CHAPTER 6 - CLEARING, GRADING, FILLING AND DRAINAGE

"URBAN SERVICES STANDARDS AND GUIDELINES"

CITY OF PORT ANGELES - PUBLIC WORKS & UTILITIES DEPARTMENT

6.01 GENERAL

6.01.1 APPLICABILITY

The standards and requirements contained in this chapter are promulgated pursuant to the Clearing and Grading Ordinance of the City of Port Angeles and shall be the minimum standards and requirements for the protection of vegetation and soil during any changes being made to the surface of the land through clearing, grading, filling, and/or construction or modification of natural or constructed drainage facilities in the City. Where there are conflicts or differences between these standards and City Ordinances, the City Ordinances shall apply.

6.01.2 PURPOSE

The purpose of these standards and requirements include, but are not limited to, the following:

1. To promote the public health, safety, and general welfare of the citizens and protect public and private resources of the City without preventing the reasonable use, development, and maintenance of land;
2. To avoid or minimize impacts of clearing and grading as a component of land disturbance activities to adjacent and downstream public or private property;
3. To encourage site development on public and private property, including clearing, excavation, and filling in such a manner as to minimize hazards to life, health, and property;
4. To preserve and enhance the physical and aesthetic character of the City by preventing untimely and indiscriminate removal or destruction of trees and ground cover;
5. To preserve, replace, or enhance the natural qualities of lands, watercourses, and aquatic resources, preserve and protect priority fish and wildlife habitats, minimize water quality degradation and the sedimentation of creeks, streams, ponds, lakes, wetlands, marine waters, and other water bodies, and preserve and enhance beneficial uses;
6. To minimize surface water runoff and diversion which may contribute to flooding;
7. To reduce siltation in City streams, lakes, storm sewer systems, and public roadside improvements;
8. To reduce the risk of slides and the creation of unstable building sites;
9. To promote building and site planning practices that are consistent with the City's natural topography, soils, and vegetative features while at the same time recognizing that certain factors such as disease, danger of fallings, proximity to existing and proposed structures and improvements, interference with utility services, protection of scenic views, and the realization of a reasonable enjoyment of property may require the removal of certain trees and ground cover;
10. To ensure prompt development, restoration, and replanting and effective erosion control of property after land clearing and grading;
11. To promote site development planning and building practices that provide for managing surface water runoff on-site and are consistent with the City's natural topography, vegetation cover, and hydrology;
12. To establish a City review process for land disturbing projects to ensure these regulations and goals are met.

6.01.3 AUTHORITY

1. As provided herein, the City Engineer is given authority to interpret and apply, and the responsibility to enforce, this chapter to accomplish the stated purpose.
2. The City Engineer may withhold, condition, or deny development permits or activity approvals to ensure that

the proposed action is consistent with this chapter.

6.02 CLEARING AND GRADING PERMIT

6.02.1 WHEN A PERMIT IS REQUIRED

A Clearing and Grading Permit is required prior to any of the following:

1. Any clearing, filling, excavation, or grading in a critical area or critical area buffer.
2. Land disturbance of one (1) acre or more, or is part of a larger area of contiguous properties developed under the same ownership, common plan of development, or sale.
3. Fill and/or excavation of one hundred (100) cubic yards or more, even if the excavated material is used as fill on the same site. [Quantities of fill and excavation are calculated separately and then added together to determine the total quantity for the site.]
4. Clearing or grading that will likely penetrate the ground water table, including the construction of ponds and reservoirs.
5. An excavation which is more than five (5) feet in depth or which creates a cut slope greater than five (5) feet in depth or which creates a cut slope greater than five (5) feet in height and steeper than two units horizontal in one unit vertical (2:1).
6. Any re-grading or paving on an area used for stormwater retention or detention or alteration of an existing drainage course.
7. Any proposal to cut down or top by more than one quarter any tree(s) that are required to be preserved by City code, plat condition, or other requirement.

6.02.2 EXEMPTIONS TO OBTAINING A PERMIT

The following activities do not require an approved Clearing and Grading Permit:

1. Land clearing, grading, filling, sandbagging, diking, ditching, or similar work during or after periods of extreme weather or other emergency conditions that present immediate danger to life or property.
2. Land clearing ordered by the City Council for abatement of a public nuisance.
3. Clearing performed under the direction of the City Engineer within a public right-of-way or upon an easement, for the purpose of installing and maintaining water, stormwater, sanitary sewer, power, cable, or communication lines.
4. Cemetery graves.
5. Land disturbance that is less than one acre, except those sites meeting any of the conditions listed in 6.02.1, or where an adjacent area containing disturbed areas under the same ownership or chain of ownership has been similarly exempted so that the combined area is one acre or more and final site stabilization is not complete.
6. If a building permit is issued, no additional clearing, grading, or filling permit or associated fee will be required. However, the standards established in this manual and by City ordinance shall be applied as a condition of said building permit.
7. Forest practices regulated under RCW 76.09. *Activities involving conversion of land to uses other than commercial timber production are subject to clearing and grading regulations.*
8. Refuse disposal sites controlled by other regulations.
9. Mining, quarrying, excavation, processing, or stockpiling of rock, sand, gravel, aggregate, or clay where established and provided by law provided such operations do not affect the lateral support of or increase the stresses in or pressure upon any adjacent or contiguous property.

