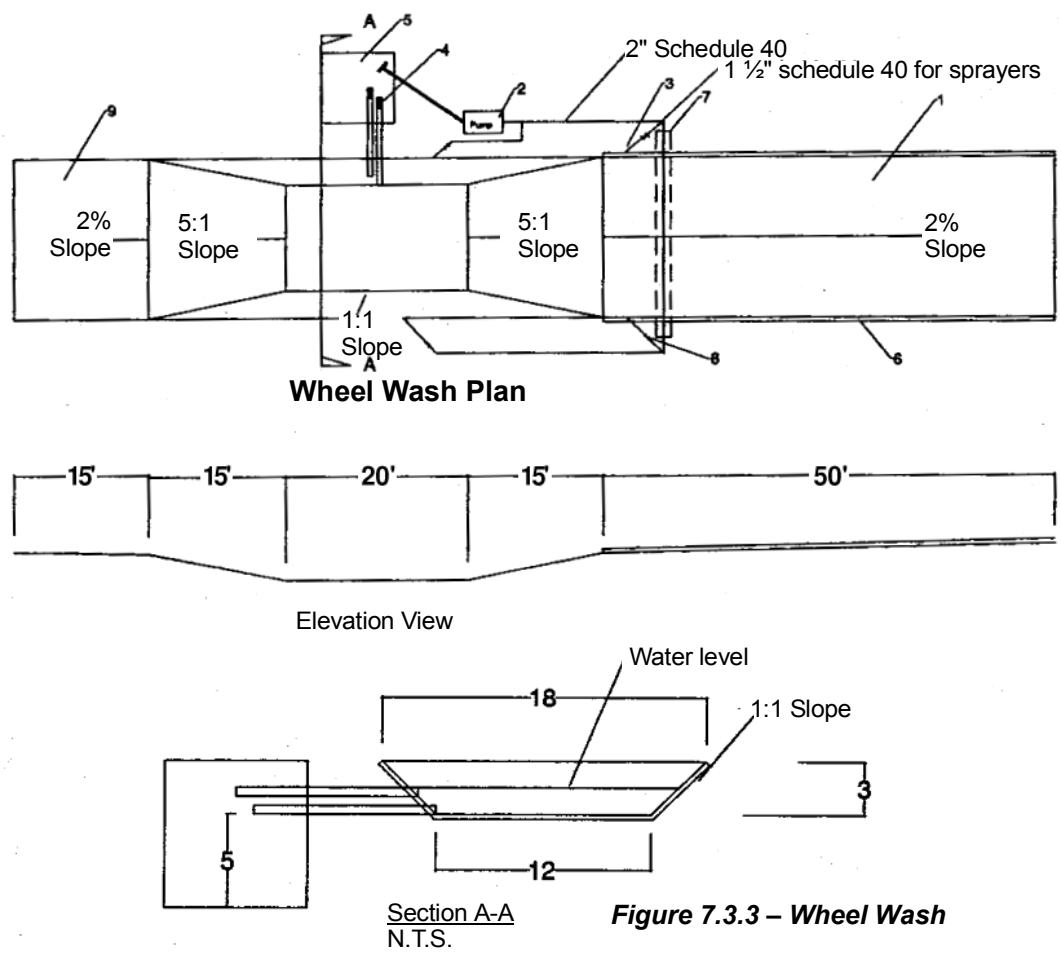

Figure 7.3.3 – Wheel Wash

Notes for Figure 7.3.3 – Wheel Wash:

1. Asphalt construction entrance 6 in. asphalt treated base (ATB).
2. 3-inch trash pump with floats on the suction hose.
3. Midpoint spray nozzles, if needed.
4. 6-inch sewer pipe with butterfly valves. Bottom one is a drain. Locate top pipe's invert 1 foot above bottom of wheel wash.
5. 8 foot x 8 foot sump with 5 feet of catch. Build so can be cleaned with trackhoe.
6. Asphalt curb on the low road side to direct water back to pond.
7. 6-inch sleeve under road.
8. Ball valves.
9. 15 foot. ATB apron to protect ground from splashing water.

BMP C107: Construction Road/Parking Area Stabilization

Purpose: Stabilizing subdivision roads, parking areas, and other onsite vehicle transportation routes immediately after grading reduces erosion caused by construction traffic or runoff.

Conditions of Use:

- Roads or parking areas shall be stabilized wherever they are constructed, whether permanent or temporary, for use by construction traffic.
- Fencing (see BMPs C103 and C104) shall be installed, if necessary, to limit the access of vehicles to only those roads and parking areas that are stabilized.

Design and Installation Specifications:

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

Maintenance Standards:

- Inspect stabilized areas regularly, especially after large storm events.

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- Crushed rock, gravel base, hog fuel, etc. shall be added as required to maintain a stable driving surface and to stabilize any areas that have eroded.
- Following construction, these areas shall be restored to pre-construction condition or better to prevent future erosion.

BMP C120: Temporary and Permanent Seeding

Purpose: Seeding is intended to reduce erosion by stabilizing exposed soils. A well-established vegetative cover is one of the most effective methods of reducing erosion.

Conditions of Use:

- Seeding may be used throughout the project on disturbed areas that have reached final grade of that will remain unworked for more than 30 days.
- Channels that will be vegetated should be installed before major earthwork and hydroseeded with a Bonded Fiber Matrix. The vegetation should be well established (i.e., 75 percent cover) before water is allowed to flow in the ditch. With channels that will have high flows, erosion control blankets should be installed over the hydroseed. If vegetation cannot be established from seed before water is allowed in the ditch, sod should be installed in the bottom of the ditch over hydromulch and blankets.
- Retention/detention ponds should be seeded as required.
- Mulch is required at all times because it protects seeds from heat, moisture loss, and transport due to runoff.
- All disturbed areas should be reviewed prior to the beginning of the optimum seeding windows. Seeding shall be completed during the earliest optimal seeding window following disturbance. Otherwise, vegetation will not become established well enough to provide more than average soil protection.
- At final site stabilization, all disturbed areas not otherwise vegetated or stabilized shall be seeded and mulched. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions or geotextiles) which will prevent erosion.

Design and Installation Specifications:

- Seeding should be done during those seasons most conducive to growth and will vary with the climate conditions of the region. Local experience should be used to determine the appropriate seeding periods.
- The optimum seeding windows for Eastern Washington are April 1 through June 30 and September 1 through October 15. Seeding that occurs between July 1 and August 30 will require irrigation until 75 percent grass cover is established.
- To prevent seed from being washed away, confirm that all required surface

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water control measures have been installed.

- The seedbed should be firm and rough. All soil should be roughened no matter what the slope. If compaction is required for engineering purposes, slopes must be track walked before seeding. Backblading or smoothing of slopes greater than 4:1 is not allowed if they are to be seeded.
- New and more effective restoration-based landscape practices rely on deeper incorporation than that provided by a simple single-pass rototilling treatment. Wherever practical the subgrade should be initially ripped to improve long-term permeability, infiltration, and water inflow qualities. At a minimum, permanent areas shall use soil amendments to achieve organic matter and permeability performance defined in engineered soil/landscape systems. For systems that are deeper than 8 inches, the rototilling process should be done in multiple lifts, or the prepared soil system shall be prepared properly and then placed to achieve the specified depth.
- Because it is hard to generalize soil and climate conditions in eastern Washington, the project proponent is directed to check with the local Conservation District for appropriate seed and fertilizer types and application rates for their site.
- Organic matter is the most appropriate form of "fertilizer" because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form. A natural system typically releases 20 to 10 percent of its nutrients annually. Chemical fertilizers have since been formulated to simulate what organic matter does naturally.
- It is recommended that areas being seeded for final landscaping conduct soil tests to determine the exact type and quantity of fertilizer needed. This will prevent the over-application of fertilizer. Fertilizer should not be added to the hydromulch machine and agitated more than 20 minutes before it is to be used. If agitated too much, the slow release coating is destroyed.
- There are numerous products available on the market which take the place of chemical fertilizers. A good, long-acting, slow release organic fertilizer is Biosol mix 7-2-3. It can be applied dry or with a hydroseeder. It should not be applied over snow. .
- Hydroseed applications shall include a minimum of 1,500 lbs. per acre of mulch with 3 percent tackifier. Mulch may be made up of 100 percent fibers made of wood, recycled cellulose, compost or blends of these. Tackifier shall be plant-based, such as guar or alpha plantago, or chemical-based such as polyacrylamide or polymers. Any mulch or tackifier product used shall be installed per manufacturer's instructions. Generally, mulches come in 40 to 50 lb. bags. Seed and fertilizer are added at time of application.
- Mulch is always required for seeding. Mulch can be applied on top of the seed or simultaneously by hydroseeding.
- On steep slopes, Bonded Fiber Matrix (BFM) or Mechanically Bonded Fiber

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Matrix (MBFM) products should be used. BFM/MBFM products are applied at a minimum rate of 3,000 lbs. per acre of mulch with approximately 10 percent tackifier. Application is made so that a minimum of 95 percent soil coverage is achieved. Numerous products are available commercially and should be installed per manufacturer's instructions. Most products required 24 to 36 hours to cure before a rainfall and cannot be installed on wet or saturated soils. Generally, these products come in 40 to 50 lb. bags and include all necessary ingredients except for seed and fertilizer.

BFMs and MBFMs have some advantages over blankets:

- No surface preparation required;
- Can be installed via helicopter in remote areas;
- On slopes steeper than 2:5:1, blanket installers may need to be roped and harnessed for safety;
- They are at least $1,000 per acre cheaper installed.

- When installing seed via hydroseeding operations, only about 1/3 of the seed actually ends up in contact with the soil surface. This reduces the ability to establish a good stand of grass quickly. One way to overcome this is to increase seed quantities by up to 50 percent.
- Vegetation establishment can also be enhanced by dividing the hydromulch operation into two phases:
  - Phase 1 – Install all seed and fertilizer with 25 to 30 percent mulch and tackifier onto the soil in the first lift;
  - Phase 2 – Install the remaining mulch and tackifier over the first lift.

  An alternative is to install the mulch, seed, fertilizer, and tackifier in one lift. Then, spread or blow straw over the top of the hydromulch at a rate of about 800 to 1000 lbs. per acre. Hold straw in place with a standard tackifier. Both of these approaches will increase cost moderately but will greatly improve and enhance vegetative establishment. The increased cost may be offset by the reduced need for:

  - Irrigation
  - Reapplication of mulch
  - Repair of failed slope surfaces

  This technique works with standard hydromulch (1,500 lbs. per acre minimum) and BFM/MBFMs (3,000 lbs. per acre minimum).

  In most cases, the shear strength of blankets is not a factor when used on slopes, only when used in channels. BFMs and MBFMs are good alternatives to blankets in most situations where vegetation establishment is the goal.

  - Areas to be permanently landscaped shall provide a healthy topsoil or

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amend the existing soil to reduce the need for fertilizers, improve overall topsoil quality, provide for better plant health and vitality, improve hydrologic characteristics, and reduce the need for irrigation.

- Areas that already have good topsoil, such as undisturbed areas, do not require soil amendments.
- Areas that will be seeded only and not landscaped may need compost or meal-based mulch included in the hydroseed in order to establish vegetation. Native topsoil should be re-installed on the disturbed soil surface before application.
- Seed that is installed as a temporary measure may be installed by hand if it will be covered by straw, mulch, or topsoil. Seed that is installed as a permanent measure may be installed by hand on small areas (usually less than one acre) that will be covered with mulch, topsoil, or erosion blankets. The seed mixes listed below include recommended mixes for both temporary and permanent seeding. Alternative seed mixes approved by the local authority may be used.

  Local suppliers or the local conservation district should be consulted for their recommendations because the appropriate mix and application rate depend on a variety of factors, including location, exposure, soil type, slope, and expected foot traffic.

Table 7.3.1 shows the composition of a standard mix for those areas where only a temporary vegetative cover is required.

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Table 7.3.1
Temporary Erosion Control Seed Mix

	% Weight	% Purity	% Germination
Creeping Red fescue	30	95	85
Durar hard fescue	20	95	85
Talon Canada bluegrass	20	92	80
Annual ryegrass	20	98	90
Quatro sheep fescue	10	95	80

Table 7.3.2 shows the composition of a recommended mix for landscaping seed.

Table 7.3.2
Landscaping Seed Mix

	% Weight	% Purity	% Germination
Parkland Kentucky bluegrass	15	98	85
Denim Kentucky bluegrass	15	98	85
Superblue Kentucky bluegrass	10	98	85
Longfellow chewings fescue	20	95	85
PhD Perennial ryegrass blend	40	97	85

Table 7.3.3 shows the composition of a mix for dry situations. This mix requires very little maintenance.

Table 7.3.3
Low-Grow Mix/Meadow Mix

	% Weight	% Purity	% Germination
Talon Canada bluegrass	50	92	80
Durar hard fescue	25	95	85
Quatro sheep fescue	15	95	80
Longfellow chewings fescue	20	95	85

Table 7.3.4 shows the composition of a mix recommended for bioswales and other intermittently wet areas.

Table 7.3.4
Bioswale Seed Mix

	% Weight	% Purity	% Germination
Talon Canada bluegrass	25	92	80
Durar hard fescue	25	95	85
Quatro sheep fescue	25	95	80
Longfellow chewings fescue	25	95	85

Table 7.3.5 shows the composition of a recommended mix for low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Other mixes may be appropriate, depending on the soil type and hydrology of the area.

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Table 7.3.5
Wet Area Seed Mix

	% Weight	% Purity	% Germination
Redtop	10	92	80
Tall fescue	40	98	85
Orchard grass	40	90	80
Timothy	10	97	80

Maintenance Standards:

- Any seeded areas that fail to establish at lest 80 percent cover (100 percent cover for areas that receive sheet or concentrated flows) shall be reseeded. If reseeding is ineffective, an alternate method, such as sodding, mulching, or nets/blankets, shall be used. If winter weather prevents adequate grass growth, this time limit may be relaxed at the discretion of the local authority when sensitive areas would otherwise be protected.
- After adequate cover is achieved, any areas that experience erosion shall be reseeded and protected by mulch. If the erosion problem is drainage related, the problem shall be fixed and the eroded area reseeded and protected by mulch.
- Seeded areas shall be supplied with adequate moisture, but not watered to the extent that is causes runoff.

BMP C121: Mulching

Purpose: The purpose of mulching soils is to provide immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture, holding fertilizer, seed, and topsoil in place, and moderating soil temperatures. There is an enormous variety of mulches that can be used. Only the most common types are discussed in this section.

Conditions of Use: As a temporary cover measure, mulch should be used:

- On disturbed areas that require cover measures for less than 30 days.
- As a cover for seed during the wet season and during the hot summer months.
- During the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.
- Mulch may be applied at any time of the year and must be refreshed periodically.

Design and Installation Specifications:

- For mulch materials, application rates, and specifications see Table 4.7.

  Note: *Thicknesses may be increased for disturbed areas in or near sensitive areas or other areas highly susceptible to erosion.*

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- Mulch seed within the ordinary high-water mark of surface waters should be selected to minimize potential flotation of organic matter. Composted organic materials have higher specific gravities (densities) than straw, wood, or chipped material.

Maintenance Standards:

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

BMP C122: Nets and Blankets

Purpose: Erosion control nets and blankets are intended to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become well established. In addition, some nets and blankets can be used to permanently reinforce turf to protect drainage ways during high flows. Nets (commonly called matting) are strands of material woven into an open, but high-tensile strength net (for example, coconut fiber matting). Blankets are strands of material that are not tightly woven, but instead form a layer of interlocking fibers, typically held together by a biodegradable or photodegradable netting (for example, excelsior or straw blankets). They generally have lower tensile strength than nets, but cover the ground more completely. Coir (coconut fiber) fabric comes as both nets and blankets.

Conditions of Use: Erosion control nets and blankets should be used:

- To aid permanent vegetated stabilization of slopes 2H:1V or greater and with more than 10 feet of vertical relief.
- For drainage ditches and swales (highly recommended). The application of appropriate netting or blanket to drainage ditches and swales can protect bare soil from channelized runoff while vegetation is established. Nets and blankets also can capture a great deal of sediment due to their open, porous structure. Synthetic nets and blankets can be used to permanently stabilize channels and may provide a cost-effective, environmentally preferable alternative to riprap. 100 percent synthetic blankets manufactured for use in ditches may be easily reused as temporary ditch liners.

Disadvantages of blankets include:

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

Advantages of blankets include:

- Can be installed without mobilizing special equipment;
- Can be installed by anyone with minimal training;

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- Can be installed in stages or phases as the project progresses;
- Seed and fertilizer can be hand-placed by the installers as they progress down the slope;
- Can be installed in any weather;
- There are numerous types of blankets that can be designed with various parameters in mind. Those parameters include: fiber blend, mesh strength, longevity, biodegradability, cost, and availability.

Design and Installation Specifications:

- See Figure 7.3.4 and Figure 7.3.5 for typical orientation and installation of blankets used in channels and as slope protection. Note: these are typical only; all blankets must be installed per manufacturer's installation instructions.
- Installation is critical to the effectiveness of these products. If good ground contact is not achieved, runoff can concentrate under the product, resulting in significant erosion.
- Installation of Blankets on Slopes:
  1. Complete final grade and track walk up and down the slope.
  2. Install hydromulch with seed and fertilizer.
  3. Dig a small trench, approximately 12 inches wide by 6 inches deep along the top of the slope.
  4. Install the leading edge of the blanket into the small trench and staple approximately every 18 inches. NOTE: Staples are metal, "U"-shaped, and a minimum of 6 inches long. Longer staples are used in sandy soils. Biodegradable stakes are also available.
  5. Roll the blanket slowly down the slope as installer walks backwards. NOTE: The blanket rests against the installer's legs. Staples are installed as the blanket is unrolled. It is critical that the proper staple pattern is used for the blanket being installed. The blanket is not to be allowed to roll down the slope on its own as this stretches the blanket making it impossible to maintain soil contact. In addition, no one is allowed to walk on the blanket after it is in place.
  6. If the blanket is not long enough to cover the entire slope length, the trailing edge of the upper blanket should overlap the leading edge of the lower blanket and be stapled. On steeper slopes, this overlap should be installed in a small trench, stapled, and covered with soil.
- With the variety of products available, it is impossible to cover all the details of appropriate use and installation. Therefore, it is critical that the design engineer consults the manufacturer's information and that a site visit takes place in order to insure that the product specified is appropriate. Information

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is also available at the following web sites:

WSDOT: http://www.wsdot.wa.gov/eesc/environmental/WQTESC.htm

Texas Transportation Institute: http://www.dot.state.tx.us/insdtdot/orgchart/cmd/erosion/contents.htm

- Jute matting must be used in conjunction with mulch (BMP C121). Excelsior, woven straw blankets and coir (coconut fiber) blankets may be installed without mulch. There are many other types of erosion control nets and blankets on the market that may be appropriate in certain circumstances.
- In general, most nets (e.g., jute matting) require mulch in order to prevent erosion because they have a fairly open structure. Blankets typically do not require mulch because they usually provide complete protection of the surface.
- Extremely steep, unstable, wet, or rocky slopes are often appropriate candidates for use of synthetic blankets, as are riverbanks, beaches and other high-energy environments. If synthetic blankets are used, the soil should be hydromulched first.
- 100 percent biodegradable blankets are available for use in sensitive areas. These organic blankets are usually held together with a paper or fiber mesh and stitching which may last up to a year.
- Most netting used with blankets is photodegradable, meaning they break down under sunlight (not UV stabilized). However, this process can take months or years even under bright sun. Once vegetation is established, sunlight does not reach the mesh. It is not uncommon to find non-degraded netting still in place several years after installation. This can be a problem if maintenance requires the use of mowers or ditch cleaning equipment. In addition, birds and small animals can become trapped in the netting.

Maintenance Standards:

- Good contact with the ground must be maintained, and erosion must not occur beneath the net or blanket.
- Any areas of the net or blanket that are damaged or not in close contact with the ground shall be repaired and stapled.
- If erosion occurs due to poorly controlled drainage, the problem shall be fixed and the eroded area protected.

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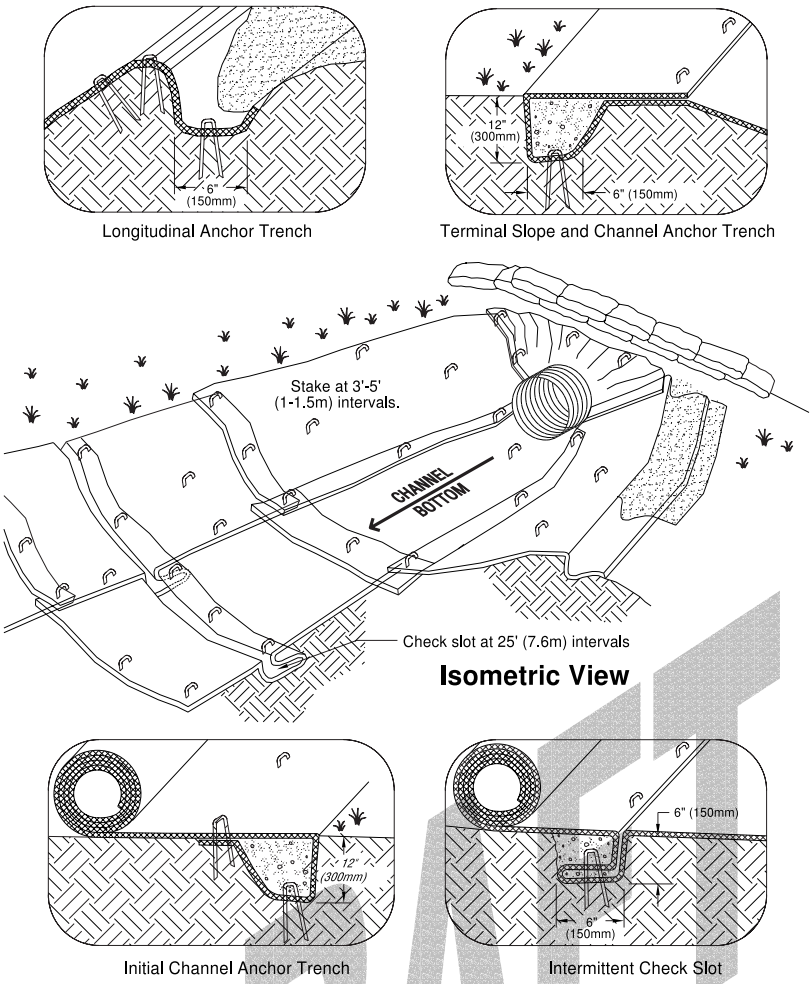

NOTES:
1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.

Figure 7.3.4 - Channel Installation

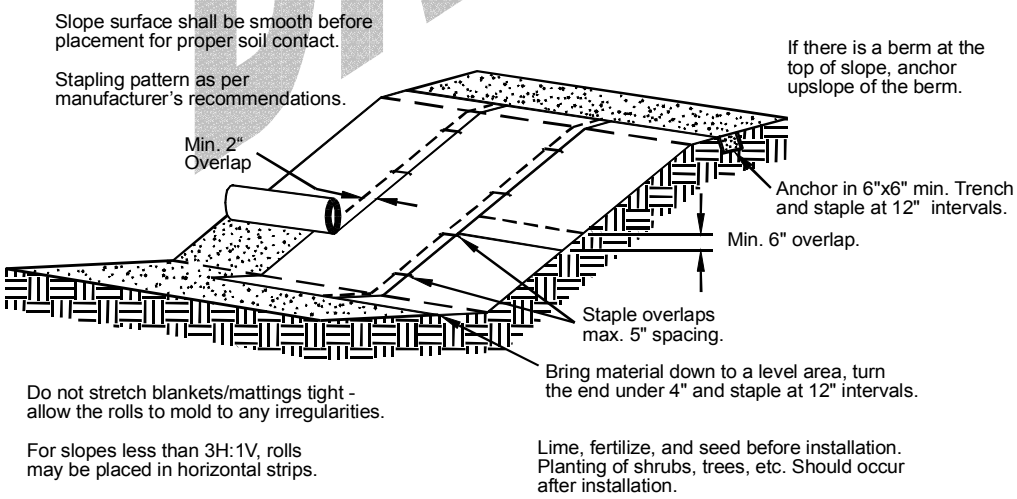

Figure 7.3.5 - Slope Installation

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BMP C123: Plastic Covering

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

Conditions of Use:

- Plastic covering may be used on disturbed areas that require cover measures for less than 30 days, except as stated below.
- Plastic is particularly useful for protecting cut and fill slopes and stockpiles. Note: The relatively rapid breakdown of most polyethylene sheeting makes it unsuitable for long-term (greater than six months) applications.
- Clear plastic sheeting can be used over newly-seeded areas to create a greenhouse effect and encourage grass growth if the hydroseed was installed too late in the season to establish 75 percent grass cover, or if the wet season started earlier than normal. Clear plastic should not be used for this purpose during the summer months because the resulting high temperatures can kill the grass.
- Due to rapid runoff caused by plastic sheeting, this method shall not be used upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- While plastic is inexpensive to purchase, the added cost of installation, maintenance, removal, and disposal make this an expensive material, up to $1.50-2.00 per square yard.
- Whenever plastic is used to protect slopes, water collection measures must be installed at the base of the slope. These measures include plastic-covered berms, channels, and pipes used to covey clean rainwater away from bare soil and disturbed areas. At no time is clean runoff from a plastic covered slope to be mixed with dirty runoff from a project.
- Other uses for plastic include:
  - Temporary ditch liner;
  - Pond liner in temporary sediment pond;
  - Liner for bermed temporary fuel storage area if plastic is not reactive to the type of fuel being stored;
  - Emergency slope protection during heavy rains; and,
  - Temporary drainpipe ("elephant trunk") used to direct water.

Design and Installation Specifications:

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

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

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

Maintenance Standards:

- Torn sheets must be replaced and open seams repaired.
- If the plastic begins to deteriorate due to ultraviolet radiation, it must be completely removed and replaced.
- When the plastic is no longer needed, it shall be completely removed.
- Dispose of old tires appropriately.

BMP C124: Sodding

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

Conditions of Use: Sodding may be used in the following areas:

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

Design and Installation Specifications:

- Sod shall be free of weeds, of uniform thickness (approximately 1-inch thick), and shall have a dense root mat for mechanical strength.
- The following steps are recommended for sod installation:
- Shape and smooth the surface to final grade in accordance with the approved grading plan. The swale needs to be overexcavated 4 to 6 inches below

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design elevation to allow room for placing soil amendment and sod.

- Amend 4 inches (minimum) of compost into the top 8 inches of the soil if the organic content of the soil is less than ten percent or the permeability is less than 0.6 inches per hour. Compost used should meet Ecology publication 98-3894-038 specifications for Grade A quality compost.
- Fertilize according to the supplier's recommendations.
- Work lime and fertilizer 1 to 2 inches into the soil, and smooth the surface.
- Lay strips of sod beginning at the lowest area to be sodded and perpendicular to the direction of water flow. Wedge strips securely into place. Square the ends of each strip to provide for a close, tight fit. Stagger joints at least 12 inches. Staple on slopes steeper than 3H:1V. Staple the upstream edge of each sod strip.
- Roll the sodded area and irrigate.
- When sodding is carried out in alternating strips or other patterns, seed the areas between the sod immediately after sodding.

Maintenance Standards:

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

BMP C125: Topsoiling

Purpose: To provide a suitable growth medium for final site stabilization with vegetation. While not a permanent cover practice in itself, topsoiling is an integral component of providing permanent cover in those areas where there is an unsuitable soil surface for plant growth. Native soils and disturbed soils that have been organically amended not only retain much more stormwater, but they also serve as effective biofilters for urban pollutants and, by supporting more vigorous plant growth, reduce the water, fertilizer and pesticides needed to support installed landscapes. Topsoil does not include any subsoils but only the material from the top several inches including organic debris.

Conditions of Use:

- Native soils should be left undisturbed to the maximum extent practicable. Native soils disturbed during clearing and grading should be restored, to the maximum extent practicable, to a condition where moisture-holding capacity is equal to or better than the original site conditions. This criterion can be met by using on-site native topsoil, incorporating amendments into on-site soil, or importing blended topsoil.
- Topsoiling is a required procedure when establishing vegetation on shallow soils, and soils of critically low pH (high acid) levels.
- Stripping of existing, properly functioning soil system and vegetation for the

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purpose of topsoiling during construction is not acceptable. If an existing soil system is functioning properly it shall be preserved in its undisturbed and uncompacted condition.

- Depending on where the topsoil comes from, or what vegetation was on site before disturbance, invasive plant seeds may be included and could cause problems for establishing native plants, landscaped areas, or grasses.
- Topsoil from the site will contain mycorrhizal bacteria that are necessary for healthy root growth and nutrient transfer. These native mycorrhiza are acclimated to the site and will provide optimum conditions for establishing grasses. Commercially available mycorrhiza products should be used when topsoil is brought in from off-site.

Design and Installation Specifications: If topsoiling is to be done, the following items should be considered:

- Maximize the depth of the topsoil wherever possible to provide the maximum possible infiltration capacity and beneficial growth medium. Topsoil depth shall be at least 8 inches with a minimum organic content of 10 percent dry weight and pH between 6.0 and 8.0 or matching the pH of the undisturbed soil. This can be accomplished either by returning native topsoil to the site and/or incorporating organic amendments. Organic amendments should be incorporated to a minimum 8-inch depth except where tree roots or other natural features limit the depth of incorporation. Subsoils below the 12-inch depth should be scarified at least 2 inches to avoid stratified layers, where feasible. The decision to either layer topsoil over a subgrade or incorporate topsoil into the underlying layer may vary depending on the planting specified.
- If blended topsoil is imported, then fines should be limited to 25 percent passing through a 200 sieve.
- The final composition and construction of the soil system will result in a natural selection or favoring of certain plant species over time. For example, recent practices have shown that incorporation of topsoil may favor grasses, while layering with mildly acidic, high-carbon amendments may favor more woody vegetation.
- Locate the topsoil stockpile so that it meets specifications and does not interfere with work on the site. It may be possible to locate more than one pile in proximity to areas where topsoil will be used.
- Allow sufficient time in scheduling for topsoil to be spread prior to seeding, sodding, or planting.
- Care must be taken not to apply to subsoil if the two soils have contrasting textures. Sandy topsoil over clayey subsoil is a particularly poor combination, as water creeps along the junction between the soil layers and causes the topsoil to slough.
- If topsoil and subsoil are not properly bonded, water will not infiltrate the

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soil profile evenly and it will be difficult to establish vegetation. The best method to prevent a lack of bonding is to actually work the topsoil into the layer below for a depth of at least 6 inches.

- Ripping or re-structuring the subgrade may also provide additional benefits regarding the overall infiltration and interflow dynamics of the soil system.
- Field exploration of the site shall be made to determine if there is surface soil of sufficient quantity and quality to justify stripping. Topsoil shall be friable and loamy (loam, sandy loam, silt loam, sandy clay loam, clay loam). Areas of natural ground water recharge should be avoided.
- Stripping shall be confined to the immediate construction area. A 4- to 6-inch stripping depth is common, but depth may vary depending on the particular soil. All surface runoff control structures shall be in place prior to stripping.

One way of stockpiling topsoil is as follows:

- Side slopes of the stockpile shall not exceed 2:1.
- An interceptor dike with gravel outlet and silt fence should surround all topsoil stockpiles between October 1 and April 30. Between May 1 and September 30, an interceptor dike with gravel outlet and silt fence shall be installed if the stockpile will remain in place for a longer period of time than active construction grading.
- Erosion control seeding or covering with clear plastic or other mulching materials of stockpiles should be completed within 7 days (October 1 through April 30) or 30 days (May 1 through September 30) of the formation of the stockpile. Native topsoil stockpiles shall not be covered with plastic.
- Topsoil shall not be placed while in a frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed sodding or seeding.
- Previously established grades on the areas to be topsoiled shall be maintained according to the approved plan.
- When native topsoil is to be stockpiled and reused the following should apply to ensure that the mycorrhizal bacterial, earthworms, and other beneficial organisms will not be destroyed:
    1. Topsoil is to be re-installed within 4 to 6 weeks;
    2. Topsoil is not to become saturated with water;
    3. Plastic cover is not allowed.

Maintenance Standards:

- Inspect stockpiles regularly, especially after large storm events. Stabilize any areas that have eroded.

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BMP C126: Polyacrylamide for Soil Erosion Protection

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

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

Conditions of Use

Conditions of Use: PAM shall not be directly applied to water or allowed to enter a water body. In areas that drain to a sediment pond, PAM can be applied to bare soil under the following conditions:

- During rough grading operations.
- Staging areas.
- Balanced cut and fill earthwork.
- Haul roads prior to placement of crushed rock surfacing.
- Compacted soil roadbase.
- Stockpiles.
- After final grade and before paving or final seeding and planting.
- Pit sites.

Sites having a winter shut down. In the case of winter shut down, or where soil will remain unworked for several months, PAM should be used together with mulch.

Design and Installation Specifications: PAM may be applied in dissolved form with water, or it may be applied in dry, granular or powdered form. The preferred application method is the dissolved form.

PAM is to be applied at a maximum rate of ½ pound PAM per 1000 gallons water per 1 acre of bare soil. Table 7.3.8 and Figure 7.3.6 can be used to determine the PAM and water application rate for a disturbed soil area. Higher concentrations of PAM do not provide any additional effectiveness.

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Table 7.3.8
PAM and Water Application Rates

Disturbed Area (ac)	PAM (lbs)	Water (gal)
0.50	0.25	500
1.00	0.50	1,000
1.50	0.75	1,500
2.00	1.00	2,000
2.50	1.25	2,500
3.00	1.50	3,000
3.50	1.75	3,500
4.00	2.00	4,000
4.50	2.25	4,500
5.00	2.50	5,000

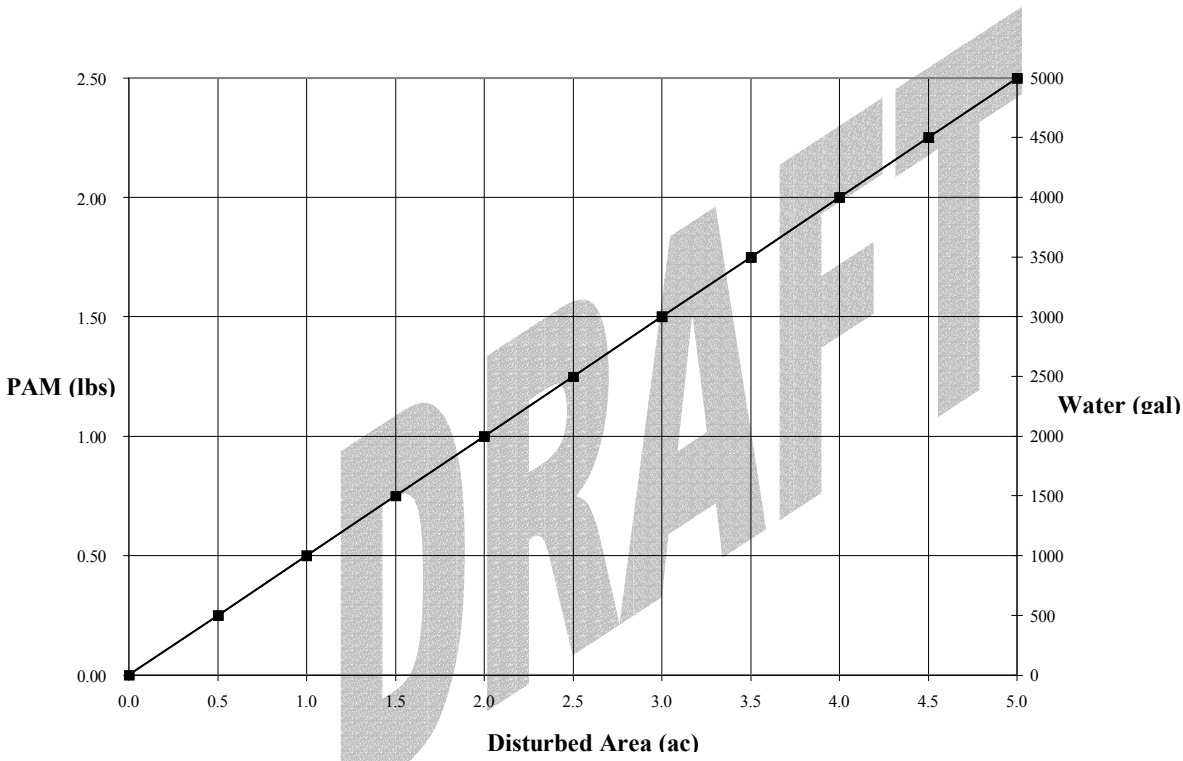

Figure 7.3.6 - PAM and Water Application

The Preferred Method:

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

An Alternate Method:

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

The following shall be used for application of PAM:

- PAM shall be used in conjunction with other BMPs and not in place of other BMPs.
- Do not use PAM on a slope that flows directly into a stream or wetland. The stormwater runoff shall pass through a sediment control BMP prior to discharging to surface waters.
- Do not add PAM to water discharging from site.
- When the total drainage area is greater than or equal to 5 acres, PAM treated areas shall drain to a sediment pond.
- Areas less than 5 acres shall drain to sediment control BMPs, such as a minimum of 3 check dams per acre. The total number of check dams used shall be maximized to achieve the greatest amount of settlement of sediment prior to discharging from the site. Each check dam shall be spaced evenly in the drainage channel through which stormwater flows are discharged off-site.
- On all sites, the use of silt fence shall be maximized to limit the discharges of sediment from the site.
- All areas not being actively worked shall be covered and protected from

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rainfall. PAM shall not be the only cover BMP used.

- PAM can be applied to wet soil, but dry soil is preferred due to less sediment loss.
- PAM will work when applied to saturated soil but is not as effective as applications to dry or damp soil.
- Keep the granular PAM supply out of the sun. Granular PAM loses its effectiveness in three months after exposure to sunlight and air.
- Proper application and re-application plans are necessary to ensure total effectiveness of PAM usage.
- PAM, combined with water, is very slippery and can be a safety hazard. Care must be taken to prevent spills of PAM powder onto paved surfaces. During an application of PAM, prevent over-spray from reaching pavement as pavement will become slippery. If PAM powder gets on skin or clothing, wipe it off with a rough towel rather than washing with water-this only makes cleanup messier and take longer.
- Some PAMs are more toxic and carcinogenic than others. Only the most environmentally safe PAM products should be used.

The specific PAM copolymer formulation must be anionic. Cationic PAM shall not be used in any application because of known aquatic toxicity problems. Only the highest drinking water grade PAM, certified for compliance with ANSI/NSF Standard 60 for drinking water treatment, will be used for soil applications. Recent media attention and high interest in PAM has resulted in some entrepreneurial exploitation of the term "polymer." All PAM are polymers, but not all polymers are PAM, and not all PAM products comply with ANSI/NSF Standard 60. PAM use shall be reviewed and approved by the local permitting authority. The Washington State Department of Transportation (WSDOT) has listed approved PAM products on their web page.

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

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Maintenance Standards: PAM may be reapplied on actively worked areas after a 48-hour period.

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

BMP C130: Surface Roughening

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

Conditions for Use:

- All slopes steeper than 3:1 and greater than 5 vertical feet require surface roughening.
- Areas with grades steeper than 3:1 should be roughened to a depth of 2 to 4 inches prior to seeding.
- Areas that will not be stabilized immediately may be roughened to reduce runoff velocity until seeding takes place.
- Slopes with a stable rock face do not require roughening.
- Slopes where mowing is planned should not be excessively roughened.

Design and Installation Specifications:

- There are different methods for achieving a roughened soil surface on a slope, and the selection of an appropriate method depends upon the type of slope. Roughening methods include stair-step grading, grooving, contour furrows, and tracking. See Figure 7.3.7 for tracking and contour furrows. Factors to be considered in choosing a method are slope steepness, mowing requirements, and whether the slope is formed by cutting or filling.
- Disturbed areas that will not require mowing may be stair-step graded, grooved, or left rough after filling.
- Stair-step grading is particularly appropriate in soils containing large amounts of soft rock. Each "step" catches material that sloughs from above, and provides a level site where vegetation can become established. Stairs should be wide enough to work with standard earth moving equipment. Stair steps must be on contour or gullies will form on the slope.
- Areas that will be mowed (these areas should have slopes less steep than 3:1) may have small furrows left by disking, harrowing, raking, or seed-planting

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machinery operated on the contour.

- Graded areas with slopes greater than 3:1 but less than 2:1 should be roughened before seeding. This can be accomplished in a variety of ways, including "track walking," or driving a crawler tractor up and down the slope, leaving a pattern of cleat imprints parallel to slope contours.
- Tracking is done by operating equipment up and down the slope to leave horizontal depressions in the soil.

Maintenance Standards: Areas that are graded in this manner should be seeded as quickly as possible.

- Regular inspections should be made of the area. If rills appear, they should be re-graded and re-seeded immediately.

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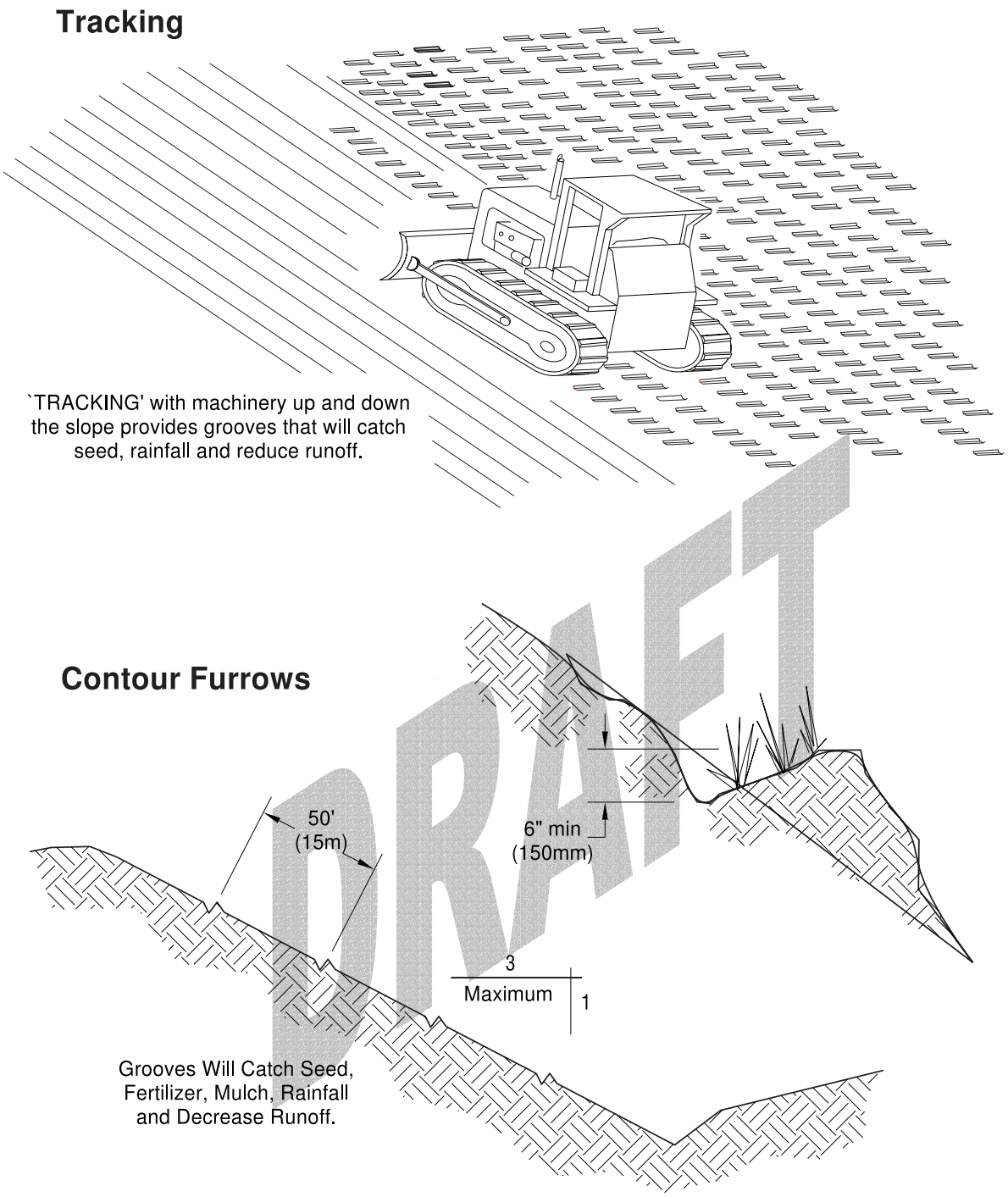

Figure 7.3.7 - Tracking and Contour Furrows

BMP C131: Gradient Terraces

Purpose: Gradient terraces reduce erosion damage by intercepting surface runoff and conducting it to a stable outlet at a non-erosive velocity.

Conditions for Use: Gradient terraces normally are limited to denuded land having a water erosion problem. They should not be constructed on deep sands or on soils that are too stony, steep, or shallow to permit practical and economical installation and maintenance. Gradient terraces may be used only where suitable outlets are or will be made available. See Figure 7.3.8 for gradient terraces.

Design and Installation Specifications:

- The maximum spacing of gradient terraces should be determined by the following method:

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

  Where:

  VI = vertical interval in feet
  s = land rise per 100 feet, expressed in feet
  y = a soil and cover variable with values from 1.0 to 4.0

  Values of "y" are influenced by soil erodibility and cover practices. The lower values are applicable to erosive soils where little to no residue is left on the surface. The higher value is applicable only to erosion-resistant soils where a large amount of residue (1½ tons of straw/acre equivalent) is on the surface.

- The minimum constructed cross-section should meet the design dimensions.
- The top of the constructed ridge should not be lower at any point than the design elevation plus the specified overfill for settlement The opening at the outlet end of the terrace should have a cross section equal to that specified for the terrace channel.
- Channel grades may be either uniform or variable with a maximum grade of 0.6 feet per 100 feet length. For short distances, terrace grades may be increased to improve alignment. The channel velocity should not exceed that which is nonerosive for the soil type with the planned treatment.
- All gradient terraces should have adequate outlets. Such an outlet may be a grassed waterway, vegetated area, or tile outlet. In all cases the outlet must convey runoff from the terrace or terrace system to a point where the outflow will not cause damage. Vegetative cover should be used in the outlet channel.
- The design elevation of the water surface of the terrace should not be lower than the design elevation of the water surface in the outlet at their junction, when both are operating at design flow.
- Vertical spacing determined by the above methods may be increased as much

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as 0.5 feet or 10 percent, whichever is greater, to provide better alignment or location, to avoid obstacles, to adjust for equipment size, or to reach a satisfactory outlet.

- **The drainage area above the top should not exceed the area that would be drained by a terrace with normal spacing.**
- The terrace should have enough capacity to handle the peak runoff expected from a 2-year, 24-hour design storm without overtopping.
- The terrace cross-section should be proportioned to fit the land slope. The ridge height should include a reasonable settlement factor. The ridge should have a minimum top width of 3 feet at the design height. The minimum cross-sectional area of the terrace channel should be 8 square feet for land slopes of 5 percent or less, 7 square feet for slopes from 5 to 8 percent, and 6 square feet for slopes steeper than 8 percent. The terrace can be constructed wide enough to be maintained using a small cat.