10. Agricultural crop management of existing and ongoing farmed areas as defined per RCW 84.34.020.

11. Routine landscape maintenance of existing landscaped areas on developed lots.

12. Routine drainage maintenance of existing, constructed stormwater drainage facilities located outside of a protected area, including, but not limited to, detention/retention ponds, wetponds, sediment ponds, constructed drainage swales, water quality treatment facilities, such as filtration systems and regional storm facilities that are necessary to preserve the water quality treatment and flow control functions of the facility. *This exemption does not apply to any expansion or modification to existing excavated and constructed stormwater drainage facilities.*

13. Roadway repairs and overlays within a public street right of way for the purpose of maintaining the pavement, curbing, or sidewalk of existing paved roadways.

NOTE: Exemptions 6 and 7 do not apply in Environmentally Sensitive Areas, Critical Areas, or Buffer Zones. In addition, an exemption from a Clearing and Grading Permit does not exempt the person doing the work from meeting all applicable federal, state, and local codes, standards, guidelines, regulations, and permit requirements.

6.02.3 DURATION OF PERMIT

The Clearing and Grading Permit shall be effective for one year from the date of issuance but may, with the explicit approval of the City Engineer, be extended for an additional one year period. The fee schedule for the review of plans and the permit are as detailed in Chapter 3.70.110 of the Port Angeles Municipal Code (PAMC). While the fee schedule reflects separate review activities, only one permit for clearing, grading, filling, and drainage will be issued per applicant for a specific project. A current schedule of the fees is available upon request.

6.02.4 CONDITIONS APPLICABLE TO ALL PERMITS

Permittees shall comply with the following conditions, which shall apply to all clearing and grading permits:

1. Notify the City forty-eight (48) hours before commencing any land disturbing activity.
2. Notify the City of completion of any erosion control and or vegetation protection measures within forty-eight (48) hours after their completion.
3. Obtain approval in writing from the City for any plan changes.
4. Meet all applicable minimum standards as described below in Section 6.03.
5. Install all control measures as identified in the approved plans.
6. Maintain all road drainage systems, stormwater drainage systems, control measures, and other facilities whether or not they are identified in the plans.
7. Repair siltation or erosion damage to adjoining surfaces and drainage ways resulting from land disturbing activities.
8. Inspect, maintain, install, modify, and/or repair the erosion control measures as needed to assure the continued performance of their intended function. Inspections shall be conducted by a Certified Erosion and Sediment Control Specialist and a written record of said inspections shall be kept on site at all times. Said Specialist shall be identified in writing to the City and shall be on-site or on-call at all times.
9. Provide safe and ready access to allow the City to enter the site for the purpose of inspecting for compliance with the plans or for performing any work necessary to bring the site into compliance with the plans.
10. Keep an up-to-date copy of the approved plans on the site.
11. Ensure that all workmanship and materials are in accordance with City of Port Angeles standards and the most current edition of the State of Washington Standard Specifications for Road, Bridge and Municipal Construction.

12. Meet any and all additional conditions contained in, or referred by, the issued permit.

13. Submission and approval of a Construction Stormwater Pollution Prevention Plan meeting the requirements of Section 6.04.

6.02.5 ENVIRONMENTALLY SENSITIVE AREAS

Construction within critical areas or their buffers shall be in compliance with the appropriate Chapter(s) of the PAMC and shall be subject to the review of the Community and Economic Development Director.

Compliance with the regulations of this chapter does not constitute compliance with other federal, state, or local regulations and permit requirements. The responsibility for determining the existence and application of these requirements rests solely with the applicant; provided, that to the extent known, the City will inform the applicant of other agency requirements or permits that may apply to a site such as: Shoreline Substantial Development permits, Critical Area and Resource Lands regulations, Hydraulics Permit Act permits, Section 106 of the National Historic Preservation Act, U.S. Army Corps of Engineers Section 404 Permits, and National Pollution Discharge Elimination System permits. The applicant is responsible for complying with these requirements apart from the process established in these regulations.

6.03 MINIMUM STANDARDS

6.03.1 SILTATION AND EROSION CONTROL

The following are the minimum standards for siltation and vehicular access controls during construction on any site. For sites which require a SWPPP, see Section 6.05 and Appendix E of this chapter.

1. Construction Access Control - Provide a clean hard surface for vehicles entering the construction site to eliminate tracking soil onto the street. This surface shall be in place and maintained during the full period of construction.

2. Stabilization of Denuded Areas -

    a. All exposed and unworked soils shall be stabilized using suitable best management practices (sod, vegetation, plastic covering, mulching, etc).

    b. No land disturbing activity shall be undertaken until installation of sufficient erosion and sediment control devices to retain the sediment that may be generated by the activity is complete.

    c. Vegetation measures shall be used for erosion and sediment control wherever feasible, rather than structural measures such as pipes, structures, or other devices. Native plants shall be used in environmentally sensitive areas.