Maintenance Standards

- Maintenance should be performed as needed. Terraces should be inspected regularly; at least once a year, and after large storm events.

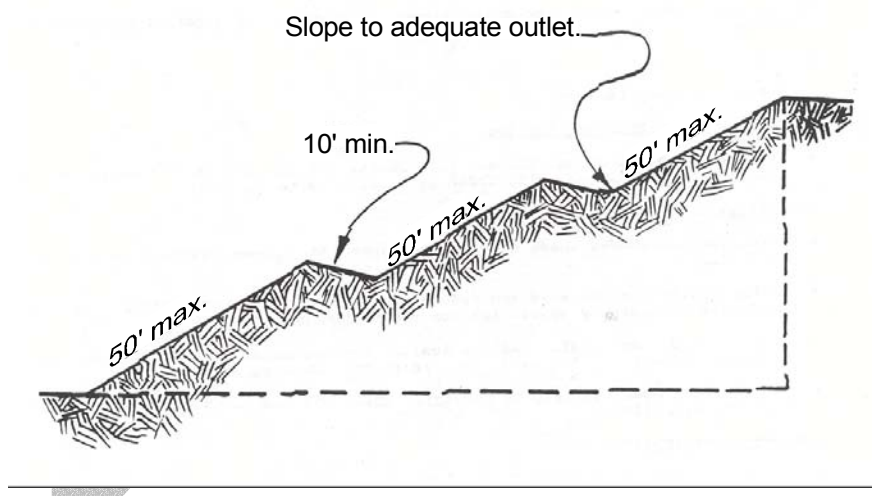

Figure 7.3.8 - Gradient Terraces

BMP C140: Dust Control

Purpose: Dust control prevents wind transport of dust from disturbed soil surfaces onto roadways, drainage ways, and surface waters. Wind erosion is a significant cause of soil movement from construction sites in Eastern Washington. Although wind erosion can contribute to water quality impacts, dust control is regulated in some areas of Eastern Washington primarily through local air quality authorities. Where such an entity exists, contact the local air quality authority for appropriate and required BMPs for dust control to implement at your project site.

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

Design and Installation Specifications:

- Contact your local Air Pollution Control Authority for guidance and training on other dust control measures. Compliance with the local Air Pollution Control Authority constitutes compliance with this BMP.
- Water applied to construction sites for dust control must not leave the site as surface runoff.
- See also "Techniques for Dust Prevention and Suppression," Ecology Publication Number 96-433, revised April 2002.
- Techniques that can be used for construction projects include:
- Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.
- Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition, if stable. Maintain the original ground cover as long as practical.
- Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.
- Sprinkle the site with water until surface is wet. Repeat as needed. To prevent carryout of mud onto street, refer to Stabilized Construction Entrance (BMP C105).
- Irrigation water can be used for dust control. Irrigation systems should be installed as a first step on sites where dust control is a concern.
- Spray exposed soil areas with a dust palliative, following the manufacturer's instructions and cautions regarding handling and application. Used oil is prohibited from use as a dust suppressant. Local governments may approve other dust palliatives such as calcium chloride or PAM.
- PAM (BMP C126) added to water at a rate of 0.5 lbs. per 1,000 gallons of water per acre and applied from a water truck is more effective than water

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alone. This is due to the increased infiltration of water into the soil and reduced evaporation. In addition, small soil particles are bonded together and are not as easily transported by wind. Adding PAM may actually reduce the quantity of water needed for dust control, especially in eastern Washington. Since the wholesale cost of PAM is about $ 4.00 per pound, this is an extremely cost-effective dust control method.

Techniques that can be used for unpaved roads and lots include:

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

Maintenance Standards:

- Respray area as necessary to keep dust to a minimum. Water applied to construction sites for dust control must not leave the site as surface runoff.

BMP C150: Materials On Hand

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

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Conditions for Use:

- Construction projects of any size or type can benefit from having materials on hand. A small commercial development project could have a roll of plastic and some gravel available for immediate protection of bare soil and temporary berm construction. A large earthwork project, such as highway construction, might have several tons of straw, several rolls of plastic, flexible pipe, sandbags, geotextile fabric and steel "T" posts.
- Materials are stockpiled and readily available before any site clearing, grubbing, or earthwork begins. A large contractor or developer could keep a stockpile of materials that are available to be used on several projects.
- If storage space at the project site is at a premium, the contractor could maintain the materials at their office or yard. The office or yard must be less than an hour from the project site.

Design and Installation Specifications: Depending on project type, size, complexity, and length, materials and quantities will vary. A good minimum that will cover numerous situations includes:

Material	Measure	Quantity
Clear Plastic, 6 mil	100 foot roll	1-2
Drainpipe, 6 or 8 inch diameter	25 foot section	4-6
Sandbags, filled	each	25-50
Straw Bales for mulching,	approx. 50# each	10-20
Quarry Spalls	ton	2-4
Washed Gravel	cubic yard	2-4
Geotextile Fabric	100 foot roll	1-2
Catch Basin Inserts	each	2-4
Steel "T" Posts	each	12-24

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Maintenance Standards:

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

BMP C151: Concrete Handling

Purpose: Concrete work can generate process water and slurry that contain fine particles and high pH, both of which can violate water quality standards in the receiving water. This BMP is intended to minimize and eliminate concrete process water and slurry from entering waters of the state.

Conditions for Use: Any time concrete is used, these management practices shall be utilized. Concrete construction projects include, but are not limited to, the following:

- Curbs

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

Design and Installation Specifications:

- Concrete truck chutes, pumps, and internals shall be washed out only into formed areas awaiting installation of concrete or asphalt.
- Unused concrete remaining in the truck and pump shall be returned to the originating batch plant for recycling.
- Hand tools including, but not limited to, screeds, shovels, rakes, floats, and trowels shall be washed off only into formed areas awaiting installation of concrete or asphalt.
- Equipment that cannot be easily moved, such as concrete pavers, shall only be washed in areas that do not directly drain to natural or constructed stormwater conveyances.
- Washdown from areas such as concrete aggregate driveways shall not drain directly to natural or constructed stormwater conveyances.
- When no formed areas are available, washwater and leftover product shall be contained in a lined container. Contained concrete shall be disposed of in a manner that does not violate groundwater or surface water quality standards.

Maintenance Standards:

- Containers shall be checked for holes in the liner daily during concrete pours and repaired the same day.

BMP C152: Sawcutting and Surfacing Pollution Prevention

Purpose: Sawcutting and surfacing operations generate slurry and process water that contain fine particles and high pH (concrete cutting), both of which can violate the water quality standards in the receiving water. This BMP is intended to minimize and eliminate process water and slurry from entering waters of the State.

Conditions for Use: Anytime sawcutting or surfacing operations take place, these management practices should be utilized. Sawcutting and surfacing operations include, but are not limited to, the following:

- Sawing
- Coring
- Grinding

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- Roughening
- Hydro-demolition
- Bridge and road surfacing

Design and Installation Specifications:

- Slurry and cuttings should be vacuumed during cutting and surfacing operations.
- Slurry and cuttings should not remain on permanent concrete or asphalt pavement overnight.
- Slurry and cuttings should not drain to any natural or constructed drainage conveyance.
- Collected slurry and cuttings shall be disposed of in a manner that does not violate groundwater or surface water quality standards.
- Process water that is generated during hydro-demolition, surface roughening or similar operations should not drain to any natural or constructed drainage conveyance and shall be disposed of in a manner that does not violate groundwater or surface water quality standards.
- Cleaning waste material and demolition debris should be handled and disposed of in a manner that does not cause contamination of water. If the area is swept with a pick-up sweeper, the material should be hauled out of the area to an appropriate disposal site.

Maintenance Standards:

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

BMP C160: Contractor Erosion and Spill Control Lead

Purpose: The Contractor designates at least one person as the responsible representative in charge of erosion and spill control. The designated employee or contact shall be the Contractor Erosion and Spill Control Lead (CESCL) who is responsible for ensuring compliance with all local, State, and Federal erosion and sediment control requirements.

Conditions for Use: A CESCL should be made available on project types that include, but are not limited to, the following:

- Projects with an NPDES and State Waste Discharge Permit for Stormwater Discharges Associated with Construction Activities.
- Heavy construction of roads, bridges, highways, airports, buildings.
- Projects near wetlands and sensitive or critical areas.
- Projects in or over water.

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Design and Installation Specifications: The CESCL shall be qualified in construction site erosion and sediment control regulatory requirements and BMPs:

- The CESCL shall have thorough knowledge and understanding of the Construction Stormwater Pollution Prevention Plan (SWPPP) for the project site.
- The CESCL shall have authority to act on behalf of the contractor or developer and shall be available, on call, 24 hours per day throughout the period of construction.
- The Construction SWPPP shall include the name, telephone number, fax number, and address of the designated CESCL.
- The CESCL shall have up-to-date training and field experience in construction erosion and sediment control practices.
- The CESCL should have a current certificate proving attendance in the "Construction Site Erosion and Sediment Control Certification Course," offered throughout the year by the Associated General Contractors of Washington Education Foundation or a similar course or certification program such as:
    - WSDOT certification in Construction Site Erosion and Sediment Control.
    - Certified Professional in Erosion and Sediment Control (CPESC) offered by the International Erosion Control Association (IECA).

Duties and responsibilities of the CESCL shall include, but are not limited to the following:

- Maintaining permit file on site at all times which includes the SWPPP and any associated permits and plans.
- Directing BMP installation, inspection, maintenance, modification, and removal.
- Availability 24 hours per day, 7 days per week by telephone.
- Updating all project drawings and the Construction SWPPP with changes made.
- Keeping daily logs, and inspection reports. Inspection reports should include:
    - When, where and how BMPs were installed, removed, or modified.
    - Repairs needed or made.
    - Observations of BMP effectiveness and proper placement.
    - Recommendations for improving performance of BMPs.
    - Identify the points where storm water runoff potentially leaves the site, is collected in a surface water conveyance system (i.e., road ditch, storm

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sewer), and enters receiving waters of the state.

- If water sheet flows from the site, identify the point at which it becomes concentrated in a collection system.
- Inspect for SWPPP requirements including BMPs as required to ensure adequacy.
- Facilitate, participate in, and take corrective actions resulting from inspections performed by outside agencies or the owner.

BMP C161: Payment of Erosion Control Work

Purpose: As with any construction operation, the contractor should be paid for erosion control work. Payment for erosion control must be addressed during project development and design. Method of payment should be identified in the SWPPP.

Conditions for Use: Erosion control work should never be "incidental" to the contract as it is extremely difficult for the contractor to bid the work. Work that is incidental to the contract is work where no separate measurement or payment is made. The cost for incidental work is included in payments made for applicable bid items in the Schedule of Unit Prices. For example, any erosion control work associated with an item called "Clearing and Grubbing" is bid and paid for as part of that item, not separately.

Several effective means for payment of erosion control work are described below. These include:

- Temporary Erosion and Sediment Control (TESC) Lump Sum.
- TESC-Force Account.
- Unit Prices.
- Lump Sum.

TESC Lump Sum

One good method for achieving effective erosion and sediment control is to set up a Progress Payment system whereby the contract spells out exactly what is expected and allows for monthly payments over the life of the contract.

For example, an Item called "TESC Lump Sum" is listed in the Bid Schedule of Unit Prices. An amount, such as $10,000, is written in both the Unit Price and Amount columns. This requires all bidders to bid $10,000 for the item. If $10,000 is not shown in the Amount column, each contractor bids the amount. Often this is under-bid, which can cause compliance difficulties later. In this example, the contractor is required to revise the project Construction SWPPP by developing a Contractor's Erosion and Sediment Control Plan (CESCP) that is specific to their operations.

Next, the following language is included in the TESC specification Payment section.

Based upon lump sum Bid Item "TESC Lump Sum", payments will be made as

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follows:

A. Upon receipt of the Contractor's CESCP, 25 percent.

B. After Notice To Proceed and before Substantial Completion, 50 percent will be pro rated and paid monthly for compliance with the CESCP. Non-compliance will result in withholding of payment for the month of non-compliance.

C. At Final Payment, 25 percent for a clean site.

Payment for "TESC Lump Sum" will be full compensation for furnishing all labor, equipment, materials and tools to implement the CESCP, install, inspect, maintain, and remove temporary erosion and sediment controls as detailed in the drawings and specified herein, with the exception of those items measured and paid for separately.

TESC Force Account

One good method for ensuring that contingency money is available to address unforeseen erosion and sediment control problems is to set up an item called "TESC-Force Account". For example, an amount such as $15,000 is written in both the Unit Price and Amount columns for the item. This requires all bidders to bid $15,000 for the item.

The Force Account is used only at the discretion of the contracting agency or developer. If there are no unforeseen erosion problems, the money is not used. If there are unforeseen erosion problems, the contracting agency would direct the work to be done and pay an agreed upon amount for the work (such as predetermined rates under a Time and Materials setting).

Contract language for this item could look like this:

> Measurement and Payment for "TESC-Force Account" will be on a Force Account basis in accordance with_____*(include appropriate section of the Contract Specifications).* The amount entered in the Schedule of Unit Prices is an estimate.

Unit Prices

When the material or work can be quantified, it can be paid by Unit Prices. For example, the project designer knows that 2 acres will need to be hydroseeded and sets up an Item of Work for Hydroseed, with a Bid Quantity of 2, and a Unit for Acre. The bidder writes in the unit Prices and Amount.

Unit Price items can be used in conjunction with TESC-Force Account and TESC-Lump Sum.

Lump Sum

In contracts where all the work in a project is paid as a Lump Sum, erosion control is usually not paid as a separate item. In order to ensure that appropriate amounts are bid into the contract, the contracting agency can request a Schedule of Values and require that all erosion control costs be identified.

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BMP C162: Scheduling

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

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

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

Design Considerations:

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

BMP C180: Small Project Construction Stormwater Pollution Prevention

Purpose: To prevent the discharge of sediment and other pollutants to the maximum extent practicable from small construction projects.

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Conditions for Use: On small construction projects, those adding or replacing less than 2,000 square feet of impervious surface or clearing less than 7,000 square feet.

Design Considerations:

- Plan and implement proper clearing and grading of the site. It is most important only to clear the areas needed, thus keeping exposed areas to a minimum. Phase clearing so that only those areas that are actively being worked are uncovered. Note: Clearing limits should be flagged in the lot or area prior to initiating clearing.
- Soil should be managed in a manner that does not permanently compact or deteriorate the final soil and landscape system. If disturbance and/or compaction occur the impact must be corrected at the end of the construction activity. This should include restoration of soil depth, soil quality, permeability, and percent organic matter. Construction practices must not cause damage to or compromise the design of permanent landscape or infiltration areas.

- Locate excavated basement soil a reasonable distance behind the curb, such as in the backyard or side yard area. This will increase the distance eroded soil must travel to reach the storm sewer system. Soil piles should be covered until the soil is either used or removed. Piles should be situated so that sediment does not run into the street or adjoining yards.
- Backfill basement walls as soon as possible and rough grade the lot. This will eliminate large soil mounds, which are highly erodible, and prepares the lot for temporary cover, which will further reduce erosion potential.
- Remove excess soil from the site as soon as possible after backfilling. This will eliminate any sediment loss from surplus fill.
- If a lot has a soil bank higher than the curb, a trench or berm should be installed moving the bank several feet behind the curb. This will reduce the occurrence of gully and rill erosion while providing a storage and settling area for stormwater.
- The construction entrance should be stabilized where traffic will be leaving the construction site and traveling on paved roads or other paved areas within 1,000 feet of the site.
- Provide for periodic street cleaning to remove any sediment that may have been tracked out. Sediment should be removed by shoveling or sweeping and carefully removed to a suitable disposal area where it will not be re-eroded.
- Utility trenches that run up and down slopes should be backfilled within seven days. Cross-slope trenches may remain open throughout construction to provide runoff interception and sediment trapping, provided that they do not convey turbid runoff off site.

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7.3.2 Runoff Conveyance and Treatment BMPs

BMP C200: Interceptor Dike and Swale

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

Conditions for Use:

- Where the runoff from an exposed site or disturbed slope must be conveyed to an erosion control facility which can safely convey the stormwater. Locate upslope of a construction site to prevent runoff from entering disturbed area.
- When placed horizontally across a disturbed slope, it reduces the amount and velocity of runoff flowing down the slope.
- Locate downslope to collect runoff from a disturbed area and direct it to a sediment basin.

Design Considerations:

- Dike and/or swale and channel must be stabilized with temporary or permanent vegetation or other channel protection during construction.
- Channel requires a positive grade for drainage, steeper grades require channel protection and check dams.
- Review construction for areas where overtopping may occur.
- Can be used at top of new fill before vegetation is established.
- May be used as a permanent diversion channel to carry the runoff.
- Sub-basin tributary area should be one acre or less.
- Design capacity for 10-year, 24-hour storm for temporary facilities, 25-year, 24-hour storm for permanent facilities.

Interceptor dikes shall meet the following criteria:

Top Width 2 feet minimum.
Height 1.5 feet minimum on berm.
Side Slope 2:1 or flatter.
Grade Depends on topography, however, dike system minimum is 0.5%, maximum is 1%.
Compaction Minimum of 90 percent ASTM D698 standard proctor.

Horizontal Spacing of Interceptor Dikes:

Average Slope	Slope Percent	Flowpath Length
20H:1V or less	3-5%	300 feet
(10 to 20)H:1V	5-10%	200 feet
(4 to 10)H:1V	10-25%	100 feet
(2 to 4)H:1V	25-50%	50 feet

Stabilization depends on velocity and reach

Slopes <5% Seed and mulch applied within 5 days of dike construction (*see BMP C121, Mulching*).

Slopes 5 - 40% Dependent on runoff velocities and dike materials. Stabilization should be done immediately using either sod or riprap or other measures to avoid erosion.

- The upslope side of the dike shall provide positive drainage to the dike outlet. No erosion shall occur at the outlet. Provide energy dissipation measures as necessary. Sediment-laden runoff must be released through a sediment trapping facility.
- Minimize construction traffic over temporary dikes. Use temporary cross culverts for channel crossing.

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Interceptor swales shall meet the following criteria:

Bottom Width	2 feet minimum; the bottom shall be level.
Depth	1-foot minimum.
Side Slope	2:1 or flatter.
Grade	Maximum 5 percent, with positive drainage to a suitable outlet (such as a sediment pond).
Stabilization	Seed as per BMP C120, Temporary and Permanent Seeding, or BMP C202, Channel Lining, 12 inches thick of riprap pressed into the bank and extending at least 8 inches vertical from the bottom.

- Inspect diversion dikes and interceptor swales once a week and after every rainfall. Immediately remove sediment from the flow area.
- Damage caused by construction traffic or other activity must be repaired before the end of each working day.
- Check outlets and make timely repairs as needed to avoid gully formation. When the area below the temporary diversion dike is permanently stabilized, remove the dike and fill and stabilize the channel to blend with the natural surface.

BMP C201: Grass-Lined Channels

Purpose: To provide a channel with a vegetative lining for conveyance of runoff. See Figure 7.3.9 for typical grass-lined channels.

Conditions of Use: This practice applies to construction sites where concentrated runoff needs to be contained to prevent erosion or flooding.

- When a vegetative lining can provide sufficient stability for the channel cross section and at lower velocities of water (normally dependent on grade). This means that the channel slopes are generally less than 5 percent and space is available for a relatively large cross section.
- Typical uses include roadside ditches, channels at property boundaries, outlets for diversions, and other channels and drainage ditches in low areas.
- Channels that will be vegetated should be installed before major earthwork and hydroseeded with a bonded fiber mulch (BFM). The vegetation should be well established (i.e., 75 percent cover) before water is allowed to flow in the ditch. With channels that will have high flows, erosion control blankets should be installed over the hydroseed. If vegetation cannot be established from seed before water is allowed in the ditch, sod should be installed in the bottom of the ditch in lieu of hydromulch and blankets.

Design and Installation Specifications:

- Locate the channel where it can conform to the topography and other features such as roads.
- Locate them to use natural drainage systems to the greatest extent possible.

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Maintenance Standards:

- During the establishment period, check grass-lined channels after every rainfall.
- Avoid sharp changes in alignment or bends and changes in grade.
- Do not reshape the landscape to fit the drainage channel.
- Design velocities are to be below 5 ft/sec.; however, the design velocity should be based on soil conditions, type of vegetation, and method of establishment.
- An established grass or vegetated lining is required before the channel can be used to convey stormwater, unless stabilized with nets or blankets.
- If design velocity of a channel to be vegetated by seeding exceeds 2 ft/sec, a temporary channel liner is required. Geotextile or special mulch protection such as fiberglass roving or straw and netting provide stability until the vegetation is fully established. See Figure 4.10.
- Check dams shall be removed when the grass has matured sufficiently to protect the ditch or swale unless the slope of the swale is greater than 4 percent. The area beneath the check dams shall be seeded and mulched immediately after dam removal.
- If vegetation is established by sodding, the permissible velocity for established vegetation may be used and no temporary liner is needed.
- Do not subject grass-lined channel to sedimentation from disturbed areas. Use sediment-trapping BMPs upstream of the channel.
- V-shaped grass channels generally apply where the quantity of water is small, such as in short reaches along roadsides. The V-shaped cross section is least desirable because it is difficult to stabilize the bottom where velocities may be high.
- Trapezoidal grass channels are used where runoff volumes are large and slope is low so that velocities are nonerosive to vegetated linings. (Note: it is difficult to construct small parabolic shaped channels.)
- Subsurface drainage, or riprap channel bottoms, may be necessary on sites that are subject to prolonged wet conditions due to long duration flows or a high water table.
- Provide outlet protection at culvert ends and at channel intersections.
- Grass channels, at a minimum, should carry peak runoff for temporary construction drainage facilities from the 10-year, 24-hour storm without eroding. Where flood hazard exists, increase the capacity according to the potential damage.
- Grassed channel side slopes generally are constructed 3:1 or flatter to aid in the establishment of vegetation and for maintenance.

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- Construct channels a minimum of 0.2 foot larger around the periphery to allow for soil bulking during seedbed preparations and sod buildup.
- After grass is established, periodically check the channel; check it after every heavy rainfall event. Immediately make repairs.
- It is particularly important to check the channel outlet and all road crossings for bank stability and evidence of piping or scour holes.
- Remove all significant sediment accumulations to maintain the designed carrying capacity. Keep the grass in a healthy, vigorous condition at all times, since it is the primary erosion protection for the channel.

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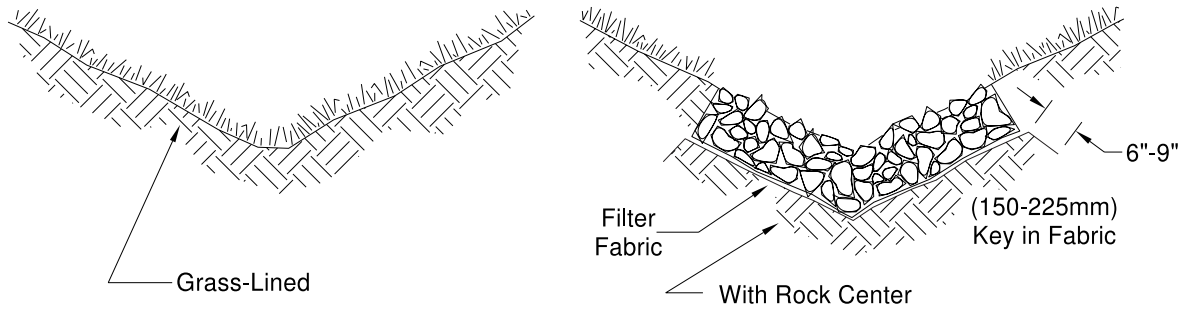
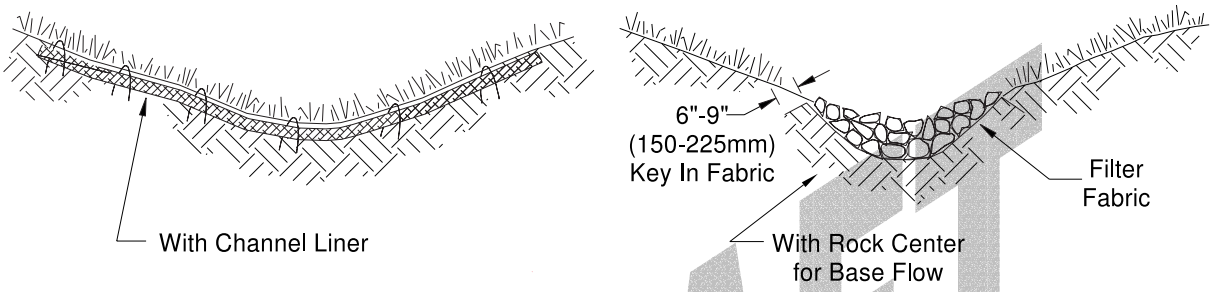
Typical V-Shaped Channel Cross-section



Typical Parabolic Channel Cross-Section



Typical Trapezoidal Channel Cross-Section

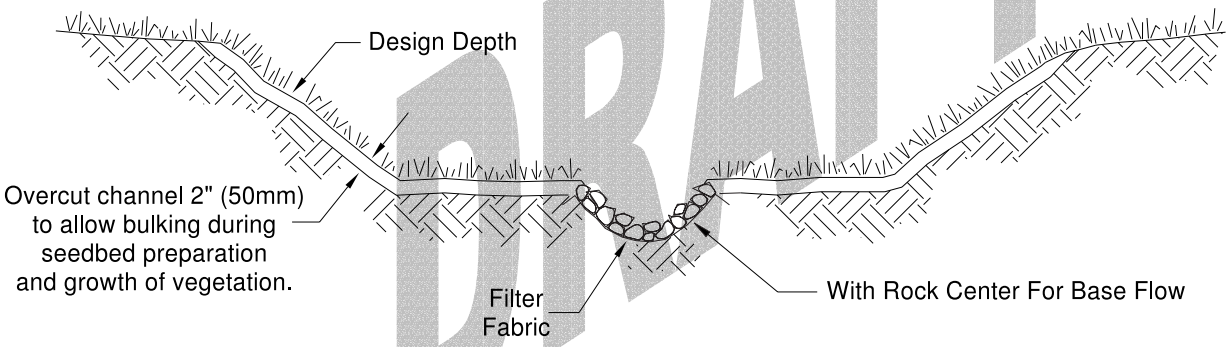


Figure 7.3.9 – Typical Grass-Lined Channels

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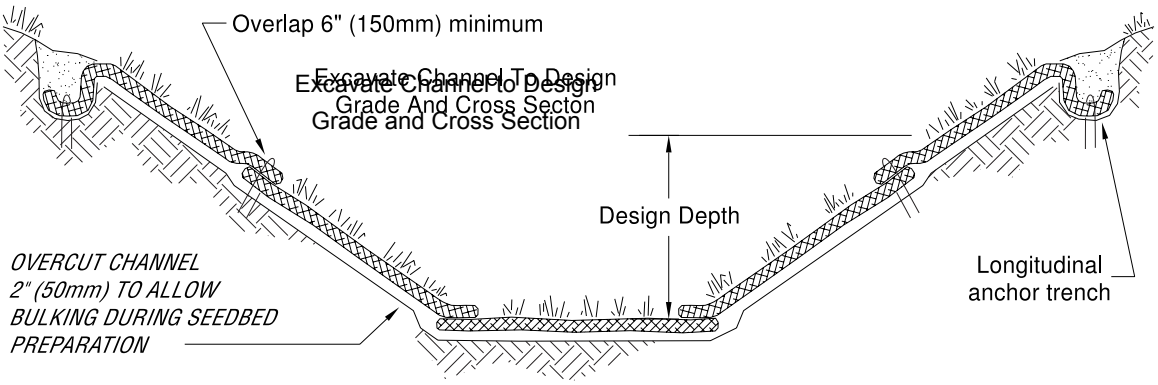
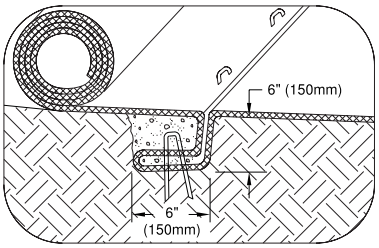
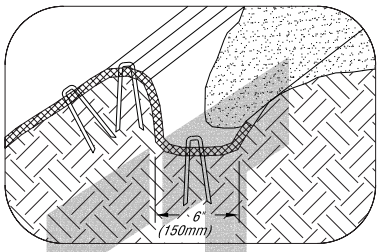




Intermittent Check Slot

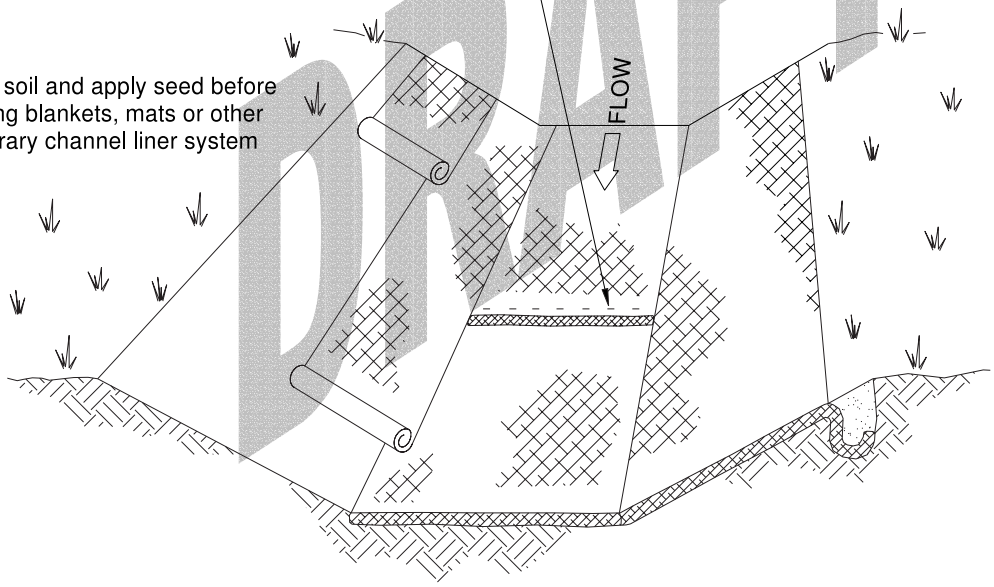
TYPICAL INSTALLATION WITH EROSION CONTROL BLANKETS OR TURF REINFORCEMENT MATS



Longitudinal Anchor Trench

Shingle-lap spliced ends or begin new roll in an intermittent check slot

Prepare soil and apply seed before installing blankets, mats or other temporary channel liner system



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NOTES:
1. Design velocities exceeding 2 ft/sec (0.5m/sec) require temporary blankets, mats or similar liners to protect seed and soil until vegetation becomes established.
2. Grass-lined channels with design velocities exceeding 6 ft/sec (2m/sec) should include turf reinforcement mats.

Figure 7.3.10 - Temporary Channel Liners

BMP C202: Channel Lining

Purpose: To protect erodible channels by providing a channel liner using either blankets or riprap.

Conditions of Use:

- When natural soils or vegetated stabilized soils in a channel are not adequate to prevent channel erosion.
- When a permanent ditch or pipe system is to be installed and a temporary measure is needed.
- In almost all cases, synthetic and organic coconut blankets are more effective than riprap for protecting channels from erosion. Blankets can be used with and without vegetation. Blanketed channels can be designed to handle any expected flow and longevity requirement. Some synthetic blankets have a predicted life span of 50 years or more, even in sunlight.
- Other reasons why blankets are better than rock include the availability of blankets over rock. In many areas of the state, rock is not easily obtainable or is very expensive to haul to a site. Blankets can be delivered anywhere. Rock requires the use of dump trucks to haul and heavy equipment to place. Blankets usually only require laborers with hand tools, and sometimes a backhoe.
- The Federal Highway Administration recommends not using flexible liners whenever the slope exceeds 10 percent or the shear stress exceeds 8 lbs/ft^2.

Design and Installation Specifications:

- See BMP C122 for information on blankets.
- Since riprap is used where erosion potential is high, construction must be sequenced so that the riprap is put in place with the minimum possible delay.
- Disturbance of areas where riprap is to be placed should be undertaken only when final preparation and placement of the riprap can follow immediately behind the initial disturbance. Where riprap is used for outlet protection, the riprap should be placed before or in conjunction with the construction of the pipe or channel so that it is in place when the pipe or channel begins to operate.
- The designer, after determining the riprap size that will be stable under the flow conditions, shall consider that size to be a minimum size and then, based on riprap gradations actually available in the area, select the size or sizes that equal or exceed the minimum size. The possibility of drainage structure damage by children shall be considered in selecting a riprap size, especially if there is nearby water or a gully in which to toss the stones.
- Stone for riprap shall consist of field stone or quarry stone of approximately rectangular shape. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering and it shall be suitable in all respects for the purpose intended.

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- Rubble concrete may be used provided it has a density of at least 150 pounds per cubic foot, and otherwise meets the requirement of this standard and specification.
- A lining of engineering filter fabric (geotextile) shall be placed between the riprap and the underlying soil surface to prevent soil movement into or through the riprap. The geotextile should be keyed in at the top of the bank.
- Filter fabric shall not be used on slopes greater than 1-1/2:1 as slippage may occur. It should be used in conjunction with a layer of coarse aggregate (granular filter blanket) when the riprap to be placed is 12 inches and larger.

BMP C203: Water Bars

Purpose: A small ditch or ridge of material is constructed diagonally across a road or right-of-way to divert stormwater runoff from the road surface, wheel tracks, or a shallow road ditch.

Conditions of Use:

- Clearing right-of-way and construction of access for power lines, pipelines, and other similar installations often require long narrow right-of-ways over sloping terrain. Disturbance and compaction promotes gully formation in these cleared strips by increasing the volume and velocity of runoff. Gully formation may be especially severe in tire tracks and ruts. To prevent gullying, runoff can often be diverted across the width of the right-of-way to undisturbed areas by using small predesigned diversions.
- Give special consideration to each individual outlet area, as well as to the cumulative effect of added diversions. Use gravel to stabilize the diversion where significant vehicular traffic is anticipated.

Design and Installation Specifications: Height: 8-inch minimum measured from the channel bottom to the ridge top.

- Side slope of channel: 2:1 maximum; 3:1 or flatter when vehicles will cross.
- Base width of ridge: 6-inch minimum.
- Locate them to use natural drainage systems and to discharge into well vegetated stable areas.

Guideline for Spacing:

Slope %	Spacing (ft)
< 5	125
5 - 10	100
10 - 20	75
20 - 35	50
> 35	Use rock lined ditch

- Grade of water bar and angle: Select angle that results in ditch slope less than 2 percent.
- Install as soon as the clearing and grading is complete. Reconstruct when construction is complete on a section when utilities are being installed.

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- Compact the ridge when installed.
- Stabilize, seed and mulch the portions that are not subject to traffic. Gravel the areas crossed by vehicles.

Maintenance Standards:

- Periodically inspect right-of-way diversions for wear and after every heavy rainfall for erosion damage.
- Immediately remove sediment from the flow area and repair the dike.
- Check outlet areas and make timely repairs as needed.
- When permanent road drainage is established and the area above the temporary right-of-way diversion is permanently stabilized, remove the dike and fill the channel to blend with the natural ground, and appropriately stabilize the disturbed area.

BMP C204: Pipe Slope Drains

Purpose: To use a pipe to convey stormwater anytime water needs to be diverted away from or over bare soil to prevent gullies, channel erosion, and saturation of slide-prone soils.

Conditions of Use: Pipe slope drains should be used when a temporary or permanent stormwater conveyance is needed to move the water down a steep slope to avoid erosion (Figure 7.3.11).

On highway projects, they should be used at bridge ends to collect runoff and pipe it to the base of the fill slopes along bridge approaches. These can be designed into a project and included as bid items. Another use on road projects is to collect runoff from pavement and pipe it away from side slopes. These are useful because there is generally a time lag between having the first lift of asphalt installed and the curbs, gutters, and permanent drainage installed. Used in conjunction with sand bags, or other temporary diversion devices, these will prevent massive amounts of sediment from leaving a project.

Water can be collected, channeled with sand bags, Triangular Silt Dikes, berms, or other material, and piped to temporary sediment ponds.

Pipe slope drains can be:

- Connected to new catch basins and used temporarily until all permanent piping is installed;
- Used to drain water collected from aquifers exposed on cut slopes and take it to the base of the slope;
- Used to collect clean runoff from plastic sheeting and direct it away from exposed soil;
- Installed in conjunction with silt fence to drain collected water to a controlled area;
- Used to divert small seasonal streams away from construction. They have been used successfully on culvert replacement and extension jobs. Large

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flex pipe can be used on larger streams during culvert removal, repair, or replacement; and,

- Connected to existing down spouts and roof drains and used to divert water away from work areas during building renovation, demolition, and construction projects.
- There are now several commercially available collectors that are attached to the pipe inlet and help prevent erosion at the inlet.

Design and Installation Specifications: Size the pipe to convey the flow. The capacity for temporary drains shall be sufficient to handle the peak flow from a 10-year, 24-hour storm event. Permanent pipe slope drains shall be sized for the 25-year, 24-hour peak flow.

- Use care in clearing vegetated slopes for installation.
- Re-establish cover immediately on areas disturbed by installation.
- Use temporary drains on new cut or fill slopes.
- Use diversion dikes or swales to collect water at the top of the slope.
- Ensure that the entrance area is stable and large enough to direct flow into the pipe.
- Piping of water through the berm at the entrance area is a common failure mode.
- The entrance shall consist of a standard flared end section for culverts 12 inches and larger with a minimum 6-inch metal toe plate to prevent runoff from undercutting the pipe inlet. The slope of the entrance shall be at least 3 percent. Sand bags may also be used at pipe entrances as a temporary measure.
- The soil around and under the pipe and entrance section shall be thoroughly compacted to prevent undercutting.
- The flared inlet section shall be securely connected to the slope drain and have watertight connecting bands.
- Slope drain sections shall be securely fastened together, fused or have gasketed watertight fittings, and shall be securely anchored into the soil.
- Thrust blocks should be installed anytime 90 degree bends are utilized. Depending on size of pipe and flow, these can be constructed with sand bags, straw bales staked in place, “t” posts and wire, or ecology blocks.
- Pipe needs to be secured along its full length to prevent movement. This can be done with steel “t” posts and wire. A post is installed on each side of the pipe and the pipe is wired to them. This should be done every 10-20 feet of pipe length or so, depending on the size of the pipe and quantity of water to be diverted.
- Interceptor dikes shall be used to direct runoff into a slope drain. The height

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of the dike shall be at least 1 foot higher at all points than the top of the inlet pipe.

- The area below the outlet must be stabilized with a riprap apron (see BMP C209 Outlet Protection, for the appropriate outlet material).
- If the pipe slope drain is conveying sediment-laden water, direct all flows into the sediment trapping facility.
- Materials specifications for any permanent piped system shall be set by the local government.

Maintenance Standards: Check inlet and outlet points regularly, especially after storms.

The inlet should be free of undercutting, and no water should be going around the point of entry. If there are problems, the headwall should be reinforced with compacted earth or sand bags.

- The outlet point should be free of erosion and installed with appropriate outlet protection.
- For permanent installations, inspect pipe periodically for vandalism and physical distress such as slides and wind-throw.
- Normally the pipe slope is so steep that clogging is not a problem with smooth wall pipe, however, debris may become lodged in the pipe.

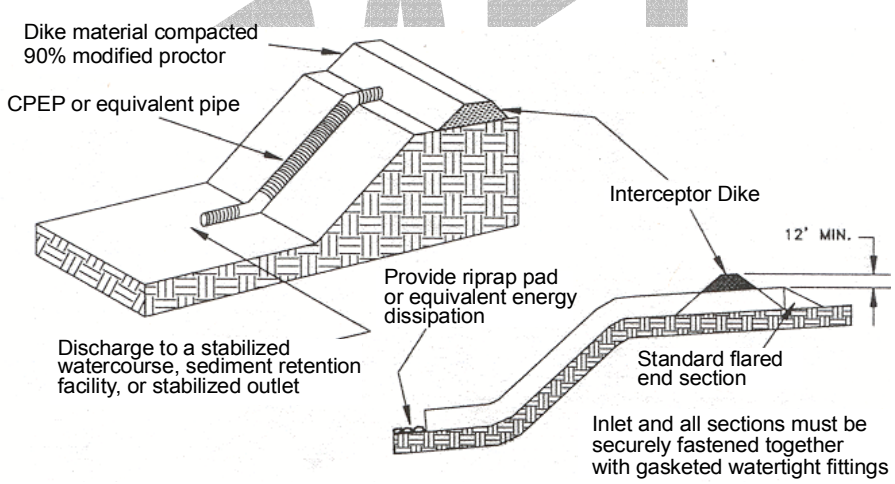

Figure 7.3.11 - Pipe Slope Drain

BMP C205: Subsurface Drains

Purpose: To intercept, collect, and convey ground water to a satisfactory outlet, using a perforated pipe or conduit below the ground surface. Subsurface drains are also known as "french drains." The perforated pipe provides a dewatering mechanism to drain excessively wet soils, provide a stable base for construction, improve stability of structures with shallow foundations, or to reduce hydrostatic

pressure to improve slope stability.

Conditions of Use: Use when excessive water must be removed from the soil. The soil permeability, depth to water table and impervious layers are all factors which may govern the use of subsurface drains.

Design and Installation Specifications:

- **Relief drains** are used either to lower the water table in large, relatively flat areas, improve the growth of vegetation, or to remove surface water.

  They are installed along a slope and drain in the direction of the slope.

  They can be installed in a grid pattern, a herringbone pattern, or a random pattern.

- **Interceptor drains a**re used to remove excess ground water from a slope, stabilize steep slopes, and lower the water table immediately below a slope to prevent the soil from becoming saturated.

  They are installed perpendicular to a slope and drain to the side of the slope.

  They usually consist of a single pipe or series of single pipes instead of a patterned layout.

- **Depth and spacing of interceptor drains** - The depth of an interceptor drain is determined primarily by the depth to which the water table is to be lowered or the depth to a confining layer. For practical reasons, the maximum depth is usually limited to 6 feet, with a minimum cover of 2 feet to protect the conduit.

- The soil should have depth and sufficient permeability to permit installation of an effective drainage system at a depth of 2 to 6 feet.

- An adequate outlet for the drainage system must be available either by gravity or by pumping.

- The quantity and quality of discharge needs to be accounted for in the receiving stream (additional detention may be required).

- This standard does not apply to subsurface drains for building foundations or deep excavations.

- The capacity of an interceptor drain is determined by calculating the maximum rate of ground water flow to be intercepted. Therefore, it is good practice to make complete subsurface investigations, including hydraulic conductivity of the soil, before designing a subsurface drainage system.

- **Size of drain** - Size subsurface drains to carry the required capacity without pressure flow. Minimum diameter for a subsurface drain is 4 inches.

- The minimum velocity required to prevent silting is 1.4 ft./sec. The line shall be graded to achieve this velocity at a minimum. The maximum allowable velocity using a sand-gravel filter or envelope is 9 ft/sec.

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- Filter material and fabric shall be used around all drains for proper bedding and filtration of fine materials. Envelopes and filters should surround the drain to a minimum of 3-inch thickness.
- The outlet of the subsurface drain shall empty into a sediment pond through a catch basin. If free of sediment, it can then empty into a receiving channel, swale, or stable vegetated area adequately protected from erosion and undermining.
- 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.
- Backfilling shall be done immediately after placement of the pipe. No sections of pipe shall remain uncovered overnight or during a rainstorm. Backfill material shall be placed in the trench in such a manner that the drain pipe is not displaced or damaged.
- Do not install permanent drains near trees to avoid the tree roots that tend to clog the line. Use solid pipe with watertight connections where it is necessary to pass a subsurface drainage system through a stand of trees.
- Outlet -Ensure that the outlet of a drain empties into a channel or other watercourse above the normal water level.
- Secure an animal guard to the outlet end of the pipe to keep out rodents.
- Use outlet pipe of corrugated metal, cast iron, or heavy-duty plastic without perforations and at least 10 feet long. Do not use an envelope or filter material around the outlet pipe, and bury at least two-thirds of the pipe length.
- When outlet velocities exceed those allowable for the receiving stream, outlet protection must be provided.

Maintenance Standards: Subsurface drains shall be checked periodically to ensure that they are free-flowing and not clogged with sediment or roots.

- The outlet shall be kept clean and free of debris.
- Surface inlets shall be kept open and free of sediment and other debris.
- Trees located too close to a subsurface drain often clog the system with their roots. If a drain becomes clogged, relocate the drain or remove the trees as a last resort. Drain placement should be planned to minimize this problem.
- Where drains are crossed by heavy vehicles, the line shall be checked to ensure that it is not crushed.

BMP C206: Level Spreader

Purpose: To provide a temporary outlet for dikes and diversions consisting of an excavated depression constructed at zero grade across a slope. To convert concentrated runoff to sheet flow and release it onto areas stabilized by existing

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vegetation or an engineered filter strip.

Conditions of Use: Used when a concentrated flow of water needs to be dispersed over a large area with existing stable vegetation.

Items to consider are:

- What is the risk of erosion or damage if the flow may become concentrated?
- Is an easement required if discharged to adjoining property?
- Most of the flow should be as ground water and not as surface flow.
- Is there an unstable area downstream that cannot accept additional ground water?
- Use only where the slopes are gentle, the water volume is relatively low, and the soil will adsorb most of the low flow events.

Design and Installation Specifications: Use above undisturbed areas that are stabilized by existing vegetation.

If the level spreader has any low points, flow will concentrate, create channels and may cause erosion.

- Discharge area below the outlet must be uniform with a slope of less than 5H:1V.
- Outlet to be constructed level in a stable, undisturbed soil profile (not on fill).
- The runoff shall not re-concentrate after release unless intercepted by another downstream measure.
- The grade of the channel for the last 20 feet of the dike or interceptor entering the level spreader shall be less than or equal to 1 percent. The grade of the level spreader shall be 0 percent to ensure uniform spreading of storm runoff.
- A 6-inch high gravel berm placed across the level lip shall consist of washed crushed rock, 2- to 4-inch or ¾-inch to 1½-inch size.
- The spreader length shall be determined by estimating the peak flow expected from the 10-year, 24-hour design storm. The length of the spreader shall be a minimum of 15 feet for 0.1 cfs and shall be 10 feet for each 0.1 cfs there after to a maximum of 0.5 cfs per spreader. Use multiple spreaders for higher flows.
- The width of the spreader should be at least 6 feet.
- The depth of the spreader as measured from the lip should be at least 6 inches and it should be uniform across the entire length.
- Level spreaders shall be setback from the property line unless there is an easement for flow.
- Level spreaders, when installed every so often in grassy swales, keep the

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flows from concentrating. Materials that can be used include sand bags, lumber, logs, concrete, and pipe. To function properly, the material needs to be installed level and on contour. Figures 7.3.12 and 7.3.13 provide a cross-section and a detail of a level spreader.

Maintenance Standards: The spreader should be inspected after every runoff event to ensure that it is functioning correctly.

- The contractor should avoid the placement of any material on the structure and should prevent construction traffic from crossing over the structure.
- If the spreader is damaged by construction traffic, it shall be immediately repaired.