3. Protection of Adjacent Properties - Adjacent properties shall be protected from sediment deposition by appropriate use of vegetated buffer strips, sediment barriers or filters, dikes or mulching, or combinations of measures. All reasonable measures to protect all public and private property from damage shall be taken.

6.03.2 GRADING

The following are the minimum standards for grading unless otherwise modified by an approved grading plan:

1. Grading shall not contribute to or create landslides, accelerated soil creep, or settlement of soils.

2. Natural land and water features, vegetation, drainage and other natural features of the site shall be preserved to the greatest extent possible and in accordance with the approved plans.

3. Grading shall not create or contribute to flooding, erosion, increased turbidity, or siltation of a watercourse.

4. Groundcover and tree disturbance shall be minimized. Where trees are to be retained on site, a tree protection plan shall be submitted to the City and approved prior to the beginning of any on-site clearing or grading.

5. Grading operations shall be conducted and/or phased so as to expose the smallest practical area to erosion

for the least possible time.

6. Grading shall not divert existing watercourses.

6.03.3 CUTS AND FILLS

The following are the minimum standards for cutting and filling slopes; provided that some or all of these provisions may be waived by the City Engineer for grading operations of a minor nature:

1. Cut slopes shall be no steeper than is safe for the intended use. Cut slopes greater than five (5) feet in height shall be no steeper than two (2) horizontal to one (1) vertical, except where approved retaining walls are to be installed.
2. Filling should only occur where the ground surface has been prepared by removal of vegetation and other unsuitable materials or preparation of steps where natural slopes are steeper than five to one (5 to 1). Fill slopes should not be constructed on natural slopes greater than two to one (2 to 1).
3. Fill slopes shall be no steeper than is safe for the intended use. Fill slopes greater than five (5) feet in height shall be no steeper than two (2) horizontal to one (1) vertical, except where approved retaining walls are engineered and installed.
4. Steeper cut/fills may be permitted if supported by an approved geotechnical report.
5. Cut and fill slopes shall not encroach upon adjoining property without prior written approval of the adjacent property owner.
6. Cut and fill slopes shall be provided with subsurface and surface drainage provisions to approved discharge locations as necessary to retain the slope.
7. The faces of slopes shall be prepared and maintained to control erosion. Approved best management practices (BMP's) shall be initiated and/or installed as soon as possible and shall be maintained by the owner.
8. Fill materials used as structural fill shall be compacted and tested in accordance with the requirements applicable to support the planned use.

6.03.4 CRITICAL AREAS AND CRITICAL AREA BUFFERS

No land disturbing activity shall be permitted in a designated critical area or critical area buffer zone, except as otherwise allowed by applicable laws and permits.

6.03.5 CLEAN-UP

Persons and/or firms engaged in clearing, grading, and filling, or drainage activities shall be responsible for maintaining work areas free of debris or other material that may cause damage to or siltation of existing or new facilities or have the potential of creating a safety hazard.

6.03.6 CONSTRUCTION PLAN

The CONSTRUCTION PLAN - GENERAL CONDITIONS in Chapter 1 of the Urban Services Standards and Guidelines (Section 1A.085) shall apply to and be included on any plans dealing with clearing, grading, filling or drainage activities.

6.04 TEMPORARY EROSION/SEDIMENTATION CONTROL PLAN

1. A Temporary Erosion/Sedimentation Control Plan is required in conjunction with a Clearing and Grading Permit for sites that disturb less than one acre of land, unless otherwise exempted by the City Engineer. The design of temporary erosion control measures shall reflect the site's soil conditions, topographic features, hydrology, and weather during the construction period and shall comply with the standards set forth herein.
2. Prior to the initial clearing and grading of any land, provisions shall be made to intercept all potential silt-laden runoff that could result from the clearing and grading. The interception shall preclude any silt-laden

runoff from discharging from the proposed land development to downstream properties, unless approved otherwise. The interception shall cause all silt-laden runoff to be conveyed by open ditch or other means to whatever temporary facility is necessary to remove silt from the runoff prior to its discharge.

3. Details of siltation ponds and channels shall be submitted to the City prior to construction. The location and profiles of interim drainage channels may be shown by a typical cross-section and flow direction arrows. A plan example is shown in Volume 3 of the DOE Manual.
4. The maximum velocities and channel slopes shall be shown on the Temporary Erosion/Sedimentation Control Plan.
5. Check dams shall be employed or some other acceptable method to limit ditch velocities to 5 feet per second, unless an approved revetment is placed.
6. A siltation pond shall provide a minimum of 1.5 feet of storage below the pond discharge. The volume of the pond above the 1.5 foot storage shall be calculated based upon the 6-month, 24-hour storm for the area contributing runoff to the pond. (see Volume 3 of the DOE Manual, as well as the detail in the Appendices)
7. Discharge from a siltation pond shall be directed through filter fabric or some other acceptable filtering system before leaving the development.
8. A minimum of one foot of freeboard shall be provided for all siltation ponds.
9. The GENERAL CONDITIONS in Chapter 1, section 1A.085 shall be included on any plans dealing with clearing, grading, filling or drainage activities.