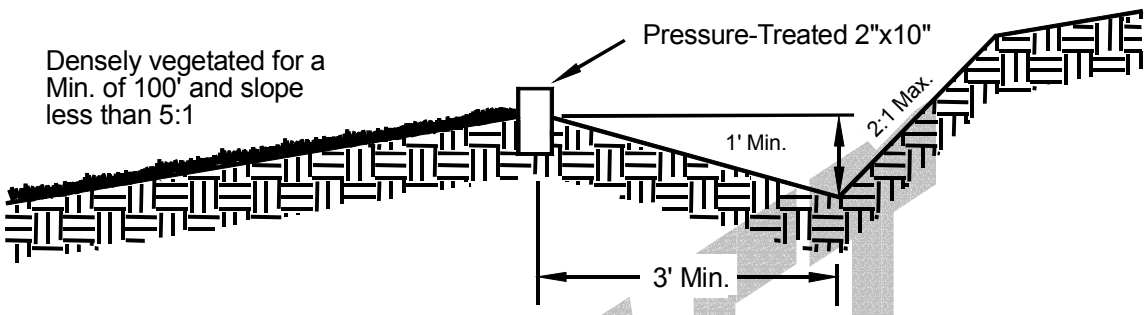

Figure 7.3.12 - Level-spreader Profile

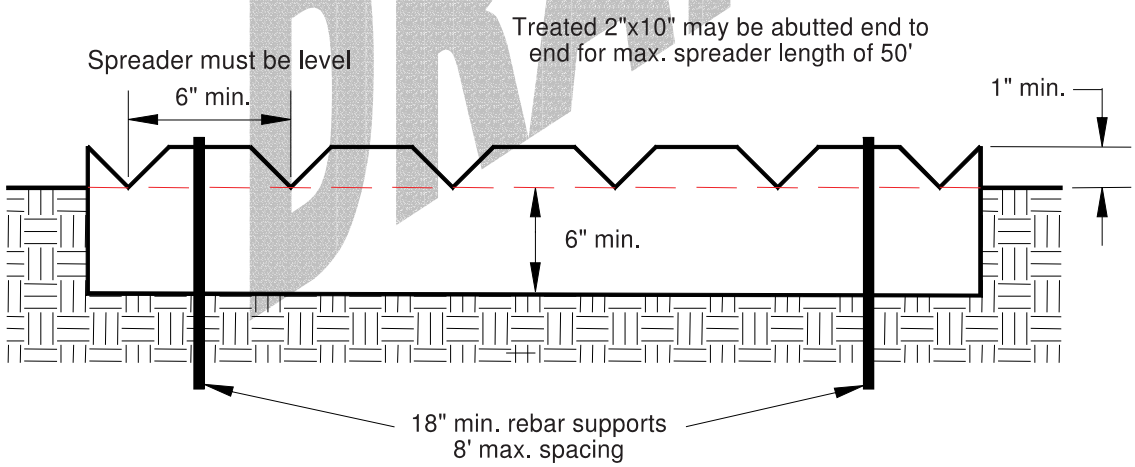

Figure 7.3.13 - Level Spreader Elevation

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BMP C207: Check Dams

Purpose: Construction of small dams across a swale or ditch reduces the velocity of concentrated flow and dissipates energy at the check dam.

Conditions of Use: Where temporary channels or permanent channels are not yet vegetated, channel lining is infeasible, and velocity checks are required.

- Check dams may not be placed in streams unless approved by the State Department of Fish and Wildlife. Check dams may not be placed in wetlands without approval from a permitting agency.
- Check dams shall not be placed below the expected backwater from any salmonid bearing water between October 1 and May 31 to ensure that there is no loss of high flow refuge habitat for overwintering juvenile salmonids and emergent salmonid fry.

Design and Installation Specifications: Whatever material is used, the dam should form a triangle when viewed from the side. This prevents undercutting as water flows over the face of the dam rather than falling directly onto the ditch bottom.

- Check dams in association with sumps work more effectively at slowing flow and retaining sediment than just a check dam alone. A deep sump should be provided immediately upstream of the check dam.
- In some cases, if carefully located and designed, check dams can remain as permanent installations with very minor regrading. They may be left as either spillways, in which case accumulated sediment would be graded and seeded, or as check dams to prevent further sediment from leaving the site.
- Check dams can be constructed of either rock or pea-gravel filled bags. Numerous new products are also available for this purpose. They tend to be re-usable, quick and easy to install, effective, and cost efficient.
- Check dams should be placed perpendicular to the flow of water.
- The maximum spacing between the dams shall be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam.
- Keep the maximum height at 2 feet at the center of the dam.
- Keep the center of the check dam at least 12 inches lower than the outer edges at natural ground elevation.
- Keep the side slopes of the check dam at 2:1 or flatter.
- Key the stone into the ditch banks and extend it beyond the abutments a minimum of 18 inches to avoid washouts from overflow around the dam.
- Use filter fabric foundation under a rock or sand bag check dam. If a blanket ditch liner is used, this is not necessary. A piece of organic or synthetic blanket cut to fit will also work for this purpose.
- Rock check dams shall be constructed of appropriately sized rock. The rock

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must be placed by hand or by mechanical means (no dumping of rock to form dam) to achieve complete coverage of the ditch or swale and to ensure that the center of the dam is lower than the edges. The rock used must be large enough to stay in place given the expected design flow through the channel.

- In the case of grass-lined ditches and swales, all check dams and accumulated sediment shall be removed when the grass has matured sufficiently to protect the ditch or swale - unless the slope of the swale is greater than 4 percent. The area beneath the check dams shall be seeded and mulched immediately after dam removal.
- Ensure that channel appurtenances, such as culvert entrances below check dams, are not subject to damage or blockage from displaced stones. Figure 7.3.14 depicts a typical rock check dam.

Maintenance Standards: Check dams shall be monitored for performance and sediment accumulation during and after each runoff producing rainfall. Sediment shall be removed when it reaches one half the sump depth.

- Anticipate submergence and deposition above the check dam and erosion from high flows around the edges of the dam.
- If significant erosion occurs between dams, install a protective riprap liner in that portion of the channel.

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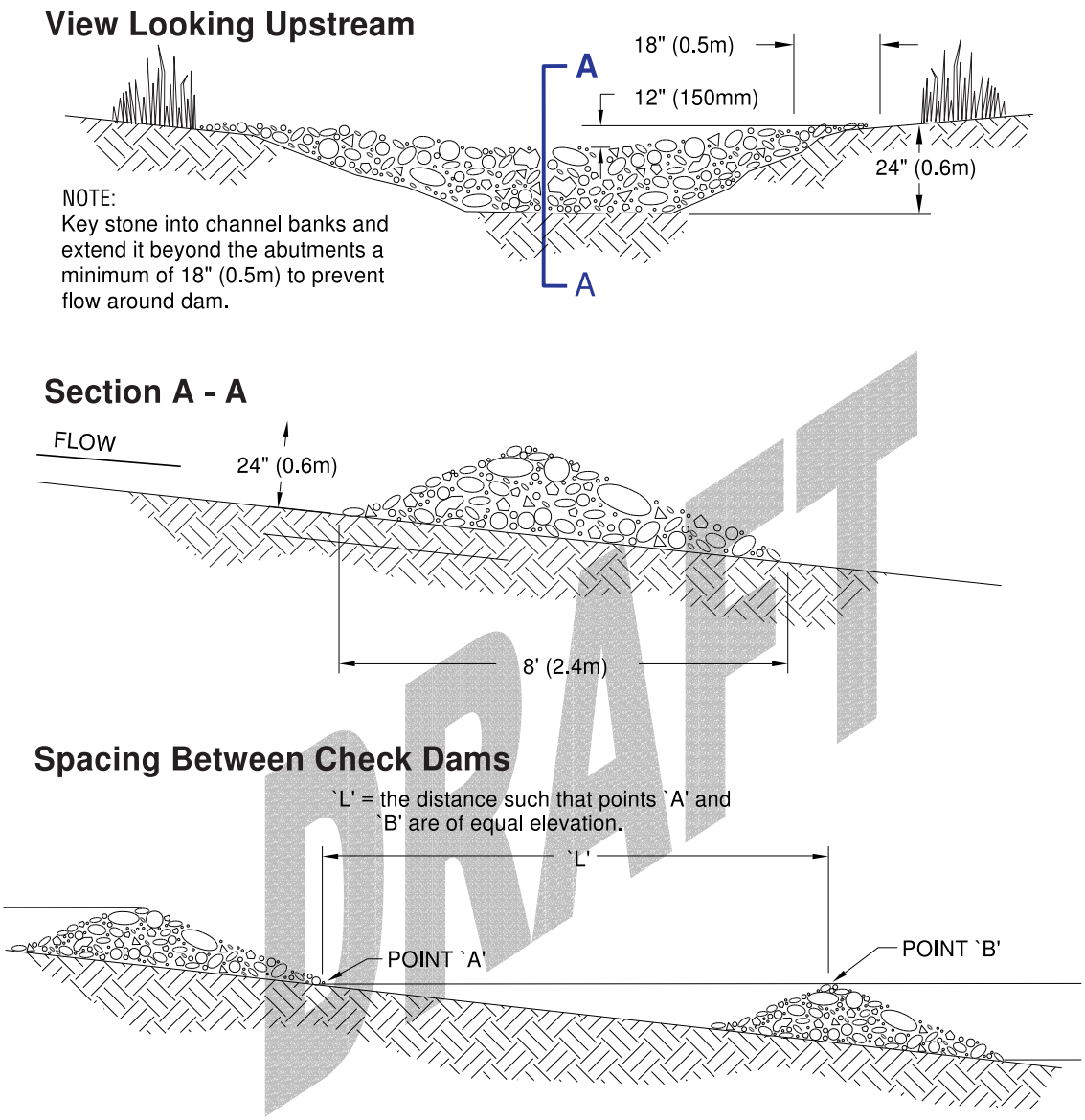

Figure 7.3.14 - Check Dams *NOT TO SCALE*

BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam)

Purpose: Triangular silt dikes may be used as check dams, for perimeter protection, for temporary soil stockpile protection, for drop inlet protection, or as a temporary interceptor dike.

Conditions of Use:

- May be used in place of straw bales for temporary check dams in ditches of any dimension.
- May be used on soil or pavement with adhesive or staples.
- TSDs have been used to build temporary:
  - sediment ponds;
  - diversion ditches;
  - concrete wash out facilities;
  - curbing;
  - water bars;
  - level spreaders; and,
  - berms.

Design and Installation Specifications: Made of urethane foam sewn into a woven geosynthetic fabric.

It is triangular, 10 inches to 14 inches high in the center, with a 20-inch to 28-inch base. A 2–foot apron extends beyond both sides of the triangle along its standard section of 7 feet. A sleeve at one end allows attachment of additional sections as needed.

- Install with ends curved up to prevent water from flowing around the ends.
- The fabric flaps and check dam units are attached to the ground with wire staples. Wire staples should be No. 11 gauge wire and should be 200 mm to 300 mm in length.
- When multiple units are installed, the sleeve of fabric at the end of the unit shall overlap the abutting unit and be stapled.
- Check dams should be located and installed as soon as construction will allow.
- Check dams should be placed perpendicular to the flow of water.
- When used as check dams, the leading edge must be secured with rocks, sandbags, or a small key slot and staples.
- In the case of grass-lined ditches and swales, check dams and accumulated sediment shall be removed when the grass has matured sufficiently to protect the ditch or swale unless the slope of the swale is greater than 4 percent. The

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area beneath the check dams shall be seeded and mulched immediately after dam removal.

Maintenance Standards: Triangular silt dams shall be monitored for performance and sediment accumulation during and after each runoff producing rainfall. Sediment shall be removed when it reaches one half the height of the dam.

- Anticipate submergence and deposition above the triangular silt dam and erosion from high flows around the edges of the dam. Immediately repair any damage or any undercutting of the dam.

BMP C209: Outlet Protection

Purpose: Outlet protection prevents scour at conveyance outlets and minimizes the potential for downstream erosion by reducing the velocity of concentrated stormwater flows.

Conditions of Use: 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.

Design and Installation Specifications: The receiving channel at the outlet of a culvert shall be protected from erosion by rock lining a minimum of 6 feet downstream and extending up the channel sides a minimum of 1–foot above the maximum tailwater elevation or 1-foot above the crown, whichever is higher. For large pipes (more than 18 inches in diameter), the outlet protection lining of the channel is lengthened to four times the diameter of the culvert.

- Standard wingwalls, and tapered outlets and paved channels should also be considered when appropriate for permanent culvert outlet protection. (See WSDOT Hydraulic Manual, available through WSDOT Engineering Publications).
- Organic or synthetic erosion blankets, with or without vegetation, are usually more effective than rock, cheaper, and easier to install. Materials can be chosen using manufacturer product specifications. ASTM test results are available for most products and the designer can choose the correct material for the expected flow.
- With low flows, vegetation (including sod) can be effective.
- The following guidelines shall be used for riprap outlet protection:
- If the discharge velocity at the outlet is less than 5 fps (pipe slope less than 1 percent), use 2-inch to 8-inch riprap. Minimum thickness is 1-foot.
- For 5 to 10 fps discharge velocity at the outlet (pipe slope less than 3 percent), use 24-inch to 4-foot riprap. Minimum thickness is 2 feet.
- For outlets at the base of steep slope pipes (pipe slope greater than 10 percent), an engineered energy dissipator shall be used.
- Filter fabric or erosion control blankets should always be used under riprap to prevent scour and channel erosion.

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- New pipe outfalls can provide an opportunity for low-cost fish habitat improvements. For example, an alcove of low-velocity water can be created by constructing the pipe outfall and associated energy dissipator back from the stream edge and digging a channel, over-widened to the upstream side, from the outfall. Overwintering juvenile and migrating adult salmonids may use the alcove as shelter during high flows. Bank stabilization, bioengineering, and habitat features may be required for disturbed areas. See Chapter 6 for more information on outfall system design.

Maintenance Standards:

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

BMP C220: Storm Drain Inlet Protection

Purpose: To prevent coarse sediment from entering drainage systems prior to permanent stabilization of the disturbed area.

Conditions of Use: Where storm drain inlets are to be made operational before permanent stabilization of the disturbed drainage area. Protection should be provided for all storm drain inlets downslope and within 500 feet of a disturbed or construction area, unless the runoff that enters the catch basin will be conveyed to a sediment pond or trap. Inlet protection may be used anywhere to protect the drainage system. It is likely that the drainage system will still require cleaning.

Table 7.3.9 lists several options for inlet protection. All of the methods for storm drain inlet protection are prone to plugging and require a high frequency of maintenance. Drainage areas should be limited to 1 acre or less. Emergency overflows may be required where stormwater ponding would cause a hazard. If an emergency overflow is provided, additional end-of-pipe treatment may be required.

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Table 7.3.9 Storm Drain Inlet Protection

Type of Inlet Protection	Emergency Overflow	Applicable for Paved/ Earthen Surfaces	Conditions of Use
Drop Inlet Protection			
Excavated drop inlet protection	Yes, temporary flooding will occur	Earthen	Applicable for heavy flows. Easy to maintain. Large area Requirement: 30' X 30'/acre
Block and gravel drop inlet protection	Yes	Paved or Earthen	Applicable for heavy concentrated flows. Will not pond.
Gravel and wire drop inlet protection	No		Applicable for heavy concentrated flows. Will pond. Can withstand traffic.
Catch basin filters	Yes	Paved or Earthen	Frequent maintenance required.

Curb Inlet Protection			
Curb inlet protection with a wooden weir	Small capacity overflow	Paved	Used for sturdy, more compact installation.
Block and gravel curb inlet protection	Yes	Paved	Sturdy, but limited filtration.
Culvert Inlet Protection			
Culvert inlet sediment trap			18 month expected life.

Design and Installation Specifications: Excavated Drop Inlet Protection - An excavated impoundment around the storm drain. Sediment settles out of the stormwater prior to entering the storm drain.

- Depth 1-2 ft as measured from the crest of the inlet structure.
- Side Slopes of excavation no steeper than 2:1.
- Minimum volume of excavation 35 cubic yards.
- Shape basin to fit site with longest dimension oriented toward the longest inflow area.
- Install provisions for draining to prevent standing water problems.
- Clear the area of all debris.
- Grade the approach to the inlet uniformly.
- Drill weep holes into the side of the inlet.
- Protect weep holes with screen wire and washed aggregate.
- Seal weep holes when removing structure and stabilizing area.
- It may be necessary to build a temporary dike to the down slope side of the structure to prevent bypass flow.
- Block and Gravel Filter - A barrier formed around the storm drain inlet with standard concrete blocks and gravel. See Figure 4.15.
- Height 1 to 2 feet above inlet.
- Recess the first row 2 inches into the ground for stability.
- Support subsequent courses by placing a 2x4 through the block opening.
- Do not use mortar.
- Lay some blocks in the bottom row on their side for dewatering the pool.
- Place hardware cloth or comparable wire mesh with ½-inch openings over all block openings.
- Place gravel just below the top of blocks on slopes of 2:1 or flatter.

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- An alternative design is a gravel donut.
- Inlet slope of 3:1.
- Outlet slope of 2:1.
- 1-foot wide level stone area between the structure and the inlet.
- Inlet slope stones 3 inches in diameter or larger.
- Outlet slope use gravel ½- to ¾-inch at a minimum thickness of 1-foot.

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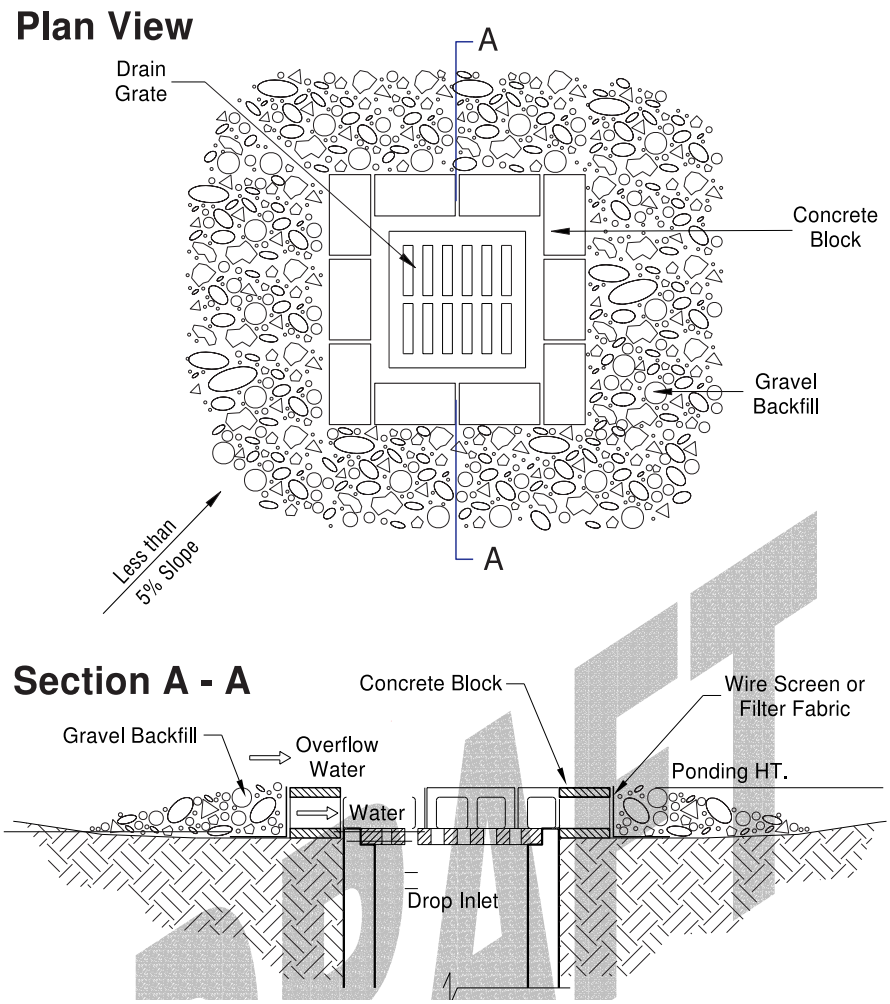

Notes:
1. Drop inlet sediment barriers are to be used for small, nearly level drainage areas. (less than 5%)
2. Excavate a basin of sufficient size adjacent to the drop inlet.
3. The top of the structure (ponding height) must be well below the ground elevation downslope to prevent runoff from bypassing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

Figure 7.3.15 – Block and Gravel Filter

Gravel and Wire Mesh Filter - A gravel barrier placed over the top of the inlet. This structure does not provide an overflow.

- Hardware cloth or comparable wire mesh with ½-inch openings.
- Coarse aggregate.
- Height 1-foot or more, 18 inches wider than inlet on all sides.
- Place wire mesh over the drop inlet so that the wire extends a minimum of 1-foot beyond each side of the inlet structure.
- If more than one strip of mesh is necessary, overlap the strips.
- Place coarse aggregate over the wire mesh.
- The depth of the gravel should be at least 12 inches over the entire inlet opening and extend at least 18 inches on all sides.

Catchbasin Filters - Inserts should be designed by the manufacturer for use at construction sites. The limited sediment storage capacity increases the amount of inspection and maintenance required, which may be daily for heavy sediment loads. The maintenance requirements can be reduced by combining a catchbasin filter with another type of inlet protection. This type of inlet protection provides flow bypass without overflow and therefore may be a better method for inlets located along active rights-of-way.

- 5 cubic feet of storage.
- Dewatering provisions.
- High-flow bypass that will not clog under normal use at a construction site.
- The catchbasin filter is inserted in the catchbasin just below the grating.

Curb Inlet Protection with Wooden Weir – Barrier formed around a curb inlet with a wooden frame and gravel.

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

Block and Gravel Curb Inlet Protection – Barrier formed around an inlet with concrete blocks and gravel. See Figure 7.3.16.

- Wire mesh with ½-inch openings.
- Place two concrete blocks on their sides abutting the curb at either side of the

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inlet opening. These are spacer blocks.

- Place a 2x4 stud through the outer holes of each spacer block to align the front blocks.
- Place blocks on their sides across the front of the inlet and abutting the spacer blocks.
- Place wire mesh over the outside vertical face.
- Pile coarse aggregate against the wire to the top of the barrier.

Curb and Gutter Sediment Barrier – Sandbag or rock berm (riprap and aggregate) 3 feet high and 3 feet wide in a horseshoe shape. See Figure 7.3.17.

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

Maintenance Standards:

- Catch basin filters should be inspected frequently, especially after storm events. If the insert becomes clogged, it should be cleaned or replaced.
- For systems using stone filters: If the stone filter becomes clogged with sediment, the stones must be pulled away from the inlet and cleaned or replaced. Since cleaning of gravel at a construction site may be difficult, an alternative approach would be to use the clogged stone as fill and put fresh stone around the inlet.
- Do not wash sediment into storm drains while cleaning. Spread all excavated material evenly over the surrounding land area or stockpile and stabilize as appropriate.

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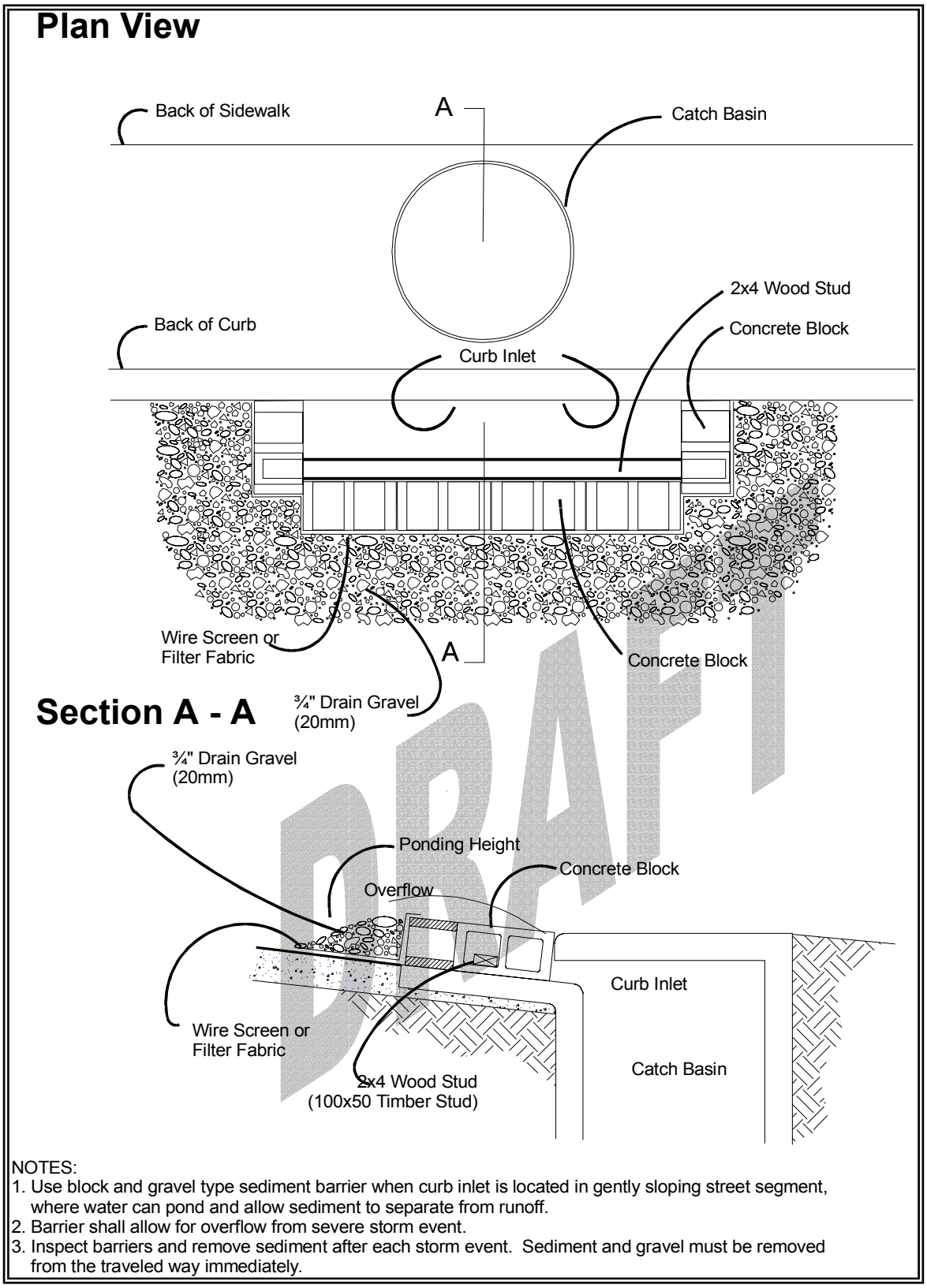
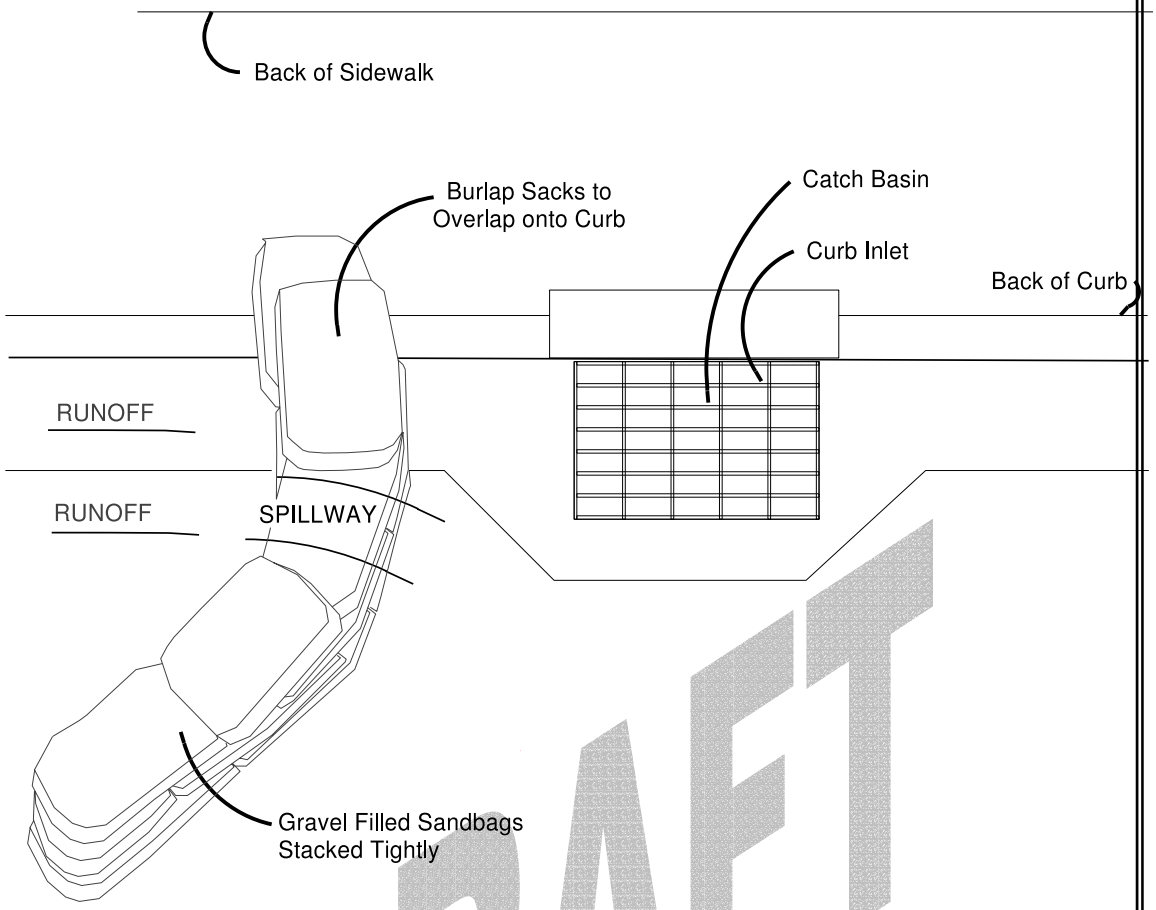


NOTES:
1. Use block and gravel type sediment barrier when curb inlet is located in gently sloping street segment, where water can pond and allow sediment to separate from runoff.
2. Barrier shall allow for overflow from severe storm event.
3. Inspect barriers and remove sediment after each storm event.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

Figure 7.3.16 - Block and Gravel Curb Inlet Protection

Plan View

Figure 7.3.17 – Curb and Gutter Barrier



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

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BMP C230: Straw Bale Barrier

Purpose: To decrease the velocity of sheet flows and intercept and detain small amounts of sediment from disturbed areas of limited extent, preventing sediment from leaving the site. See Figure 7.3.18 for details on straw bale barriers.

Conditions of Use: Below disturbed areas subject to sheet and rill erosion.

- Straw bales are among the most used and least effective BMPs. The best use of a straw bale is hand spread on the site.
- Where the size of the drainage area is no greater than ¼ acre per 100 feet of barrier length; the maximum slope length behind the barrier is 100 feet; and the maximum slope gradient behind the barrier is 2:1.
- Where effectiveness is required for less than three months.
- Under no circumstances should straw bale barriers be constructed in streams, channels, or ditches.
- Straw bale barriers should not be used where rock or hard surfaces prevent the full and uniform anchoring of the barrier.

Design and Installation Specifications: Bales shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another.

All bales shall be either wire-bound or string-tied. Straw bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings.

- The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. The trench must be deep enough to remove all grass and other material that might allow underflow. After the bales are staked and chinked (filled by wedging), the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side of the barrier.
- Each bale shall be securely anchored by at least two stakes or re-bars driven through the bale. The first stake in each bale shall be driven toward the previously laid bale to force the bales together. Stakes or re-bars shall be driven deep enough into the ground to securely anchor the bales. Stakes should not extend above the bales but instead should be driven in flush with the top of the bale for safety reasons.
- The gaps between the bales shall be chinked (filled by wedging) with straw to prevent water from escaping between the bales. Loose straw scattered over the area immediately uphill from a straw bale barrier tends to increase barrier efficiency. Wedging must be done carefully in order not to separate the bales.

Maintenance Standards:

- Straw bale barriers shall be inspected immediately after each runoff-

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producing rainfall and at least daily during prolonged rainfall.

- Close attention shall be paid to the repair of damaged bales, end runs, and undercutting beneath bales.
- Necessary repairs to barriers or replacement of bales shall be accomplished promptly.
- Sediment deposits should be removed after each runoff-producing rainfall. They must be removed when the level of deposition reaches approximately one-half the height of the barrier.
- Any sediment deposits remaining in place after the straw bale barrier is no longer required shall be dressed to conform to the existing grade, prepared and seeded.
- Straw bales used as a temporary straw bale barrier shall be removed after project completion and stabilization to prevent sprouting of unwanted vegetation.

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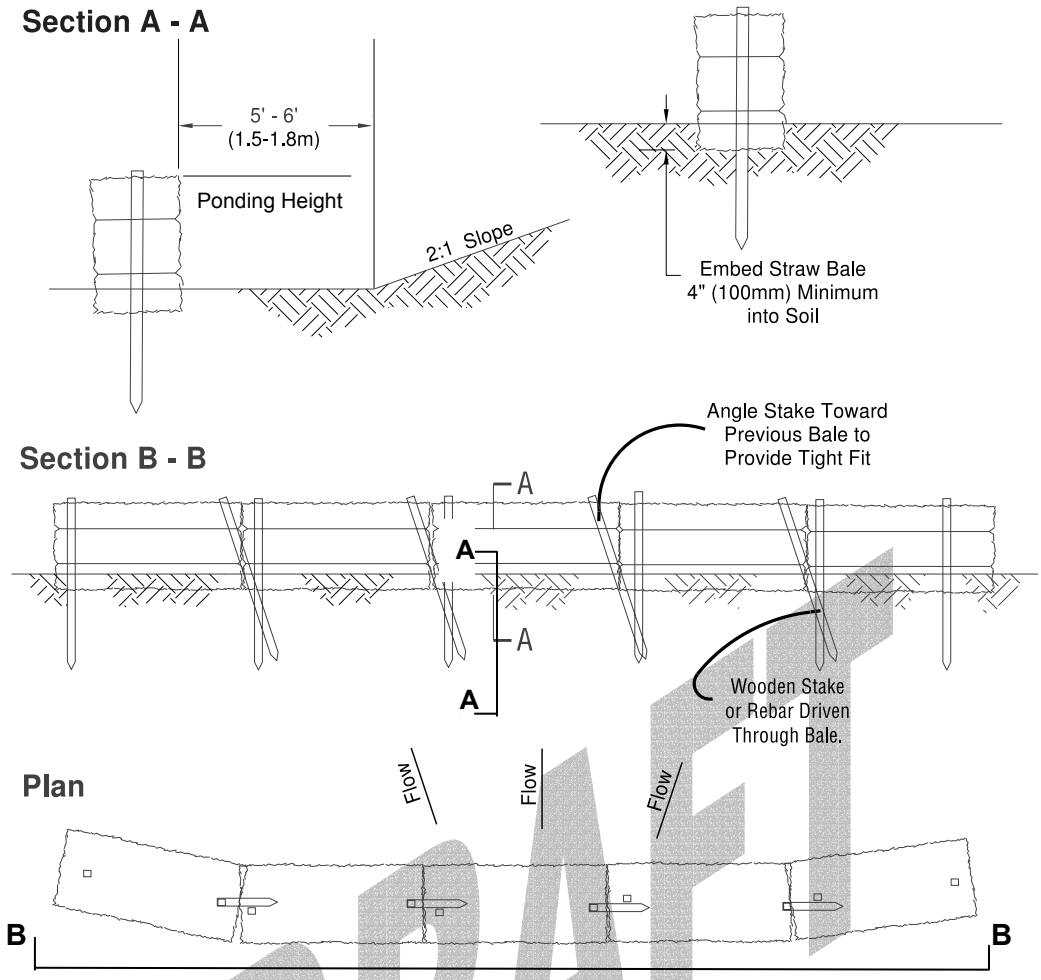

NOTES:
1. The straw bales shall be placed on slope contour.
2. Bales to be placed in a row with the ends tightly abutting.
3. Key in bales to prevent erosion or flow under bales.

Figure 7.3.18 Straw Bale Barrier

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BMP C231: Brush Barrier

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

Conditions of Use: Brush barriers may be used downslope of all disturbed areas of less than one-quarter acre.

- Brush barriers are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a barrier, rather than by a sediment pond, is when the area draining to the barrier is small.
- Brush barriers should only be installed on contours.

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

- Chipped site vegetation, composted mulch, or wood-based mulch (hog fuel) can be used to construct brush barriers.
- A 100 percent biodegradable installation can be constructed using 10-ounce burlap held in place by wooden stakes. Figure 7.3.19 depicts a typical brush barrier.

Maintenance Standards:

- There shall be no signs of erosion or concentrated runoff under or around the barrier. If concentrated flows are bypassing the barrier, it must be expanded or augmented by toed-in filter fabric.
- The dimensions of the barrier must be maintained.

BMP C232: Gravel Filter Berm

Purpose: A gravel filter berm is constructed on rights-of-way or traffic areas within a construction site to retain sediment by using a filter berm of gravel or crushed rock.

Conditions of Use: Where a temporary measure is needed to retain sediment from rights-of-way or in traffic areas on construction sites.

Design and Installation Specifications:

- Berm material shall be ¾ to 3 inches in size, washed well-grade gravel or crushed rock with less than 5 percent fines.
- Spacing of berms:

  Every 300 feet on slopes less than 5 percent
  Every 200 feet on slopes between 5 percent and 10 percent
  Every 100 feet on slopes greater than 10 percent

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- Berm dimensions:

  1 foot high with 3:1 side slopes
  8 linear feet per 1 cfs runoff based on the 10-year, 24-hour design storm

Maintenance Standards

- Regular inspection is required. Sediment shall be removed and filter material replaced as needed.

BMP C233: Silt Fence

Purpose: Use of a silt fence reduces the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow. See Figure 7.3.20 for details on silt fence construction.

Conditions of Use:

- Silt fence may be used downslope of all disturbed areas. Silt fence is not intended to treat concentrated flows, nor is it intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a silt fence, rather than by a sediment pond, is when the area draining to the fence is one acre or less and flow rates are less than 0.5 cfs.
- Silt fences should not be constructed in streams or used in V-shaped ditches. They are not an adequate method of silt control for anything deeper than sheet or overland flow.

Design and Installation Specifications: Drainage area of 1 acre or less or in combination with sediment basin in a larger site.

- Maximum slope steepness (normal (perpendicular) to fence line) 1:1.
- Maximum sheet or overland flow path length to the fence of 100 feet.
- No flows greater than 0.5 cfs.
- The geotextile used shall meet the following standards. All geotextile properties listed below are minimum average roll values (i.e., the test result for any sampled roll in a lot shall meet or exceed the values shown in Table 7.3.10).

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Table 7.3.10 Geotextile Standards

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

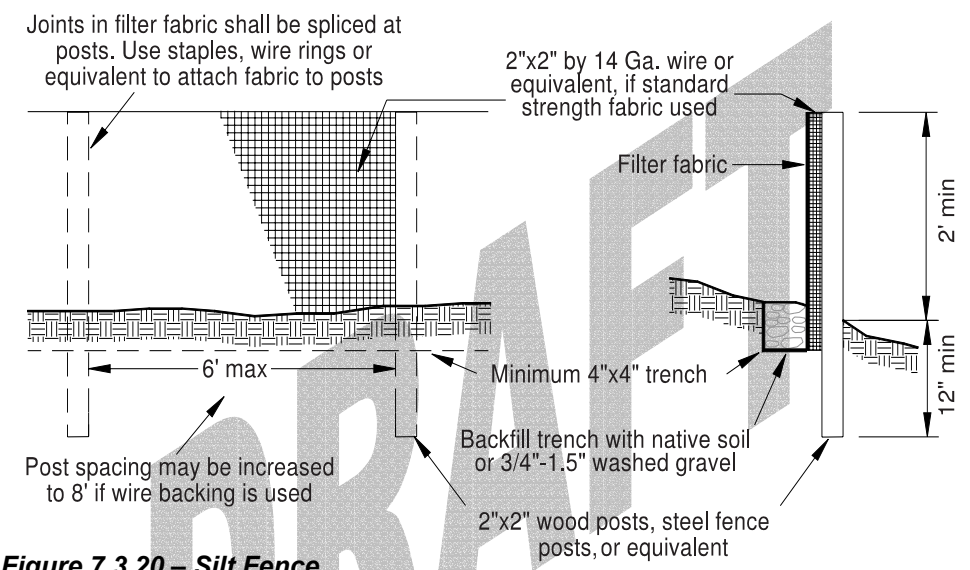

Figure 7.3.20 – Silt Fence

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Design and Installation Specifications:

- Standard strength fabrics shall be supported with wire mesh, chicken wire, 2-inch x 2-inch wire, safety fence, or jute mesh to increase the strength of the fabric. Silt fence materials are available that have synthetic mesh backing attached.
- Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0°F. to 120°F.
- 100 percent biodegradable silt fence is available that is strong, long lasting, and can be left in place after the project is completed, if permitted by local regulations.

- The contractor shall install and maintain temporary silt fences at the locations shown in the Plans. The silt fences shall be constructed in the areas of clearing, grading, or drainage prior to starting those activities. A silt fence shall not be considered temporary if the silt fence must function beyond the life of the contract. The silt fence shall prevent soil carried by runoff water from going beneath, through, or over the top of the silt fence, but shall allow the water to pass through the fence.
- The minimum height of the top of silt fence shall be 2 feet and the maximum height shall be 2½ feet above the original ground surface.
- The geotextile shall be sewn together at the point of manufacture, or at an approved location as determined by the Engineer, to form geotextile lengths as required. All sewn seams shall be located at a support post. Alternatively, two sections of silt fence can be overlapped, provided the Contractor can demonstrate, to the satisfaction of the Engineer, that the overlap is long enough and that the adjacent fence sections are close enough together to prevent silt laden water from escaping through the fence at the overlap.
- The geotextile shall be attached on the up-slope side of the posts and support system with staples, wire, or in accordance with the manufacturer's recommendations. The geotextile shall be attached to the posts in a manner that reduces the potential for geotextile tearing at the staples, wire, or other connection device. Silt fence back-up support for the geotextile in the form of a wire or plastic mesh is dependent on the properties of the geotextile selected for use. If wire or plastic back-up mesh is used, the mesh shall be fastened securely to the up-slope of the posts with the geotextile being up-slope of the mesh back-up support.
- The geotextile at the bottom of the fence shall be buried in a trench to a minimum depth of 4 inches below the ground surface. The trench shall be backfilled and the soil tamped in place over the buried portion of the geotextile, such that no flow can pass beneath the fence and scouring can not occur. When wire or polymeric back-up support mesh is used, the wire or polymeric mesh shall extend into the trench a minimum of 3 inches.
- The fence posts shall be placed or driven a minimum of 18 inches. A minimum depth of 12 inches is allowed if topsoil or other soft subgrade soil is not present and a minimum depth of 18 inches cannot be reached. Fence post depths shall be increased by 6 inches if the fence is located on slopes of 3:1 or steeper and the slope is perpendicular to the fence. If required post depths cannot be obtained, the posts shall be adequately secured by bracing or guying to prevent overturning of the fence due to sediment loading.
- Silt fences shall be located on contour as much as possible, except at the ends of the fence, where the fence shall be turned uphill such that the silt fence captures the runoff water and prevents water from flowing around the end of the fence.
- If the fence must cross contours, with the exception of the ends of the fence,

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

- Wood, steel or equivalent posts shall be used. Wood posts shall have minimum dimensions of 2 inches by 2 inches by 3 feet minimum length, and shall be free of defects such as knots, splits, or gouges. Steel posts shall consist of either size No. 6 rebar or larger, ASTM A 120 steel pipe with a minimum diameter of 1-inch, U, T, L, or C shape steel posts with a minimum weight of 1.35 lbs./ft. or other steel posts having equivalent strength and bending resistance to the post sizes listed. The spacing of the support posts shall be a maximum of 6 feet.
- Fence back-up support, if used, shall consist of steel wire with a maximum mesh spacing of 2 inches, or a prefabricated polymeric mesh. The strength of the wire or polymeric mesh shall be equivalent to or greater than 180 lbs. grab tensile strength. The polymeric mesh must be as resistant to ultraviolet radiation as the geotextile it supports.
- Silt fence installation using the slicing method specification details follow. Refer to Figure 7.3.21 for slicing method details.
- The base of both end posts must be at least 2 to 4 inches above the top of the silt fence fabric on the middle posts for ditch checks to drain properly. Use a hand level or string level, if necessary, to mark base points before installation.
- Install posts 3 to 4 feet apart in critical retention areas and 6 to 7 feet apart in standard applications.
- Install posts 24 inches deep on the downstream side of the silt fence, and as close as possible to the fabric, enabling posts to support the fabric from upstream water pressure.
- Install posts with the nipples facing away from the silt fence fabric.
- Attach the fabric to each post with three ties, all spaced within the top 8 inches of the fabric. Attach each tie diagonally 45 degrees through the fabric, with each puncture at least 1 inch vertically apart. In addition, each tie should be positioned to hang on a post nipple when tightening to prevent sagging.
- Wrap approximately 6 inches of fabric around the end posts and secure with 3 ties.
- No more than 24 inches of a 36-inch fabric is allowed above ground level.
- The rope lock system must be used in all ditch check applications.

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- The installation should be checked and corrected for any deviation before compaction. Use a flat-bladed shovel to tuck fabric deeper into the ground if necessary.
- Compaction is vitally important for effective results. Compact the soil immediately next to the silt fence fabric with the front wheel of the tractor, skid steer, or roller exerting at least 60 pounds per square inch. Compact the upstream side first and then each side twice for a total of four trips.

Maintenance Standards:

- Any damage shall be repaired immediately.
- If concentrated flows are evident uphill of the fence, they must be intercepted and conveyed to a sediment pond.
- It is important to check the uphill side of the fence for signs of the fence clogging and acting as a barrier to flow and then causing channelization of flows parallel to the fence. If this occurs, replace the fence or remove the trapped sediment.
- Sediment deposits shall either be removed when the deposit reaches approximately one-third the height of the silt fence, or a second silt fence shall be installed.
- If the filter fabric (geotextile) has deteriorated due to ultraviolet breakdown, it shall be replaced.

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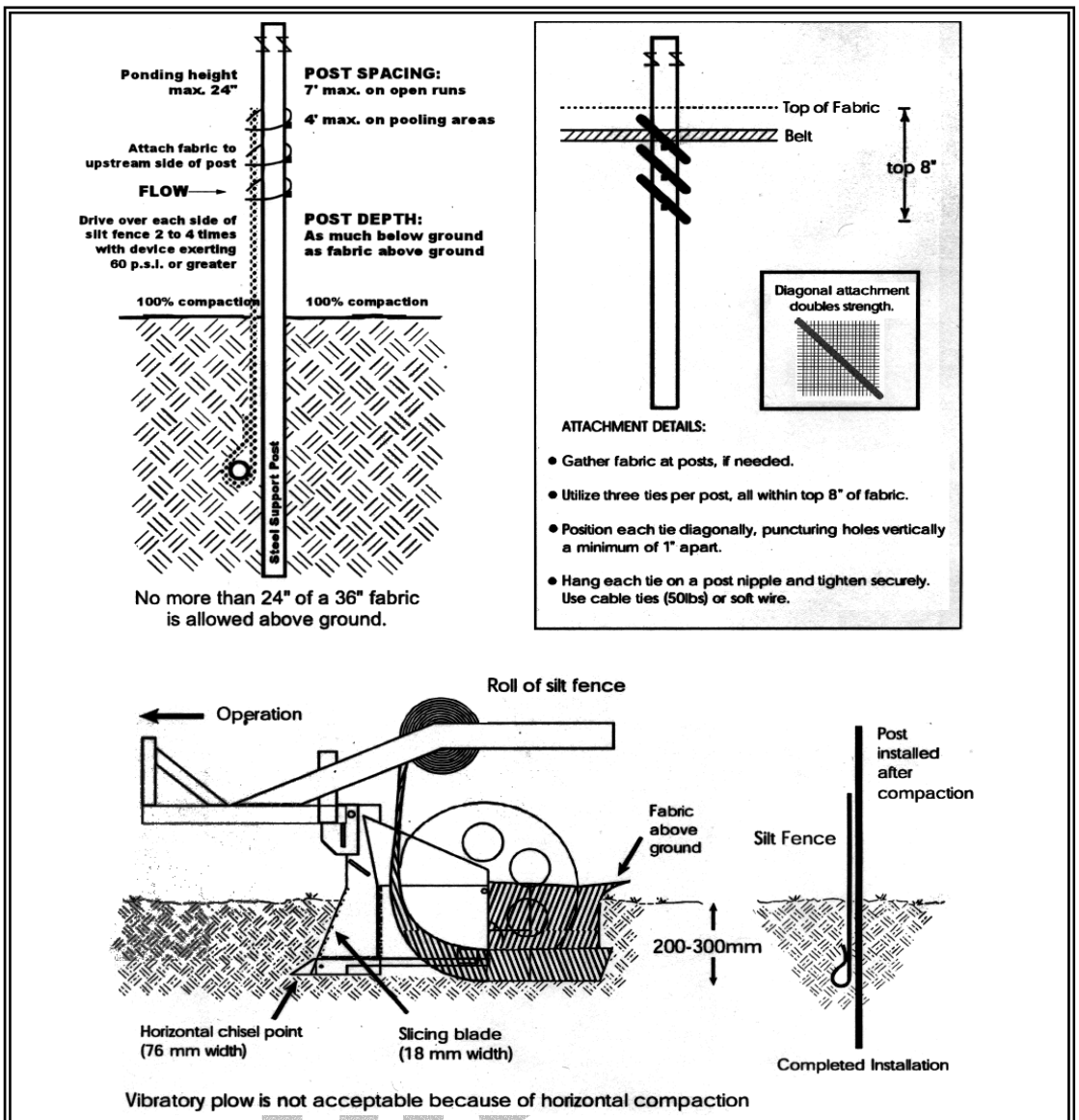

Figure 7.3.21 – Silt Fence Installation by Slicing Method

BMP C234: Vegetated Strip

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

Conditions of Use:

- Vegetated strips may be used downslope of all disturbed areas.
- Vegetated strips are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a strip, rather than by a sediment pond, is when the following criteria are met (see Table 7.3.11):

Table 7.3.11 - Vegetated Strips

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

Design and Installation Specifications: The vegetated strip shall consist of a minimum of a 25-foot wide continuous strip of dense vegetation with a permeable topsoil. Grass-covered, landscaped areas are generally not adequate because the volume of sediment overwhelms the grass. Ideally, vegetated strips shall consist of undisturbed native growth with a well-developed soil that allows for infiltration of runoff.

- The slope within the strip shall not exceed 4H:1V.
- The uphill boundary of the vegetated strip shall be delineated with clearing limits.

Maintenance Standards: Any areas damaged by erosion or construction activity shall be seeded immediately and protected by mulch.

- If more than 5 feet of the original vegetated strip width has had vegetation removed or is being eroded, sod must be installed.
- If there are indications that concentrated flows are traveling across the buffer, surface water controls must be installed to reduce the flows entering the buffer, or additional perimeter protection must be installed.

BMP C235: Straw Wattles

Purpose: Straw wattles are temporary erosion and sediment control barriers consisting of straw that is wrapped in biodegradable tubular plastic or similar encasing material. They reduce the velocity and can spread the flow of rill and sheet runoff, and can capture and retain sediment. Straw wattles are typically 8 to

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10 inches in diameter and 25 to 30 feet in length. The wattles are placed in shallow trenches and staked along the contour of disturbed or newly constructed slopes. See Figure 7.3.22 for typical construction details.

Conditions of Use:

- Disturbed areas that require immediate erosion protection.
- Exposed soils during the period of short construction delays, or over winter months.
- On slopes requiring stabilization until permanent vegetation can be established.
- Straw wattles are effective for one to two seasons.
- If conditions are appropriate, wattles can be staked to the ground using willow cuttings for added revegetation.
- Rilling can occur beneath wattles if not properly entrenched and water can pass between wattles if not tightly abutted together.

Design Criteria:

- It is critical that wattles are installed perpendicular to the flow direction and parallel to the slope contour.
- Narrow trenches should be dug across the slope on contour to a depth of 3 to 5 inches on clay soils and soils with gradual slopes. On loose soils, steep slopes, and areas with high rainfall, the trenches should be dug to a depth of 5 to 7 inches, or ½ to 2/3 of the thickness of the wattle.
- Start building trenches and installing wattles from the base of the slope and work up. Excavated material should be spread evenly along the uphill slope and compacted using hand tamping or other methods.
- Construct trenches at contour intervals of 3 to 30 feet apart depending on the steepness of the slope, soil type, and rainfall. The steeper the slope the closer together the trenches.
- Install the wattles snugly into the trenches and abut tightly end to end. Do not overlap the ends.
- Install stakes at each end of the wattle, and at 4-foot centers along entire length of wattle.
- If required, install pilot holes for the stakes using a straight bar to drive holes through the wattle and into the soil.
- At a minimum, wooden stakes should be approximately ¾ x ¾ x 24 inches. Willow cuttings or 3/8-inch rebar can also be used for stakes.
- Stakes should be driven through the middle of the wattle, leaving 2 to 3 inches of the stake protruding above the wattle.

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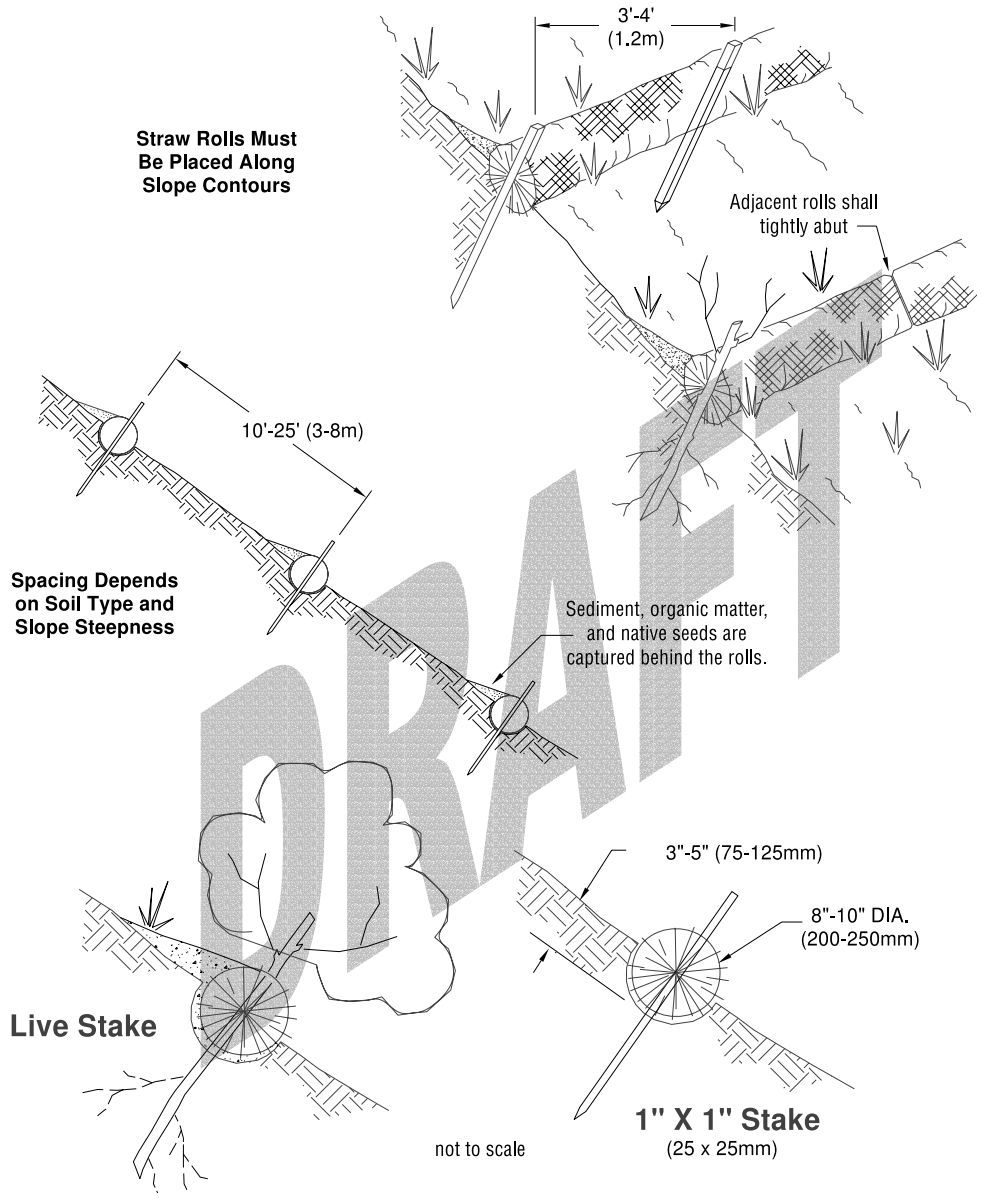
Maintenance Standards:

- Wattles may require maintenance to ensure they are in contact with soil and thoroughly entrenched, especially after significant rainfall on steep sandy soils.
- Inspect the slope after significant storms and repair any areas where wattles are not tightly abutted or water has scoured beneath the wattles.



NOTE:
Straw roll installation requires the placement and secure staking of the roll in a trench, 3”x5” (75-125mm) deep, dug on contour. Runoff must not be allowed to run under or around roll.

Figure 7.3.22 - Straw Wattles

BMP C240: Sediment Trap

Purpose: A sediment trap is a small temporary ponding area with a gravel outlet used to collect and store sediment from sites cleared and/or graded during construction. Sediment traps, along with other perimeter controls, shall be installed before any land disturbance takes place in the drainage area.

Conditions of Use: Prior to leaving a construction site, stormwater runoff must pass through a sediment pond or trap or other appropriate sediment removal best management practice. Non-engineered sediment traps may be used on-site prior to an engineered sediment trap or sediment pond to provide additional sediment removal capacity.

It is intended for use on sites where the tributary drainage area is less than 3 acres, with no unusual drainage features, and a projected build-out time of six months or less. The sediment trap is a temporary measure (with a design life of approximately 6 months) and shall be maintained until the site area is permanently protected against erosion by vegetation and/or structures.

Sediment traps and ponds are only effective in removing sediment down to about the medium silt size fraction. Runoff with sediment of finer grades (fine silt and clay) will pass through untreated, emphasizing the need to control erosion to the maximum extent first.

Whenever possible, sediment-laden water shall be discharged into onsite, relatively level, vegetated areas (see BMP C234 – Vegetated Strip). This is the only way to effectively remove fine particles from runoff unless chemical treatment or filtration is used. This can be particularly useful after initial treatment in a sediment trap or pond. The areas of release must be evaluated on a site-by-site basis in order to determine appropriate locations for and methods of releasing runoff. Vegetated wetlands shall not be used for this purpose. Frequently, it may be possible to pump water from the collection point at the downhill end of the site to an upslope vegetated area. Pumping shall only augment the treatment system, not replace it, because of the possibility of pump failure or runoff volume in excess of pump capacity.

All projects that are constructing permanent facilities for runoff quantity control should use the rough-graded or final-graded permanent facilities for traps and ponds. This includes combined facilities and infiltration facilities. When permanent facilities are used as temporary sedimentation facilities, the surface area requirement of a sediment trap or pond must be met. If the surface area requirements are larger than the surface area of the permanent facility, then the trap or pond shall be enlarged to comply with the surface area requirement. The permanent pond shall also be divided into two cells as required for sediment ponds.

Either a permanent control structure or the temporary control structure (described in BMP C241, Temporary Sediment Pond) can be used. 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 pond. A shut-off valve may be added to the control structure to allow complete retention

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of stormwater in emergency situations. In this case, an emergency overflow weir must be added.

A skimmer may be used for the sediment trap outlet if approved by the Local Permitting Authority.

Design and Installation Specifications:

See Figures 7.3.23 and 7.3.24 for details.

If permanent runoff control facilities are part of the project, they should be used for sediment retention.

To determine the sediment trap geometry, first calculate the design surface area (SA) of the trap, measured at the invert of the weir. Use the following equation:

$SA = FS(Q_2/Vs)$

Where,

Q_2 = Design inflow based on the peak discharge from the developed 2-year runoff event from the contributing drainage area as computed in the hydrologic analysis. The 10-year peak flow shall be used if the project size, expected timing and duration of construction, or downstream conditions warrant a higher level of protection. If no hydrologic analysis is required, the Rational Method may be used.

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 (Vs) 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:

$SA = 2 \times Q_2/0.00096$ or 2080 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.*

- To aid in determining sediment depth, all sediment traps shall have a staff gauge with a prominent mark 1-foot above the bottom of the trap.
- Sediment traps may not be feasible on utility projects due to the limited work space or the short-term nature of the work. Portable tanks may be used in place of sediment traps for utility projects.

Maintenance Standards:

- Sediment shall be removed from the trap when it reaches 1-foot in depth.
- Any damage to the pond embankments or slopes shall be repaired.

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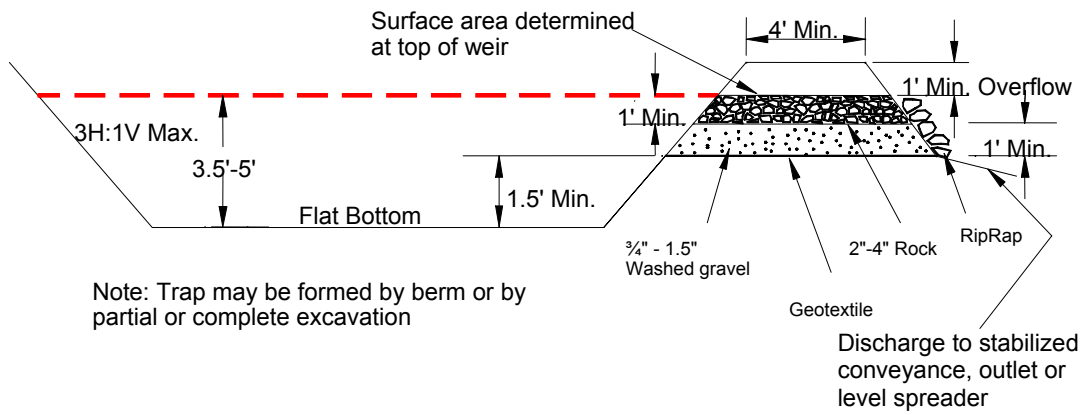

Figure 7.3.23 Cross-Section of Sediment Trap

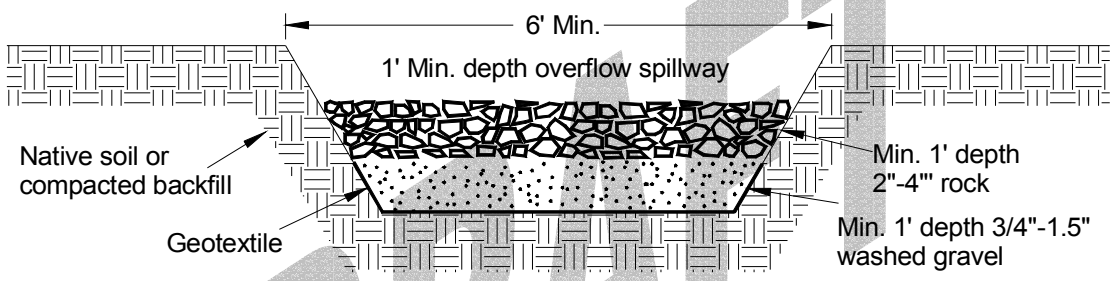

Figure 7.3.24 Sediment Trap Outlet

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BMP C241: Temporary Sediment Pond

Purpose: Sediment ponds remove sediment from runoff originating from disturbed areas of the site. Sediment ponds are typically designed to remove sediment no smaller than medium silt (0.02 mm). Consequently, they usually reduce turbidity only slightly.

Conditions of Use

Conditions of Use: Prior to leaving a construction site, stormwater runoff must pass through a sediment pond or other appropriate sediment removal best management practice.

A sediment pond shall be used where the contributing drainage area is 3 acres or more. Ponds must be used in conjunction with erosion control practices to reduce the amount of sediment flowing into the basin.

Design and Installation Specifications: Sediment basins should be installed only on sites where failure of the structure would not result in loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities. Also, sediment traps and ponds are attractive to children and can be very dangerous. Compliance with local ordinances regarding health and safety must be addressed. If fencing of the pond is required, the type of fence and its location shall be shown on the ESC plan.

- Structures having a maximum storage capacity at the top of the dam of 10 acre-ft (435,600 ft3) or more are subject to the Washington Dam Safety Regulations (Chapter 173-175 WAC).
- See Figures 7.3.25, 7.3.26, and 7.3.27 for details.
- If permanent runoff control facilities are part of the project, they should be used for sediment retention. The surface area requirements of the sediment basin must be met. This may require enlarging the permanent basin to comply with the surface area 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 basin.
- Use of infiltration facilities for sedimentation basins during construction tends to clog the soils and reduce their capacity to infiltrate. If infiltration facilities are to be used, the sides and bottom of the facility should only be rough excavated to a minimum of 2 feet above final grade. Final grading of the infiltration facility shall occur only when all contributing drainage areas are fully stabilized. The infiltration pretreatment facility should be fully constructed and used with the sedimentation basin to help prevent clogging.

Determining Pond Geometry

The storage capacity of the basin may be sized by obtaining the discharge from the hydrologic calculations of the peak flow for the 2-year runoff event (Q2). The 10-year peak flow should be used if the project size, expected timing and duration of construction, or downstream conditions warrant a higher level of protection. If no hydrologic analysis is required, the Rational Method may be used.

Alternatively, the sediment basin, as measured from the bottom of the basin to the

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principal outlet, shall have at least a capacity equivalent to 3,600 cubic feet of storage per acre draining into the sediment basin.

Determine the required surface area at the top of the riser pipe with the equation:

$SA = 2 \times Q_2/0.00096$, or 2080 square feet per cfs of inflow

See BMP C240 for more information on the derivation of the surface area calculation. The basic geometry of the pond can now be determined using the following design criteria:

- Required surface area SA (from Step 2 above) at top of riser.
- Minimum 3.5-foot depth from top of riser to bottom of pond.
- Maximum 3:1 interior side slopes and maximum 2:1 exterior slopes. The interior slopes can be increased to a maximum of 2:1 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.
- The length of the basin, as determined by measuring the distance between the inlet and the outlet, shall be between 3 and 6 times the width of the basin.

Sizing of Discharge Mechanisms

The outlet for the basin consists of a combination of principal and emergency spillways. These outlets must pass the peak runoff expected from the contributing drainage area for a 100-year storm. If, due to site conditions and basin geometry, a separate emergency spill-way 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 designed by the procedures contained in this standard will result in some reduction in the peak rate of runoff. However, the riser outlet design will not adequately control the basin discharge to the predevelopment discharge limitations. However, if the basin for a permanent stormwater detention pond is used for a temporary sedimentation basin, the control structure for the permanent pond can be used to maintain predevelopment discharge limitations. The size of the basin, the expected life of the construction project, the anticipated downstream effects and the anticipated weather conditions during construction, should be considered to determine the need for additional discharge control. See Figure 7.3.28 for riser inflow curves.

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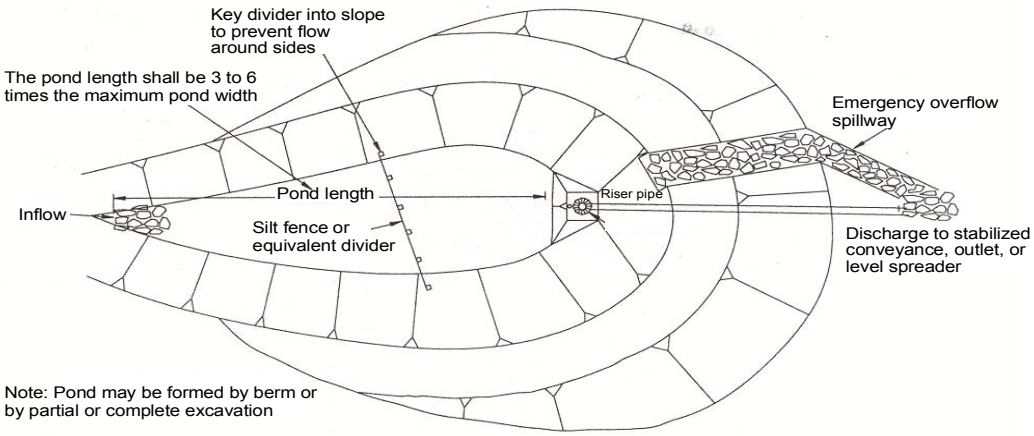


Figure 7.3.25 – Sediment Pond Plan View

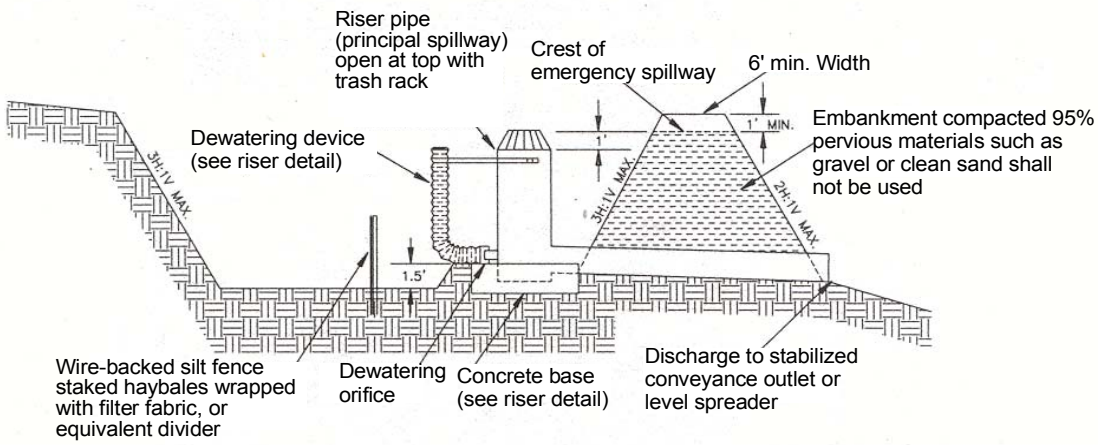


Figure 7.3.26 - Sediment Pond Cross Section

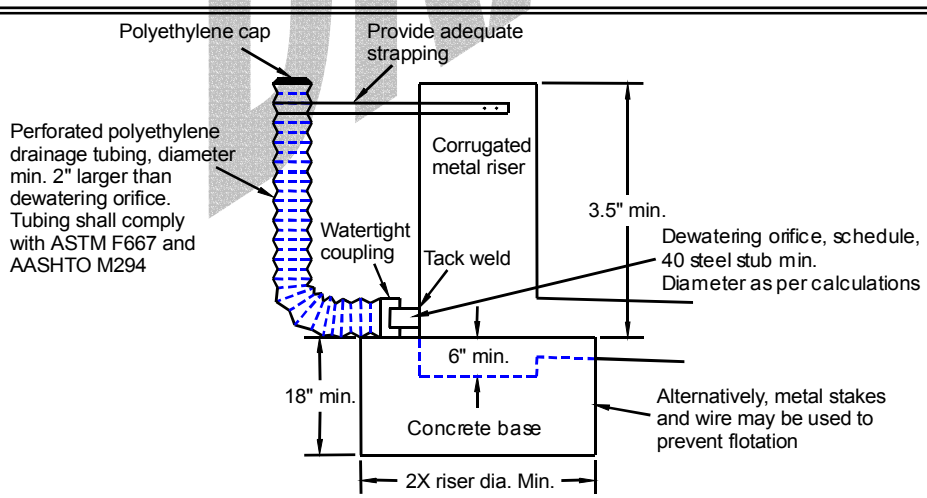
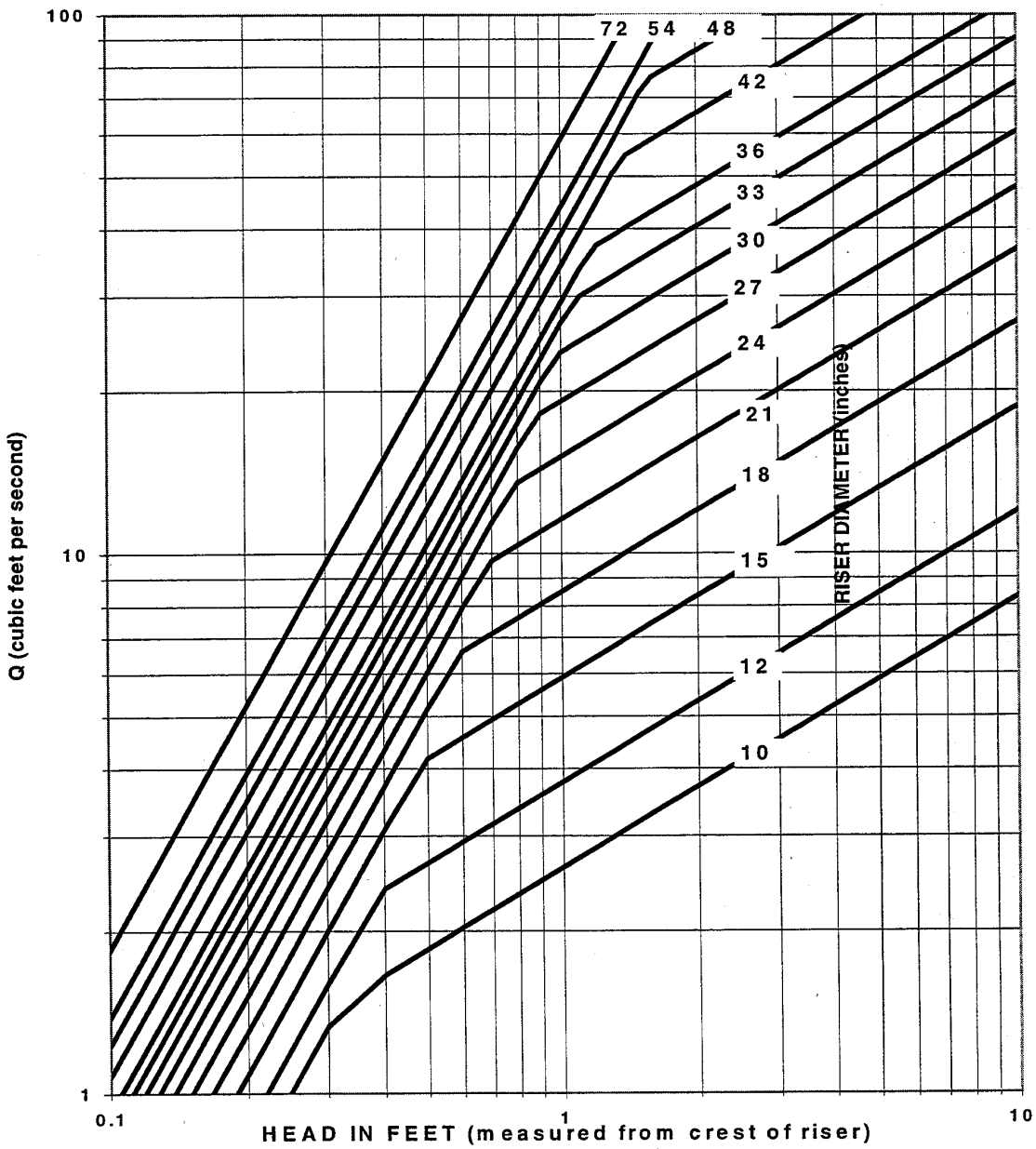


Figure 7.3.27 – Sediment Pond Riser Detail



$Q_{weir} = 9.739\ DH^{3/2}$

$Q_{orifice} = 3.782\ D^2H^{1/2}$

Q in cfs, D and H in feet

Slope change occurs at weir-orifice transition

Figure 7.3.28 - Riser Inflow Curves

Principal Spillway: Determine the required diameter for the principal spillway (riser pipe). The diameter shall be the minimum necessary to pass the pre-developed 10-year peak flow (Q10). Use Figure 4.28 to determine this diameter (h = 1-foot). Note: A permanent control structure may be used instead of a temporary riser.

Emergency Overflow Spillway: Determine the required size and design of the emergency overflow spillway for the developed 100-year peak flow using the method contained in Chapter 4.

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 Ao = orifice area (square feet)

As = 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/second2)

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

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 pond should 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 should be at least one-half the height of the riser and a minimum of one foot below the top of the riser. Wire-backed, 2- to 3-foot high, extra strength filter fabric supported by treated 4”x4”s can be used as a divider. Alternatively, staked straw bales wrapped with filter fabric (geotextile) may be used. 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, one-foot intervals should be prominently

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marked on the riser.

If an embankment of more than 6 feet is proposed, the pond must comply with the criteria contained in Chapter 5 regarding dam safety for detention BMPs.

The most common structural failure of sedimentation basins is caused by piping. Piping refers to two phenomena: (1) water seeping through fine-grained soil, eroding the soil grain by grain and forming pipes or tunnels; and, (2) water under pressure flowing upward through a granular soil with a head of sufficient magnitude to cause soil grains to lose contact and capability for support.

The most critical construction 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 anti-seep devices.

Maintenance Standards:

- Sediment shall be removed from the pond when it reaches 1–foot in depth.
- Any damage to the pond embankments or slopes shall be repaired.

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Appendix 7A - Resource Materials

- Association of General Contractors of Washington, Water Quality Manual.
- Clark County Conservation District, Erosion and Runoff Control, January 1981.
- King County Conservation District, Construction and Erosion Control, December 1981.
- King County Department of Transportation Road Maintenance BMP Manual (Final Draft), May 1998.
- King County Surface Water Design Manual, September 1998.
- Maryland Erosion and Sedimentation Control Manual, 1983.
- Michigan State Guidebook for Erosion and Sediment Control, 1975.
- Snohomish County Addendum to the 1992 Ecology Stormwater Management Manual for the Puget Sound Basin, September 1998.
- University of Washington, by Loren Reinelt, Construction Site Erosion and Sediment Control Inspector Training Manual, Center for Urban Water Resources Management, October 1991.
- University of Washington, by Loren Reinelt, Processes, Procedures, and Methods to Control Pollution Resulting from all Construction Activity, Center for Urban Water Resources Management, October 1991.
- Virginia Erosion and Sediment Control Handbook, 2nd Edition, 1980.

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Appendix 7B - Recommended Standard Notes for Erosion/Sedimentation Control (ESC) Plans

The following standard notes are suggested for use in erosion/ sedimentation control (ESC) plans. Local jurisdictions may have other mandatory notes for construction plans that are applicable. Plans should also identify with phone numbers the person or firm responsible for the preparation of and maintenance of the erosion control plan.

Standard Notes

Approval of this ESC plan does not constitute an approval of permanent road or drainage design (e.g. size and location of roads, pipes, restrictors, channels, retention facilities, utilities, etc.).

The implementation of these ESC plans and the construction, maintenance, replacement, and upgrading of these ESC facilities is the responsibility of the applicant/contractor until all construction is completed and approved and vegetation/landscaping is established.

The boundaries of the clearing limits shown on this plan shall be clearly flagged in the field prior to construction. During the construction period, no disturbance beyond the flagged clearing limits shall be permitted. The flagging shall be maintained by the applicant/contractor for the duration of construction.

The ESC facilities shown on this plan must be constructed in conjunction with all clearing and grading activities, and in such a manner as to insure that sediment and sediment laden water do not enter the drainage system, roadways, or violate applicable water standards.

The ESC facilities shown on this plan are the minimum requirements for anticipated site conditions. During the construction period, these ESC facilities shall be upgraded as needed for unexpected storm events and to ensure that sediment and sediment-laden water do not leave the site.

The ESC facilities shall be inspected daily by the applicant/contractor and maintained as necessary to ensure their continued functioning.

The ESC facilities on inactive sites shall be inspected and maintained a minimum of once a month or within the 48 hours following a major storm event.

At no time shall more than one foot of sediment be allowed to accumulate within a trapped catch basin. All catch basins and conveyance lines shall be cleaned prior to paving. The cleaning operation shall not flush sediment laden water into the downstream system.

Stabilized construction entrances shall be installed at the beginning of construction and maintained for the duration of the project. Additional measures may be required to insure that all paved areas are kept clean for the duration of the project.

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Chapter 8 - Source Control

8.1 Introduction

8.1.1 Purpose

The purpose of this chapter is to provide guidance for selecting BMPs to meet the Core Element #3 that "all known, available, and reasonable" source control BMPs shall be applied to all projects. This chapter can assist local governments and businesses to control urban sources of both conventional and toxic pollutants in stormwater. Application of the source control BMPs contained in this chapter can help attain State water-quality standards to protect beneficial uses of receiving waters.

Best Management Practices (BMPs) are schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices, that when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington State.

This chapter of the stormwater manual focuses on prevention of water-quality impacts from potential pollutant sources. Source control BMPs are structures or operations that are intended to prevent pollutants from coming into contact with stormwater through physical separation of areas or careful management of activities that are sources of pollutants. This chapter also identifies certain treatment BMPs that apply to specific types of pollutant sources.

***8-1 Feedback Requested**:*

This Chapter is based largely on the Stormwater Management Manual for Western Washington (August 2001). If reviewers are aware of any proven or emerging Best Management Practices (BMPs) not included in this Manual that are appropriate for preventing pollution of stormwater runoff in arid/semi-arid and cold-weather climates, the Eastern Washington Stormwater Manual Subcommittee would appreciate receiving such information, including descriptions of practices or technical design of structures, as well as studies and references regarding the methods.

8.1.2 Content and Organization of this Chapter

Chapter 8 of the stormwater manual contains four sections. Section 8.1 serves as an introduction and provides descriptions of operational and structural source control BMPs. It distinguishes between applicable (mandatory) BMPs, and recommended BMPs. It describes the relationship between the source control BMPs in this chapter and regulatory requirements. Section 8.2 presents operational BMPs that are

applicable to commercial and industrial establishments. Section 8.2.2 presents operational and structural BMPs that are designed to address specific types of pollutant sources. This chapter should be consulted to select specific BMPs for source control for inclusion in Stormwater Site Plans (see Chapter 3). The BMPs described in this chapter can also satisfy permit requirements under the National Pollutant Discharge Elimination System (NPDES). (Washington Department of Ecology, 1995).
Section 8.3 identifies stormwater pollutants and their adverse impacts.
Appendix 8A identifies pollutant generating sources at various land uses.
Appendix 8B presents BMPs for managing street waste.

8.1.3 Operational and Structural Source Control BMPs

There are two categories of Source Control BMPs: operational and structural.

Operational Source Control BMPs are non-structural practices that prevent or reduce pollutants from entering stormwater. Examples include formation of a pollution prevention team, good housekeeping practices, preventive maintenance procedures, spill prevention and cleanup, employee training, inspections of pollutant sources, and record keeping. They can also include process changes, raw material/product changes, and recycling wastes.

Operational Source Control BMPs are considered the most cost-effective pollutant minimization practices.

Structural Source Control BMPs are physical, structural, or mechanical devices or facilities that are intended to prevent pollutants from entering stormwater. Examples of Structural Source Control BMPs typically include:

- Enclosing and/or covering the pollutant source (e.g., within a building or other enclosure, a roof over storage and working areas, temporary tarp, etc.).
- Physically segregating the pollutant source to prevent run-on of uncontaminated stormwater.
- Devices that direct only contaminated stormwater to appropriate treatment BMPs (e.g., discharge to a sanitary sewer if allowed by the local sewer authority).

8.1.4 Treatment BMPs for Specific Pollutant Sources

This chapter identifies specific treatment BMPs that apply to particular pollutant sources, such as fueling stations, railroad yards, storage and transfer of materials, etc. After identifying the applicable treatment BMPs, the reader can refer to Chapter 6 for design information.

Treatment BMPs include settling basins or vaults, oil/water separators, biofilters, wet ponds, infiltration systems, and emerging technologies such

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as media filtration. Treatment BMPs may be required by Ecology or local governments if a significant amount of a pollutant remains in the stormwater discharge after the application of operational and structural source control BMPs, or if the stormwater is discharged from a pollutant generating surface.

Ecology defines a "significant amount" as an amount of a pollutant in a stormwater discharge that is amenable to available and reasonable methods of prevention and treatment; or an amount of a pollutant that has a reasonable potential to cause a violation of surface or ground water quality, or sediment management standards. Refer to Chapter 6 for expected performance criteria of treatment BMPs.

To provide guidance for significant amount determinations and performance goals, Ecology's 1995 industrial stormwater general permit refers to the use of maximum discharge targets for the following stormwater pollutants:

- Oil and grease: a maximum 24-hour average concentration (or during a calendar day) of 10 mg/L, or a grab sample maximum concentration of 15 mg/L at any time, and no ongoing or frequently recurring visible sheen in the stormwater discharge.
- Settleable solids: a maximum 0.1 ml/L (grab sample) based on an analytical procedure using a 1-hour settling time.
- pH: between 6.0 and 9.0 (grab sample).
- Other pollutants, particularly heavy metals and other toxics, must also be considered when identifying pollutants at a facility.

Discharge targets are not mandatory effluent limits and discharging below target levels does not necessarily guarantee compliance with Water Quality Standards. Local jurisdictions may implement more stringent requirements for total suspended solids and total petroleum hydrocarbons (TPH).

8.1.5 Distinction Between Applicable BMPs and Recommended BMPs

This chapter uses the terminology "applicable BMPs" and "recommended BMPs" to address an important distinction. This section explains the use of these terms.

8.1.5.1 Applicable BMPs

The NPDES General Stormwater Permits for municipal, industrial and construction stormwater discharges require the adoption or use of Ecology's stormwater manual or an equivalent manual. BMPs identified in this chapter as applicable must be included in local government manuals to be considered equivalent to Ecology's stormwater manual. Ecology expects local governments to require those BMPs described as

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applicable at new developments and redevelopment sites. The applicable BMPs will also be required if they are incorporated into NPDES permits, or if they are included by local governments in a stormwater program for existing facilities. The applicable BMPs in this chapter may also be required by other regulatory programs such as the State Environmental Policy Act (SEPA), water quality certification under Section 401 of the Clean Water Act, and Hydraulic Project Approvals (HPAs).

8.1.5.2 Recommended BMPs

This chapter also contains recommended BMPs. These are not expected to be mandatory, but are offered as approaches that go beyond or complement the minimum applicable BMPs. Implementing the recommended BMPs may improve control of pollutants and provide a more comprehensive and environmentally effective stormwater management program.

8.2 Selection of Operational and Structural Source Control BMPs

Urban stormwater pollutant sources include manufacturing and commercial areas; high use vehicle parking lots; material (including wastes) storage and handling; vehicle/equipment fueling, washing, maintenance, and repair areas; erodible soil; streets/highways; and the handling/application of deicers and lawn care products.

Reduction or the elimination of stormwater pollutants can be achieved by implementing "operational source control BMPs" including good housekeeping, employee training, spill prevention and cleanup, preventive maintenance, regular inspections, and record keeping. These BMPs can be combined with impervious containments and covers, i.e., structural source control BMPs. If operational and structural source control BMPs are not feasible or adequate then stormwater treatment BMPs will be necessary. Selecting cost-effective BMPs should be based on an assessment of the pollutants and their sources.

The applicable BMPs described in this section, or equivalent BMPs, will help businesses comply with Ecology's Stormwater General Permit requirements which apply to new and existing facilities. For new developments or redevelopments, that are not covered under that Permit, implementation of those BMPs which are specified as applicable BMPs in this Manual, or equivalent BMPs, will also be required if incorporated into local government ordinances or equivalent documents. Facilities that are not required to apply the applicable and recommended BMPs described in this chapter are encouraged to implement them.

The selection of source control BMPs described in this section should be based on land use and the pollutant generating sources. Appendix 8A describes various land uses and activities and the potential pollutant generating sources associated with those activities. For example, if a

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commercial printing business conducts vehicle maintenance, weed control with herbicides, loading and unloading of materials, and vehicle washing, it should refer to the following BMP sections for these activities: Maintenance and Repair of Vehicles and Equipment; Landscaping and Lawn/Vegetation Management; Loading and Unloading Areas for Liquid or Solid Material; Washing and Steam Cleaning Vehicle/Equipment/ Building Structures; and Commercial Printing Operations.

The entire Operational BMP section of this chapter must be reviewed for applicability. The BMPs described herein may also be applicable for land uses not listed in Appendix 8A.

8.2.1 Applicable Operational Source Control BMPs

The following operational source control BMPs must be implemented at the commercial and industrial establishments listed in Appendix 8A, where required by Ecology's Industrial General Permit or by local government ordinances.

- Promptly contain and clean up solid and liquid pollutant leaks and spills including oils, solvents, fuels, and dust from manufacturing operations on any exposed soil, vegetation, or paved area.
- Sweep paved material handling and storage areas regularly as needed, for the collection and disposal of dust and debris that could contaminate stormwater. Do not hose down pollutants from any area to the ground, storm drain, conveyance ditch, or receiving water unless necessary for dust control purposes to meet air quality regulations and unless the pollutants are conveyed to a treatment system approved by the local jurisdiction.
- Clean oils, debris, sludge, etc. from all BMP systems regularly, including catch basins, settling/detention basins, oil/water separators, boomed areas, and conveyance systems, to prevent the contamination of stormwater. Refer to Appendix IV-D R.3 of the SWMMWW for references to assist in determining if a waste must be handled as hazardous waste.
- Promptly repair or replace all substantially cracked or otherwise damaged paved secondary containment, high-intensity parking and any other drainage areas, which are subjected to pollutant material leaks or spills.
- Promptly repair or replace all leaking connections, pipes, hoses, valves, etc. which can contaminate stormwater.

The following are recommended additional good housekeeping BMPs:

- Clean up pollutant liquid leaks and spills in impervious uncovered containment areas at the end of each working day.

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- Use solid absorbents, e.g., clay and peat absorbents and rags for cleanup of liquid spills/leaks, where practicable.
- Recycle materials, such as oils, solvents, and wood waste, to the maximum extent practicable.

8.2.1.1 Preventive Maintenance

- Prevent the discharge of unpermitted liquid or solid wastes, process wastewater, and sewage to ground or surface water, or to storm drains which discharge to surface water, or to the ground.
- Do not connect floor drains in potential pollutant source areas to storm drains, surface water, or to the ground.
- Conduct all oily parts cleaning, steam cleaning, or pressure washing of equipment or containers inside a building, or on an impervious contained area, such as a concrete pad. Direct contaminated stormwater from such an area to a sanitary sewer where allowed by local sewer authority, or to other approved treatment.
- Do not pave over contaminated soil unless it has been determined that ground water has not been and will not be contaminated by the soil. Call Ecology for assistance.
- Construct impervious areas that are compatible with the materials handled. Portland cement concrete, asphalt, or equivalent material may be considered.
- Use drip pans to collect leaks and spills from industrial/ commercial equipment such as log stackers, industrial parts, trucks and other vehicles, which are stored outside.
- At industrial and commercial facilities, drain oil and fuel filters before disposal. Discard empty oil and fuel filters, oily rags and other oily solid waste into appropriately closed and properly labeled containers, and in compliance with the Uniform Fire Code.
- For the storage of liquids use containers, such as steel and plastic drums, that are rigid and durable, corrosion resistant to the weather and fluid content, non-absorbent, water tight, rodent-proof, and equipped with a close fitting cover.
- For the temporary storage of solid wastes contaminated with liquids or other potential pollutant materials use dumpsters, garbage cans, drums and comparable containers, which are durable, corrosion resistant, non-absorbent, non-leaking, and equipped with either a solid cover or screen cover to prevent littering. If covered with a screen, the container must be stored under a lean-to or equivalent structure.

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- Where exposed to stormwater, use containers, piping, tubing, pumps, fittings, and valves that are appropriate for their intended use and for the contained liquid.

The following are recommended additional preventive maintenance BMPs:

- Where feasible, store potential stormwater pollutant materials inside a building or under a cover and/or containment.
- Minimize use of toxic cleaning solvents, such as chlorinated solvents, and other toxic chemicals.
- Use environmentally safer raw materials, products, additives, etc. such as substitutes for zinc used in rubber production.
- Recycle waste materials such as solvents, coolants, oils, degreasers, and batteries to the maximum extent feasible.
- Empty drip pans immediately after a spill or leak is collected in an uncovered area.
- Stencil warning signs at stormwater catch basins and drains, e.g., "Dump no waste."

Note: *Evidence of stormwater contamination can include the presence of visible sheen, color, or turbidity in the runoff, or present or historical operational problems at the facility. Simple pH measurements with litmus or pH paper can be used to test for stormwater contamination in areas subject to acid or alkaline contamination.*

8.2.1.2 Spill Prevention and Cleanup

- Immediately upon discovery, stop, contain, and clean up all spills.
- If pollutant materials are stored on-site, have spill containment and cleanup kits readily accessible.
- If the spill has reached or may reach a sanitary or a storm sewer, ground water, or surface water notify Ecology and the local sewer authority immediately. Notification must comply with and federal spill reporting requirements. (See also record keeping at the end of this section and BMPs for Spills of Oil and Hazardous Substances)
- Do not flush absorbent materials or other spill cleanup materials to a storm drain. Collect the contaminated absorbent material as a solid and place in appropriate disposal containers.

The following is a recommended additional BMP:

- Place and maintain emergency spill containment and cleanup kit(s) at outside areas where there is a potential for fluid spills. These kits should be appropriate for the materials being handled and the size of the potential spill.

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Note: *Ecology recommends that the kit(s) include salvage drums or containers, such as high density polyethylene, polypropylene or polyethylene sheet-lined steel; polyethylene or equivalent disposal bags; an emergency response guidebook; safety gloves/clothes/equipment; shovels or other soil removal equipment; and oil containment booms and absorbent pads; all stored in an impervious container.*

8.2.1.3 Employee Training

Train all employees that work in pollutant source areas in identifying pollutant sources and in understanding pollutant control measures, spill response procedures, and environmentally acceptable material handling practices - particularly those related to vehicle/equipment liquids such as fuels, and vehicle/equipment cleaning. Use Ecology's "Stormwater Pollution Prevention Planning for Industrial Facilities" (WQ-R-93-015, 9/93) as a training reference.

8.2.1.4 Inspections

At a minimum during normal or dry weather years, conduct two visual inspections each year, one inspection during October 1-April 30, and the other during May 1-September 30, as follows:

- Verify that the descriptions of the pollutant sources identified in the stormwater pollution control program are accurate.
- Verify that the stormwater pollutant controls (BMPs) being implemented are adequate.
- Include observations of the presence of floating materials, suspended solids, oil and grease, discoloration, turbidity and odor in the stormwater discharges; in outside vehicle maintenance/repair; and liquid handling and storage areas. In areas where acid or alkaline materials are handled or stored use a simple litmus or pH paper to identify those types of stormwater contaminants where needed.
- Determine whether there is/are unpermitted non-stormwater discharges to storm drains or receiving waters, such as process wastewater and vehicle/equipment washwater, and either eliminate or obtain a permit for such a discharge.