6.05 CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

6.05.01 GENERAL

A Construction Stormwater Pollution Prevention Plan (SWPPP) is required in conjunction with a Clearing and Grading Permit for sites that disturb one acre of land or more. Refer to Section 6.04 above for requirements for sites that disturb less than one acre of land. The SWPPP is a document that describes the potential for pollution problems on a construction project. The Construction SWPPP explains and illustrates the measures to be taken on the construction site to control those problems. The owner or lessee of the land being developed has the responsibility for Construction SWPPP preparation and submission to the City. The owner or lessee may designate a qualified individual or individuals to prepare the Construction SWPPP, but the owner or lessee retains the ultimate responsibility.

The following general principles should be applied to the development of the Construction SWPPP. Additional guidance and information related to preparation and implementation of the SWPPP and approved BMPs are available in the current edition of the Department of Ecology's Stormwater Management Manual for Western Washington.

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

8. Minimize slope length and steepness.
9. Reduce runoff velocities to prevent channel erosion.
10. Prevent the tracking of sediment off-site.
11. Select appropriate BMPs for the control of pollutants other than sediment.

6.05.02 REQUIRED ELEMENTS

Each of the 12 elements listed below must be considered and included in the Construction SWPPP unless site conditions render the element unnecessary and the exemption is clearly justified in the narrative of the SWPPP:

Refer to Appendix E for the requirements of each SWPPP element.

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 Inlets
9. Control Pollutants
10. Control Dewatering
11. Maintain BMPs
12. Manage the Project

6.05.03 NARRATIVE

The Construction SWPPP shall consist of two parts, a narrative (Section 6.05.03) and drawings (Section 6.05.04). All narrative items must be addressed in the SWPPP. A checklist is provided in the Appendix of this chapter that can be used as a quick reference to determine if all the major items are included in the Construction SWPPP.

1. Twelve (12) Elements – Describe how the Construction SWPPP addresses each of the 12 required elements. Include the type and location of BMPs used to satisfy the required element. If an element is not applicable to a project, provide a written justification for why it is not necessary.
2. Project Description – Describe the nature and purpose of the construction project. Include the total size of the area, any increase in existing impervious area; the total area expected to be disturbed by clearing, grading, excavation, or other construction activities, including off-site borrow and fill areas; and the volumes of grading cut and fill that are proposed.
3. Existing Site Conditions – Describe the existing topography, vegetation, and drainage. Include a description of any structures or development on the parcel including the area of existing impervious surfaces.
4. Adjacent Areas – Describe adjacent areas, including streams, lakes, wetlands, residential areas, and roads that might be affected by the construction project. Provide a description of the downstream drainage leading from the site to the receiving body of water.
5. Critical Areas – Describe areas on or adjacent to the site that are classified as critical areas. Critical areas that receive runoff from the site shall be described up to ¼ mile away. The distance may be increased at

the discretion of the City. Describe special requirements for working near or within these areas.

6. Soil – Describe the soil on the site, giving such information as soil names, mapping unit, erodibility, settleability, permeability, depth, texture, and soil structure.

7. Potential Erosion Problem Areas – Describe areas on the site that have potential erosion problems.

8. Construction Phasing – Describe the intended sequence and timing of construction activities and any proposed construction phasing.

9. Construction Schedule – Describe the construction schedule. If the schedule extends into the wet season, describe what activities will continue during the wet season and how the transport of sediment from the construction site to receiving waters will be prevented.

10. Financial/Ownership Responsibilities – Describe ownership and obligations for the project. Include bond forms and other evidence of financial responsibility for environmental liabilities associated with construction.

11. Engineering Calculations – Attach any calculations made for the design of such items as sediment ponds, diversions, and waterways, as well as calculations for runoff and stormwater detention design (if applicable). Engineering calculations must bear the signature and stamp of an engineer licensed in the state of Washington.

12. Erosion Control Specialist – A responsible, certified erosion control specialist shall be identified. Contact information shall be included.

6.05.04 DRAWINGS

The following is a list of items that need to be shown or otherwise addressed in the drawings.

1. Vicinity Map – Provide a map with enough detail to identify the location of the construction site; adjacent roads; and receiving waters.