8.2.1.5 Recordkeeping

Retain the following reports for three years:

- Visual inspection reports which should include: scope of the inspection, the personnel conducting the inspection, the date(s) of the inspection, major observations relating to the implementation of the SWPPP (performance of the BMPs, etc.) and actions taken to correct BMP inadequacies.
- Reports on spills of oil or hazardous substances in greater than Reportable Quantities (Code of Federal Regulations Title 40 Parts

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302.4 and 117), including the following: oil, gasoline, or diesel fuel, that causes a violation of the State of Washington's Water Quality Standards, or, that causes a film or sheen upon or discoloration of the waters of the State or adjoining shorelines or causes a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines.

- To report a spill or to determine if a spill is a substance of a Reportable Quantity, call your Ecology regional office and ask for an oil spill operations or a hazardous waste specialist:

  Eastern Region (509) 456-2926

  Central Region (509) 575-2490

  Also refer to Emergency Spill Response in Washington State, Publication #97-1165-CP.

The following is additional recommended record keeping:

- Maintain records of all related pollutant control and pollutant generating activities such as training, materials purchased, material use and disposal, maintenance performed, etc.

8.2.2 Pollutant Source-Specific BMPs

The source-specific BMPs described in this section, or equivalent BMPs, can be applied to control the sources of pollutants identified in Appendix 8A.

BMPs for the Building, Repair, and Maintenance of Boats and Ships

Description of Pollutant Sources: Sources of pollutants at boat and shipbuilding, repair, and maintenance at boatyards, shipyards, ports, and marinas include pressure washing, surface preparation, paint removal, sanding, painting, engine maintenance and repairs, and material handling and storage, if conducted outdoors. Potential pollutants include spent abrasive grits, solvents, oils, ethylene glycol, washwater, paint over-spray, cleaners/ detergents, anti-corrosive compounds, paint chips, scrap metal, welding rods, resins, glass fibers, dust, and miscellaneous trash. Pollutant constituents include TSS, oil and grease, organics, copper, lead, tin, and zinc.

Pollutant Control Approach: Apply good housekeeping, preventive maintenance and cover and contain BMPs in and around work areas.

Applicable Operational BMPs: All boatyards in Washington State with haul out facilities are required to be covered under the NPDES General Permit for Boatyard Activities. All shipyards in Washington State with haul out facilities such as drydocks, graving docks, marine railways or synchrolifts are required to be covered under an individual NPDES Permit. Any facility conducting boatyard or shipyard activities strictly from dockside, with no vessel haul out, must be covered by the NPDES General Stormwater Permit for Industrial Activities. The applicable operational BMPs are:

- Clean regularly all accessible work, service and storage areas to remove

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debris, spent sandblasting material, and any other potential stormwater pollutants.

- Sweep rather than hose debris on the dock. If hosing is unavoidable the hose water must be collected and conveyed to treatment.
- Collect spent abrasives regularly and store under cover to await proper disposal.
- Dispose of greasy rags, oil filters, air filters, batteries, spent coolant, and degreasers properly.
- Drain oil filters before disposal or recycling.
- Immediately repair or replace leaking connections, valves, pipes, hoses and equipment that causes the contamination of stormwater.
- Use drip pans, drop cloths, tarpaulins or other protective devices in all paint mixing and solvent operations unless carried out in impervious contained and covered areas.
- Convey sanitary sewage to pump-out stations, portable on-site pump-outs, or commercial mobile pump-out facilities or other appropriate onshore facilities.
- Maintain automatic bilge pumps in a manner that will prevent waste material from being pumped automatically into surface water.
- Prohibit uncontained spray painting, blasting or sanding activities over open water.
- Do not dump or pour waste materials down floor drains, sinks, or outdoor storm drain inlets that discharge to surface water. Plug floor drains that are connected to storm drains or to surface water. If necessary, install a sump that is pumped regularly.
- Prohibit outside spray painting, blasting or sanding activities during windy conditions that render containment ineffective.
- Do not burn paint and/or use spray guns on topsides or above decks.
- Immediately clean up any spillage on dock, boat or ship deck areas and dispose of the wastes properly.
- In the event of an accidental discharge of oil or hazardous material into waters of the state or onto land with a potential for entry into state waters, immediately notify the yard, port, or marina owner or manager, the Department of Ecology, and the National Response Center at 1-800-424-8802 (24-hour). If the spill can reach or has reached marine water, call the U.S. Coast Guard at (206) 217-6232.

Applicable Structural Source Control BMPs:

- Use fixed platforms with appropriate plastic or tarpaulin barriers as work surfaces and for containment when work is performed on a vessel in the

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water to prevent blast material or paint overspray from contacting stormwater or the receiving water. Use of such platforms will be kept to a minimum and at no time be used for extensive repair or construction (anything in excess of 25 percent of the surface area of the vessel above the waterline).

- Use plastic or tarpaulin barriers beneath the hull and between the hull and dry dock walls to contain and collect waste and spent materials. Clean and sweep regularly to remove debris.
- Enclose, cover, or contain blasting and sanding activities to the maximum extent practicable to prevent abrasives, dust, and paint chips, from reaching storm sewers or receiving water. Use plywood and/or plastic sheeting to cover open areas between decks when sandblasting (scuppers, railings, freeing ports, ladders, and doorways).
- Direct deck drainage to a collection system sump for settling and/or additional treatment.
- Store cracked batteries in a covered secondary container.
- Apply source control BMPs given in this chapter for other activities conducted at the marina, boat yard, shipyard, or port facility (BMPs for Fueling at Dedicated Stations, BMPs for Washing and Steam Cleaning Vehicle/Equipment/Building Structures, and BMPs for Spills of Oil and Hazardous Substances).

Recommended Additional Operational BMPs: The following BMPs are recommended unless they are required under a NPDES or Washington State waste discharge permit:

- Consider recycling paint, paint thinner, solvents, used oils, oil filters, pressure wash wastewater and any other recyclable materials.
- Perform paint and solvent mixing, fuel mixing, etc. on shore.

BMPs for Commercial Animal Handling Areas

Description of Pollutant Sources: Animals at racetracks, kennels, fenced pens, veterinarians, and businesses that provide boarding services for horses, dogs, cats, etc., can generate pollutants from the following activities: manure deposits, animal washing, grazing and any other animal handling activity that could contaminate stormwater. Pollutants can include coliform bacteria, nutrients, and total suspended solids.

Pollutant Control Approach: To prevent, to the maximum extent practicable, the discharge of contaminated stormwater from animal handling and keeping areas.

Applicable Operational BMPs

- Regularly sweep and clean animal keeping areas to collect and properly dispose of droppings, uneaten food, and other potential stormwater contaminants
- Do not hose down to storm drains or to receiving water those areas that contain potential stormwater contaminants

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- Do not allow any washwaters to be discharged to storm drains or to receiving water without proper treatment
- If animals are kept in unpaved and uncovered areas, the ground must either have vegetative cover or some other type of ground cover such as mulch
- If animals are not leashed or in cages, the area where animals are kept must be surrounded by a fence or other means that prevents animals from moving away from the controlled area where BMPs are used.

BMPs for Commercial Composting

Description of Pollutant Sources: Commercial compost facilities, operating outside without cover, require large areas to decompose wastes and other feedstocks. These facilities should be designed to separate stormwater from leachate (i.e., industrial wastewater) to the greatest extent possible. When stormwater is allowed to contact any active composting areas, including waste receiving and processing areas, it becomes leachate. Pollutants in leachate include nutrients, biochemical oxygen demand (BOD), organics, coliform bacteria, acidic Ph, color, and suspended solids. Stormwater at a compost facility consists of runoff from areas at the facility that are not associated with active processing and curing, such as product storage areas, vehicle maintenance areas, and access roads.

NPDES Permit Requirements: Discharge of leachate from a compost facility will require a State or NPDES permit from Ecology, depending on the disposal method chosen for managing leachate at the facility. (See Chapter 2 in "Compost Facility Resource Handbook, Guidance for Washington State", November 1998, Publication # 97-502.) An additional alternative, zero discharge, is possible by containing all leachate from the facility (in tanks or ponds) or preventing production of leachate (by composting under a roof or in an enclosed building).

Pollutant Control Approach: Consider the leachate control specified in publication #97-502 or zero leachate discharge.

Applicable Operational BMPs:

- Ensure that the compost feedstocks do not contain dangerous wastes, regulated under Chapter 173-303 WAC or hazardous products of a similar nature, or solid wastes that are not beneficial to the composting process. Employees must be trained to screen these materials in incoming wastes.
- Contact other federal, state, and local agencies with environmental or zoning authority for applicable permit and regulatory information. Local health departments are responsible for issuing solid waste handling permits for commercial compost facilities.
- Apply for coverage under the General Permit to Discharge Stormwater Associated with Industrial Activities, if the facility discharges stormwater to surface water or a municipal stormwater system. If all stormwater from the facility infiltrates into the surrounding area, the General Permit is not required.

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- Develop a plan of operations as outlined in the Compost Facility Resource Handbook, Publication #97-502.
- Store finished compost in a manner to prevent contamination of stormwater.

Applicable Structural Source Control BMPs:

- Refer to "Compost Facility Resource Handbook, Guidance for Washington State," November 1998, Publication # 97-502, for additional design criteria and information.
- Compost pads are required for all uncovered facilities in areas of the state with wet climates (per water quality regulations).
- Provide curbing for all compost pads to prevent stormwater run-on and leachate run-off.
- Slope all compost pads sufficiently to direct leachate to the collection device.
- Provide one or more sumps or catch basins capable of collecting all leachate generated by the design storm and conveying it to the leachate holding structure for all compost pads.

Applicable Treatment BMPs:

- Convey all leachate from composting operations to a sanitary sewer, holding tank, or on-site treatment systems designed to treat the leachate and TSS.
- Ponds used to collect, store, or treat leachate and other contaminated waters associated with the composting process must be lined to prevent ground water contamination. Apply "AKART" or All Known Available and Reasonable Methods of Prevention and Treatment to all pond liners, regardless of the construction materials.

Recommended Additional BMPs:

- Clean up debris from yard areas regularly.
- Locate stored residues in areas designed to collect leachate.
- Limit storage times of residues to prevent degradation and generation of leachate.
- Consider using leachate as make-up water in early stages of the composting process. Since leachate can contain pathogenic bacteria, care should be taken to avoid contaminating finished product or nearly finished product with leachate.
- In areas of the state with dry climates, consider using evaporation as a means of reducing the quantity of leachate.

BMPs for Commercial Printing Operations

Description of Pollutant Sources: Materials used in the printing process include inorganic and organic acids, resins, solvents, polyester film, developers, alcohol, vinyl lacquer, dyes, acetates, and polymers. Waste products may include waste inks and ink sludge, resins, photographic chemicals, solvents, acid

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and alkaline solutions, chlorides, chromium, zinc, lead, spent formaldehyde, silver, plasticizers, and used lubricating oils. As the printing operations are conducted indoors, the only likely points of potential contact with stormwater are the outside temporary storage of waste materials and offloading of chemicals at external unloading bays. Pollutants can include TSS, pH, heavy metals, oil and grease, and COD.

Pollutant Control Approach: Ensure appropriate disposal and NPDES permitting of process wastes. Cover and contain stored raw and waste materials.

Applicable Operational BMPs:

- Discharge process wastewaters to a sanitary sewer, if approved by the local sewer authority, or to an approved process wastewater treatment system.
- Do not discharge process wastes or wastewaters into storm drains or surface water.
- Determine whether any of these wastes qualify for regulation as dangerous wastes and dispose of them accordingly.

Applicable Structural Source Control BMP: Store raw materials or waste materials that could contaminate stormwater in covered and contained areas.

Recommended Additional BMPs:

- Train all employees in pollution prevention, spill response, and environmentally acceptable materials handling procedures.
- Store materials in proper, appropriately labeled containers. Identify and label all chemical substances.
- All stormwater management devices should be inspected regularly and maintained as necessary.
- Try to use press washes without listed solvents, and with the lowest VOC content possible. Don't evaporate ink cleanup trays to the outside atmosphere.
- Place cleanup sludges into a container with a tight lid and dispose of as hazardous waste. Do not dispose of cleanup sludges in the garbage or in containers of soiled towels.

For additional information on pollution prevention, the following Washington Department of Ecology publications are recommended: A Guide for Screen Printers, Publication #94-137 and A Guide for Lithographic Printers, Publication #94-139.

BMPs for Deicing and Anti-Icing Operations - Airports and Streets

Description of Pollutant Sources: Deicing and/or anti-icing compounds are used on highways, streets, airport runways, and on aircraft to control ice and snow. Typically ethylene glycol and propylene glycol are deicers used on aircraft. Deicers commonly used on highways and streets include calcium magnesium acetate (CMA), calcium chloride, magnesium chloride, sodium chloride, urea, and potassium acetate. The deicing and anti-icing compounds

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become pollutants when they are conveyed to storm drains or to surface water after application. Leaks and spills of these chemicals can also occur during their handling and storage.

Applicable BMPs for Streets and Highways

- Select de and anti-icers that cause the least adverse environmental impact. Apply only as needed using minimum quantities.
- Where feasible and practicable use roadway deicers, such as calcium magnesium acetate, potassium acetate, or similar materials, that cause less adverse environmental impact than urea and sodium chloride.
- Store and transfer de/anti-icing materials on an impervious containment pad in accordance with BMP Storage or Transfer (Outside) of Solid Raw Materials, By-Products, or Finished Products in this document.
- Sweep/clean up accumulated de/anti-icing materials and grit from roads as soon as possible after the road surface clears.

Recommended Additional BMPs

- Intensify roadway cleaning in early spring to help remove particulates from road surfaces.
- Include limits on toxic metals in the specifications for de/anti-icers.

BMPs for Airport Deicing and Anti-icing Operations

EPA is currently studying airport deicing as part of the pretreatment regulations (40 CFR 403). These regulations are not expected to be promulgated for several years.

Pollutant Control Approach for Aircraft: Spent glycol discharges in aircraft application areas are process wastewaters that are regulated under Ecology's industrial stormwater general permit. (Contact the Ecology Regional Office for details.) BMPs for aircraft de/anti-icers must be consistent with aviation safety and the operational needs of the aircraft operator.

Applicable BMPs for Aircraft:

- Conduct aircraft deicing or anti-icing applications in impervious containment areas. Collect aircraft deicer or anti-icer spent chemicals, such as glycol, draining from aircraft in deicing or anti-icing application areas and convey to a sanitary sewer, treatment, or other approved disposal or recovery method. Divert deicing runoff from paved gate areas to appropriate collection areas or conveyances for proper treatment or disposal.
- Do not allow spent deicer or anti-icer chemicals or stormwater contaminated with aircraft deicer or anti-icer chemicals to be discharged from application areas including gate areas, to surface water, or ground water, directly or indirectly.
- Transfer deicing and anti-icing chemicals on an impervious containment pad, or equivalent spill/leak containment area, and store in secondary containment areas. (See Storage of Liquids in Above-Ground Tanks).

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Recommended Additional BMPs for Aircraft:

- Establish a centralized aircraft de/anti-icing facility, if feasible and practicable, or in designated areas of the tarmac equipped with separate collection drains for the spent deicer liquids.
- Consider installing an aircraft de/anti-icing chemical recovery system, or contract with a chemical recycler, if practicable.

Note: *The applicable containment BMP of aircraft de/anti-icing applications, and applicable treatment BMPs for de/anti-icer spent chemicals such as glycols.*

Applicable BMPs for Airport Runways/Taxiways:

- Avoid excessive application of all de/anti-icing chemicals, which could contaminate stormwater.
- Store and transfer de/anti-icing materials on an impervious containment pad or an equivalent containment area and/or under cover in accordance with BMP Storage or Transfer (Outside) of Solid Raw Materials, By-Products, or Finished Products in this document. Other material storage and transfer approaches may be considered if it can be demonstrated that stormwater will not be contaminated, or that the de/anti-icer material cannot reach surface or ground waters.

Recommended Additional BMPs for Airport Runways/Taxiways:

- Include limits on toxic materials and phosphorous in the specifications for de/anti-icers, where applicable.
- Consider using anti-icing materials rather than deicers if it will result in less adverse environmental impact.
- Select cost-effective de/anti-icers that cause the least adverse environmental impact.

BMPs for Dust Control at Disturbed Land Areas and Unpaved Roadways and Parking Lots

Note: *Contact the local Air Quality Authority for appropriate and required BMPs for dust control to implement at your project site.*

Description of Pollutant Sources: Dust can cause air and water pollution problems particularly at demolition sites and in arid areas where reduced rainfall exposes soil particles to transport by air.

Pollutant Control Approach: Minimize dust generation and apply environmentally friendly and government approved dust suppressant chemicals, if necessary.

Applicable Operational BMPs:

- Sprinkle or wet down soil or dust with water as long as it does not result in a wastewater discharge.
- Use only local and/or state government approved dust suppressant chemicals such as those listed in Ecology Publication #96-433, "Techniques for Dust Prevention and Suppression."

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- Avoid excessive and repeated applications of dust suppressant chemicals. Time the application of dust suppressants to avoid or minimize their wash-off by rainfall or human activity such as irrigation.
- Apply stormwater containment to prevent the conveyance of stormwater TSS into storm drains or receiving waters.
- The use of motor oil for dust control is prohibited. Care should be taken when using lignin derivatives and other high BOD chemicals in excavations or areas easily accessible to surface water or ground water.
- Consult with the Ecology Regional Office in your area on discharge permit requirements if the dust suppression process results in a wastewater discharge to the ground, ground water, storm drain, or surface water.

Recommended Additional Operational BMPs for Roadways and Other Trafficked Areas:

- Consider limiting use of off-road recreational vehicles on dust generating land.
- Consider paving unpaved permanent roads and other trafficked areas at municipal, commercial, and industrial areas.
- Consider paving or stabilizing shoulders of paved roads with gravel, vegetation, or local government approved chemicals.
- Encourage use of alternate paved routes, if available.
- Vacuum or wet sweep fine dirt and skid control materials from paved roads soon after winter weather ends or when needed.
- Consider using traction sand that is pre-washed to reduce dust emissions.

Additional Recommended Operational BMPs for Dust Generating Areas:

- Prepare a dust control plan. Helpful references include: Control of Open Fugitive Dust Sources (EPA-450/3-88-088), and Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures (EPA-450/2-92-004)
- Limit exposure of soil (dust source) as much as feasible.
- Stabilize dust-generating soil by growing and maintaining vegetation, mulching, topsoiling, and/or applying stone, sand, or gravel.
- Apply windbreaks in the soil such as trees, board fences, tarp curtains, bales of hay, etc.
- Cover dust-generating piles with wind-impervious fabric, or equivalent material.

BMPs for Dust Control at Manufacturing Areas

Note*: Contact the local Air Quality Authority for appropriate and required BMPs for dust control to implement at your project site.*

Description of Pollutant Sources: Industrial material handling activities can generate considerable amounts of dust that is typically removed using exhaust

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systems. This can generate air emissions that can contaminate stormwater. Dusts can be generated at cement and concrete products mixing, and wherever powdered materials are handled. Particulate materials that are of concern to air pollution control agencies include grain dust, sawdust, coal, gravel, crushed rock, cement, and boiler fly ash. The objective of this BMP is to reduce the stormwater pollutants caused by dust generation and control.

Pollutant Control Approach: Prevent dust generation and emissions where feasible, regularly clean-up dust that can contaminate stormwater, and convey dust contaminated stormwater to proper treatment.

Applicable BMPs:

- Clean, as needed, powder material handling equipment and vehicles that can be sources of stormwater pollutants, to remove accumulated dust and residue.
- Regularly sweep dust accumulation areas that can contaminate stormwater. Sweeping should be conducted using vacuum filter equipment to minimize dust generation and to ensure optimal dust removal.

Recommended BMPs:

- In manufacturing operations, train employees to carefully handle powders to prevent generation of dust.
- Use dust filtration/collection systems such as bag house filters, cyclone separators, etc. to control vented dust emissions that could contaminate stormwater. Control of zinc dusts in rubber production is one example.
- Use water spray to flush dust accumulations to sanitary sewers where allowed by the local sewer authority or to other appropriate treatment system.
- Use approved dust suppressants such as those listed in Ecology Publication "Techniques for Dust Prevention and Suppression," #96-433. (Ecology, 1996). Application of some products may not be appropriate in close proximity to receiving waters or conveyances close to receiving waters. For more information check with the Ecology Regional Office or the local jurisdiction.

Recommended Treatment BMPs: For removal of TSS in stormwater use sedimentation basins, wet ponds, wet vaults, catch basin filters, vegetated filter strips, or equivalent sediment removal BMPs.

BMPs for Fueling at Dedicated Stations

Description of Pollutant Sources: A fueling station is a facility dedicated to the transfer of fuels from a stationary pumping station to mobile vehicles or equipment. It includes above or under-ground fuel storage facilities. In addition to general service gas stations, fueling may also occur at 24-hour convenience stores, construction sites, warehouses, car washes, manufacturing establishments, port facilities, and businesses with fleet vehicles. Typically, stormwater contamination at fueling stations is caused by leaks/spills of fuels, lube oils, radiator coolants, and vehicle washwater.

Pollutant Control Approach: New or substantially remodeled* fueling stations

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must be constructed on an impervious concrete pad under a roof to keep out rainfall and stormwater run-on. A treatment BMP must be used for contaminated stormwater and wastewaters in the fueling containment area.

** Substantial remodeling includes replacing the canopy, or relocating or adding one or more fuel dispensers in such a way that the Portland cement concrete (or equivalent) paving in the fueling area is modified.*

For new or substantially remodeled Fueling Stations:

Applicable Operational BMPs:

- Prepare an emergency spill response and cleanup plan (per BMPs for Spills of Oil and Hazardous Substances) and have designated trained person(s) available either on site or on call at all times to promptly and properly implement that plan and immediately cleanup all spills. Keep suitable cleanup materials, such as dry adsorbent materials, on site to allow prompt cleanup of a spill.
- Train employees on the proper use of fuel dispensers. Post signs in accordance with the Uniform Fire Code (UFC). Post "No Topping Off" signs (topping off gas tanks causes spillage and vents gas fumes to the air). Make sure that the automatic shutoff on the fuel nozzle is functioning properly.
- The person conducting the fuel transfer must be present at the fueling pump during fuel transfer, particularly at unattended or self-serve stations.
- Keep drained oil filters in a suitable container or drum.

Applicable Structural Source Control BMPs:

- Design the fueling island to control spills (dead-end sump or spill control separator in compliance with the UFC), and to treat collected stormwater and/or wastewater to required levels. Slope the concrete containment pad around the fueling island toward drains; either trench drains, catch basins and/or a dead-end sump. The slope of the drains shall not be less than 1 percent (Section 7901.8 of the UFC). Drains to treatment shall have a shutoff valve, which must be closed in the event of a spill. The spill control sump must be sized in compliance with Section 7901.8 of the UFC; or
- Design the fueling island as a spill containment pad with a sill or berm raised to a minimum of four inches (Section 7901.8 of the UFC) to prevent the runoff of spilled liquids and to prevent run-on of stormwater from the surrounding area. Raised sills are not required at the open-grate trenches that connect to an approved drainage-control system.
- The fueling pad must be paved with Portland cement concrete, or equivalent. Asphalt is not considered an equivalent material.

The fueling island must have a roof or canopy to prevent the direct entry of precipitation onto the spill containment pad (see Figure 8.2.1). The roof or canopy should, at a minimum, cover the spill containment pad (within the grade break or

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fuel dispensing area) and preferably extend several additional feet to reduce the introduction of windblown rain. Convey all roof drains to storm drains outside the fueling containment area.

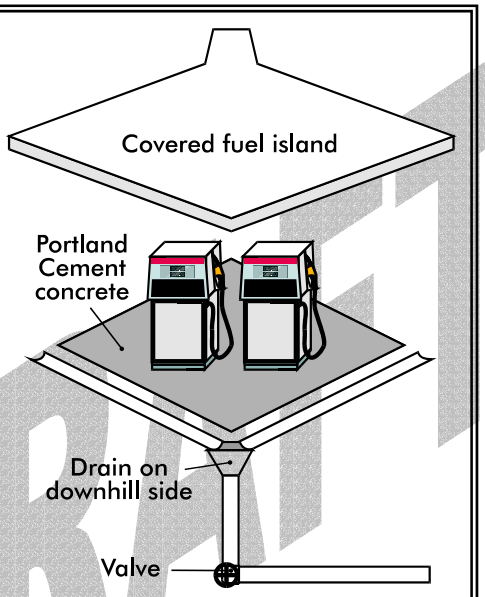

Figure 8.2.1 – Covered Fuel Island

- Stormwater collected on the fuel island containment pad must be conveyed to a sanitary sewer system, if approved by the sanitary authority; or to an approved treatment system such as an oil/water separator and a water quality treatment BMP. (Water quality treatment BMPs are listed in Chapter 6 and include media filters and biofilters.) Discharges from treatment systems to storm drains or surface water or to the ground must not display ongoing or recurring visible sheen and must not contain greater than a significant amount of oil and grease.
- Alternatively, stormwater collected on the fuel island containment pad may be collected and held for proper off site disposal.
- Conveyance of any fuel-contaminated stormwater to a sanitary sewer must be approved by the local sewer authority and must comply with pretreatment regulations (WAC 173-216-060). These regulations prohibit discharges that could "cause fire or explosion." An explosive or flammable mixture is defined under state and federal pretreatment regulations, based on a flash

point determination of the mixture. If contaminated stormwater is determined not to be explosive, then it could be conveyed to a sanitary sewer system.

- Transfer the fuel from the delivery tank trucks to the fuel storage tank in impervious contained areas and ensure that appropriate overflow protection is used. Alternatively, cover nearby storm drains during the filling process and use drip pans under all hose connections.

Additional BMP for Vehicles 10 feet in height or greater

A roof or canopy may not be practicable at fueling stations that regularly fuel vehicles that are 10 feet in height or greater, particularly at industrial or WSDOT sites. At those types of fueling facilities, the following BMPs apply, as well as the applicable BMPs and fire prevention (UFC requirements) of this BMP for fueling stations:

- If a roof or canopy is impractical the concrete fueling pad must be equipped with emergency spill control, which includes a shutoff valve for the drainage from the fueling area. The valve must be closed in the event of a spill. An electronically actuated valve is preferred to minimize the time lapse between spill and containment. Spills must be cleaned up and disposed off-site in accordance with BMPs for Spills of Oil and Hazardous Substances.
- The valve may be opened to convey contaminated stormwater to a sanitary sewer, if approved by the sewer authority, or to oil removal treatment such as an API or CP oil/water separator, catchbasin insert, or equivalent treatment, and then to a basic treatment BMP. Discharges from treatment systems to storm drains or surface water or to the ground must not display ongoing or recurring visible sheen and must not contain greater than a significant amount of oil and grease.

An explosive or flammable mixture is defined under state and federal pretreatment regulations, based on a flash point determination of the mixture. If contaminated stormwater is determined not to be explosive or flammable then it could be conveyed to a sanitary sewer system.

BMPs for Illicit Connections to Storm Drains

Description of Pollutant Sources: Illicit connections are unpermitted sanitary or process wastewater discharges to a storm drain or to a surface water, rather than to a sanitary sewer, industrial process wastewater or other appropriate treatment. They can also include swimming pool water, filter backwash, cleaning solutions/washwaters, cooling water, etc. Experience has shown that illicit connections are common, particularly in older buildings.

Pollutant Control Approach: Identify and eliminate unpermitted discharges or obtain an NPDES permit, where necessary, particularly at industrial and commercial facilities.

Applicable Operational BMPs:

- Eliminate unpermitted wastewater discharges to storm drains, ground water, or surface water; and,

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- Convey unpermitted discharges to a sanitary sewer if allowed by the local sewer authority, or to other approved treatment; and,
- Obtain appropriate permits for these discharges.

Recommended Additional Operational BMPs: At commercial and industrial facilities conduct a survey of wastewater discharge connections to storm drains and to surface water as follows:

- Conduct a field survey of buildings, particularly older buildings, and other industrial areas to locate storm drains from buildings and paved surfaces. Note where these join the public storm drain(s).
- During non-stormwater conditions inspect each storm drain for non-stormwater discharges. Record the locations of all non-stormwater discharges. Include all permitted discharges.
- If useful, prepare a map of each area as it is to be surveyed. Show on the map the known location of storm drains, sanitary sewers, and permitted and unpermitted discharges. Aerial photos may be useful. Check records such as piping schematics to identify known side sewer connections and show these on the map. Consider using smoke, dye or chemical analysis tests to detect connections between two conveyance systems (e.g., process water and stormwater). If desirable, conduct TV inspections of the storm drains and record the footage on videotape.
- Compare the observed locations of connections with the information on the map and revise the map accordingly. Note suspect connections that are inconsistent with the field survey.
- Identify all connections to storm drains or to surface water and take the actions specified above as applicable BMPs.

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BMPs for Landscaping and Lawn/Vegetation Management

Description of Pollutant Sources: Landscaping can include grading, soil transfer, vegetation removal, pesticide and fertilizer applications, and watering. Stormwater contaminants include toxic organic compounds, heavy metals, oils, total suspended solids, coliform bacteria, fertilizers, and pesticides.

Lawn and vegetation management can include control of objectionable weeds, insects, mold, bacteria and other pests with chemical pesticides and is conducted commercially at commercial, industrial, and residential sites. Examples include weed control on golf course lawns, access roads, and utility corridors and during landscaping; sap stain and insect control on lumber and logs; rooftop moss removal; killing nuisance rodents; fungicide application to patio decks, and residential lawn/plant care. Toxic pesticides such as pentachlorophenol, carbamates, and organometallics can be released to the environment by leaching and dripping from treated parts, container leaks, product misuse, and outside storage of pesticide contaminated materials and equipment. Poor management of the vegetation and poor application of pesticides or fertilizers can cause appreciable stormwater contamination.

Pollutant Control Approach: Control of fertilizer and pesticide applications, soil erosion, and site debris to prevent contamination of stormwater.

Develop and implement an Integrated Pest Management Plan (IPM) and use pesticides only as a last resort. If pesticides/herbicides are used they must be carefully applied in accordance with label instructions on U.S. Environmental Protection Agency (EPA) registered materials. Maintain appropriate vegetation, with proper fertilizer application where practicable, to control erosion and the discharge of stormwater pollutants. Where practicable grow plant species appropriate for the site, or adjust the soil properties of the subject site to grow desired plant species.

Applicable Operational BMPs for Landscaping:

- Install engineered soil/landscape systems to improve the infiltration and regulation of stormwater in landscaped areas.
- Do not dispose of collected vegetation into waterways or storm drainage systems.

Recommended Additional Operational BMPs for Landscaping:

- Conduct mulch-mowing whenever practicable
- Dispose of grass clippings, leaves, sticks, or other collected vegetation, by composting, if feasible.
- Use mulch or other erosion control measures when soils are exposed for more than one week.
- If oil or other chemicals are handled, store and maintain appropriate oil and chemical spill cleanup materials in readily accessible locations. Ensure that employees are familiar with proper spill cleanup procedures.
- Till fertilizers into the soil rather than dumping or broadcasting onto the surface. Determine the proper fertilizer application for the types of soil and vegetation encountered.
- Till a topsoil mix or composted organic material into the soil to create a well-mixed transition layer that encourages deeper root systems and drought-resistant plants.
- Use manual and/or mechanical methods of vegetation removal rather than applying herbicides, where practical.

Applicable Operational BMPs for the Use of Pesticides:

- Develop and implement an IPM and use pesticides only as a last resort.
- Implement a pesticide-use plan and include at a minimum: a list of selected pesticides and their specific uses; brands, formulations, application methods and quantities to be used; equipment use and maintenance procedures; safety, storage, and disposal methods; and monitoring, record keeping, and public notice procedures. All procedures shall conform to the requirements of Chapter 17.21 RCW and Chapter 16-228 WAC.

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- Choose the least toxic pesticide available that is capable of reducing the infestation to acceptable levels. The pesticide should readily degrade in the environment and/or have properties that strongly bind it to the soil. Any pest control used should be conducted at the life stage when the pest is most vulnerable. For example, if it is necessary to use a Bacillus thuringiens is application to control tent caterpillars, it must be applied before the caterpillars cocoon or it will be ineffective. Any method used should be site-specific and not used wholesale over a wide area.
- Apply the pesticide according to label directions. Under no conditions shall pesticides be applied in quantities that exceed manufacturer's instructions.
- Mix the pesticides and clean the application equipment in an area where accidental spills will not enter surface or ground waters, and will not contaminate the soil.
- Store pesticides in enclosed areas or in covered impervious containment. Ensure that pesticide contaminated stormwater or spills/leaks of pesticides are not discharged to storm drains. Do not hose down the paved areas to a storm drain or conveyance ditch. Store and maintain appropriate spill cleanup materials in a location known to all near the storage area.
- Clean up any spilled pesticides and ensure that the pesticide contaminated waste materials are kept in designated covered and contained areas.
- The pesticide application equipment must be capable of immediate shutoff in the event of an emergency.
- Do not spray pesticides within 100 feet of open waters including wetlands, ponds, and streams, sloughs and any drainage ditch or channel that leads to open water except when approved by Ecology or the local jurisdiction. All sensitive areas including wells, creeks and wetlands must be flagged prior to spraying.
- As required by the local government or by Ecology, complete public posting of the area to be sprayed prior to the application.
- Spray applications should only be conducted during weather conditions as specified in the label direction and applicable local and state regulations. Do not apply during rain or immediately before expected rain.

Recommended Additional Operational BMPs for the use of pesticides:

- Consider alternatives to the use of pesticides such as covering or harvesting weeds, substitute vegetative growth, and manual weed control/moss removal.
- Consider the use of soil amendments, such as compost, that are known to control some common diseases in plants, such as Pythium root rot, ashy stem blight, and parasitic nematodes. The following are three possible mechanisms for disease control by compost addition (USEPA Publication 530-F-9-044):

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1. Successful competition for nutrients by antibiotic production;
2. Successful predation against pathogens by beneficial microorganism; and
3. Activation of disease-resistant genes in plants by composts.

Installing an amended soil/landscape system can preserve both the plant system and the soil system more effectively. This type of approach provides a soil/landscape system with adequate depth, permeability, and organic matter to sustain itself and continue working as an effective stormwater infiltration system and a sustainable nutrient cycle.

- Once a pesticide is applied, its effectiveness should be evaluated for possible improvement. Records should be kept showing the applicability and inapplicability of the pesticides considered.
- An annual evaluation procedure should be developed including a review of the effectiveness of pesticide applications, impact on buffers and sensitive areas (including potable wells), public concerns, and recent toxicological information on pesticides used/proposed for use. If individual or public potable wells are located in the proximity of commercial pesticide applications contact the regional Ecology hydrogeologist to determine if additional pesticide application control measures are necessary.
- Rinseate from equipment cleaning and/or triple-rinsing of pesticide containers should be used as product or recycled into product.
- The application equipment used should be capable of immediate shutoff in the event of an emergency.

For more information, contact the WSU Extension Home-Assist Program, (253) 445-4556, or Bio-Integral Resource Center (BIRC), P.O. Box 7414, Berkeley, CA.94707, or the Washington Department of Ecology to obtain "Hazardous Waste Pesticides" (Publication #89-41); and/or EPA to obtain a publication entitled "Suspended, Canceled and Restricted Pesticides" which lists all restricted pesticides and the specific uses that are allowed. Valuable information from these sources may also be available on the internet.

Applicable Operational BMPs for Vegetation Management:

- Use at least an eight-inch "topsoil" layer with at least 8 percent organic matter to provide a sufficient vegetation-growing medium. Amending existing landscapes and turf systems by increasing the percent organic matter and depth of topsoil can substantially improve the permeability of the soil, the disease and drought resistance of the vegetation, and reduce fertilizer demand. This reduces the demand for fertilizers, herbicides, and pesticides. Organic matter is the least water-soluble form of nutrients that can be added to the soil. Composted organic matter generally releases only between 2 and 10 percent of its total nitrogen annually, and this release corresponds closely to the plant growth cycle. If natural plant debris and mulch are returned to the soil, this system can continue recycling nutrients indefinitely.

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- Select the appropriate turfgrass mixture for your climate and soil type. Certain tall fescues and rye grasses resist insect attack because the symbiotic endophytic fungi found naturally in their tissues repel or kill common leaf and stem-eating lawn insects. They do not, however, repel root-feeding lawn pests such as Crane Fly larvae, and are toxic to ruminants such as cattle and sheep. The fungus causes no known adverse effects to the host plant or to humans. Endophytic grasses are commercially available and can be used in areas such as parks or golf courses where grazing does not occur. The local Cooperative Extension office can offer advice on which types of grass are best suited to the area and soil type.
- Use the following seeding and planting BMPs, or equivalent BMPs to obtain information on grass mixtures, temporary and permanent seeding procedures, maintenance of a recently planted area, and fertilizer application rates: Temporary Seeding, Mulching and Matting, Clear Plastic Covering, Permanent Seeding and Planting, and Sodding as described in Chapter 7).
- Selection of desired plant species can be made by adjusting the soil properties of the subject site. For example, a constructed wetland can be designed to resist the invasion of reed canary grass by layering specific strata of organic matters (e.g., compost forest product residuals) and creating a mildly acidic pH and carbon-rich soil medium. Consult a soil restoration specialist for site-specific conditions.
- Aerate lawns regularly in areas of heavy use where the soil tends to become compacted. Aeration should be conducted while the grasses in the lawn are growing most vigorously. Remove layers of thatch greater than ¾-inch deep.
- Mowing is a stress-creating activity for turfgrass. When grass is mowed too short its productivity is decreased and there is less growth of roots and rhizomes. The turf becomes less tolerant of environmental stresses, more disease prone and more reliant on outside means such as pesticides, fertilizers and irrigation to remain healthy. Set the mowing height at the highest acceptable level and mow at times and intervals designed to minimize stress on the turf. Generally mowing only 1/3 of the grass blade height will prevent stressing the turf.

Irrigation:

- The depth from which a plant normally extracts water depends on the rooting depth of the plant. Appropriately irrigated lawn grasses normally root in the top 6 to 12 inches of soil; lawns irrigated on a daily basis often root only in the top 1 inch of soil. Improper irrigation can encourage pest problems, leach nutrients, and make a lawn completely dependent on artificial watering. The amount of water applied depends on the normal rooting depth of the turfgrass species used, the available water holding capacity of the soil, and the efficiency of the irrigation system. Consult with the local water utility, Conservation District, or Cooperative Extension office to help determine optimum irrigation practices.

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Fertilizer Management:

- Turfgrass is most responsive to nitrogen fertilization, followed by potassium and phosphorus. Fertilization needs vary by site depending on plant, soil and climatic conditions. Evaluation of soil nutrient levels through regular testing ensures the best possible efficiency and economy of fertilization. For details on soils testing, contact the local Conservation District or Cooperative Extension Service.
- Fertilizers should be applied in amounts appropriate for the target vegetation and at the time of year that minimizes losses to surface and ground waters. Do not fertilize during a drought or when the soil is dry. Alternatively, do not apply fertilizers within three days prior to predicted rainfall. The longer the period between fertilizer application and either rainfall or irrigation, the less fertilizer runoff occurs.
- Use slow release fertilizers such as methylene urea, IDBU, or resin coated fertilizers when appropriate, generally in the spring. Use of slow release fertilizers is especially important in areas with sandy or gravelly soils.
- Time the fertilizer application to periods of maximum plant uptake. Generally fall and spring applications are recommended, although WSU turf specialists recommend four fertilizer applications per year.
- Properly trained persons should apply all fertilizers. At commercial and industrial facilities fertilizers should not be applied to grass swales, filter strips, or buffer areas that drain to sensitive water bodies unless approved by the local jurisdiction.

Integrated Pest Management

An IPM program might consist of the following steps:

Step 1: Correctly identify problem pests and understand their life cycle

Step 2: Establish tolerance thresholds for pests.

Step 3: Monitor to detect and prevent pest problems.

Step 4: Modify the maintenance program to promote healthy plants and discourage pests.

Step 5: Use cultural, physical, mechanical, or biological controls first if pests exceed the tolerance thresholds.

Step 6: Evaluate and record the effectiveness of the control and modify maintenance practices to support lawn or landscape recovery and prevent recurrence.

For an elaboration of these steps refer to Appendix IV-F of the SWMMWW.

BMPs for Loading and Unloading Areas for Liquid or Solid Material

Description of Pollutant Sources: Loading/unloading of liquid and solid materials at industrial and commercial facilities are typically conducted at shipping and receiving, outside storage, fueling areas, etc. Materials transferred can include products, raw materials, intermediate products, waste materials, fuels, scrap metals, etc. Leaks and spills of fuels, oils, powders, organics, heavy

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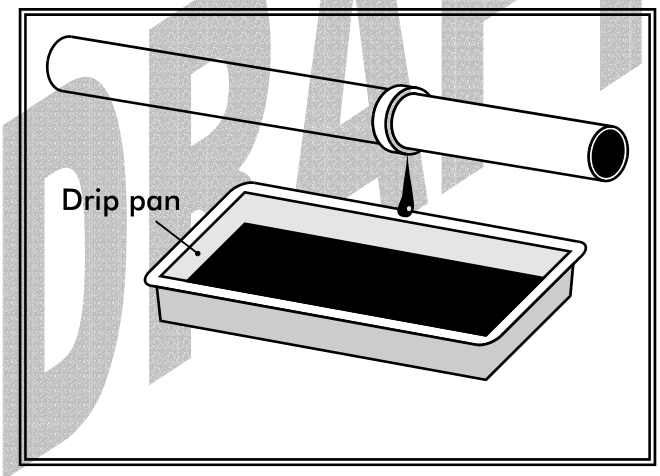
metals, salts, acids, alkalis, etc. during transfer are potential causes of stormwater contamination. Spills from hydraulic line breaks are a common problem at loading docks.

Pollutant Control Approach: Cover and contain the loading/ unloading area where necessary to prevent run-on of stormwater and runoff of contaminated stormwater.

Applicable Operational BMPs:

At All Loading/ Unloading Areas:

- A significant amount of debris can accumulate at outside, uncovered loading/unloading areas. Sweep these surfaces frequently to remove material that could otherwise be washed off by stormwater. Sweep outside areas that are covered for a period of time by containers, logs, or other material after the areas are cleared.
- Place drip pans, or other appropriate temporary containment device, at locations where leaks or spills may occur such as hose connections, hose reels and filler nozzles. Drip pans shall always be used when making and breaking connections (see Figure 8.2.2). Check loading/ unloading equipment such as valves, pumps, flanges, and connections regularly for leaks and repair as needed.



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At Tanker Truck and Rail Transfer Areas to Above/Below-ground Storage Tanks:

- To minimize the risk of accidental spillage, prepare an "Operations Plan" that describes procedures for loading/unloading. Train the employees, especially fork lift operators, in its execution and post it or otherwise have it readily available to employees.
- Report spills of reportable quantities to Ecology (refer to Section 8.1 for telephone numbers of Ecology Regional Offices).

- Prepare and implement an Emergency Spill Cleanup Plan for the facility (BMP Spills of Oil and Hazardous Substances) which includes the following BMPs:
  - Ensure the clean up of liquid/solid spills in the loading/ unloading area immediately, if a significant spill occurs, and, upon completion of the loading/unloading activity, or, at the end of the working day.
  - Retain and maintain an appropriate oil spill cleanup kit on-site for rapid cleanup of material spills. (See BMP Spills of Oil and Hazardous Substances).
  - Ensure that an employee trained in spill containment and cleanup is present during loading/unloading.

At Rail Transfer Areas to Above/below-ground Storage Tanks: Install a drip pan system as illustrated (see Figure 8.2.3) within the rails to collect spills/leaks from tank cars and hose connections, hose reels, and filler nozzles.

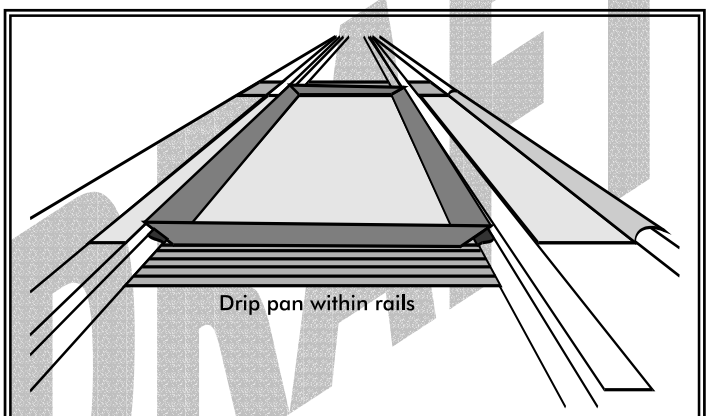

Figure 8.2.3 – Drip Pan Within Rails

Loading/Unloading from/to Marine Vessels: Facilities and procedures for the loading or unloading of petroleum products must comply with Coast Guard requirements.

Transfer of Small Quantities from Tanks and Containers: Refer to BMPs Storage of Liquids in Permanent Above-Ground Tanks, and Storage of Liquid, Food Waste, or Dangerous Waste Containers, for requirements on the transfer of small quantities from tanks and containers, respectively.

Applicable Structural Source Control BMPs:

At All Loading/ Unloading Areas:

- Consistent with Uniform Fire Code requirements and to the extent practicable, conduct unloading or loading of solids and liquids in a manufacturing building, under a roof, or lean-to, or other appropriate cover.

- Berm, dike, and/or slope the loading/unloading area to prevent run-on of stormwater and to prevent the runoff or loss of any spilled material from the area.
- Pave and slope loading/unloading areas to prevent the pooling of water. The use of catch basins and drain lines within the interior of the paved area must be minimized as they will frequently be covered by material, or they should be placed in designated "alleyways" that are not covered by material, containers or equipment.

Recommended Structural Source Control BMP: For the transfer of pollutant liquids in areas that cannot contain a catastrophic spill, install an automatic shutoff system in case of unanticipated off-loading interruption (e.g. coupling break, hose rupture, overfill, etc.).

At Loading and Unloading Docks:

- Install/maintain overhangs, or door skirts that enclose the trailer end (see Figures 8.2.4 and 8.2.5) to prevent contact with rainwater.
- Design the loading/unloading area with berms, sloping, etc. to prevent the run-on of stormwater.
- Retain on-site the necessary materials for rapid cleanup of spills.