2. Site Map – Provide a site map(s) showing the following features. The site map requirements may be met using multiple plan sheets for ease of legibility.

    a. A legal description of the property boundaries or an illustration of property lines (including distances) in the drawing(s).

    b. The direction of north in relation to the site.

    c. Existing structures and roads, if present.

    d. The boundaries and labels for the different soil types.

    e. Areas of potential erosion problems.

    f. Any on-site and adjacent surface waters, critical area, their buffers, FEMA base flood boundaries, and Shoreline Management boundaries.

    g. Existing contours and drainage basins and the direction of flow for the different drainage areas.

    h. Final and interim grade contours as appropriate, drainage basins, and the direction of stormwater flow during and upon completion of construction.

    i. Areas of soil disturbance, including all areas affected by clearing, grading, and excavation.

    j. Locations where stormwater discharges to surface waters during and upon completion of construction.

    k. Existing unique or valuable vegetation and the vegetation that is to be preserved.

    l. Cut and fill slopes indicating top and bottom of slope catch lines.

    m. Stockpile, waste storage, and vehicle storage/maintenance areas.

n. Total cut and fill quantities and the method of disposal for excess material.

3. Conveyance Systems – Show on the site map the following temporary and permanent conveyance features:

   a. Locations for swales, interceptor trenches, or ditches.

   b. Drainage pipes, ditches, or cut-off trenches associated with erosion and sediment control and stormwater management.

   c. Temporary and permanent pipe invert elevations, minimum slopes, and depth of cover.

   d. Grades, dimensions, and direction of flow in all ditches and swales, culverts, and pipes.

   e. Details for bypassing off-site runoff round disturbed areas.

   f. Locations and outlets of any dewatering systems.

5. Location of Detention BMPs – Show on the site map the locations of stormwater detention BMPs.

6. Erosion and Sediment Control (ESC) BMPs – Show on the site map all major structural an nonstructural ESC BMPs including:

   a. The location of sediment pond(s), pipes, and structures.

   b. Dimension pond berm widths and inside and outside pond slopes.

   c. The trap/pond storage required and the depth, length, and width dimensions.

   d. Typical section views through pond and outlet structure.

   e. Typical details of gravel cone and standpipe, and/or other filtering devices.

   f. Stabilization technique details for inlets and outlets.

   g. Control/restrictor device location and details.

   h. Stabilization practices for berms, slopes, and disturbed areas.

   i. Rock specifications and detail for rock check dam, if used.

   j. Spacing for rock check dams as required.

   k. Front and side sections of typical rock check dams.

   l. The location, detail, and specification for silt fence.

   m. The construction entrance and location.

7. Detailed Drawings – Any structural practices used that are not referenced in State or City manuals should be explained and illustrated with detailed drawings.

8. Other Pollutant BMPs – Indicate on the site map the location of BMPs to be used for the control of pollutants other than sediment.

9. Monitoring Locations – Indicate on the site map the water quality sampling locations, if required by the City or the Department of Ecology. Sampling stations shall be located in accordance with applicable permit requirements.

10. Notes addressing construction phasing and scheduling shall be included on the drawings.

6.06 MAINTENANCE SCHEDULE

The Permittee may be required to provide a maintenance schedule for constructed temporary private facilities shall be developed to ensure the continuing intended function for the life of any such temporary private facilities

and shall state the type of maintenance and inspection to be completed, the time period for completion, and indicate the party or parties responsible for the maintenance and inspection. This schedule shall be prepared by a Professional Engineer licensed to practice in the State of Washington and shall be included with all required plans and permits. The schedule shall be recorded with the County Auditor by the owner of the private facilities and a copy of the recorded document shall be provided to the City. See Chapter 5 for maintenance requirements for permanent facilities.

6.07 SECURITY

Per PAMC 15.28.140, the City Engineer may require the applicant to furnish security in the form of a bond, cash escrow account, an irrevocable letter of credit, or other security which may be acceptable to the City in its sole discretion, in an amount determined by the City Engineer to be sufficient to reimburse the City if it should become necessary for the City to enter the property to correct conditions relating to soil instability, erosion, or environmental damage caused by lack of or improper completion of the work. When a bond is required, an engineer's estimate will be required to determine the amount of the bond. The amount of the bond will be a minimum of 150% of the approved engineer's estimate.

6.08 INSURANCE

The applicant shall comply with the insurance provisions of the Clearing and Grading Ordinance as contained in PAMC 15.28.150.

6.09 PRE-CONSTRUCTION MEETING

Prior to any clearing, grading, filling, and/or drainage facility construction, the Contractor may be required to conduct a pre-construction conference with City Staff to coordinate the project.

6.10 INSPECTIONS

1. All projects which include clearing, grading, filling or drainage shall be subject to inspection by the City Engineer or his designee, who shall be granted reasonable right of entry to the work site by the permittee. When required by the City Engineer, special inspection of the grading operations and special testing shall be performed by qualified professionals employed by the permittee. Inspections in conjunction with Hydraulic Project Approvals may also be enforced by the Washington State Department of Fisheries or Wildlife.

2. Each permitted site must be inspected as necessary to ensure that the sediment control measures are installed and effectively maintained in compliance with the approved Construction SWPPP. Where applicable, the permittee must obtain inspection by the City at the following stages:

    a. Following the installation of sediment control measures or practices and prior to any other land disturbing activity;

    b. Following the establishment of any tree protection zone(s) and prior to any other land disturbing activity.

    c. During the construction of sediment basins or stormwater management structures;

    d. During rough grading, including hauling of imported or wasted materials;

    e. Prior to the removal or modification of any sediment control measure or facility; and

    f. Upon completion of final grading, including establishment of ground covers and planting, installation of all vegetative measures, and all other work in accordance with the approved plan and/or permit.

3. The permittee may secure the services of an engineer, subject to the approval of the City Engineer, to inspect the construction of the facilities and provide the City with a fully documented certification that all construction is in accordance with the provisions of the approved plan, applicable rules, regulations, permit conditions and specifications. If inspection certification is provided to the City, then the normal inspections performed by the City for the permit may be waived. In these cases the City shall be notified at the required inspection points and may make spot inspections. The engineer shall use the "Engineer's Construction Inspection Report" form attached for certification of the construction or other similar form approved by the City Engineer.

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6.11 COMPLETION OF THE WORK

1. Construction Changes - Whenever changes must be made to the approved plan, the changes shall be submitted in writing to and approved by the City Engineer in advance of the construction of those changes.

2. Final reports - Upon completion of the rough grading and at the final completion of the work, the City Engineer may require the following reports, drawings, and supplements thereto to be prepared and submitted by the owner and/or an appropriate qualified professional approved by the City Engineer:

    a. An as-built grading plan, including original ground surface elevations, final surface elevations, lot drainage patterns, and locations and elevations of all surface and subsurface drainage facilities.

    b. A soils grading and/or geologic grading report, including locations and elevations of field density tests and geologic features, summaries of field and other laboratory tests, and other substantiating data and comments or any other changes made during grading and their effect on the recommendations made in the approved grading plan.

3. Notification of completion - The permittee or his/her agent shall notify the City Engineer when the grading operation is ready for final inspection. Final approval shall not be given until all work has been completed in accordance with the approved Construction SWPPP and other approved plans, and the required reports have been submitted and accepted.

- END OF CHAPTER 6

CHAPTER 6 - CLEARING, GRADING, FILLING AND DRAINAGE

APPENDICES

	Filename
A. Clearing and Grading Permit Application	c&g application.doc
B. Clearing and Grading Permit	c&g permit.doc
C. Engineer's Construction Inspection Report for Clearing, Grading, Filling, and Drainage	construction report.doc
D. Construction Stormwater Pollution Prevention Plan (SWPPP) Checklist	
E. Requirements for Each SWPPP Element	
F. Selected Standard Details from the Department of Ecology Stormwater Management Manual	
1. Stabilized Construction Entrance	BMP C105
2. Mulching	BMP C121
3. Surface Roughening	BMP C130
4. Temporary Channel Liners	BMP C202
5. Rock Check Dams	BMP C207
6. Storm Drain Inlet Protection	BMP C220
7. Straw Bale Barrier	BMP C230
8. Silt Fence	BMP C233
9. Sediment Trap	BMP C240
10. Temporary Sediment Pond	BMP C241

(A complete listing of approved BMPs can be found in Chapter 4, Volume II of the DOE Manual)

Application No. _____

CLEARING AND GRADING PERMIT APPLICATION

(Applicant must complete Page 1 of Application. Page 2 will be completed by the City.)

Name of Applicant: _____
Applicant's Mailing Address: _____

_____

Applicant's Phone Number: _____

Plan Preparer (Architect/Engineer): _____
Preparer's Mailing Address: _____

_____

Preparer's Phone Number: _____

Location of Proposed Activity: _____
(Street address or lot and block number) _____

Owner of Property: _____
(If not applicant, attach letter of authorization from property owner)

Description of Proposed Activity (Also attach plans, sketches or other important information which would assist in our initial review)**:**

_____

_____

_____

_____

_____

Estimated Amount of Material, in cubic yards, to be excavated, imported, or exported: _____

If the answer to any of the following three questions is yes, an Environmentally Sensitive Area (ESA) application with a SEPA checklist and associated fees are required to be submitted with this application and will be processed according to the City's consolidated permitting process.

1. Is the excavation or fill associated with the development of a parking lot for more than 20 vehicles? _____(yes or no)

2. Is the total amount of excavation or fill expected to exceed 100 cubic yards? _____(yes or no)

3. Will any portion of the grading, excavating or filling occur within 200 feet of any of the following? [If the answer is yes, please check the appropriate condition(s):]
   _____Shoreline _____Stream/Creek _____40% or greater slope.

The applicant hereby affirms and commits that the information submitted for this permit is accurate and that the applicant will comply with the terms and conditions of this permit and the City of Port Angeles Clearing and Grading Ordinance.