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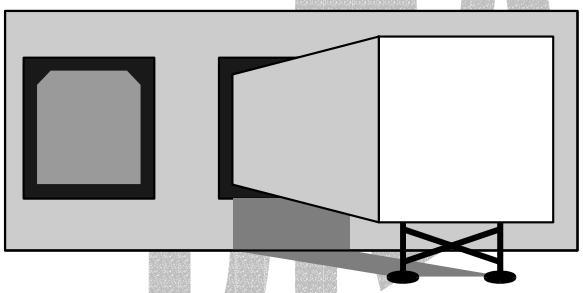
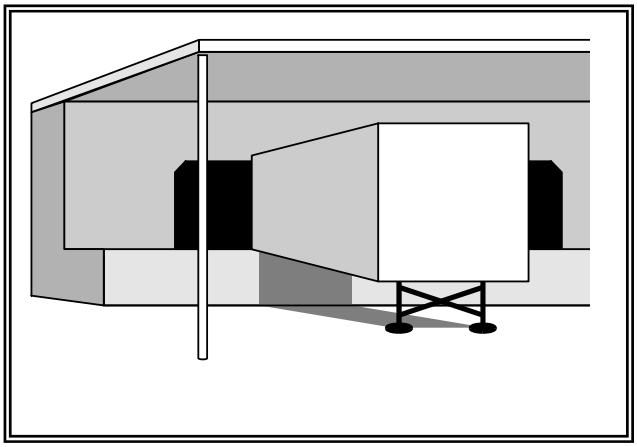


Figure 8.2.4 – Loading Dock with Door Skirt



At Tanker Truck Transfer Areas to Above/Below-Ground Storage Tanks:

- Pave the area on which the transfer takes place. If any transferred liquid, such as gasoline, is reactive with asphalt pave the area with Portland cement concrete.
- Slope, berm, or dike the transfer area to a dead-end sump, spill containment sump, a spill control (SC) oil/water separator, or other spill control device. The minimum spill retention time should be 15 minutes at the greater flow rate of the highest fuel dispenser nozzle through-put rate, or the peak flow rate of the 6-month, 24-hour storm event over the surface of the containment pad, whichever is greater. The volume of the spill containment sump should be a minimum of 50 gallons with an adequate grit sedimentation volume.

BMPs for Log Sorting and Handling

Description of Pollutant Sources: Log yards are paved or unpaved areas where logs are transferred, sorted, debarked, cut, and stored to prepare them for shipment or for the production of dimensional lumber, plywood, chips, poles, or other products. Log yards are generally maintained at sawmills, shipping ports, and pulp mills. Typical pollutants include oil and grease, BOD, settleable solids, total suspended solids (including soil), high and low pH, heavy metals, pesticides, wood-based debris, and leachate.

The following are pollutant sources:

- Log storage, rollout, sorting, scaling, and cutting areas
- Log and liquid loading areas
- Log sprinkling
- Debarking, bark bin and conveyor areas
- Bark, ash, sawdust and wood debris piles, and other solid wastes
- Metal salvage areas
- Truck, rail, ship, stacker, and loader access areas
- Log trucks, stackers, loaders, forklifts, and other heavy equipment
- Maintenance shops and parking areas
- Cleaning areas for vehicles, parts, and equipment
- Storage and handling areas for hydraulic oils, lubricants, fuels, paints, liquid wastes, and other liquid materials
- Pesticide usage for log preservation and surface protection
- Application of herbicides for weed control
- Contaminated soil resulting from leaks or spills of fluids

Ecology's Baseline General Permit Requirements:

Industries with log yards are required to obtain coverage under the baseline general permit for discharges of stormwater associated with industrial activities

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to surface water. The permit requires preparation and on-site retention of Stormwater Pollution Prevention Plans (SWPPP). The SWPPP must identify operational, source control, erosion and sediment control and, if necessary, treatment BMPs. Required and recommended operational, source control, and treatment BMPs are presented in detail in Ecology's Guidance Document: Best Management Practices to Prevent Stormwater Pollution at Log Yards, Publication # 95-053, May 1995. It is recommended that all log yard facilities obtain a copy of this document.

BMPs for Maintenance and Repair of Vehicles and Equipment

Description of Pollutant Sources: Pollutant sources include parts/vehicle cleaning, spills/leaks of fuel and other liquids, replacement of liquids, outdoor storage of batteries/liquids/parts, and vehicle parking.

Pollutant Control Approach: Control of leaks and spills of fluids using good housekeeping and cover and containment BMPs.

Applicable Operational BMPs:

- Inspect for leaks all incoming vehicles, parts, and equipment stored temporarily outside.
- Use drip pans or containers under parts or vehicles that drip or that are likely to drip liquids, such as during dismantling of liquid containing parts or removal or transfer of liquids.
- Remove batteries and liquids from vehicles and equipment in designated areas designed to prevent stormwater contamination. Store cracked batteries in a covered non-leaking secondary containment system.
- Empty oil and fuel filters before disposal. Provide for proper disposal of waste oil and fuel.
- Do not pour/convey washwater, liquid waste, or other pollutant into storm drains or to surface water. Check with the local sanitary sewer authority for approval to convey to a sanitary sewer.
- Do not connect maintenance and repair shop floor drains to storm drains or to surface water. To allow for snowmelt during the winter a drainage trench with a sump for particulate collection can be installed and used only for draining the snowmelt and not for discharging any vehicular or shop pollutants.

Applicable Structural Source Control BMPs:

- Conduct all maintenance and repair of vehicles and equipment in a building, or other covered impervious containment area that is sloped to prevent run-on of uncontaminated stormwater and runoff of contaminated stormwater.
- The maintenance of refrigeration engines in refrigerated trailers may be conducted in the parking area with due caution to avoid the release of engine or refrigeration fluids to storm drains or surface water.
- Park large mobile equipment, such as log stackers, in a designated contained area.

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For additional applicable BMPs refer to the following BMPs: Fueling at Dedicated Stations; Washing and Steam Cleaning Vehicle/Equipment/Building Structures; Loading and Unloading Areas for Liquid or Solid Material; Storage of Liquids in Permanent Above-Ground Tanks; Storage of Liquid, Food Waste, or Dangerous Waste Containers; Storage or Transfer (Outside) of Solid Raw Materials, By-Products, or Finished Products; Spills of Oil and Hazardous Substances; Illicit Connections to Storm Drains; and other BMPs provided in this chapter.

Applicable Treatment BMPs: Contaminated stormwater runoff from vehicle staging and maintenance areas must be conveyed to a sanitary sewer, if allowed by the local sewer authority, or to an API or CP oil and water separator followed by a water quality treatment BMP (See Chapter 6), applicable filter, or other equivalent oil treatment *system.*

Note*: A treatment BMP is applicable for contaminated stormwater.*

Recommended Additional Operational BMPs:

- Consider storing damaged vehicles inside a building or other covered containment, until all liquids are removed. Remove liquids from vehicles retired for scrap.
- Clean parts with aqueous detergent based solutions or non-chlorinated solvents such as kerosene or high flash mineral spirits, and/or use wire brushing or sand blasting whenever practicable. Avoid using toxic liquid cleaners such as methylene chloride, 1,1,1-trichloroethane, trichloroethylene or similar chlorinated solvents. Choose cleaning agents that can be recycled.
- Inspect all BMPs regularly, particularly after a significant storm. Identify and correct deficiencies to ensure that the BMPs are functioning as intended.
- Avoid hosing down work areas. Use dry methods for cleaning leaked fluids.
- Recycle greases, used oil, oil filters, antifreeze, cleaning solutions, automotive batteries, hydraulic fluids, transmission fluids, and engine oils (see Appendix IV-C of the SWMMWW).
- Do not mix dissimilar or incompatible waste liquids stored for recycling.

BMPs for Maintenance of Public and Private Utility Corridors and Facilities

Description of Pollutant Sources: Passageways and equipment at petroleum product, natural gas, and water pipelines, and electrical power transmission corridors and rights-of-way can be sources of pollutants such as herbicides used for vegetation management, and eroded soil particles from unpaved access roads. At pump stations waste materials generated during maintenance activities may be temporarily stored outside. Additional potential pollutant sources include the leaching of preservatives from wood utility poles, PCBs in older transformers, water that is removed from underground transformer vaults, and leaks/spills from petroleum pipelines. The following are potential pollutants: oil and grease, TSS, BOD, organics, PCB, pesticides, and heavy metals.

Pollutant Control Approach: Control of fertilizer and pesticide applications, soil erosion, and site debris that can contaminate stormwater.

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Applicable Operational BMPs:

- Implement BMPs for landscaping and lawn/vegetation management.
- When water or sediments are removed from electric transformer vaults, determine whether contaminants might be present before disposing of the water and sediments. This includes inspecting for the presence of oil or sheen, and determining from records or testing if the transformers contain PCBs. If records or tests indicate that the sediment or water are contaminated above applicable levels, manage these media in accordance with applicable federal and state regulations, including the federal PCB rules (40 CFR 761) and the state MTCA cleanup regulations (Chapter 173-340 WAC). Water removed from the vaults can be discharged in accordance with the federal 40 CFR 761.79, and state regulations (Chapter 173-201A WAC and Chapter 173-200 WAC), or via the sanitary sewer if the requirements, including applicable permits, for such a discharge are met.
- Within utility corridors, consider preparing maintenance procedures and an implementation schedule that provides for a vegetative, gravel, or equivalent cover that minimizes bare or thinly vegetated ground surfaces within the corridor, to prevent the erosion of soil.
- Provide maintenance practices to prevent stormwater from accumulating and draining across and/or onto roadways. Stormwater should be conveyed through roadside ditches and culverts. The road should be crowned, outsloped, water barred or otherwise left in a condition not conducive to erosion. Appropriately maintaining grassy roadside ditches discharging to surface waters is an effective way of removing some pollutants associated with sediments carried by stormwater.
- Maintain ditches and culverts at an appropriate frequency to ensure that plugging and flooding across the roadbed, with resulting overflow erosion, does not occur.
- Apply the appropriate BMPs in this chapter for the storage of waste materials that can contaminate stormwater.

Recommended Operational BMPs:

- When selecting utility poles for a specific location, consideration should be given to the potential environmental effects of the pole or poles during storage, handling, and end-use, as well as its cost, safety, efficacy and expected life. If a wood product treated with chemical preservatives is used, it should be made in accordance with generally accepted industry standards such as the American Wood Preservers Association Standards. If the pole or poles will be placed in or near an environmentally sensitive area, such as a wetland or a drinking water well, alternative materials or technologies should be considered. These include poles constructed with material(s) other than wood such as fiberglass composites, metal, or concrete. Other technologies and materials, such as sleeves or caissons for wood poles, may also be considered when they are determined to be practicable and available.

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- As soon as practicable remove all litter from wire cutting/replacing operations, etc.
- Implement temporary erosion and sediment control in areas where clear-cuts are conducted and new roads are constructed.

BMPs for Maintenance of Roadside Ditches

Description of Pollutant Sources: Common road debris including eroded soil, oils, vegetative particles, and heavy metals can be sources of stormwater pollutants.

Pollutant Control Approach: Roadside ditches should be maintained to preserve the condition and capacity for which they were originally constructed, and to minimize bare or thinly vegetated ground surfaces. Maintenance practices should provide for erosion and sediment control (Refer to BMP Landscaping and Lawn/Vegetation Management).

Applicable Operational BMPs:

- Inspect roadside ditches regularly, as needed, to identify sediment accumulations and localized erosion.
- Clean ditches on a regular basis, as needed. Ditches should be kept free of rubbish and debris.
- Vegetation in ditches often prevents erosion and cleanses runoff waters. Remove vegetation only when flow is blocked or excess sediments have accumulated. Conduct ditch maintenance (seeding, fertilizer application, harvesting) in late spring and/or early fall, where possible. This allows vegetative cover to be re-established by the next wet season thereby minimizing erosion of the ditch as well as making the ditch effective as a biofilter.
- In the area between the edge of the pavement and the bottom of the ditch, commonly known as the "bare earth zone," use grass vegetation, wherever possible. Vegetation should be established from the edge of the pavement if possible, or at least from the top of the slope of the ditch.
- Diversion ditches on top of cut slopes that are constructed to prevent slope erosion by intercepting surface drainage must be maintained to retain their diversion shape and capability.
- Ditch cleanings are not to be left on the roadway surfaces. Sweep dirt and debris remaining on the pavement at the completion of ditch cleaning operations.
- Roadside ditch cleanings, not contaminated by spills or other releases and not associated with a stormwater treatment system such as a bioswale, may be screened to remove litter and separated into soil and vegetative matter (leaves, grass, needles, branches, etc.). The soil fraction may be handled as 'clean soils' and the vegetative matter can be composted or disposed of in a municipal waste landfill.
- Roadside ditch cleanings contaminated by spills or other releases known or suspected to contain dangerous waste must be handled following the

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Dangerous Waste Regulations (Chapter 173-303 WAC) unless testing determines it is not dangerous waste.

- Examine culverts on a regular basis for scour or sedimentation at the inlet and outlet, and repair as necessary. Give priority to those culverts conveying perennial and/or salmon-bearing streams and culverts near streams in areas of high sediment load, such as those near subdivisions during construction.

Recommended Treatment BMPs:

- Install biofiltration swales and filter strips (see Chapter 6) to treat roadside runoff wherever practicable and use engineered topsoils wherever necessary to maintain adequate vegetation (CH2M Hill, 2000). These systems can improve infiltration and stormwater pollutant control upstream of roadside ditches.

BMPs for Maintenance of Stormwater Drainage and Treatment Systems

Description of Pollutant Sources: Facilities include roadside catch basins on arterials and within residential areas, conveyance systems, detention facilities such as ponds and vaults, oil and water separators, biofilters, settling basins, infiltration systems, and all other types of stormwater treatment systems presented in Chapter 6. Roadside catch basins can remove from 5 to 15 percent of the pollutants present in stormwater. When catch basins are about 60 percent full of sediment, they cease removing sediments. Oil and grease, hydrocarbons, debris, heavy metals, sediments and contaminated water are found in catch basins, oil and water separators, settling basins, etc.

Pollutant Control Approach: Provide maintenance and cleaning of debris, sediments, and oil from stormwater collection, conveyance, and treatment systems to obtain proper operation.

Applicable Operational BMPs:

Maintain stormwater treatment facilities according to the O&M procedures presented in this manual in addition to the following BMPs:

- Inspect and clean treatment BMPs, conveyance systems, and catch basins as needed, and determine whether improvements in O&M are needed.
- Promptly repair any deterioration threatening the structural integrity of the facilities. These include replacement of clean-out gates, catch basin lids, and rock in emergency spillways.
- Ensure that storm sewer capacities are not exceeded and that heavy sediment discharges to the sewer system are prevented.
- Regularly remove debris and sludge from BMPs used for peak-rate control, treatment, etc. and discharge to a sanitary sewer if approved by the sewer authority, or truck to a local or state government approved disposal site.
- Clean catch basins when the depth of deposits reaches 60 percent of the sump depth as measured from the bottom of basin to the invert of the lowest pipe into or out of the basin. However, in no case should there be less than six inches clearance from the debris surface to the invert of the lowest pipe.

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Some catch basins (for example, WSDOT Type 1L basins) may have as little as 12 inches sediment storage below the invert. These catch basins will need more frequent inspection and cleaning to prevent scouring. Where these catch basins are part of a stormwater collection and treatment system, the system owner/operator may choose to concentrate maintenance efforts on downstream control devices as part of a systems approach.

- Clean woody debris in a catch basin as frequently as needed to ensure proper operation of the catchbasin.
- Post warning signs; "Dump No Waste - Drains to Ground Water," "Streams," "Lakes," or emboss on or adjacent to all storm drain inlets where practical.
- Disposal of sediments and liquids from the catch basins must comply with "Recommendations for Management of Street Wastes" described in Appendix 8B.

Additional Applicable BMPs: Select additional applicable BMPs from this chapter depending on the pollutant sources and activities conducted at the facility. Those BMPs include:

- BMPs for Soil Erosion and Sediment Control at Industrial Sites
- BMPs for Storage of Liquid, Food Waste, or Dangerous Waste Containers
- BMPs for Spills of Oil and Hazardous Substances
- BMPs for Illicit Connections to Storm Drains
- BMPs for Urban Streets.

BMPs for Manufacturing Activities - Outside

Description of Pollutant Sources: Manufacturing pollutant sources include outside process areas, stack emissions, and areas where manufacturing activity has taken place in the past and significant pollutant materials remain and are exposed to stormwater.

Pollution Control Approach: Cover and contain outside manufacturing and prevent stormwater run-on and contamination, where feasible.

Applicable Operational BMP: Sweep paved areas regularly, as needed, to prevent contamination of stormwater.

Applicable Structural Source Control BMPs:

- Alter the activity by eliminating or minimizing the contamination of stormwater.
- Enclose the activity (see Figure 8.2.6): If possible, enclose the manufacturing activity in a building.
- Cover the activity and connect floor drains to a sanitary sewer, if approved by the local sewer authority. Berm or slope the floor as needed to prevent drainage of pollutants to outside areas. (Figure 8.2.7)

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- Isolate and segregate pollutants as feasible. Convey the segregated pollutants to a sanitary sewer, process treatment or a dead-end sump depending on available methods and applicable permit requirements.

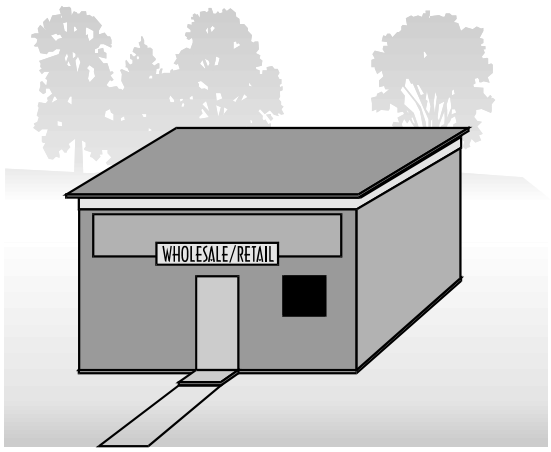

Figure 8.2.6 – Enclose the Activity

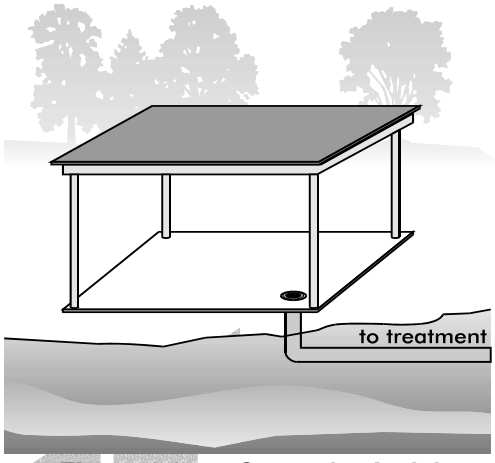

Figure 8.2.7 – Cover the Activity

BMPs for Mobile Fueling of Vehicles and Heavy Equipment

Description of Pollutant Sources: Mobile fueling, also known as fleet fueling, wet fueling, or wet hosing, is the practice of filling fuel tanks of vehicles by tank trucks that are driven to the yards or sites where the vehicles to be fueled are located. Mobile fueling is only conducted using diesel fuel, as mobile fueling of gasoline is prohibited. Diesel fuel is considered as a Class II Combustible Liquid, whereas gasoline is considered as a Flammable Liquid.

Historically mobile fueling has been conducted for off-road vehicles that are operated for extended periods of time in remote areas. This includes construction sites, logging operations, and farms. Mobile fueling of on-road vehicles is also conducted commercially in the State of Washington.

Note that some local fire departments may have restrictions on mobile fueling practices.

Pollutant Control Approach: Proper training of the fueling operator, and the use of spill/drip control and reliable fuel transfer equipment with backup shutoff valving are typically needed.

Applicable Operational BMPs:

Organizations and individuals conducting mobile fueling operations must implement the following BMPs. The operating procedures for the driver/operator should be simple, clear, effective and their implementation verified by the organization that will potentially be liable for environmental and third party damage.

- Ensure that all mobile fueling operations are approved by the local fire department and comply with local and Washington State fire codes.

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- In fueling locations that are in close proximity to sensitive aquifers, designated wetlands, wetland buffers, or other waters of the State, approval by local jurisdictions is necessary to ensure compliance with additional local requirements.
- Ensure the compliance with all 49 CFR 178 requirements for DOT 406 cargo tanker. Documentation from a Department of Transportation (DOT) Registered Inspector shall be proof of compliance.
- Ensure the presence and the constant observation/monitoring of the driver/operator at the fuel transfer location at all times during fuel transfer and ensure that the following procedures are implemented at the fuel transfer locations:
    - Locating the point of fueling at least 25 feet from the nearest storm drain or inside an impervious containment with a volumetric holding capacity equal to or greater than 110 percent of the fueling tank volume, or covering the storm drain to ensure no inflow of spilled or leaked fuel. Storm drains that convey the inflow to a spill control separator approved by the local jurisdiction and the fire department need not be covered. Potential spill/leak conveyance surfaces must be impervious and in good repair.
    - Placement of a drip pan, or an absorbent pad under each fueling location prior to and during all dispensing operations. The pan (must be liquid tight) and the absorbent pad must have a capacity of 5 gallons. Spills retained in the drip pan or the pad need not be reported.
    - The handling and operation of fuel transfer hoses and nozzle, drip pan(s), and absorbent pads as needed to prevent spills/leaks of fuel from reaching the ground, storm drains, and receiving waters.
    - Not extending the fueling hoses across a traffic lane without fluorescent traffic cones, or equivalent devices, conspicuously placed so that all traffic is blocked from crossing the fuel hose.
    - Removing the fill nozzle and cessation of filling when the automatic shut-off valve engages. Do not allow automatic shutoff fueling nozzles to be locked in the open position.
    - Not “topping off” the fuel receiving equipment
- Provide the driver/operator of the fueling vehicle with:
    - Adequate flashlights or other mobile lighting to view fill openings with poor accessibility. Consult with local fire department for additional lighting requirements.
    - Two-way communication with his/her home base.
- Train the driver/operator annually in spill prevention and cleanup measures and emergency procedures. Make all employees aware of the significant liability associated with fuel spills.

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- The fueling operating procedures should be properly signed and dated by the responsible manager, distributed to the operators, retained in the organization files, and made available in the event an authorized government agency requests a review.
- Ensure that the local fire department (911) and the appropriate regional office of the Department of Ecology are immediately notified in the event of any spill entering the surface or ground waters. Establish a "call down list" to ensure the rapid and proper notification of management and government officials should any significant amount of product be lost off-site. Keep the list in a protected but readily accessible location in the mobile fueling truck. The "call down list" should also pre-identify spill response contractors available in the area to ensure the rapid removal of significant product spillage into the environment.
- Maintain a minimum of the following spill clean-up materials in all fueling vehicles, that are readily available for use:
  - Non-water absorbents capable of absorbing 15 gallons of diesel fuel;
  - A storm drain plug or cover kit;
  - A non-water absorbent containment boom of a minimum 10 feet in length with a 12-gallon absorbent capacity;
  - A non-metallic shovel; and,
  - Two, five-gallon buckets with lids.
- Use automatic shutoff nozzles for dispensing the fuel. Replace automatic shut-off nozzles as recommended by the manufacturer.
- Maintain and replace equipment on fueling vehicles, particularly hoses and nozzles, at established intervals to prevent failures.

Applicable Structural Source Control BMPs: Include the following fuel transfer site components:

- Automatic fuel transfer shut-off nozzles; and,
- An adequate lighting system at the filling point.

BMPs for Painting/ Finishing Coating of Vehicles/Boats/ Buildings/ Equipment

Description of Pollutant Sources: Surface preparation and the application of paints, finishes and/or coatings to vehicles, boats, buildings, and/or equipment outdoors can be sources of pollutants. Potential pollutants include organic compounds, oils and greases, heavy metals, and suspended solids.

Pollutant Control Approach: Cover and contain painting and sanding operations and apply good housekeeping and preventive maintenance practices to prevent the contamination of stormwater with painting oversprays and grit from sanding.

Applicable Operational BMPs:

- Train employees in the careful application of paints, finishes, and coatings to

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reduce misuse and over spray. Use ground or drop cloths underneath outdoor painting, scraping, sandblasting work, and properly clean and temporarily store collected debris daily.

- Do not conduct spraying, blasting, or sanding activities over open water or where wind may blow paint into water.
- Wipe up spills with rags and other absorbent materials immediately. Do not hose down the area to a storm drain or receiving water or conveyance ditch to receiving water.
- On dock areas sweep rather than hose down debris. Collect any hose water generated and convey to appropriate treatment and disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control device if dust, grit, washwater, or other pollutants may escape the work area and enter a catch basin. The containment device(s) must be in place at the beginning of the workday. Collect contaminated runoff and solids and properly dispose of such wastes before removing the containment device(s) at the end of the workday.
- Use a ground cloth, pail, drum, drip pan, tarpaulin, or other protective device for activities such as paint mixing and tool cleaning outside or where spills can contaminate stormwater.
- Properly dispose of all wastes and prevent all uncontrolled releases to the air, ground or water.
- Clean brushes and tools covered with non-water-based paints, finishes, or other materials in a manner that allows collection of used solvents (e.g., paint thinner, turpentine, xylol, etc.) for recycling or proper disposal.
- Store toxic materials under cover (tarp, etc.) during precipitation events and when not in use to prevent contact with stormwater.

Applicable Structural Source Control BMPs: Enclose and/or contain all work while using a spray gun or conducting sand blasting and in compliance with applicable air pollution control, OSHA, and WISHA requirements. Do not conduct outside spraying, grit blasting, or sanding activities during windy conditions which render containment ineffective.

Recommended Additional Operational BMPs:

- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain.
- Recycle paint, paint thinner, solvents, pressure washwater, and any other recyclable materials.
- Use efficient spray equipment such as electrostatic, air-atomized, high volume/low pressure, or gravity feed spray equipment.
- Purchase recycled paints, paint thinner, solvents, and other products if feasible.

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BMPs for Parking and Storage of Vehicles and Equipment

Description of Pollutant Sources: Public and commercial parking lots such as retail store, fleet vehicle (including rent-a-car lots and car dealerships), equipment sale and rental parking lots, and parking lot driveways, can be sources of toxic hydrocarbons and other organic compounds, oils and greases, metals, and suspended solids caused by the parked vehicles.

Pollutant Control Approach: If the parking lot is a high-use site as defined below, provide appropriate oil removal equipment for the contaminated stormwater runoff.

Applicable Operational BMPs:

- If washing of a parking lot is conducted, discharge the washwater to a sanitary sewer, if allowed by the local sewer authority, or other approved wastewater treatment system, or collect it for off-site disposal.
- Do not hose down the area to a storm drain or to a receiving water. Sweep parking lots, storage areas, and driveways, regularly to collect dirt, waste, and debris.

Applicable Treatment BMPs: An oil removal system such as an API or CP oil and water separator, catch basin filter, or equivalent BMP, approved by the local jurisdiction, is applicable for parking lots meeting the threshold vehicle traffic intensity level of a high-use site.

Vehicle High-Use Sites

Establishments subject to a vehicle high-use intensity have been determined to be significant sources of oil contamination of stormwater. Examples of potential high use areas include customer parking lots at fast food stores, grocery stores, taverns, restaurants, large shopping malls, discount warehouse stores, quick-lube shops, and banks. If the PGIS for a high-use site exceeds 5,000 square feet in a threshold discharge area, and oil control BMP from the Oil Control Menu is necessary. A high-use site at a commercial or industrial establishment has one of the following characteristics: (Gaus/King County, 1994).

- Is subject to an expected average daily vehicle traffic (ADT) count equal to or greater than 100 vehicles per 1,000 square feet of gross building area: or
- Is subject to storage of a fleet of 25 or more diesel vehicles that are over 10 tons gross weight (trucks, buses, trains, heavy equipment, etc.).

BMPs for Railroad Yards

Description of Pollutant Sources: Pollutant sources can include drips/leaks of vehicle fluids onto the railroad bed, human waste disposal, litter, locomotive/railcar/equipment cleaning areas, fueling areas, outside material storage areas, the erosion and loss of soil particles from the railroad bed, maintenance and repair activities at railroad terminals, switching yards, and maintenance yards, and herbicides used for vegetation management. Waste materials can include waste oil, solvents, degreasers, antifreeze solutions, radiator flush, acids, brake fluids, soiled rags, oil filters, sulfuric acid and battery sludges, and machine chips with residual machining oil and toxic fluids/solids

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lost during transit. Potential pollutants include oil and grease, TSS, BOD, organics, pesticides, and metals.

Pollutant Control Approach: Apply good housekeeping and preventive maintenance practices to control leaks and spills of liquids in railroad yard areas.

Applicable Operational and Structural Source Control BMPs:

- Implement the applicable BMPs in this chapter depending on the pollutant generating activities/sources at a railroad yard facility.
- Do not allow discharge to outside areas from toilets while a train is in transit. Pumpout facilities should be used to service these units.
- Use drip pans at hose/pipe connections during liquid transfer and other leak-prone areas.
- During maintenance do not discard debris or waste liquids along the tracks or in railroad yards.

Applicable Treatment BMPs: In areas subjected to leaks/spills of oils or other chemicals convey the contaminated stormwater to appropriate treatment such as a sanitary sewer, if approved by the appropriate sewer authority, or, to a CP or API oil/water separator for floating oils, or other treatment, as approved by the local jurisdiction.

BMPs for Recyclers and Scrap Yards

Description of Pollutant Sources: Includes businesses that reclaim various materials for resale or for scrap, such as vehicles and vehicle/ equipment parts, construction materials, metals, beverage containers, and papers.

Potential sources of pollutants include paper, plastic, metal scrap debris, engines, transmissions, radiators, batteries, and other materials that contain fluids or are contaminated with fluids. Other pollutant sources include leachate from metal components, contaminated soil, and the erosion of soil. Activities that can generate pollutants include the transfer, dismantling, and crushing of vehicles and scrap metal; the transfer and removal of fluids; maintenance and cleaning of vehicles, parts, and equipment; and storage of fluids, parts for resale, solid wastes, scrap parts, and materials, equipment and vehicles that contain fluids; generally in uncovered areas.

Potential pollutants typically found at vehicle recycle and scrap yards include oil and grease, ethylene and propylene glycol, total suspended solids, BOD, heavy metals, and acidic pH.

Applicable Best Management Practices:

For facilities subject to Ecology's Industrial Stormwater General Permit refer to BMP Guidance Document #94-146, "Best Management Practices to Prevent Stormwater Pollution at Vehicle Recycler Facilities," Washington Department of Ecology, September 1994 for selection of BMPs. The BMPs in that guidance document can also be applied to scrap material recycling facilities depending on the pollutant sources existing at those facilities and to non-permitted facilities.

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BMPs for Roof/ Building Drains at Manufacturing and Commercial Buildings

Description of Pollutant Sources: Stormwater runoff from roofs and sides of manufacturing and commercial buildings can be sources of pollutants caused by leaching of roofing materials, building vents, and other air emission sources. Vapors and entrained liquid and solid droplets/particles have been identified as potential pollutants in roof/building runoff. Metals, solvents, acidic/alkaline pH, BOD, and organics, are some of the pollutant constituents identified.

Pollutant Control Approach: Evaluate the potential sources of stormwater pollutants and apply source control BMPs where feasible.

Applicable Operational Source Control BMPs:

- If leachates and/or emissions from buildings are suspected sources of stormwater pollutants, then sample and analyze the stormwater draining from the building.
- If a roof/building stormwater pollutant source is identified, implement appropriate source control measures such as air pollution control equipment, selection of materials, operational changes, material recycle, process changes, etc.

BMPs for Soil Erosion and Sediment Control at Industrial Sites

Description of Pollutant Sources: Industrial activities on soil areas; exposed and disturbed soils; steep grading; etc. can be sources of sediments that can contaminate stormwater runoff.

Pollutant Control Approach: Limit the exposure of erodible soil, stabilize or cover erodible soil where necessary to prevent erosion, and/or provide treatment for stormwater contaminated with TSS caused by eroded soil.

Applicable BMPs:

Cover Practice Options:

- Vegetative cover such as grass, trees, shrubs, on erodible soil areas; or,
- Covering with mats such as jute, synthetic fiber; and/or,
- Preservation of natural vegetation including grass, trees, shrubs, and vines

Structural Practice Options:

- Vegetated swale, dike, silt fence, check dam, gravel filter berm, sedimentation basin, and proper grading.

BMPs for Spills of Oil and Hazardous Substances

Description of Pollutant Sources: Owners or operators of facilities engaged in drilling, producing, gathering, storing, processing, transferring, distributing, refining or consuming oil and/or oil products are required by Federal Law to have a Spill Prevention and Control Plan if the storage capacity of the facility, which is not buried, is 1,320 gallons or more of oil, or any single container with a capacity in excess of 660 gallons and which, due to their location, could reasonably be expected to discharge oil in harmful quantities, as defined in 40 CFR Part 110, into or upon the navigable waters of the United States or adjoining shorelines {40 CFR 112.1 (b)}. Onshore and offshore facilities, which, due to their location, could not reasonably be expected to discharge oil

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into or upon the navigable waters of the United States or adjoining shorelines are exempt from these regulations {40 CFR 112.1(1)(i)}. Owners of businesses that produce Dangerous Wastes are also required by State Law to have a spill control plan. These businesses should refer to Appendix IV-D R.6 of the SWMMWW. The federal definition of oil is oil of any kind or any form, including, but not limited to petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil.

Pollutant Control Approach: Maintain, update, and implement an oil spill prevention/cleanup plan.

Applicable Operational BMPs: The businesses and public agencies identified that are required to prepare and implement an Emergency Spill Cleanup Plan shall implement the following:

- Prepare an Emergency Spill Control Plan (SCP), which includes:
  - A description of the facility including the owner's name and address;
  - The nature of the activity at the facility;
  - The general types of chemicals used or stored at the facility;
  - A site plan showing the location of storage areas for chemicals, the locations of storm drains, the areas draining to them, and the location and description of any devices to stop spills from leaving the site such as positive control valves;
  - Cleanup procedures;
  - Notification procedures to be used in the event of a spill, such as notifying key personnel. Agencies such as Ecology, local fire department, Washington State Patrol, and the local Sewer Authority, shall be notified;
  - The name of the designated person with overall spill cleanup and notification responsibility.
- Train key personnel in the implementation of the Emergency SCP. Prepare a summary of the plan and post it at appropriate points in the building, identifying the spill cleanup coordinators, location of cleanup kits, and phone numbers of regulatory agencies to be contacted in the event of a spill;
- Update the SCP regularly;
- Immediately notify Ecology and the local Sewer Authority if a spill may reach sanitary or storm sewers, ground water, or surface water, in accordance with federal and Ecology spill reporting requirements;
- Immediately clean up spills. Do not use emulsifiers for cleanup unless an appropriate disposal method for the resulting oily wastewater is implemented. Absorbent material shall not be washed down a floor drain or storm sewer; and,
- Locate emergency spill containment and cleanup kit(s) in high potential spill

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areas. The contents of the kit shall be appropriate for the type and quantities of chemical liquids stored at the facility.

Recommended Additional Operational BMP: Spill kits should include appropriately lined drums, absorbent pads, and granular or powdered materials for neutralizing acids or alkaline liquids where applicable. In fueling areas: absorbent should be packaged in small bags for easy use and small drums should be available for storage of absorbent and/or used absorbent. Spill kits should be deployed in a manner that allows rapid access and use by employees.

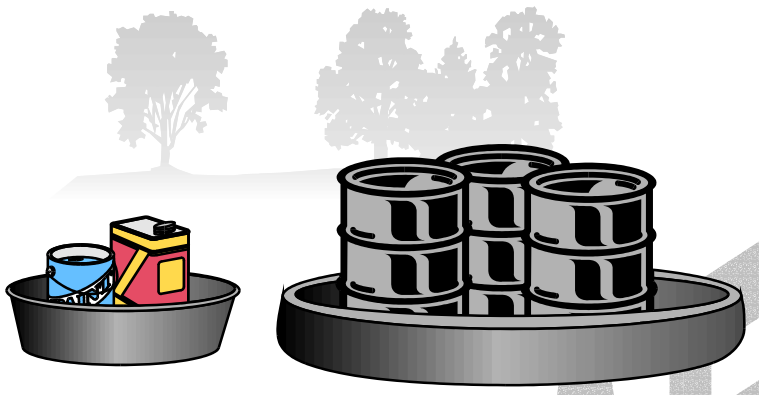

Figure 8.2.8 – Secondary Containment System

BMPs for Storage of Liquid, Food Waste, or Dangerous Waste Containers

Description of Pollutant Sources: Steel and plastic drums with volumetric capacities of 55 gallons or less are typically used at industrial facilities for container storage of liquids and powders. The BMPs specified below apply to container(s) located outside a building used for temporary storage of accumulated food wastes, vegetable or animal grease, used oil, liquid feedstock or cleaning chemical, or Dangerous Wastes (liquid or solid) unless the business is permitted by Ecology to store the wastes. Leaks and spills of pollutant materials during handling and storage are the primary sources of pollutants. Oil and grease, acid/alkali pH, BOD, COD are potential pollutant constituents.

Pollutant Control Approach: Store containers in impervious containment under a roof or other appropriate cover, or in a building. For roll-containers (for example, dumpsters) that are picked up directly by the collection truck, a filet can be placed on both sides of the curb to facilitate moving the dumpster. If a storage area is to be used on-site for less than 30 days, a portable temporary secondary system like that shown in Figure 8.2.8 can be used in lieu of a permanent system as described above.

Applicable Operational BMPs:

- Place tight-fitting lids on all containers.
- Place drip pans beneath all mounted container taps and at all potential drip and spill locations during filling and unloading of containers.

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- Inspect container storage areas regularly for corrosion, structural failure, spills, leaks, overfills, and failure of piping systems. Check containers daily for leaks/spills. Replace containers, and replace and tighten bungs in drums as needed.
- Businesses accumulating Dangerous Wastes that do not contain free liquids need only to store these wastes in a sloped designated area with the containers elevated or otherwise protected from storm water run-on.
- Drums stored in an area where unauthorized persons may gain access must be secured in a manner that prevents accidental spillage, pilferage, or any unauthorized use (see Figure 8.2.9).

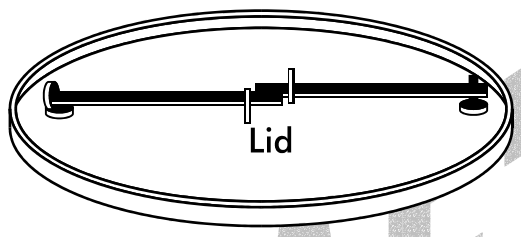

Figure 8.2.9 – Locking System for Drum Lid

- If the material is a Dangerous Waste, the business owner must comply with any additional Ecology requirements.
- Storage of reactive, ignitable, or flammable liquids must comply with the Uniform Fire Code.
- Cover dumpsters, or keep them under cover such as a lean-to, to prevent the entry of stormwater. Replace or repair leaking garbage dumpsters.
- Drain dumpsters and/or dumpster pads to sanitary sewer. Keep dumpster lids closed. Install waterproof liners.

Applicable Structural Source Control BMPs:

- Keep containers with Dangerous Waste, food waste, or other potential pollutant liquids inside a building unless this is impracticable due to site constraints or Uniform Fire Code requirements.
- Store containers in a designated area, which is covered, bermed or diked, paved and impervious in order to contain leaks and spills (see Figure 8.2.10). The secondary containment shall be sloped to drain into a dead-end sump for the collection of leaks and small spills.
- For liquid wastes, surround the containers with a dike as illustrated in Figure 8.2.10. The dike must be of sufficient height to provide a volume of either 10 percent of the total enclosed container volume or 110 percent of the volume contained in the largest container, whichever is greater, or, if a single container, 110 percent of the volume of that container.

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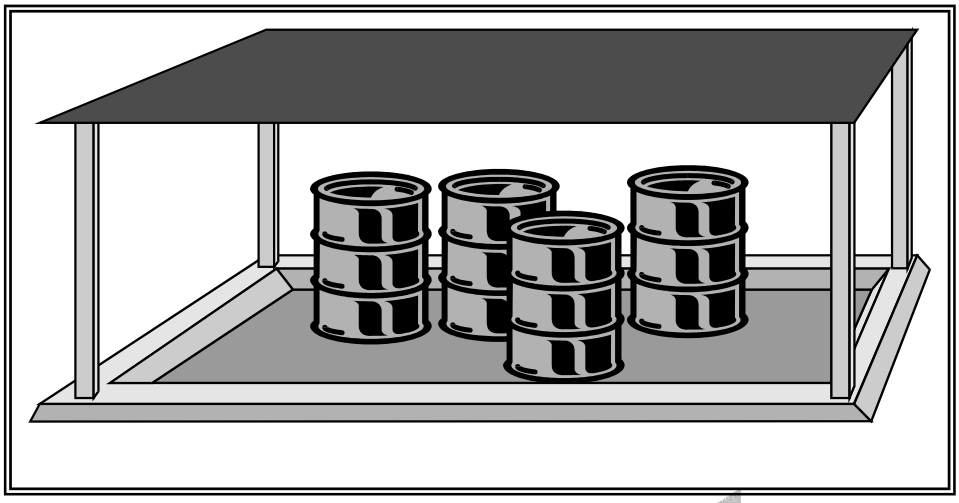

- Where material is temporarily stored in drums, a containment system can be used as illustrated, in lieu of the above system (see Figure 8.2.8).
- Place containers mounted for direct removal of a liquid chemical for use by employees inside a containment area as described above. Use a drip pan during liquid transfer (see Figure 8.2.11).

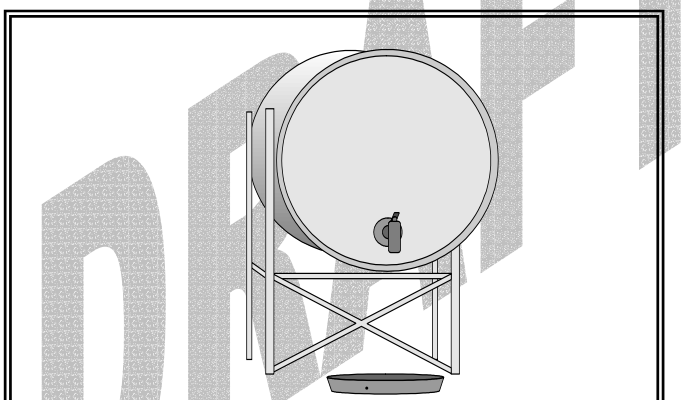

Figure 8.2.11 – Mounted Container - with drip pan

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Applicable Treatment BMP:

- For contaminated stormwater in the containment area, connect the sump outlet to a sanitary sewer, if approved by the local Sewer Authority, or to appropriate treatment such as an API or CP oil/water separator, catch basin filter or other appropriate system (see Chapter 6). Equip the sump outlet with a normally closed valve to prevent the release of spilled or leaked liquids, especially flammables (compliance with Fire Codes), and dangerous liquids. This valve may be opened only for the conveyance of contaminated stormwater to treatment.
- Another option for discharge of contaminated stormwater is to pump it from a dead-end sump or catchment to a tank truck or other appropriate vehicle for off-site treatment and/or disposal.

BMPs for Storage of Liquids in Permanent Above-ground Tanks

Description of Pollutant Sources: Above-ground tanks containing liquids (excluding uncontaminated water) may be equipped with a valved drain, vent, pump, and bottom hose connection. They may be heated with steam heat exchangers equipped with steam traps. Leaks and spills can occur at connections and during liquid transfer. Oil and grease, organics, acids, alkalis, and heavy metals in tank water and condensate drainage can also cause stormwater contamination at storage tanks.

Pollutant Control Approach: Install secondary containment or a double-walled tank. Slope the containment area to a drain with a sump. Stormwater collected in the containment area may need to be discharged to treatment such as an API or CP oil/water separator, or equivalent BMP. Add safeguards against accidental releases including protective guards around tanks to protect against vehicle or forklift damage, and tagging valves to reduce human error. Tank water and condensate discharges are process wastewater that may need an NPDES Permit.

Applicable Operational BMPs:

- Inspect the tank containment areas regularly to identify problem components such as fittings, pipe connections, and valves, for leaks/spills, cracks, corrosion, etc.
- Place adequately sized drip pans beneath all mounted taps and drip/spill locations during filling/unloading of tanks. Valved drain tubing may be needed in mounted drip pans.
- Sweep and clean the tank storage area regularly, if paved.
- Replace or repair tanks that are leaking, corroded, or otherwise deteriorating.
- All installations shall comply with the Uniform Fire Code and the National Electric Code.

Applicable Structural Source Control BMPs:

- Locate permanent tanks in impervious (Portland cement concrete or equivalent) secondary containment surrounded by dikes as illustrated in Figure 8.2.12, or UL Approved double-walled. The dike must be of sufficient height to provide a containment volume of either 10 percent of the total enclosed tank volume or 110 percent of the volume contained in the largest tank, whichever is greater, or, if a single tank, 110 percent of the volume of that tank.
- Slope the secondary containment to drain to a dead-end sump (optional), or equivalent, for the collection of small spills.
- Include a tank overfill protection system to minimize the risk of spillage during loading.

Applicable Treatment BMPs:

- If the tank containment area is uncovered, equip the outlet from the spill-containment sump with a shutoff valve, which is normally closed and may be

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opened, manually or automatically, only to convey contaminated stormwater to approved treatment or disposal, or to convey uncontaminated stormwater to a storm drain. Evidence of contamination can include the presence of visible sheen, color, or turbidity in the runoff, or existing or historical operational problems at the facility. Simple pH measurements with litmus or pH paper can be used for areas subject to acid or alkaline contamination.

- At petroleum tank farms, convey stormwater contaminated with floating oil or debris in the contained area through an API or CP-type oil/water separator, or other approved treatment prior to discharge to storm drain or surface water.

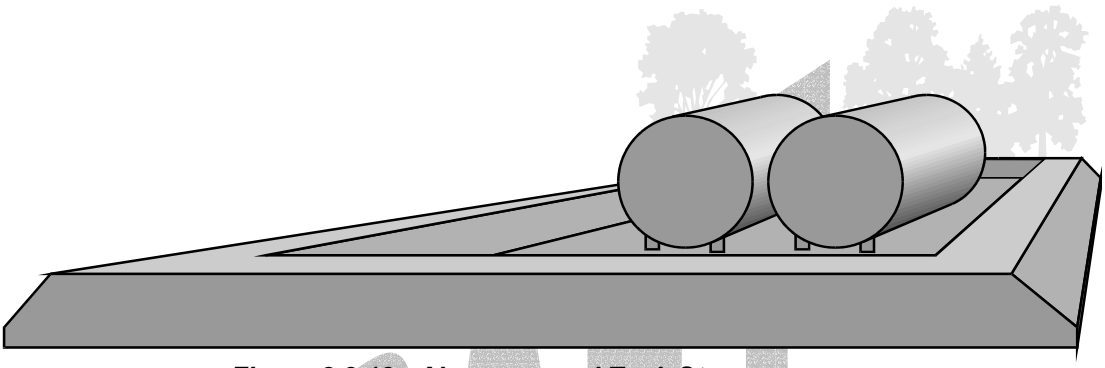

Figure 8.2.12 - Above-ground Tank Storage

BMPs for Storage or Transfer (Outside) of Solid Raw Materials, By-Products, or Finished Products

Description of Pollutant Sources: Solid raw materials, by-products, or products such as gravel, sand, salts, topsoil, compost, logs, sawdust, wood chips, lumber and other building materials, concrete, and metal products sometimes are typically stored outside in large piles, stacks, etc. at commercial or industrial establishments. Contact of outside bulk materials with stormwater can cause leachate, and erosion of the stored materials. Contaminants include TSS, BOD, organics, and dissolved salts (sodium, calcium, and magnesium chloride, etc).

Pollutant Control Approach: Provide impervious containment with berms, dikes, etc. and/or cover to prevent run-on and discharge of leachate pollutant(s) and TSS.