_____
Signature of Applicant or authorized representative Date

CLEARING AND GRADING PERMIT APPLICATION

☐ **1. THE PROPOSED ACTION HAS BEEN DETERMINED TO BE EXEMPT FROM A CLEARING AND GRADING PERMIT, BASED UPON THE INFORMATION PROVIDED BY THE APPLICANT. THE BASIS FOR THIS EXEMPTION IS AS CHECKED BELOW:**

☐ A. Land clearing, grading, filling, sandbagging, diking, ditching, or similar work during or after periods of extreme weather or other emergency conditions which have created situations such as flooding or high fire danger that present immediate danger to life or property, as authorized by the City Engineer.
☐ B. Land clearing necessitated by order of the City Council related to the abatement of a public nuisance, where the work is administered by the City.
☐ C. Removal of dead, diseased, or damaged trees which constitute an imminent hazard to life or property.
☐ D. Clearing performed under the direction of the City Engineer within a public right-of-way or upon an easement, for the purpose of installing and maintaining water, storm, sewer, power, cable or communication lines.
☐ E. Cemetery graves.
☐ F. Non-destructive vegetation trimming with proper removal and disposal of debris.

EXEMPTIONS "G" THROUGH "L" SHALL NOT APPLY IN SITUATIONS WHERE THE PROPERTY INCLUDES AN ENVIRONMENTALLY SENSITIVE AREA:

☐ G. Land that is less than one acre, except where an adjacent area containing disturbed areas under the same ownership or chain of ownership has been similarly exempted so that the combined area is greater than one acre and final site stabilization is not complete.
☐ H. If a building permit is issued, no additional clearing, grading, or filling permit or associated fee will be required; provided that the standards established in the City's Urban Services Standards and Guidelines shall be applied as a condition of said building permit.
☐ I. Routine maintenance of existing stormwater drainage facilities located outside of a critical area (as defined by PAMC 15.20.030), including, but not limited to, detention/retention ponds, wetponds, sediment ponds, constructed drainage swales, water quality treatment facilities, such as filtration systems and regional storm facilities that are necessary to preserve the water quality treatment and flow control functions of the facility. *This exemption does not apply to any expansion and/or modification to any existing stormwater drainage facilities.*
☐ J. Roadway repairs and overlays within a public street right of way for the purpose of maintaining the pavement, curbing, or sidewalk on existing paved roadways.
☐ K. Forest practices regulated under RCW 76.09. *Activities involving conversion of land to uses other than commercial timber production are subject to clearing and grading regulations*
☐ L. Other reason as indicated hereon:_____

An exemption from a Clearing and Grading Permit does not exempt the person doing the work from meeting all applicable federal, state, and local codes, standards, guidelines, and regulations, including obtaining and meeting the conditions of all applicable permits.

☐ **2. THE PROPOSED ACTION IS NOT EXEMPT: C&G PERMIT REQUIRED**

Dept.of Comm. & Economic Development Date

City Engineer Date

PERMIT NO. _____

CLEARING AND GRADING PERMIT

I. PERMIT FEE CALCULATIONS

1. Grading and filling - plan review and permit fee (per PAMC 3.70.110D)
   - 0-250 cubic yards (CY) and < 4' of cut/fill ($40.00) $ _____
   - 251 - 1,000 CY ($75.00) $ _____
   - 1,001 - 10,000 CY ($110.00) $ _____
   - 10,000+ CY ($35.00 + $15.00 per 10,000 CY) $ _____
2. Clearing and drainage - plan review and permit fee (per PAMC 3.70.110D)
   - Less than one acre ($40.00) $ _____
   - One acre to 5 acres ($75.00) $ _____
   - Over 5 acres ($15.00 per acre) $ _____
3. Inspection Fees (per PAMC 3.70.110.E)($55/hr) $ _____
4. Engineering Plan Review (per PAMC 3.70.115)
   - Water ($0.50/LF) $ _____
   - Sanitary Sewer ($0.50/LF) $ _____
   - Storm Sewer ($0.50/LF) $ _____
   - Street/Alley/Parking Lot ($0.50/linear feet of centerline) $ _____
5. Additional Plan Review of changes, additions, or revisions to submitted or approved plans (per PAMC 3.70.117) ($55/hr) $ _____
6. Environmental Checklist (SEPA Review) (per PAMC 3.70.070G)($125) $ _____
7. **TOTAL PERMIT FEE:** **$** _____

II. CONDITIONS APPLIED TO *ALL* PERMITS

1. Notify the City (417-4831) forty-eight (48) hours **before** beginning any land-disturbing activity.
2. Notify the City (417-4831) within 48 hours of completion of any erosion and sediment control measures.
3. Obtain written permission from the City prior to modifying any plans.
4. Install all erosion and sediment control measures as identified in the approved plans.
5. Maintain all road drainage systems, stormwater drainage systems, control measures, and other facilities identified in the plans.
6. Repair siltation or erosion damage to adjoining surfaces and drainage ways resulting from land developing or disturbing activities.
7. Inspect all erosion and sediment control measures at least once each week during construction, and after each rain of 0.5 inches or more (over a 24-hour period), and immediately make any needed repairs.
8. Allow the City to enter the site for the purpose of inspecting compliance with the plans or for performing any work necessary to bring the site into compliance with the plans.
9. Keep an up-to-date, approved copy of the plans on the site.
10. Ensure that all workmanship and materials are in accordance with the City of Port Angeles Urban Services Standards and Guidelines, and the current edition of Washington State Department of Transportation's Standard Specifications for Road, Bridge and Municipal Construction.
11. Contact the City Engineer (417-4803) immediately if hazardous materials or soils are encountered.