Applicable Operational BMP: Do not hose down the contained stockpile area to a storm drain or a conveyance to a storm drain or to a receiving water.

Applicable Structural Source Control BMP Options: Choose one or more of the source control BMP options listed below for stockpiles greater than 5 cubic yards of erodible or water soluble materials such as soil, road deicing salts, compost, unwashed sand and gravel, sawdust, etc. Also included are outside storage areas for solid materials such as logs, bark, lumber, metal products, etc.

- Store in a building or paved and bermed covered area as shown in Figure 8.2.13, or;

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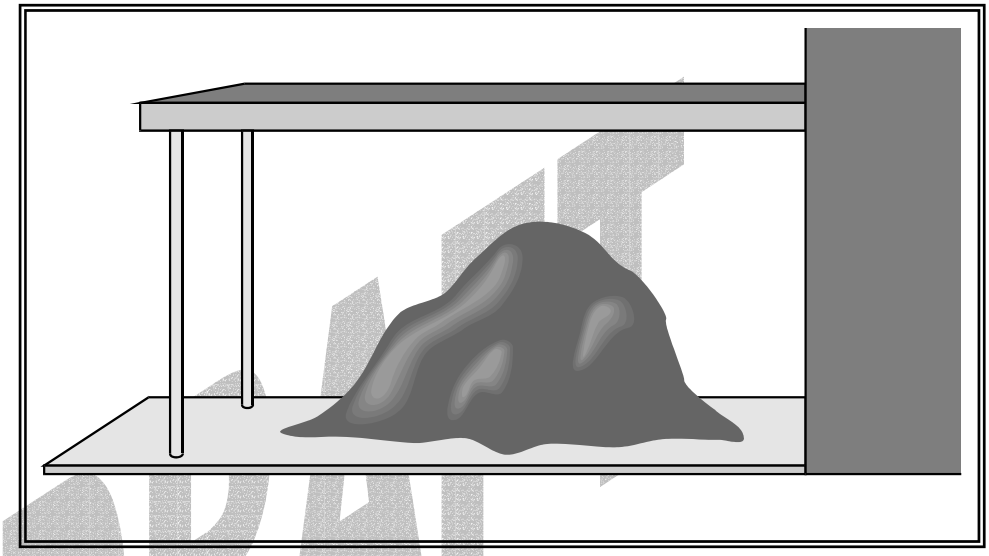
- Place temporary plastic sheeting (polyethylene, polypropylene, hypalon, or equivalent) over the material as illustrated (see Figure 8.2.14), or;
- Pave the area and install a stormwater drainage system. Place curbs or berms along the perimeter of the area to prevent the run-on of unconta-minated stormwater and to collect and convey runoff to treatment. Slope the paved area in a manner that minimizes the contact between stormwater (e.g., pooling) and leachable materials in compost, logs, bark, wood chips, etc.



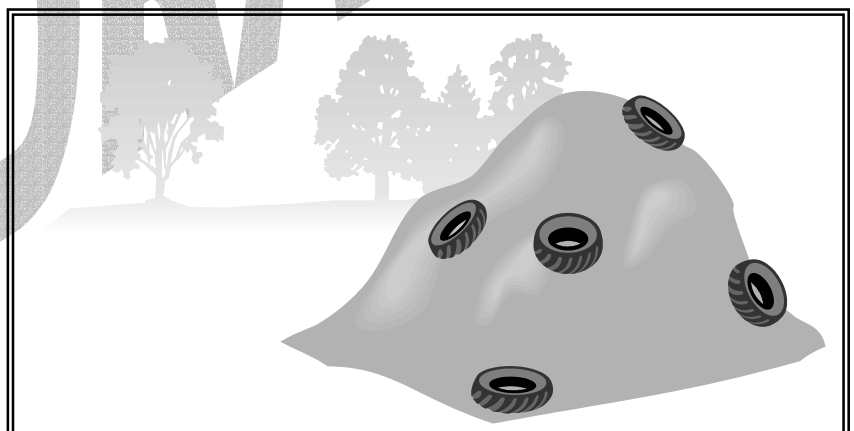


Figure 8.2.14 - Material Covered with Plastic Sheeting

- For large stockpiles that cannot be covered, implement containment practices at the perimeter of the site and at any catch basins as needed to prevent erosion and discharge of the stockpiled material offsite or to a storm drain. Ensure that contaminated stormwater is not discharged directly to catch basins without conveying through a treatment BMP.

Applicable Treatment BMP: Convey contaminated stormwater from the stockpile area to a wet pond, wet vault, settling basin, media filter, or other appropriate treatment system depending on the contamination.

Recommended Additional Operational BMPs:

- Maintain drainage areas in and around storage of solid materials with a minimum slope of 1.5 percent to prevent pooling and minimize leachate formation. Areas should be sloped to drain stormwater to the perimeter where it can be collected, or to internal drainage "alleyways" where material is not stockpiled.
- Sweep paved storage areas regularly for collection and disposal of loose solid materials.
- If and when feasible, collect and recycle water-soluble materials (leachates) to the stockpile.
- Stock cleanup materials, such as brooms, dustpans, and vacuum sweepers near the storage area.

BMPs for Urban Streets

Description of Pollutant Sources: Streets can be the sources of vegetative debris, paper, fine dust, vehicle liquids, tire wear residues, heavy metals (lead and zinc), soil particles, ice control salts, domestic wastes, lawn chemicals, and vehicle combustion products. Street surface contaminants have been found to contain significant concentrations of particle sizes less than 250 microns. (Sartor and Boyd, 1972)

Pollutant Control Approach: Conduct efficient street sweeping where and when appropriate to minimize the contamination of stormwater. Do not wash street debris into storm drains.

Recommended BMPs:

- For maximum stormwater pollutant reductions on curbed streets and high volume parking lots use efficient vacuum sweepers
- For moderate stormwater pollutant reductions on curbed streets use regenerative air sweepers or tandem sweeping operations.

  Note: *A tandem sweeping operation involves a single pass of a mechanical sweeper followed immediately by a single pass of a vacuum sweeper or regenerative air sweeper.*

  - *A regenerative air sweeper blows air down on the pavement to entrain particles and uses a return vacuum to transport the material to the hopper.*
  - *These operations usually use water to control dust. This reduces their ability to pick up fine particulates.*

  It has been reported that these types of sweepers have the capability of removing approximately 25 to 50 percent of the accumulated street dirt

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particles whose diameters are less than 250 microns. (Sutherland, 1998) This assumes pavements under good conditions and typical accumulation conditions.

- For minimal stormwater pollutant reductions on curbed streets use mechanical sweepers.

  Note: *Mechanical sweepers are referred to as broom sweepers and use the mechanical action of main and gutter brooms to throw material on a conveyor belt that transports it to the hopper.*

  - *These sweepers usually use water to control dust. This reduces their ability to pick up fine particulates.*

  It has been reported that mechanical sweepers have the capability of removing only 10 to 20 percent of the accumulated street dirt particles whose diameters are less than 250 microns. (Sutherland, 1998) This assumes pavements under good condition and the most favorable accumulation conditions.

Conduct sweeping at optimal frequencies. Optimal frequencies are those scheduled sweeping intervals that produce the most cost-effective annual reduction of pollutants normally found in stormwater and can vary depending on land use, traffic volume and rainfall patterns.

- Train operators in those factors that result in optimal pollutant removal. These factors include sweeper speed, brush adjustment and rotation rate, sweeping pattern, maneuvering around parked vehicles, and interim storage and disposal methods.
- Consider the use of periodic parking restrictions in low to medium density single-family residential areas to ensure the sweeper's ability to sweep along the curb.
- Establish programs for prompt sweeping, removal, and disposal of debris from special events that will generate higher than normal loadings.
- Inform citizens about eliminating yard debris, oil and other wastes in street gutters to reduce street pollutant sources.

BMPs to Consider:

Note: *High-efficiency street sweepers utilize strong vacuums and the mechanical action of main and gutter brooms combined with an air filtration system that only returns clean air to the atmosphere (i.e., filters very fine particulates). They sweep dry and use no water since they do not emit any dust.*

It has been reported that high-efficiency vacuum sweepers have the capability of removing, from pavements under good condition, 80 percent or more of the accumulated street dirt particles whose diameters are less than 250 microns. (Sutherland, 1998) This assumes pavements under good condition and reasonably expected accumulation conditions.

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BMPs for Washing and Steam Cleaning Vehicles/ Equipment/ Building Structures

Description of Pollutant Sources: Vehicles, aircraft, vessels, and transportation, restaurant cooking, carpet cleaning, and industrial equipment, and large buildings may be commercially cleaned with low or high pressure water or steam. This includes frequent "charity" car washes at gas stations and commercial parking lots. The cleaning can include hand washing, scrubbing, sanding, etc. Washwater from cleaning activities can contain oil and grease, suspended solids, heavy metals, soluble organics, soaps, and detergents that can contaminate stormwater.

Pollutant Control Approach: The preferred approach is to cover and/or contain the cleaning activity, or conduct the activity inside a building, to separate the uncontaminated stormwater from the pollutant sources. Washwater must be conveyed to a sanitary sewer after approval by the local sewer authority, temporarily stored before proper disposal, or recycled, with no discharge to the ground, to a storm drain, or to surface water. Washwater may be discharged to the ground after proper treatment in accordance with Ecology guidance WQ-95-056, "Vehicle and Equipment Washwater Discharges," June 1995. The quality of any discharge to the ground after proper treatment must comply with Ecology's Ground Water Quality Standards, Chapter 173-200 WAC. Contact the local Ecology Regional Office for an NPDES Permit application for discharge of washwater to surface water or to a storm drain after on-site treatment.

Applicable Structural Source Control BMPs: Conduct vehicle/ equipment washing in one of the following locations:

- At a commercial washing facility in which the washing occurs in an enclosure and drains to the sanitary sewer, or
- In a building constructed specifically for washing of vehicles and equipment, which drains to a sanitary sewer.

Conduct outside washing operation in a designated wash area with the following features:

- In a paved area, constructed as a spill containment pad to prevent the run-on of stormwater from adjacent areas. Slope the spill containment area so that washwater is collected in a containment pad drain system with perimeter drains, trench drains or catchment drains. Size the containment pad to extend out a minimum of four feet on all sides of the vehicles and/or equipment being washed.
- Convey the washwater to a sump (like a grit separator) and then to a sanitary sewer (if allowed by the local Sewer Authority), or other appropriate wastewater treatment or recycle system. An NPDES permit may be required for any washwater discharge to a storm drain or receiving water after treatment. Contact the Ecology regional office for NPDES Permit requirements.
- The containment sump must have a positive control outlet valve for spill control with live containment volume, and oil/water separation. Size the

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minimum live storage volume to contain the maximum expected daily washwater flow plus the sludge storage volume below the outlet pipe. The outlet valve will be shut during the washing cycle to collect the washwater in the sump. The valve should remain shut for at least two hours following the washing operation to allow the oil and solids to separate before discharge to a sanitary sewer. (See Ecology Publication WQ-95-056).

Note: *The purpose of the valve is to convey only washwater and contaminated stormwater to a treatment system.*

- The inlet valve in the discharge pipe should be closed when washing is not occurring, thereby preventing the entry of uncontaminated stormwater into the pretreatment/ treatment system. The stormwater can then drain into the conveyance/discharge system outside of the wash pad (essentially bypasses the washwater treatment/conveyance system). Post signs to inform people of the operation and purpose of the valve. Clean the concrete pad thoroughly until there is no foam or visible sheen in the washwater prior to closing the inlet valve and allowing uncontaminated stormwater to overflow and drain off the pad. (See Figure 2.15)
- Collect the washwater from building structures and convey it to appropriate treatment such as a sanitary sewer system if it contains oils, soaps, or detergents, where feasible. If the washwater does not contain oils, soaps, or detergents then it could drain to soils that have sufficient natural attenuation capacity for dust and sediment.

Recommended Additional BMPs:

- The wash area should be well marked at gas stations, multi-family residences and any other business where non-employees wash vehicles.
- For uncovered wash pads, the positive control outlet valve may be manually operated, but a pneumatic or electric valve system is preferable. The valve may be on a timer circuit where it is opened upon completion of a wash cycle. The timer would then close the valve after the sump or separator is drained (Figure 8.2.15).
- Use phosphate-free biodegradable detergents when practicable.
- Consider recycling the washwater.

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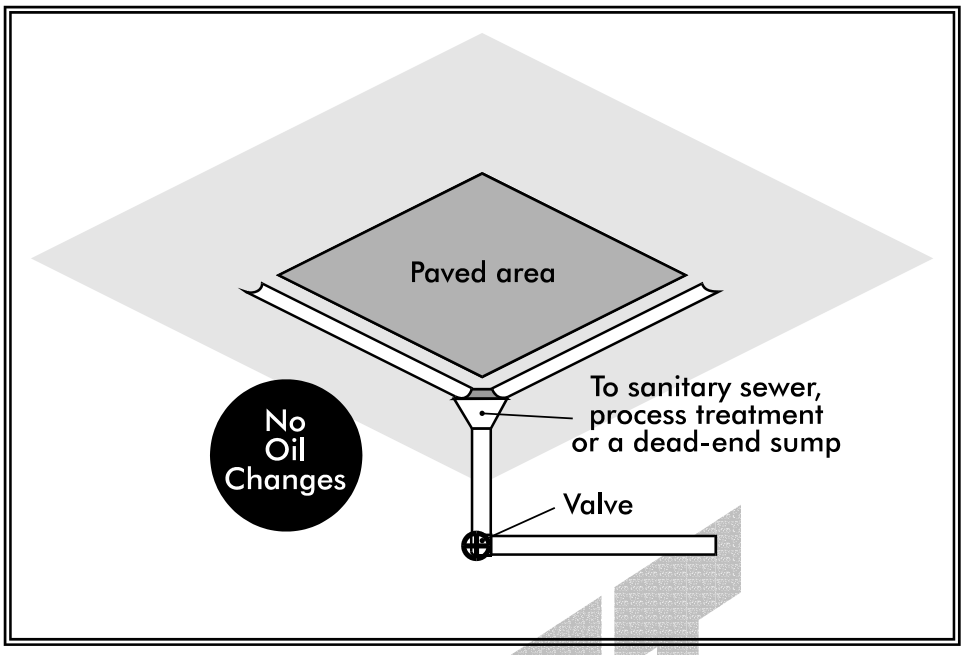

- Because soluble/emulsifiable detergents can be used in the wash medium, the selection of soaps and detergents and treatment BMPs should be considered carefully. Oil/water separators are ineffective in removing emulsified or water soluble detergents.

Exceptions:

- At gas stations (for charity car washes) or commercial parking lots, where it is not possible to discharge the washwater to a sanitary sewer, a temporary plug or a temporary sump pump can be used at the storm drain to collect the washwater for off-site disposal such as to a nearby sanitary sewer.
- New and used car dealerships may wash vehicles in the parking stalls as long as a temporary plug system is used to collect the washwater for disposal as stated above, or an approved treatment system for the washwater is in place.

At industrial sites, contact the local Ecology Regional Office for NPDES Permit requirements even if soaps, detergents, and/or other chemical cleaners are not used in washing trucks.

BMPs for Wood Treatment Areas

Description of Pollutant Sources: Wood treatment includes both anti-staining and wood preserving using pressure processes or by dipping or spraying. Wood preservatives include creosote, creosote/coal tar, pentachlorophenol, copper naphthenate, arsenic trioxide, malathion, or inorganic arsenicals such as chromated copper arsenate, acid copper chromate, chromate zinc chloride, and fluor-chrome-arsenate-phenol. Anti-staining chemical additives include iodo-prophenyl-butyl carbamate, dimethyl sulfoxide, didecyl dimethyl ammonium chloride, sodium azide, 8-quinolinol; copper (II) chelate, sodium ortho-phenylphenate, 2-(thiocyanomethylthio)-benzothiazole (TCMTB) and methylene bis- (thiocyanate), and zinc naphthenate.

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Pollutant sources include drips of condensate or preservative after pressurized treatment; product washwater (in the treatment or storage areas), spills and leaks from process equipment and preservative tanks, fugitive emissions from vapors in the process, blowouts and emergency pressure releases, and kick-back from lumber (phenomenon where preservative leaks as it returns to normal pressure). Potential pollutants typically include the wood treating chemicals, BOD, suspended solids, oil and grease, benzene, toluene, ethylbenzene, phenol, chlorophenols, nitrophenols, heavy metals, and PAH depending on the chemical additive used.

Pollutant Control Approach: Cover and contain all wood treating areas and prevent all leaching of and stormwater contamination by wood treating chemicals. All wood treating facilities in Washington State are required to be covered under an Individual NPDES Permit.

Applicable Operational BMPs: The individual NPDES Permit will require at a minimum the following Operational BMPs.

- Dedicate equipment that is used for treatment activities to prevent the tracking of treatment chemicals to other areas on the site.
- Eliminate non-process traffic on the drip pad. Scrub down non-dedicated lift trucks on the drip pad.
- Immediately remove and properly dispose of soils with visible surface contamination (green soil) to prevent the spread of chemicals to ground water and/or surface water via stormwater runoff.
- If any wood is observed to be contributing chemicals to the environment in the treated wood storage area, relocate it on a concrete chemical containment structure until the surface is clean and until it is drip free and surface dry.

Recommended Operational BMP: Consider using preservative chemicals that do not adversely impact receiving surface water and ground water.

Applicable Structural Source Control BMPs. The individual NPDES Permit will require at a minimum the following Structural Source Control BMPs:

- Cover and/or enclose, and contain with impervious surfaces, all wood treatment areas. Slope and drain areas around dip tanks, spray booths, retorts, and any other process equipment in a manner that allows return of treatment chemicals to the wood treatment process.
- Cover storage areas for freshly treated wood to prevent contact of treated wood products with stormwater. Segregate clean stormwater from process water. Ensure that all process water is conveyed to an approved treatment system.
- Seal any holes or cracks in the asphalt areas that are subject to wood treatment chemical contamination.
- Elevate stored, treated wood products to prevent contact with stormwater run-on and runoff

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- Place dipped lumber over the dip tank, or on an inclined ramp for a minimum of 30 minutes to allow excess chemical to drip back to the dip tank.
- Place treated lumber either from dip tanks or retorts in a covered paved storage area for at least 24 hours before placement in outside storage. Use a longer storage period during cold weather unless the temporary storage building is heated. The wood shall be drip free and surface dry before it is moved outside.

8.3 Stormwater Pollutants and Their Adverse Impact

The stormwater pollutants of most concern are total suspended solids (TSS), oil and grease, nutrients, pesticides, other organics, pathogens, biochemical oxygen demand (BOD), heavy metals, and salts (chlorides) (USEPA, 1995, Field and Pitt, 1997, Strecker, et.al., 1997)

Total Suspended Solids This represents particulate solids such as eroded soil, heavy metal precipitates, and biological solids (all considered as conventional pollutants), which can cause sedimentation in streams and turbidity in receiving surface waters. These sediments can destroy the desired habitat for fish and can impact drinking water supplies. The sediment may be carried to streams, lakes, or Puget Sound where they may be toxic to aquatic life and make dredging necessary.

Oil and Grease Oil and grease can be toxic to aquatic life. Concentrations in stormwater from commercial and industrial areas often exceed the Washington Department of Ecology (Ecology) guidelines of: 10 mg/l maximum daily average, 15 mg/L maximum at any time, and no ongoing or frequently recurring visible sheen.

Nutrients Phosphorus and nitrogen compounds can cause excessive growth of aquatic vegetation in lakes and marine waters.

BOD This represents organic, nitrogenous and other materials that are consumed by bacteria present in receiving waters. Oxygen may be depleted in the process, threatening higher organisms such as fish.

Toxic Organics A study found 19 of the U.S. Environmental Protection Agency's 121 priority pollutants present in the runoff from Seattle streets. The most frequently detected pollutants were pesticides, phenols, phthalates, and polynuclear aromatic hydrocarbons (PAHs).

Heavy Metals Stormwater can contain heavy metals such as lead, zinc, cadmium, and copper at concentrations that often exceed water quality criteria and that can be toxic to fish and other aquatic life. Research in Puget Sound has shown that metals and toxic organics concentrate in sediments and at the water surface (microlayer) where they interfere with the reproductive cycle of many biotic species as well as cause tumors and lesions in fish.

pH A measure of the alkalinity or acidity which can be toxic to fish if it varies appreciably from neutral pH, which is 7.0.

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Bacteria and Viruses

Stormwater can contain disease-causing bacteria and viruses, although not at concentrations found in sanitary sewage. Shellfish subjected to stormwater discharges near urban areas are usually unsafe for human consumption. Research has shown that the concentrations of pollutants in stormwater from residential, commercial, and industrial areas can exceed Ecology's water quality standards and guidelines. See table below.

	CONCENTRATIONS (µg/l or ppb)							ECOLOGY/USEPA CRITERIA (D)			
Pollutant	**Commercial**		**Industrial**		**Residential**		**Highway(C)**	**Freshwater Acute**	**Freshwater Chronic**	**Saltwater Acute**	**Saltwater Chronic**
	(A)	**(B)**	**(A)**	**(B)**	**(A)**	**(B)**					
Total Phosphorus	210	260	380	680	150	260	113-790	--	--	--	--
Tot. Copper	22	31	32	49	10	31	12-152	9	7	2.9	--
Tot. Lead	26	37	21	121	10	37	19/36	34	1.3	220	8.5
Tot. Zinc	115	200	251	1,324	69	200	56-638	65	59	95	86
TSS, mg/L	55	66	93	134	43	66	63-798	--	--	--	--
BOD, mg/L	7.4	8	18	12	5.8	8	12.7/111	--	--	--	--
Oil, mg/L	--		--		--		8.9/27	--	--	--	--
Fecal Coli	980 orgs/ 100 mls(E)		--		--		--	50 colonies/ 100 mls(F)	--	--	--

A. Eric Strecker, "Analysis of Oregon Urban Runoff Water Quality Data Collected from 1990 to 1996"- 2/1997 Report
B. Santa Clara-1990: median data
C. WSDOT Stormwater Management Plan, 3/25/97, WA. and Oregon data
D. Dissolved metal criteria in freshwater at a hardness of 50 ppm (Chapter 173-201A WAC), saltwater criteria expressed as a function of water effect ratio (40 CFR Part 131)
E. Ecology geometric mean criterion for class AA waters

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Appendix 8A – Urban Land Uses and Pollutant Generating Sources

Use this section to identify pollutant-generating sources at various land uses (manufacturing, transportation, communication, wholesale, retail, service - based on the 1987 Standard Industrial Classification codes (OMB, 1987), and public agencies). Applicable operational and structural source control, and treatment BMPs for each pollutant source can then be selected by referring to Section 8.2. Other land uses not included in this section should also consider implementing applicable BMPs for their pollutant sources.

Manufacturing Businesses

Cement
SIC: 3241

Description: These businesses produce Portland cement, the binder used in concrete for paving, buildings, pipe and other structural products. The three basic steps in cement manufacturing are: 1) proportioning, grinding, and blending raw materials; 2) heating raw materials to produce a hard, stony substance known as clinker; and 3) combining the clinker with other materials and grinding the mixture into a fine powdery form. The raw materials include limestone, silica, alumina, iron, chalk, oyster shell marl, or shale. Waste materials from other industries are often used such as slag, fly ash and spent blasting sand. Raw materials are crushed, mixed and heated in a kiln to produce the correct chemical composition. Kilns typically are coal, gas, or oil fired. The output of the kiln is a clinker that is ground to produce the final product.

The basic process may be wet or dry. In the wet process water is mixed with the raw ingredients in the initial crushing operation and in some cases is used to wash the material prior to use. Water may also be used in the air pollution control scrubber. The most significant waste material from cement production is the kiln dust. Concrete products may also be produced at ready-mix concrete facilities. Refer to "Concrete Products" for a description of the BMPs appropriate to these activities.

Potential Pollutant Generating Sources: Stormwater may be contaminated during the crushing, grinding, storage, and handling of kiln dust, limestone, shale, clay, coal, clinker, gypsum, anhydrite, slag, sand, and product and at the vehicle and equipment maintenance, fueling, and cleaning areas. Total suspended solids, aluminum, iron and other heavy metals, pH, COD, potassium, sulfate, and oil and grease are some of the potential pollutants. The following mean concentrations in stormwater discharges have been reported Environmental Protection Agency (EPA's) multi-sector permit fact sheet (EPA, 1995): TSS=1067, COD=107.5, aluminum=72.6, iron=7.5, all in mg/L, and pH=2-12. These values may be useful in characterizing stormwater contaminants at cement manufacturing facilities.

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Chemicals Manufacturing SIC: 2800, 3861

Description: This group is engaged in the manufacture of chemicals, or products based on chemicals such as acids, alkalis, inks , chlorine, industrial gases, pigments, chemicals used in the production of synthetic resins, fibers and plastics, synthetic rubber, soaps and cleaners, pharmaceuticals, cosmetics, paints, varnishes, resins, photographic materials, chemicals, organic chemicals, agricultural chemicals, adhesives, sealants, and ink .

Potential Pollutant Generating Sources: Activities that can contaminate stormwater include bagging, blending, packaging, crushing, milling, shredding, granulation, grinding, storage, distribution, loading/unloading, and processing of materials; equipment storage; application of fertilizers; foundries; lime application; use of machinery; material handling and warehousing; cooling towers; fueling; boilers; hazardous waste treatment, storage and disposal; wastewater treatment; plant yard areas of past industrial activity; access roads and tracks; drum washing, and maintenance and repair.

Chemical businesses in the Seattle area surveyed for Dangerous Wastes have been found to produce waste caustic solutions, soaps, heavy metal solutions, inorganic and organic chemicals, solvents, acids, alkalis, paints, varnishes, pharmaceuticals, and inks. The potential pollutants include BOD, TSS, COD, oil and grease, pH, total phosphorus, nitrates, nitrites, total Kjeldahl nitrogen, ammonia, specific organics, and heavy metals. EPA stormwater multi-sector permit fact sheet data (7) includes the following mean values in mg/L except pH: BOD, 4.4-143.2; TSS, 35-493; COD, 42.36-245.3; Oil and Grease, 0.3-6.0; NO2+NO3, 0.3-35.9; TKN, 1.3-108.9; tot. P, 0.1-65.7; ammonia, 40.45-73.22; Al, 1.20-1.78; Cu, .12-19; Mn, .56-. 71; Zn, 1.74-2.11; Fe, 2.24-3.52 and pH, 3.5-10.4. This data could be helpful in characterizing stormwater pollutants at the facility.

Concrete Products SIC: 3270

Description: Businesses that manufacture ready-mix concrete, gypsum products, concrete blocks and bricks, concrete sewer or drainage pipe, septic tanks, and prestressed concrete building components. Concrete is prepared on-site and poured into molds or forms to produce the desired product. The basic ingredients of concrete are sand, gravel, Portland cement, crushed stone, clay, and reinforcing steel for some products. Admixtures including fly ash, calcium chloride, triethanolamine, lignosulfonic acid, sulfonated hydrocarbon, fatty acid glyceride, or vinyl acetate, which may be added to obtain desired characteristics such as slower or more rapid curing times.

The first stage in the manufacturing process is proportioning cement, aggregate, admixtures and water, and then transporting the product to a rotary drum, or pan mixer. The mixture is then fed into an automatic block-molding machine that rams, presses, or vibrates the mixture into its final form. The final product is then stacked on iron framework cars where it cures in four hours. After being mixed in a central mixer, concrete is molded in the same manner as concrete block. The concrete

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cures in the forms for a number of hours. Forms are washed for reuse, and the concrete products are stored until they can be shipped.

Potential Pollutant Generating Sources: Pollutant generating activities/sources include stockpiles; washing of waste concrete from trucks, forms, equipment, and the general work area; and water from the curing of concrete products. Besides the basic ingredients for making concrete products, chemicals used in the curing of concrete and the removal of forms may end up in stormwater. These chemicals can include latex sealants, bitumastic coatings and release agents. Trucks and equipment maintained on-site may generate waste oil and solvents, and other waste materials. Potential pollutants include TSS, COD, BOD, pH, lead, iron, zinc, and oil and grease.

Electrical Products SIC: 3600, 3800

Description: A variety of products are produced including electrical transformers and switchgear, motors, generators, relays, and industrial controls; communications equipment for radio and TV stations and systems; electronic components and accessories including semiconductors; printed board circuits; electromedical and electrotherapeutic apparatus; and electrical instrumentation. Manufacturing processes include electroplating, machining, fabricating, etching, sawing, grinding, welding, and parts cleaning. Materials used include metals, ceramics, quartz, silicon, inorganic oxides, acids, alkaline solutions, arsenides, phosphides, cyanides, oils, fuels, solvents, and other chemicals.

Potential Pollutant Generating Sources: Pollutant generating activities/sources include bulk storage of raw materials, by-products or finished products; loading and unloading of liquid materials from truck or rail; temporary storage of waste oil and solvents from cleaning manufacturing equipment; used equipment temporarily stored on site that could drip oil and residual process materials; maintenance and repair of vehicles and equipment; and temporary storage of Dangerous Wastes.

Waste liquids which are sometimes stored outside include spent acetone and solvents, ferric chloride solutions, soldering fluxes mixed with thinner or alcohol, spent acids, and oily waste. Several of these liquid wastes contain chlorinated hydrocarbons, ammonium salts, and metals such as chromium, copper, lead, silver, zinc, nickel, and tin. Waste solids include soiled rags and sanding materials.

Wastewater consists of solutions and rinses from electroplating operations, and the wastewaters from cleaning operations. Water may also be used to cool saws and grinding machines. Sludges are produced by the wastewater treatment process. Potential pollutants include TSS, oil and grease, organics, pH, BOD, COD, Total Kjeldahl Nitrogen, Nitrate and Nitrite Nitrogen, copper, zinc, lead, and silver.

Food Products SIC: 2000

Description: Businesses in this category include meat packing plants, poultry slaughtering and processing, sausage and prepared meats, dairy

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products, preserved fruits and vegetables, flour, bakery products, sugar and confectioneries, vegetable and animal oils, beverages, canned, frozen or fresh fish, pasta products, snack foods, and manufactured ice. Food processing typically occurs inside buildings. Exceptions are meat packing plants where live animals may be kept outside, and fruit and vegetable plants where the raw material may be temporarily stored outside. Meat production facilities include stockyards, slaughtering, cutting and deboning, meat processing, rendering, and materials recovery. Dairy production facilities include receiving stations, clarification, separation, and pasteurization followed by culturing, churning, pressing, curing, blending, condensing, sweetening, drying, milling, and packaging. Canned frozen and preserved fruits and vegetables are typically produced by washing, cutting, blanching, and cooking followed by drying, dehydrating, and freezing.

Grain mill products are processed during washing, milling, debranning, heat treatment, screening, shaping, and vitamin and mineral supplementing. Bakery products processing includes mixing, shaping, of dough, cooling, and decorating. Operations at an edible oil manufacturer include refining, bleaching, hydrogenation, fractionation, emulsification, deodorization, filtration, and blending. Beverage production includes brewing, distilling, fermentation, blending, and packaging. Wine processors often crush grapes outside the process building and/or store equipment outside when not in use. Some wine producers use juice from grapes crushed elsewhere. Some vegetable and fruit processing plants use caustic solutions.

Potential Pollutant Generating Sources: The following are potential stormwater pollutant causing activities/sources: loading/unloading of materials, equipment/vehicle maintenance, liquid storage in tanks and drums, air emissions (ovens, vents), solid wastes handling and storage, wastewater treatment, pest control, animal containment and transit, and vegetable storage. Materials exposed to stormwater include acids, ammonia, activated carbon, bleach, blood, bone meal, brewing residuals, caustic soda, chlorine, coke oven tar, detergents, eggs, feathers, feed, ferric chloride, fruits, vegetables, coffee beans, gel bone, grain, hides, lard, manure, milk, salts, skim powder, starch, sugar, tallow, ethyl alcohol, oils, fats, whey, yeast, and wastes. The following are the pollutants typically expected from this industry segment: BOD, TSS, Oil and Grease, pH, Kjeldahl Nitrogen, copper, manganese, fecal coliform, and pesticides.

Glass Products SIC: 3210, 3220, 3230

Description: The glass form produced may be flat or window glass, safety glass, or container glass, tubing, glass wool, or fibers. The raw materials are sand mixed with a variety of oxides such as aluminum, antimony, arsenic, lead, copper, cobalt oxide, and barium. The raw materials are mixed and heated in a furnace. Processes that vary with the intended product shape the resulting molten material. The cooled glass

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may be edged, ground, polished, annealed and/or heat-treated to produce the final product. Air emissions from the manufacturing buildings are scrubbed to remove particulates.

Potential Pollutant Generating Sources: Raw materials are generally stored in silos except for crushed recycled glass and materials washed off recycled glass. Contamination of stormwater and/or ground water can be caused by raw materials lost during unloading operations, errant flue dust, equipment/vehicle maintenance and engine fluids from mobile lifting equipment that is stored outside. The maintenance of the manufacturing equipment will produce waste lubricants and cleaning solvents. The flue dust is likely to contain heavy metals such as arsenic, cadmium, chromium, mercury, and lead. Potential pollutants include suspended solids, oil and grease, high/low pH, and heavy metals such as arsenic, cadmium, chromium, mercury, and lead.

Industrial Machinery and Equipment, Trucks and Trailers, Aircraft, Aerospace, and Railroad SIC: 3500, 3713/14, 3720, 3740, 3760, 3800

Description: This category includes the manufacture of a variety of equipment including engines and turbines, farm and garden equipment, construction and mining machinery, metal working machinery, pumps, computers and office equipment, automatic vending machines, refrigeration and heating equipment, and equipment for the manufacturing industries. This group also includes many small machine shops, and the manufacturing of trucks, trailers and parts, airplanes and parts, missiles, spacecraft, and railroad equipment and instruments.

Manufacturing processes include various forms of metal working and finishing, such as electroplating, anodizing, chemical conversion coating, etching, chemical milling, cleaning, machining, grinding, polishing, sand blasting, laminating, hot dip coating, descaling, degreasing, paint stripping, painting, and the production of plastic and fiberglass parts. Raw materials include ferrous and non-ferrous metals, such as aluminum, copper, iron, steel, and their alloys, paints, solvents, acids, alkalis, fuels, lubricating and cutting oils, and plastics.

Potential Pollutant Generating Sources: Potential pollutant sources include fuel islands, maintenance shops, loading/unloading of materials, and outside storage of gasoline, diesel, cleaning fluids, equipment, solvents, paints, wastes, detergents, acids, other chemicals, oils, metals, and scrap materials. Air emissions from stacks and ventilation systems are potential areas for exposure of materials to rain water.

Metal Products SIC: 2514, 2522, 2542, 3312, 3314-17, 3320, 3350, 3360, 3400, 3590

Description: This group includes mills that produce basic metals and primary products, as well as foundries, electroplaters, and fabricators of final metal products. Basic metal production includes steel, copper, and aluminum. Mills that transform metal billets, either ferrous or nonferrous such as aluminum, to primary metal products are included. Primary metal forms include sheets, flat bar, building components such as columns, beams and concrete reinforcing bar, and large pipe.

Steel mills in the Pacific Northwest use recycled metal and electric

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furnaces. The molten steel is cast into billets or ingots that may be reformed on site or taken to rolling mills that produce primary products. As iron and steel billets may sit outside before reforming, surface treatment to remove scale may occur prior to reforming. Foundries pour or inject molten metal into a mold to produce a shape that cannot be readily formed by other processes. The metal is first melted in a furnace. The mold is made of sand or metal die blocks that are locked together to make a complete cavity. The molten metal is ladled in and the mold is cooled. The rough product is finished by quenching, cleaning and chemical treatment. Quenching involves immersion in a plain water bath or water with an additive.

Businesses that fabricate metal products from metal stock provide a wide range of products. The raw stock is manipulated in a variety of ways including machining of various types, grinding, heating, shearing, deformation, cutting and welding, soldering, sand blasting, brazing, and laminating. Fabricators may first clean the metal by sand blasting, descaling, or solvent degreasing. Final finishing may involve electroplating, painting, or direct plating by fusing or vacuum metalizing.

Raw materials, in particular recycled metal, are stored outside prior to use, as are billets before reforming. The descaling process may use salt baths, sodium hydroxide, or acid (pickling).

Primary products often receive a surface coating treatment. Prior to the coating the product surface may be prepared by acid pickling to remove scale or alkaline cleaning to remove oils and greases. The two major classes of metallic coating operations are hot and cold coating. Zinc, tin and aluminum coatings are applied in molten metal baths. Tin and chromium are usually applied electrolytically from plating solutions.

Potential Pollutant Generating Sources: Potential pollutant generating sources include outside storage of chemicals, metal feedstock, byproducts (fluxes), finished products, fuels, lubricants, waste oil, sludge, waste solvents, Dangerous Wastes, piles of coal, coke, dusts, fly ash, baghouse waste, slag, dross, sludges, sand refractory rubble, and machining waste; unloading of chemical feedstock and loading of waste liquids such as spent pickle liquor by truck or rail; material handling equipment such as cranes, conveyors, trucks, and forklifts; particulate emissions from scrubbers, baghouses or electrostatic precipitators; fugitive emissions; maintenance shops; erosion of soil from plant yards; and floor, sink, and process wastewater drains.

Based on EPA's multi-sector industrial stormwater permit/fact sheet the following are ranges of mean composite/grab pollutant concentrations from this industrial group (values are in mg/L except pH): BOD at 34.1/32.2; COD at 109.8/221.3; NO2+NO3 N at 1.38/1.17; TKN at 3.05/3.56; Oil and grease at 8.88 (grab); pH at 2.6-10.3 (range-grab); total phosphorus at .52/1.25; TSS at 162/368; copper at 2.28/3.53; lead at .19/.

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79; zinc at 6.60/8.90; aluminum at 2.6/4.8; iron at 32.30/45.97; cadmium at 0.015/0.074; chromium at 2.2/5.053; nickel at 0.75/0.7; manganese at .59/.68; ammonia at .55/.85; and pyrene at .01/.06.

Paper and Pulp SIC: 2610, 2620, 2630

Description: Large industrial complexes in which pulp and/or paper, and/or paperboard are produced. Products also include newsprint, bleached paper, glassine, tissue paper, vegetable parchment, and industrial papers. Raw materials include; wood logs, chips, wastepaper, jute, hemp, rags, cotton linters, bagasse, and esparto. The chips for pulping may be produced on-site from logs, and/or imported.

The following manufacturing processes are typically used: raw material preparation, pulping, bleaching, and papermaking. All of these operations use a wide variety of chemicals including caustic soda, sodium and ammonium sulfites, chlorine, titanium oxide, starches, solvents, adhesives, biocides, hydraulic oils, lubricants, dyes, and many chemical additives.

Potential Pollutant Generating Sources: The large process equipment used for pulping is not enclosed. Thus, precipitation falling over these areas may become contaminated. Maintenance of the process equipment produces waste products similar to that produced from vehicle and mobile equipment maintenance. Logs may be stored, debarked and chipped on site. Large quantities of chips are stored outside. Although this can be a source of pollution, the volume of stormwater flow is relatively small because the chip pile retains the majority of the precipitation. Mobile equipment such as forklifts, log stackers, and chip dozers are sources of leaks/spills of hydraulic fluids. Vehicles and equipment are fueled and maintained on-site.

Paper Products SIC: 2650, 2670

Description: Included are businesses that take paper stock and produce basic paper products such as cardboard boxes and other containers, and stationery products such as envelopes and bond paper. Wood chips, pulp, and paper can be used as feedstock.

Potential Pollutant Generating Sources: The following are potential pollutant sources:

- Outside loading/unloading of solid and liquid materials.
- Outside storage and handling of dangerous wastes, and other liquid and solid materials.
- Maintenance and fueling activities.
- Outside processing activities comparable to Pulp and Paper processing in preceding section.

Petroleum Products SIC: 2911, 2950

Description: The petroleum refining industry manufactures gasoline, kerosene, distillate and residual oils, lubricants and related products from crude petroleum, and asphalt paving and roofing materials. Although petroleum is the primary raw material, petroleum refineries also use other

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materials such as natural gas, benzene, toluene, chemical catalysts, caustic soda, and sulfuric acid. Wastes may include filter clays, spent catalysts, sludges, and oily water.

Asphalt paving products consist of sand, gravel and petroleum-based asphalt that serves as the binder. Raw materials include stockpiles of sand and gravel and asphalt emulsions stored in aboveground tanks.

Potential Pollutant Generating Sources:

- Outside processing such as distillation, fractionation, catalytic cracking, solvent extraction, coking, desulfuring, reforming, and desalting.
- Petrochemical and fuel storage and handling.
- Outside liquid chemical piping and tankage.
- Mobile liquid handling equipment such as tank trucks, forklifts, etc.
- Maintenance and parking of trucks and other equipment.
- Waste Piles, and handling and storage of asphalt emulsions, cleaning chemicals, and solvents.
- Waste treatment and conveyance systems.

The following are potential pollutants at oil refineries: oil and grease, BOD5, COD, TOC, phenolic compounds, PAH, ammonia nitrogen, TKN, sulfides, TSS, low and high pH, and chromium (total and hexavalent).

Printing
SIC: 2700

Description: This industrial category includes the production of newspapers, periodicals, commercial printing materials and businesses that do their own printing and those that perform services for the printing industry, for example bookbinding. Processes include typesetting, engraving, photoengraving, and electrotyping.

Potential Pollutant Generating Sources: Various materials used in modifying the paper stock include inorganic and organic acids, resins, solvents, polyester film, developers, alcohol, vinyl lacquer, dyes, acetates, and polymers. Waste products may include waste inks and ink sludge, resins, photographic chemicals, solvents, acid and alkaline solutions, chlorides, chromium, zinc, lead, spent formaldehyde, silver, plasticizers, and used lubricating oils. As the printing operations occur indoors, the only likely points of potential contact with stormwater are the outside temporary storage of waste materials, offloading of chemicals at external unloading bays, and vehicle/equipment repair and maintenance. Pollutants of concern include TSS, pH, heavy metals, oil and grease, and COD.

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Rubber and Plastic Products
SIC: 3000

Description: Although different in basic feedstock and processes used, businesses that produce rubber, fiberglass and plastic products belong to the same SIC group. Products in this category include rubber tires, hoses, belts, gaskets, seals; and plastic sheet, film, tubes, pipes, bottles, cups, ice chests, packaging materials, and plumbing fixtures. The rubber and plastics industries use a variety of processes ranging from polymerization to extrusion using natural or synthetic raw materials. These industries use natural or synthetic rubber, plastics components, pigments, adhesives, resins, acids, caustic soda, zinc, paints, fillers, and curing agents.

Potential Pollutant Generating Sources: Pollutant generating sources/activities include storage of liquids, other raw materials or by-products, scrap materials, oils, solvents, inks and paints; unloading of liquid materials from trucks or rail cars; washing of equipment; waste oil and solvents produced by cleaning manufacturing equipment; used equipment that could drip oil and residual process materials; and maintenance shops.

Based on data in EPA's multi-sector permit fact sheet the following are mean pollutant concentrations in mg/L, except for pH (unitless) and 1,1,1 trichloroethane, methylene chloride, toluene, zinc, oil/grease which are min.-max. grab sample values: BOD at 11.21-13.92, COD at 72.08-100.0, NO3 + NO2 Nitrogen at 86-1.26, TKN at 1.55-2.34, total phosphorus at .34-.41, TSS at 119.32-188.55, pH range of 2.56-10.1, trichloroethane at 0.00-0.38, methylene chloride at 0.00-13.0, toluene at 0.00-3.8, zinc at .011-7.60 and oil and grease at 0.0-91.0. These data may be helpful in characterizing potential stormwater pollutants.

Ship and Boat Building and Repair Yards
SIC: 3730

Description: Businesses that build or repair ships and boats. Typical activities include hull scraping, sandblasting, finishing, metal fabrication, electrical repairs, engine overhaul, and welding, fiberglass repairs, hydroblasting and steam cleaning.

Potential Pollutant Generating Sources: Outside boatyard activities that can be sources of stormwater pollution include pressure washing, surface preparation, paint removal, sanding, painting, engine/vessel maintenance and repairs, and material handling and storage.

Secondary sources of stormwater contaminants are cooling water, pump testing, gray water, sanitary waste, washing down the work area, and engine bilge water. Engine room bilge water and oily wastes are typically collected and disposed of through a licensed contracted disposal company. Two prime sources of copper are leaching of copper from anti-fouling paint and wastes from hull maintenance. Wastes generated by boatyard activities include spent abrasive grits, spent solvent, spent oils, fuel, ethylene glycol, washwater, paint overspray, various cleaners/detergents and anti-corrosive compounds, paint chips, scrap metal, welding rods, wood, plastic, resins, glass fibers, dust, and miscellaneous trash such as paper and glass.

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Ecology, local shipyards, and METRO have sampled pressure wash wastewater. The effluent quality has been variable and frequently exceeds water quality criteria for copper, lead, tin, and zinc. From monitoring results received to date, metal concentrations typically range from 5 to 10 mg/L, but have gone as high as 190 mg/L copper with an average 55 mg/L copper.

Wood
SIC 2420, 2450, 2434, 2490, 2511/12, 2517, 2519, 2521, 2541

Description: This group includes sawmills, and all businesses that make wood products using cut wood, with the exception of wood treatment businesses. Wood treatment as well as log storage and sorting yards are covered in other sections of this chapter. Included in this group are planing mills, millworks, and businesses that make wooden containers and prefab building components, mobile homes, and glued-wood products like laminated beams, as well as office and home furniture, partitions, and cabinets. All businesses employ cutting equipment whose by-products are chips and sawdust. Finishing is conducted in many operations.

Potential Pollutant Generating Sources: Businesses may have operations that use paints, solvents, wax emulsions, melamine formaldehyde and other thermosetting resins, and produce waste paints and paint thinners, turpentine, shellac, varnishes and other waste liquids. Outside storage, trucking, and handling of these materials can also be pollutant sources.

Potential pollutants reported in EPA's draft multi-sector permit/fact sheet (U.S. EPA, 1995) include the following (all are grab/composite mean values, in mg/L, except for oil and grease and pH): BOD at 39.6/45.4, COD at 297.6/242.5, NO3 + NO2-N at 0.95/0.75, TKN at 2.57/2.32, Tot. Phosphorus at 23.91/6.29; TSS at 1108/575, arsenic at .025/.028, copper at .047/.041, total phenols at .02/.007, oil and grease at 15.2, and pH at 3.6. These data may help in characterizing the potential stormwater pollutants at the facility.

Wood Treatment
SIC: 2491

Description: This group includes both anti-staining and wood preserving. The wood stock must be brought to the proper moisture content prior to treatment, which is achieved by either air-drying or kiln drying. Some wood trimming may occur. After treatment, the lumber is typically stored outside. Forklifts are used to move both the raw and finished product. Wood treatment consists of a pressure process using the chemicals described below. Anti-staining treatment is conducted using dip tanks or by spraying. Wood preservatives include creosote, creosote/coal tar, pentachlorophenol, copper naphthenate or inorganic arsenicals such as chromated copper arsenate dissolved in water. The use of pentachlorophenol is declining in the Puget Sound region.

Potential Pollutant Generating Sources: Potential pollutant generating sources/activities include the retort area, handling of the treated wood, outside storage of treated materials/products, equipment/vehicle storage and maintenance, and the unloading, handling, and use of the preservative

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chemicals. Based on EPA's multi-sector permit/fact sheet (U.S. EPA, 1995) the following stormwater contaminants have been reported: COD, TSS, BOD, and the specific pesticide(s) used for the wood preservation.

Other Manufacturing Businesses SIC: 2200, 2300, 2873/74, 3100, 3200, 3250-69, 3280, 3290

Description: Includes manufacturing of textiles and apparel, agricultural fertilizers, leather products, clay products such as bricks, pottery, bathroom fixtures; and nonmetallic mineral products.

Potential Pollutant Generating Sources: Pollutant generating sources at facilities in these categories include fueling, loading & unloading, material storage and handling (especially fertilizers), and vehicle and equipment cleaning and maintenance. Potential pollutants include TSS, BOD, COD, Oil and Grease, heavy metals and fertilizer components including nitrates, nitrites, ammonia nitrogen, Kjeldahl Nitrogen, and phosphorous compounds.

Transportation and Communication

Airfields and Aircraft Maintenance SIC: 4513, 4515

Description: Industrial activities include vehicle and equipment fueling, maintenance and cleaning, and aircraft/runway deicing.

Potential Pollutant Generating Sources: Fueling is accomplished by tank trucks at the aircraft and is a source of spills. Dripping of fuel and engine fluids from the aircraft and at vehicle/equipment maintenance/ cleaning areas application of deicing materials to the aircraft and the runways are potential sources of stormwater contamination. Aircraft maintenance and cleaning produces a wide variety of waste products, similar to those found with any vehicle or equipment maintenance, including: used oil and cleaning solvents, paints, oil filters, soiled rags, and soapy wastewater. Deicing materials used on aircraft and/or runways include ethylene and propylene glycol, and urea. Other chemicals currently considered for ice control are sodium and potassium acetates, isopropyl alcohol, and sodium fluoride. Pollutant constituents include oil and grease, TSS, BOD, COD, TKN, pH and specific deicing components such as glycol and urea.

Fleet Vehicle Yards SIC: 4100, 4210, 4230, 7381/2, 7510

Description: Includes all businesses which own, operate and maintain or repair large vehicle fleets, including cars, buses, trucks and taxis, as well as the renting or leasing of cars, trucks, and trailers.

Potential Pollutant Generating Sources:

1. Spills/leaks of fuels, used oils, oil filters, antifreeze, solvents, brake fluid, and batteries, sulfuric acid, battery acid sludge, and leaching from empty contaminated containers and soiled rags.
2. Leaking underground storage tanks that can cause ground water contamination and is a safety hazard.
3. Dirt, oils and greases from outside steam cleaning and vehicle washing.

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4. Dripping of liquids from parked vehicles.
5. Solid and liquid wastes (noted above) that are not properly stored while awaiting disposal or recycling.
6. Loading and unloading area.

Railroads
SIC: 4011/13

Description: Railroad activities are spread over a large geographic area: along railroad lines, in switching yards, and in maintenance yards. Railroad activity occurs on both property owned or leased by the railroad and at the loading or unloading facilities of its customers. Employing BMPs at commercial or public loading and unloading areas is the responsibility of the particular property owner.

Potential Pollutant Generating Sources: The following are potential sources of pollutants: dripping of vehicle fluids onto the road bed, leaching of wood preservatives from the railroad ties, human waste disposal, litter, locomotive sanding areas, locomotive/railcar/equipment cleaning areas, fueling areas, outside material storage areas, the erosion and loss of soil particles from the bed, and herbicides used for vegetation management.

Maintenance activities include maintenance shops for vehicles and equipment, track maintenance, and ditch cleaning. In addition to the railroad stock, the maintenance shops service highway vehicles and other types of equipment. Waste materials can include waste oil, solvents, degreasers, antifreeze, radiator flush, acid solutions, brake fluids, soiled rags, oil filters, sulfuric acid and battery sludge, and machine chips with residual machining oil and any toxic fluids or solids lost during transit. The following are potential pollutants at rail yards: Oil and grease, TSS, BOD, organics, pesticides, and heavy metals.

Warehouses and Mini-Warehouses
SIC: 4220

Description: Businesses that store goods in buildings and other structures.

Potential Pollutant Generating Sources: The following are potential pollutant sources from warehousing operations: Loading and unloading areas, outside storage of materials and equipment, fueling and maintenance areas. Potential pollutants include oil and grease and TSS.

Other Transportation and Communication
SIC: 4700-4900

Description: This group includes travel agencies, communication services such as TV and radio stations, cable companies, and electric and gas services. It does not include railroads, airplane transport services, airlines, pipeline companies, and airfields.

Potential Pollutant Generating Sources: Gas and electric services are likely to own vehicles that are washed, fueled and maintained on site. Communication service companies can generate used oils and Dangerous Wastes. The following are the potential pollutants: Oil and grease, TSS, BOD, and heavy metals.

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Retail and Wholesale Businesses

Gas Stations
SIC: 5540

Refer to BMPs for Fueling at Dedicated Stations in Section 8.2 to select applicable BMPs.

Recyclers and Scrap Yards
SIC: 5093, 5015

Refer to BMPs for Recyclers and Scrap Yards.

Commercial Composting
SIC 2875

Description: This typically applies to businesses that have numerous compost piles that require large open areas to break down the wastes. Composting can contribute nutrients, organics, coliform bacteria, low pH, color, and suspended solids to stormwater runoff.

Restaurants/Fast Food
SIC: 5800

Description: Businesses that provide food service to the general public, including drive through facilities.

Potential Pollutant Generating Sources: Potential pollutant sources include high-use customer parking lots and garbage dumpsters. The cleaning of roofs and other outside areas of restaurant and cooking vent filters in the parking lot can cause cooking grease to be discharged to the storm drains. The discharge of washwater or grease to storm drains or surface water is not allowed.

Retail/General Merchandise
SIC: 5300, 5600, 5700, 5900, and 5990

Description: This group includes general merchandising stores such as department stores, shopping malls, variety stores, 24-hour convenience stores, and general retail stores that focus on a few product types such as clothing and shoes. It also includes furniture and appliance stores.

Potential Pollutant Generating Sources: Of particular concern are the high-use parking lots of shopping malls and 24-hour convenience stores. Furniture and appliance stores may provide repair services in which Dangerous Wastes may be produced.

Retail/Wholesale Vehicle and Equipment Dealers
SIC: 5010, 5080, and 5500, 751 excluding fueling stations (5540)

Description: This group includes all retail and wholesale businesses that sell, rent, or lease cars, trucks, boats, trailers, mobile homes, motorcycles and recreational vehicles. It includes both new and used vehicle dealers. It also includes sellers of heavy equipment for construction, farming, and industry. With the exception of motorcycle dealers, these businesses have large parking lots. Most retail dealers that sell new vehicles and large equipment also provide repair and maintenance services.

Potential Pollutant Generating Sources: Oil and other materials that have dripped from parked vehicles can contaminate stormwater at high-use parking areas. Vehicles are washed regularly generating vehicle grime and detergent pollutants. The storm or washwater runoff will contain oils and various organics, metals, and phosphorus. Repair and maintenance services generate a variety of waste liquids and solids including used oils and engine fluids, solvents, waste paint, soiled rags, and dirty used engine parts. Many of these materials are Dangerous Wastes.

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Retail/Wholesale Nurseries and Building Materials SIC: 5030, 5198, 5210, 5230, and 5260

Description: These businesses are placed in a separate group because they are likely to store much of their merchandise outside of the main building. They include nurseries, and businesses that sell building and construction materials and equipment, paint (5198, 5230) and hardware.

Potential Pollutant Generating Sources: Some businesses may have small fueling capabilities for forklifts and may also maintain and repair their vehicles and equipment. Some businesses may have unpaved areas, with the potential to contaminate stormwater by leaching of nutrients, pesticides, and herbicides. Businesses in this group surveyed in the Puget Sound area for Dangerous Wastes were found to produce waste solvents, paints and used oil. Storm runoff from exposed storage areas can contain suspended solids, and oil and grease from vehicles and forklifts and high-use customer parking lots, and other pollutants. Runoff from nurseries may contain nutrients, pesticides and/or herbicides.

Retail/Wholesale Chemicals and Petroleum SIC: 5160, 5170

Description: These businesses sell plastic materials, chemicals and related products. This group also includes the bulk storage and selling of petroleum products such as diesel oil, automotive fuels, etc.

Potential Pollutant Generating Sources: The general areas of concern are the spillage of chemicals or petroleum during loading and unloading, and the washing and maintenance of tanker trucks and other vehicles. Also, the fire code requires that vegetation be controlled within a tank farm to avoid a fire hazard. Herbicides are typically used. The concentration of oil in untreated stormwater is known to exceed the water quality effluent guideline for oil and grease. Runoff is also likely to contain significant concentrations of benzene, phenol, chloroform, lead, and zinc.

Retail/Wholesale Foods and Beverages SIC 5140, 5180, 541, 542, 543

Description: Included are businesses that provide retail food stores including general groceries, fish and seafood, meats and meat products, dairy products, poultry, soft drinks, and alcoholic beverages.

Potential Pollutant Generating Sources: Vehicles may be fueled, washed and maintained at the business. Spillage of food and beverages may occur. Waste food and broken contaminated glass may be temporarily stored in containers located outside. High-use customer parking lots may be sources of oil and other contaminants.

Other Retail/Wholesale Businesses SIC: 5010 (not 5012), 5040, 5060, 5070, 5090, 515

Description: Businesses in this group include sellers of vehicle parts, tires, furniture and home furnishings, photographic and office equipment, electrical goods, sporting goods and toys, paper products, drugs, and apparel.

Potential Pollutant Generating Sources: Pollutant sources include high-use parking lots, and delivery vehicles that may be fueled, washed, and maintained on premises.

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Service Businesses

Animal Care Services SIC: 0740, 0750

Description: This group includes racetracks, kennels, fenced pens, veterinarians and businesses that provide boarding services for animals including horses, dogs, and cats.

Potential Pollutant Generating Sources: The primary sources of pollution include animal manure, washwaters, waste products from animal treatment, runoff from pastures where larger livestock are allowed to roam, and vehicle maintenance and repair shops. Pastures may border streams and direct access to the stream may occur. Both surface water and ground water may be contaminated. Potential stormwater contaminants include fecal coliform, oil and grease, suspended solids, BOD, and nutrients.

Commercial Car and Truck Washes SIC: 7542

Description: Facilities include automatic systems found at individual businesses or at gas stations and 24-hour convenience stores, as well as self-service. There are three main types: tunnels, rollovers and hand-held wands. The tunnel wash, the largest, is housed in a long building through which the vehicle is pulled. At a rollover wash the vehicle remains stationary while the equipment passes over. Wands are used at self-serve car washes. Some car washing businesses also sell gasoline.

Potential Pollutant Generating Sources: Wash wastewater may contain detergents and waxes. Wastewater should be discharged to sanitary sewers. In self-service operations a drain is located inside each car bay. Although these businesses discharge the wastewater to the sanitary sewer, some washwater can find its way to the storm drain, particularly with the rollover and wand systems. Rollover systems often do not have air-drying. Consequently, as it leaves the enclosure the car sheds water to the pavement. With the self-service system, washwater with detergents can spray outside the building and drain to storm sewer. Users of self-serve operations may also clean engines and change oil, dumping the used oil into the storm drain. Potential pollutants include oil and grease, detergents, soaps, BOD, and TSS.

Equipment Repair SIC: 7353, 7600

Description: This group includes several businesses that specialize in repairing different equipment including communications equipment, radio, TV, household appliances, and refrigeration systems. Also included are businesses that rent or lease heavy construction equipment as miscellaneous repair and maintenance may occur on site.

Potential Pollutant Generating Sources: Potential pollutant sources include storage and handling of fuels, waste oils and solvents, and loading/unloading areas. Potential pollutants include oil and grease, low/high pH, and suspended solids.

Laundries and Other Cleaning Services

Description: This category includes all types of cleaning services such as laundries, linen suppliers, diaper services, coin-operated laundries and dry cleaners, and carpet and upholstery services. Wet washing may involve

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SIC: 7211 through 7217

the use of acids, bleaches and/or multiple organic solvents. Dry cleaners use an organic-based solvent, although small amounts of water and detergent are sometimes used. Solvents may be recovered and filtered for further use. Carpets and upholstery may be cleaned with dry materials, hot water extraction process, or in-plant processes using solvents followed by a detergent wash.

Potential Pollutant Generating Sources: Wash liquids are discharged to sanitary sewers. Stormwater pollutant sources include: loading and unloading of liquid materials, particularly at large commercial operations, disposal of spent solvents and solvent cans, high-use customer parking lots, and outside storage and handling of solvents and waste materials. Potential stormwater contaminants include oil and grease, chlorinated and other solvents, soaps and detergents, low/high pH, and suspended solids.

Marinas and Boat Clubs
SIC: 7999

Description: Marinas and yacht clubs provide moorage for recreational boats. Marinas may also provide fueling and maintenance services. Other activities include cleaning and painting of boat surfaces, minor boat repair, and pumping of bilges and sanitary holding tanks. Not all marinas have a system to receive pumped bilge water.

Potential Pollutant Generating Sources: Both solid and liquid wastes are produced as well as stormwater runoff from high-use customer parking lots. Waste materials include sewage and bilge water. Maintenance by the tenants will produce used oils, oil filters, solvents, waste paints and varnishes, used batteries, and empty contaminated containers and soiled rags. Potential stormwater contaminants include oil and grease, suspended solids, heavy metals, and low/high pH.

Golf and Country Clubs
SIC: 7992, 7997

Description: Public and private golf courses and parks are included.

Potential Pollutant Generating Sources: Maintenance of grassed areas and landscaped vegetation has historically required the use of fertilizers and pesticides. Golf courses contain small lakes that are sometimes treated with algaecides and/or mosquito larvicides. The fertilizer and pesticide application process can lead to inadvertent contamination of nearby surface waters by overuse, misapplication, or the occurrence of storms shortly after application. Heavy watering of surface greens in golf courses may cause pesticides or fertilizers to migrate to surface and shallow ground water resources. The use of pesticides and fertilizers generates waste containers. Equipment must be cleaned and maintained.

Miscellaneous Services
SIC: 4959, 7260, 7312, 7332, 7333, 7340, 7395, 7641, 7990, 8411

Description: This group includes photographic studios, commercial photography, funeral services, amusement parks, furniture and upholstery repair and pest control services, and other professional offices. Pollutants from these activities can include pesticides, waste solvents, heavy metals, pH, and suspended solids, soaps and detergents, and oil and grease.

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Professional Services SIC: 6000, 7000 and 8000, 806, 807 not listed elsewhere

Description: The remaining service businesses include theaters, hotels/motels, finance, banking, hospitals, medical/dental laboratories, medical services, nursing homes, schools/universities, and legal, financial and engineering services.

Stormwater from parking lots will contain undesirable concentrations of oil and grease, suspended particulates, and metals such as lead, cadmium and zinc. Dangerous wastes might be generated at hospitals, nursing homes and other medical services.

Potential Pollutant Generating Sources: Leaks and spills of materials from the following businesses can be sources of stormwater pollutants:

1. Building maintenance produces wash and rinse solutions, oils, and solvents.
2. Pest control produces rinse water with residual pesticides from washing application equipment and empty containers.
3. Outdoor advertising produces photographic chemicals, inks, waste paints, organic paint sludges containing metals.
4. Funeral services produce formalin, formaldehyde, and ammonia.
5. Upholstery and furniture repair businesses produce oil, stripping compounds, wood preservatives and solvents.

Potential Pollutant Generating Sources: The primary concern is runoff from high use parking areas, maintenance shops, and storage and handling of dangerous wastes.

Vehicle Maintenance and Repair SIC: 4000, 7530, 7600

Description: This category includes businesses that paint, repair and maintain automobiles, motorcycles, trucks, and buses and battery, radiator, muffler, lube, tune-up and tire shops, excluding those businesses listed elsewhere in this manual.

Potential Pollutant Generating Sources: Pollutant sources include storage and handling of vehicles, solvents, cleaning chemicals, waste materials, vehicle liquids, batteries, and washing and steam cleaning of vehicles, parts, and equipment. Potential pollutants include waste oil, solvents, degreasers, antifreeze, radiator flush, acid solutions with chromium, zinc, copper, lead and cadmium, brake fluid, soiled rags, oil filters, sulfuric acid and battery sludge, and machine chips in residual machining oil.

Multi-Family Residences SIC: NA

Description: Multifamily residential buildings such as apartments and condominiums. The activities of concern are vehicle parking, vehicle washing and oil changing, minor repairs, and temporary storage of garbage.

Potential Pollutant Generating Sources: Stormwater contamination can occur at vehicle parking lots and from washing of vehicles. Runoff from parking lots may contain undesirable concentrations of oil and grease, suspended particulates, and metals such as lead, cadmium, and zinc.

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Construction Businesses SIC: 1500, 1600, 1700

Description: This category includes builders of homes, commercial and industrial buildings, and heavy equipment as well as plumbing, painting and paper hanging, carpentry, electrical, roofing and sheet metal, wrecking and demolition, stonework, drywall, and masonry contractors. It does not include construction sites.

Potential Pollutant Generating Sources: Potential pollutant sources include leaks/spills of used oils, solvents, paints, batteries, acids, strong acid/alkaline wastes, paint/varnish removers, tars, soaps, coatings, asbestos, lubricants, anti-freeze compounds, litter, and fuels at the headquarters, operation, staging, and maintenance/repair locations of the businesses.

Demolition contractors may store reclaimed material before resale. Roofing contractors generate residual tars and sealing compounds, spent solvents, kerosene, and soap cleaners, as well as non-hazardous waste roofing materials. Sheet metal contractors produce small quantities of acids and solvent cleaners such as kerosene, metal shavings, adhesive residues and enamel coatings, and asbestos residues that have been removed from buildings. Asphalt paving contractors are likely to store application equipment such as dump trucks, pavers, tack coat tankers and pavement rollers at their businesses. Stormwater passing through this equipment may be contaminated by the petroleum residuals. Potential pollutants include oil and grease, suspended solids, BOD, heavy metals, pH, COD, organic compounds, etc.

Public Agency Activities

Local, state, and federal governments conduct many of the pollutant generating activities conducted at business facilities. Local governments include cities and counties, and also single-purpose entities such as fire, sewer and water districts.

Public Facilities and Streets

Description: Included in this group are public buildings. Also included are maintenance (deicing), and repair of streets and roads.

Potential Pollutant Generating Sources: Wastes generated include deicing and anti-icing compounds, solvents, paint, acid and alkaline wastes, paint and varnish removers, and debris. Large amounts of scrap materials are also produced throughout the course of construction and street repair. Potential pollutants include suspended solids, oil and grease, and low/high pH.

Maintenance of Open Public Space Areas

Description: The maintenance of large open spaces that are covered by expanses of grass and landscaped vegetation. Examples are zoos and public cemeteries. Golf courses and parks are covered earlier in this chapter.

Potential Pollutant Generating Sources: Maintenance of grassed areas and landscaped vegetation has historically required the use of fertilizers and pesticides. Golf courses contain small lakes that are sometimes treated with algaecides and/or mosquito larvicides. The application of

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pesticides can lead to inadvertent contamination of nearby surface waters by overuse, misapplication, or the occurrence of storms shortly after application. Heavy watering of surface greens in golf courses may cause pesticides or fertilizers to migrate to surface and shallow ground water resources. The application of pesticides and fertilizers generates waste containers. Equipment must be cleaned and maintained. Maintenance shops where the equipment is maintained must comply with the BMPs specified under BMP Maintenance and Repair of Vehicles and Equipment.

Maintenance of Public Stormwater Pollutant Control Facilities

Description: Facilities include roadside catch basins on arterials and within residential areas, conveyance pipes, detention facilities such as ponds and vaults, oil and water separators, biofilters, settling basins, infiltration systems, and all other types of stormwater treatment systems.

Potential Pollutant Generating Sources: Research has shown that roadside catch basins can remove from 5 to 15 percent of the pollutants present in stormwater. However, to be effective they must be cleaned. Research has indicated that once catch- basins are about 60 percent full of sediment, they cease removing sediments. Generally in urban areas, catch basins become 60 percent full within 6 to 12 months.

Water and solids produced during the cleaning of stormwater treatment systems, including oil and water separators, can adversely affect both surface and ground water quality if disposed of improperly. Ecology has documented water quality violations and fish kills due to improper disposal of decant water (water that is removed) and catch basin sediments from maintenance activities. Disposal of decant water and solids shall be conducted in accordance with local, state, and federal requirements.

Historically, decant water from trucks has been placed back in the storm drain. Solids have been disposed of in permitted landfills and in unpermitted vacant land including wetlands. Research has shown that these residuals contain pollutants at concentrations that exceed water quality criteria. For example, limited sampling by King County and the Washington Department of Transportation of sediments removed from catch basins in residential and commercial areas has found the petroleum hydrocarbons to frequently exceed 200 mg/gram. Above this concentration, regulations require disposal at a lined landfill.

Water and Sewer Districts and Departments

Description: The maintenance of water and sewer systems can produce residual materials that, if not properly handled, can cause short-term environmental impacts in adjacent surface and/or ground waters. With the exception of a few simple processes, both water and sewage treatment produce residual sludge that must be disposed of properly. However, this activity is controlled by other Ecology regulatory programs and is not discussed in this manual. Larger water and sewer districts or departments may service their own vehicles.

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Port Districts

Description: The port districts considered here include the following business activities: recreational boat marinas and launch ramps, airfields, container trans-shipment, bulk material import/export including farm products, lumber, logs, alumina, and cement; and break-bulk (piece) material such as machinery, equipment, and scrap metals. Port districts frequently have tenants whose activities are not marine-dependent.

Potential Pollutant Generating Sources: Maintenance operations of concern include the cleaning of sewer and water lines, and water reservoirs, general activities around treatment plants, disposal of sludge, and the temporary shutdown of pump stations for either normal maintenance or emergencies. During the maintenance of water transmission lines and reservoirs, water district/departments must dispose of wastewater, both when the line or reservoir is initially emptied, as well as when it is cleaned and then sanitized. Sanitation requires chlorine concentrations of 25 to 100 ppm, considerably above the normal concentration used to chlorinate drinking water. These waters are discharged to sanitary sewers where available.

However, transmission lines from remote water supply sources often pass through both rural and urban-fringe areas where sanitary sewers are not available. In these areas, chlorinated water may have to be discharged to a nearby stream or storm drain, particularly since the emptying of a pipe section occurs at low points that frequently exist at stream crossings. Although prior to disposal the water is dechlorinated using sodium thiosulfate or a comparable chemical, malfunctioning of the dechlorination system can kill fish and other aquatic life. The drainage from reservoirs located in unsewered areas is conveyed to storm drains. The cleaning of sewer lines and manholes generates sediments. These sediments contain both inorganic and organic materials are odorous and contaminated with microorganisms and heavy metals. Activities around sewage treatment plants can be a source of non-point pollution. Besides the normal runoff of stormwater from paved surfaces, grit removed from the headworks of the plant is stored temporarily in dumpsters that may be exposed to the elements. Maintenance and repair shops may produce waste paints, used oil, cleaning solvents, and soiled rags.

Potential Pollutant Generating Sources: Marine terminals require extensive use of mobile equipment that may drip liquids. Waste materials associated with containers/vehicle/equipment washing/steam cleaning, maintenance and repair may be generated at a marine terminal. Debris can accumulate in loading/unloading or open storage areas, providing a source of stormwater contamination. Wooden debris from the crating of piece cargo crushed by passing mobile loading equipment leaches soluble pollutants when in contact with pooled stormwater. Log sorting yards produce large quantities of bark that can be a source of suspended solids and leached pollutants. Potential pollutants include oil and grease, TSS, heavy metals, and organics.

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Appendix 8B – Best Management Practices for Managing Street Waste

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Introduction

This appendix is a summary, taken from Ecology's publication titled *Recommendations for Management of Street Waste* (Publication WQ 99-09). The guidance document addresses waste generated from stormwater maintenance activities such as street sweeping and the cleaning of catch basins, and to a limited extent, other stormwater conveyance and treatment facilities. Limited information is available on the characteristics of wastes from detention/retention ponds, bioswales, and similar stormwater treatment facilities. The recommendations provided here may be generally applicable to these facilities, with extra diligence given to waste characterization.

These recommendations do not constitute rules or regulations, but are suggestions for street waste handling, reuse, and disposal using current regulations and the present state of knowledge of street waste constituents. The recommendations are intended to address the liquid and solid wastes collected during routine maintenance of stormwater catch basins, detention/retention ponds and ditches and similar storm water treatment and conveyance structures, and street and parking lot sweeping. In addition to these recommendations, end users and other authorities may have their own requirements for street waste reuse and handling.

"Street Wastes" include liquid and solid wastes collected during maintenance of stormwater catch basins, detention/retention ponds and ditches and similar storm water treatment and conveyance structures, and solid wastes collected during street and parking lot sweeping.

"Street Wastes", as defined here, does not include solids and liquids from street washing using detergents, cleaning of electrical vaults, vehicle wash sediment traps, restaurant grease traps, industrial process waste, sanitary sewage, mixed process, or combined sewage/stormwater wastes. Wastes from oil/water separators at sites that load fuel are not included as street waste. Street waste also does not include flood debris, land slide debris, and chip seal gravel.

Street waste does not ordinarily classify as dangerous waste. The owner of the storm water facility and/or collector of street waste is considered the waste generator and is responsible for determining whether or not the waste designates as dangerous waste. Sampling to date has shown that material from routine maintenance of streets and stormwater facilities does not classify as dangerous waste. However, it is possible that

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street waste from spill sites could classify as dangerous waste. Street waste from areas with exceptionally high average daily traffic counts may contain contaminants - such as heavy metals, total petroleum hydrocarbons (TPH), and carcinogenic polycyclic aromatic hydrocarbons (c-PAH) - at levels that limit reuse options.

Street waste is solid waste. While street waste from normal street and highway maintenance is not dangerous waste, it is solid waste, as defined under The Solid Waste Management Act (Chapter 70.95 RCW) and under Minimum Functional Standards for Solid Waste Handling (Chapter 173-304 WAC – these are under revision and will be renamed 173-350). Under the Solid Waste Management Act, local health departments have primary jurisdiction over solid waste management. Street waste solids may contain contaminants at levels too high to allow unrestricted reuse. There are currently no specific references in the Minimum Functional Standards to facilities managing street waste solids. These facilities will typically fit under the section dealing with Piles Used for Storage and Treatment. There are no specific references for reuse and disposal options for street wastes in the Minimum Functional Standards, although the Minimum Functional Standards do not apply to clean soils. In the proposed rule, clean soils are defined as 'soils that do not contain contaminants at concentrations which could degrade the quality of air, waters of the state, soils, or sediments; or pose a thereat to the health of humans or other living organisms' (WAC 173-350-100). Whether or not a soil is a clean soil depends primarily upon the level of contaminants and, to a lesser degree, on the background level of contaminants at a particular location and the exposure potential to humans or other living organisms. Therefore, both the soil and potential land application sites must be evaluated to determine if a soil is a clean soil. Local health departments should be contacted to determine if a street waste meets the definition of "clean soil" when it will be reused as a soil.

There is no simple regulatory mechanism available to classify street waste solids as "clean" for uncontrolled reuse or disposal. Local health districts have historically used the Model Toxics Control Act Cleanup Regulation (MTCA) Method A residential soil cleanup levels to approximate "clean" and to make decisions on land application proposals. These regulations were amended in February 2001. Although, these regulations were not intended to be used for making decisions on land application proposals, they may provide a useful framework for such decision when used in conjunction with other health and environmental considerations. The local health department should be contacted to determine local requirements for making this determination.

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Recommendations for Re-Use and Disposal of Street Waste Solids

General Handling Recommendations

Permitting of street waste treatment and storage facilities as solid waste handling facilities by the local health department is required. Under the Solid Waste Management Act, local health departments have primary jurisdiction over solid waste management. Street waste handling facilities are subject to the requirements of the Minimal Functional Standards for Solid Waste Handling. The specific requirements will depend upon the manner in which the waste is managed. Most facilities will probably be permitted under the section dealing with Piles Used for Storage and Treatment (Section 320 of the proposed revisions)

For most facilities, permit requirements include a plan of operation, sampling, record keeping and reporting, inspections, and compliance with other state and local requirements. The plan of operation should include a procedure for characterization of the waste and appropriate reuse and disposal options, consistent with the recommendations in this document and applicable federal, state and local requirements.

A street waste site evaluation (see sample at end of this report) is suggested for all street waste as a method to identify spill sites or locations that are more polluted than normal. The disposal and reuse options listed below are based on characteristics of routine street waste and are not appropriate for more polluted wastes. The collector of street waste should evaluate it both for its potential to be classified as dangerous waste and to not meet end users requirements.

Street waste that is suspected to be dangerous waste should not be collected with other street waste. Material in catch basins with obvious contamination (unusual color, staining, corrosion, unusual odors, fumes, and oily sheen) should be left in place or segregated until tested. Testing should be based on probable contaminants. Street waste that is suspected to be dangerous waste should be collected and handled by someone experienced in handling dangerous waste. If potential dangerous waste must be collected because of emergency conditions, or if the waste becomes suspect after it is collected, it should be handled and stored separately until a determination as to proper disposal is made. Street waste treatment and storage facilities should have separate "hot load" storage areas for such waste. Dangerous Waste includes street waste known and suspected to be dangerous waste. This waste must be handled following the Dangerous Waste Regulations (Chapter 173-303 WAC) unless testing determines it is not dangerous waste.

Spills should be handled by trained specialists. Public works maintenance crews and private operators conducting street sweeping or cleaning catch basins should have written policies and procedures for

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dealing with spills or suspected spill materials. Emergency Spill Response telephone numbers should be immediately available as part of these operating policies and procedures.

The end recipient of street waste must be informed of its source and may have additional requirements for its use or testing that are not listed here. This document is based primarily on average street waste's chemical constituents and their potential affect on human health and the environment. There are physical constituents (for example, broken glass or hypodermic needles) or characteristics (for example, fine grain size) that could also limit reuse options. Additional treatment such as drying, sorting, or screening may also be required, depending on the needs and requirements of the end user.

Street waste treatment and storage facilities owned or operated by governmental agencies should be made available to private waste collectors and other governmental agencies on a cost recovery basis. Proper street waste collection and disposal reduces the amount of waste released to the environment. The operators of street waste facilities should restrict the use of their facilities to certified and/or licensed waste collectors who meet their training and liability requirements.

The use of street waste solids under this guidance should not lead to designation as a hazardous waste site, requiring cleanup under MTCA. Exceeding MTCA Method A unrestricted land use cleanup levels in street waste and products made from street waste, does not automatically make the site where street waste is reused a cleanup site. A site is reportable only if "--- a release poses a threat to human health or the environment ---" (Model Toxic Control Act). The reuse options proposed below are designed to meet the condition of not posing a threat to human health or the environment. Please note that some of the suggested maximum values in Table 16 are based on soil cleanup criteria for unrestricted land uses. Values that exceed these suggested thresholds are not necessarily precluded from reuse. The local health jurisdiction should be consulted to determine appropriate reuse options.

Testing of street waste solids will generally be required as part of a plan of operation that includes procedures for characterization of the waste. Testing frequency, numbers of samples, parameters to be analyzed, and contaminant limit criteria should all be provided as part of an approved plan of operation. Tables 1 and 2, at the end of this section, provide some recommended parameters and sampling frequencies for piles of street waste solids from routine street maintenance. These are provided as guidance only, and are intended to assist the utility and the local health department in determining appropriate requirements. Sampling requirements may be modified, over time, based on accumulated data. When the material is from a street waste facility or an area that has never been characterized by testing, the test should be conducted on a

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representative sample before co-mingling with other material. Testing in these instances would be to demonstrate that the waste does not designate as dangerous waste and to characterize the waste for reuse. At a minimum, the parameters in Table 1 are recommended for these cases. Note that it will generally not be necessary to conduct TCLP analyses when the observed values do not exceed the recommended values in Table 1.

For further information on testing methods and sampling plans, refer to:

- SW 846 (US EPA, Office of Solid Waste, Test Methods for Evaluating Solid Wastes, 3rd Ed.) and
- Standard Methods for the Examination of Water and Wastewater (American Public Health Association, et al., 18th Edition 1992)

For street waste not exceeding the suggested maximum values in Table 1 the following street waste solids reuse and disposal options are recommended:

- Street sweepings that consist primarily of leaves, pine needles and branches, and grass cuttings from mowing grassy swales can be composted. Litter and other foreign material must be removed prior to composting or the composting facility must provide for such removal as part of the process. The screened trash is solid waste and must be disposed of at an appropriate solid waste handling facility.
- Coarse sand screened from street sweeping after recent road sanding, may be reused for street sanding, providing there is no obvious contamination from spills. The screened trash is solid waste and must be disposed of at an appropriate solid waste handling facility.
- Roadside ditch cleanings, not contaminated by a spill or other release and not associated with a stormwater treatment system such as a bioswale, may be screened to remove litter and separated into soil and vegetative matter (leaves, grass, needles, branches, etc.). The soils from these activities are not generally regulated as solid waste. Ditching material that may be contaminated must be stored, tested and handled in the same manner as other street waste solids. It is the generator's responsibility to visually inspect and otherwise determine whether the materials may be contaminated.
- Construction street wastes - solids collected from sweeping or in storm water treatment systems at active construction sites - may be placed back onto the site that generated it, or managed by one on the methods listed below, provided that it has not been contaminated as a result of a spill. For concrete handling at construction site, refer to Ecology's Stormwater Management Manual for Western Washington (BMP C151 in Volume II, Construction Stormwater Pollution Prevention.).

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- Screened street waste soils may be used as feedstock materials for topsoil operations. This option should be reserved for street waste soils with very low levels of contaminants. Diluting street waste soils with clean soils or composted material must not be used as a substitute for treatment or disposal. There may be physical contaminants (for example, glass, metal, nails, etc.) in street waste that cannot be entirely screened from the waste. Where present, these contaminants in street waste could preclude its use as feedstock material for topsoil operations.
- Fill in parks, play fields, golf courses and other recreational settings, where direct exposure by the public is limited or prevented. One way to accomplish is to cover the fill with sod, grass or other capping material to reduce the risk of soil being ingested. The level of contaminants in the street waste must be evaluated to ensure that the soils meet the definition of clean soils when used in this manner.
- Fill in commercial and industrial areas, including soil or top dressing for use at industrial sites, roadway medians, airport infields and similar sites, where there is limited direct human contact with the soil, and the soils will be stabilized with vegetation or other means. The level of contaminants in the street waste must be evaluated to ensure that the soils meet the definition of clean soils when used in this manner.
- Top dressing on roadway slopes, road or parking lot construction material and road subgrade, parking lot subgrade, or other road fill. The level of contaminants in the street waste must be evaluated to ensure that the soils meet the definition of clean soils when used in this manner.
- Daily cover or fill in a permitted municipal solid waste landfill, provided the street waste solids have been dewatered. Street waste solids may be acceptable as final cover during a landfill closure. The local health department and landfill operator should be consulted to determine conditions of acceptance.
- Treatment at a permitted contaminated soil treatment facility.
- Recycling through incorporation into a manufactured product, such as Portland cement, prefab concrete, or asphalt. The facility operator should be consulted to determine conditions of acceptance.
- Other end-use as approved by the local health department
- Disposal at an appropriate solid waste handling facility.

For street waste that exceed the suggested maximum values in Table 16 the following street waste solids reuse and disposal options are recommended:

- Treatment at a permitted contaminated soil treatment facility.

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- Recycling through incorporation into a manufactured product, such as Portland cement, prefab concrete, or asphalt. The facility operator should be consulted to determine conditions of acceptance.
- Other end-use as approved by the local health department. Some of the suggested maximum values in Table 1 are based on soil cleanup criteria for unrestricted land uses. Values that exceed these suggested thresholds are not necessarily precluded from reuse. The local health jurisdiction should be consulted to determine appropriate reuse options.
- Disposal at an appropriate solid waste handling facility.

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Table 1
Recommended Parameters and Suggested Values
for Determining Reuse & Disposal Options

Parameter	Suggested Maximum Value
Arsenic, Total	20.0 mg/kg (a)
Cadmium, Total	2.0 mg/kg (b)
Chromium, Total	42 mg/kg (c)
Lead, total	250 mg/kg (d)
Nickel	100 mg/kg (e)
Zinc	270 mg/kg (e)
Mercury (Inorganic)	2.0 mg/kg (f)
PAHs (Carcinogenic)	0.1 – 2.0 mg/kg (see Note at (g) below)
TPH (Heavy Fuel Oil)	200 - 460 mg/kg (see Note at (h) below)
TPH (Diesel)	200 – 460 mg/kg (see Note at (h) below)
TPH (Gasoline)	100 mg/kg (i)
Benzene	0.03 mg/kg (i)
Ethylbenzene	6 mg/kg (i)
Toluene	7 mg/kg (i)
Xylenes (Total)	9 mg/kg (i)

(a) Arsenic: from MTCA Method A - Table 740-1: Soil cleanup levels for unrestricted land uses

(b) Cadmium: from MTCA Method A – Table 740-1: Soil cleanup levels for unrestricted land uses s.

(c) Chromium; from MTCA Method A - Table 740-1: Soil cleanup levels for unrestricted land uses

(d) Lead; from MTCA Method A – Table 740-1: Soil cleanup levels for unrestricted land uses

(e) Nickel and Zinc; from MTCA Table 749-2: Protection of Terrestrial Plants and Animals

(f) Mercury; from MTCA Method A – Table 740-1: Soil cleanup levels for unrestricted land uses

(g) PAH-Carcinogenic; from MTCA Method A – Table 740-1: Soil cleanup levels for unrestricted land uses and Table 745-1, industrial properties, based on cancer risk via direct contact with contaminated soil (ingestion of soil) in residential land use situations and commercial/industrial land uses. Note: The local health department may permit higher levels as part of a Plan of Operation, where they determine that the proposed end use poses little risk of direct human contact or ingestion of soil.

(h) TPH: from MTCA Tables 749-2 & 749-3: Protection of Terrestrial Plants and Animals. Values up to 460 mg/kg may be acceptable where the soils are capped or covered to reduce or prevent exposure to terrestrial plants and animals. Where the laboratory results report no 'fingerprint' or chromatographic match to known petroleum hydrocarbons, the soils will not be considered to be petroleum contaminated soils.

(i) BETX; from MTCA Method A - Table 740-1: Soil cleanup levels for unrestricted land uses.

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Table 2
Recommended Sampling Frequency for Street Waste Solids

Cubic Yards of Solids	Minimum Number of Samples
0 – 100	3
101 – 500	5
501 – 1000	7
1001 – 2000	10
>2000	10 + 1 for each additional 500 cubic yards

Modified from Ecology's Interim Compost Guidelines

This table is provided as guidance and is intended to assist the utility and the local health department in determining appropriate requirements. Sampling requirements may be modified, over time, based on accumulated data. When the material is from a street waste facility or an area that has never been characterized by testing, the test should be conducted on a representative sample before co-mingling with other material.

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Recommendations for Disposal of Street Waste Liquids

General Handling Recommendations

- **Street waste collection should emphasize solids in preference to liquids.** Street waste solids are the principal objective in street waste collection and are substantially easier to store and treat than liquids.
- **Street waste liquids require treatment and/or must follow location limitations before their discharge.** Street waste liquids usually contain high amounts of suspended and total solids and adsorbed metals. Treatment requirements depend on the discharge location.
- **Discharges to sanitary sewer and storm sewer systems must be approved by the entity responsible for operation and maintenance of the system.** Ecology will not generally require waste discharge permits for discharge of stormwater decant to sanitary sewers or to stormwater treatment BMPs constructed and maintained in accordance with Ecology's Stormwater Management Manual for Western Washington.

The following disposal options are recommended, in order of preference, for catch basin decant liquid and for water removed from stormwater treatment facilities.

Under the Municipal General Permit, municipalities are required to use this guidance in determining appropriate means of dealing with street

wastes from stormwater maintenance activities. Your regional Department of Ecology water quality staff can help you with treatment standards and permit requirements for your particular situation.

Discharge of catch basin decant liquids to a municipal sanitary sewer connected to a Public Owned Treatment Works (POTW) is the preferred disposal option.

Discharge to a municipal sanitary sewer requires the approval of the sewer authority. Street waste liquids discharged to a POTW may be treated at a combined street waste liquid and solid facility (decant facility) or at separate liquids only facilities. These liquid only facilities may consist of modified type 2 catch basins (with a flow restrictor or oil/water separator) or water quality vaults, strategically located through the sanitary collection system. These should provide at least 4 – 6 hours detention for the expected volumes and should be constructed and operated to ensure that the decant discharge does not re-suspend sediments. Sewer authorities should require periodic sampling and decant facility operators should test their waste effluent on a regular basis. It may be desirable to operate these decant facilities as 'batch treatment' devices, with valves that allow the operator to release settled water before decanting the next load. Such a system would also allow isolating a 'hot load' and retaining it until it can be tested. Quiescent settling, with retention times of 4 – 6 hours, will likely meet most local pretreatment requirements.

State and local regulations generally prohibit discharge of stormwater runoff into sanitary sewers, to avoid hydraulic overloads and treatment performance problems. The relatively small volume of storm water discharged from cleaning catch basins and small stormwater treatment facilities is generally not sufficient to be a problem, provided the discharge point is properly selected and designed.

Stormwater removed from catch basins and stormwater treatment wetvaults may be discharged into a Basic Stormwater Treatment Facility.

Decant liquid collected from cleaning catch basins and stormwater treatment wetvaults may be discharged back into the storm sewer system under the following conditions:

- The preferred disposal option of discharge to sanitary sewer is not reasonably available, and
- The discharge is to a Basic Stormwater Treatment Facility (See Chapter 6), and

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- The storm sewer system owner/operator has granted approval and has determined that the treatment facility will accommodate the increased loading.

Where the receiving treatment facility is a wetpool device, the volume of the wet pool should be significantly greater than the volume of decanted stormwater. The volume of decant discharged should not be greater than 5% of the volume of the wetpool and the discharge must be managed to prevent scouring and re-suspension of sediments in the wetpool. Direct discharge of decanted stormwater to biofiltration or infiltration facilities is discouraged. For these facilities, pretreatment is necessary to protect the facility.

Reasonably available will be determined by the stormwater utility and by the circumstances, including such factors as distance, time of travel, load restrictions, and capacity of the stormwater treatment facility. Some jurisdictions may choose not to allow discharge back to the storm sewer system.

Discharge back into the storm sewer is an acceptable option, under certain conditions:

- Other practical means are not reasonably available, **and**
- Pretreatment is provided by discharging to a modified type 2 catch basin (with a flow restrictor or oil/water separator) or water quality vault, **and**
- The discharge is upstream of a basic or enhanced stormwater treatment facility, **and**
- The storm sewer system owner/operator has granted approval.

Other practical means includes the use of decanting facilities and field decant sites that discharge to sanitary sewers or discharge to an approved stormwater treatment facility.

Reasonably available will be determined by the stormwater utility and by the circumstances, including such factors as distance, time of travel, load restrictions, and capacity of the stormwater treatment facility. Some jurisdictions may choose not to allow discharge back to the storm sewer system.

Limited field testing of flocculent aids has been conducted. While the use of flocculent aids is promising, sufficient testing has not been conducted to allow approval of any specific product or process. In general, the following conditions must be met for flocculent use to be approved:

- The flocculent must be non-toxic under circumstances of use and approved for use by the Department of Ecology

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- The decant must be discharged to an approved basic stormwater treatment facility, with sufficient capacity and appropriate design to handle the anticipated volume and pollutant loading
- The discharge must be approved by the storm sewer system owner/operator.

Water removed from stormwater ponds, vaults and oversized catch basins may be returned to storm sewer system.

Stormwater ponds, vaults and oversized catch basins contain substantial amounts of liquid, which hampers the collection of solids and pose problems if the removed waste must be hauled away from the site. Water removed from these facilities may be discharged back into the pond, vault or catch basin provided:

- Clear water removed from a stormwater treatment structure may be discharged directly to a downgradient cell of a treatment pond or into the storm sewer system.
- Turbid water may be discharged back into the structure it was removed from if:
- The removed water has been stored in a clean container (eductor truck, Baker tank or other appropriate container used specifically for handling stormwater or clean water) and
- Sufficient settling time has elapsed (this may require 12 – 24 hours for the finer sediments typically collected in these treatment facilities.)
- The discharge must be approved by the storm sewer system owner/operator.

Vegetation management and structural integrity concerns sometimes require that the ponds be refilled as soon after solids removal as possible. For ponds and other systems relying on biological processes for waste treatment, it is often preferable to reuse at least some portion of the removed water.

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The Site Evaluation

A street waste site evaluation is suggested as method to identify spill sites or locations that are more polluted than normal.

The site evaluation will aid in determining if waste should be handled as dangerous waste and what to test for if dangerous waste is suspected. The site evaluation will also help to determine if the waste does not meet the requirements of the end users.

There are three steps to a site evaluation:

1. An **historical review** of the site for spills, previous contamination and nearby toxic cleanup sites and dangerous waste and materials.

   The historical review will be easier if done on an area wide basis prior to scheduling any waste collection. The historical review should be more thorough for operators who never collected waste at a site before. At a minimum, the historical review should include operator knowledge of the area's collection history or records kept from previous waste collections.

   Private operators should ask the owner of the site for records of previous contamination and the timing of the most recent cleaning. Ecology's Hazardous Substance Information Office maintains a Toxic Release Inventory and a "Facility Site" webpage, tracking more than 15,000 sites. This information is available through the internet at http://www.wa.gov/ecology/iss/fsweb/fshome.html or by calling a toll-free telephone number (800-633-7585). The webpage allows anyone with web-access to search for facility information by address, facility name, town, zip code, and SIC code, etc. It lists why the Department of Ecology is tracking each one (NPDES, TSCA, RCRA, Clean Air Act, etc.), as well as who to call within Ecology to find out more about the given facility.

2. An **area visual inspection** for potential contaminant sources such as a past fire, leaking tanks and electrical transformers, and surface stains.

   The area around the site should be evaluated for contaminant sources prior to collection of the waste. The area visual inspection may be done either as part of multiple or as single site inspections. If a potential contaminant source is found, the waste collection should be delayed until the potential contaminant is assessed.

   A second portion of the area visual inspection is a subjective good housekeeping evaluation of the area. Locations with poor housekeeping commonly cut corners in less obvious places and should be inspected in greater detail for illegal dumping and other contamination spreading practices.

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3. A **waste and container inspection** before and during collection.

   The inspection of the waste and catch basin or vault is the last and perhaps most critical step in the site evaluation.

   For example, if the catch basin or vault has an unusual color in or around it, then there is a strong possibility that something could have been dumped into it. Some colors to be particularly wary of are yellow-green from antifreeze dumping and black and/rainbow sheen from oil and/or grease dumping. In addition, if any staining or corrosion is observed, then a solvent may have been dumped.

   Fumes are also good indicators of potential dangerous or dangerous waste. Deliberate smelling of catch basins should be avoided for worker safety, but suspicious odors may be encountered from catch basins thought to be safe. Some suspicious odors are rotten eggs (hydrogen sulfide is present), gasoline or diesel fumes, or solvent odors. If unusual odors are noted, contact a dangerous waste inspector before cleaning the basin.

Remember - operator experience is the best guide to avoid collection of contaminated waste.

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