III. PLANNING PERMITS REQUIRED

1. SEPA Checklist (Excavation or filling 100 cubic yards or more, or part of exempt project).
2. Environmentally Sensitive Area (ESA) Application/Approval.
3. Wetlands Permit Application/Approval.
4. Other(s)_____

IV. PLANS AND SPECIFICATIONS TO INCLUDE

A. AN ACCURATE PLAN OF THE ENTIRE SITE AS IT EXISTS AT THE TIME OF APPLICATION, WHICH MUST INCLUDE:

1. All property lines.
2. Contours over the entire site (5-foot contours are standard, but other intervals may be required).

3. The date, basis, and datum of the contours.
4. Graphic representations of all existing vegetation on the site, designated by their common names, the amount of bare ground, and the amount and type of impervious material (rock and artificial).
5. The location of all existing drainage facilities, natural and man-made.
6. The locations of any wet areas and estimated capacity of any areas which impound surface water.
7. The location and estimated discharge of all visible springs.
8. The location of all structures, utilities, and their appurtenances, including structures and utilities on adjacent properties when such information is reasonably available.
9. Date, north arrow, and adequate scale as approved by the City Engineer on all maps and plans.
10. Identification of and mitigation measures for on-site areas which are subject to severe erosion, and off-site areas which are especially vulnerable to damage from erosion and/or sedimentation.

B. THE PROPOSED WORK SCHEDULE, WHICH DETAILS THE FOLLOWING:

1. Sequence for clearing, grading, filling, drainage alteration, and other land disturbing activities.
2. On-site soil or earth material storage locations and source of import materials, and location of the site where spoils will be disposed.
3. Schedule for installation and removal of all interim erosion and sediment control measures, including vegetative measures.
4. Schedule for construction of final improvements, if any.
5. Schedule for the installation and maintenance of required permanent erosion and sediment control devices.
6. Outline of the methods to be used in clearing vegetation and storing and disposing of the cleared vegetation.

C. AN ACCURATE FINISHED GRADE PLAN OF THE ENTIRE SITE AS IT WOULD APPEAR AFTER THE COMPLETION OF WORK COVERED BY THE PERMIT, WHICH MUST INCLUDE:

1. Finished contours achieved by grading (at the same intervals as the existing contours).
2. Boundaries of all areas to remain undisturbed with identification and the location of all other vegetation shown on the plan that will remain after the completion of all work.
3. Drainage and related facilities to be constructed with and as part of the work.
4. Boundaries of all areas where surface water runoff will be retained, detained, or infiltrated.
5. Method for discharging surface water off-site, including the provisions required to control the velocity and direction of discharge to protect downstream properties.
6. Location of building set-back lines, and approximate limits of cuts and fills, foundations, retaining walls, driveways, etc.
7. Location and dimensions of sensitive areas and any associated buffer zones and other areas to be maintained or established.
8. Location and description of proposed erosion and sedimentation control devices or structures.
9. Off-site grading shall be noted on the plans, and a dated letter of permission from the property owner(s) of the land effected shall be provided and noted on the plans.

V. ADDITIONAL INFORMATION REQUIRED

1. Hydrologic and hydraulic computations.
2. Engineering geology and soils reports.
3. Erosion and Sediment Control Plan.
4. Engineering cost estimate of drainage facilities and erosion control plan.
5. Inspection and maintenance agreement.
6. Letter(s) of permission for off-site work.
7. Copies of other required permit(s):_____
8. Other information:_____
9. Security deposit, bond, or other approved method of guaranteeing performance (circle one), in the amount of $_____.
10. Insurance required in the amounts of $_____ per occurrence and $_____ aggregate.

VI. ADDITIONAL CONDITIONS

1. Additional Conditions applicable to this permit listed here and/or attached:

_____
_____
_____
_____
_____

VII. PERMIT APPROVAL

This certifies that the named applicant is granted a Clearing And Grading Permit for the work described and the purpose shown in the application. This permit is granted subject to the terms of the agreement contained in the application, subject to the provisions of the City of Port Angeles Municipal Code and subject to any additional conditions which are attached to this permit or as noted in sections II through VI above and section VIII below. Nothing permitted hereunder shall be deemed to override the provisions of any applicable law of the City, County, State or Federal Government. This permit expires one year from the date of issuance, unless otherwise specified by the City Engineer.

_____ _____

City Engineer Date Dept. of Community & Economic Development Date

VIII. INSPECTIONS AND SIGN-OFFS

Please call 417-4831 to schedule required inspections, no later than noon of the previous business day to schedule an on-site inspection of the permitted activity(ies) checked below.

Required	No.	Description of Activity	Date Inspection Requested	Date Work Completed
	1	Installation of sediment control measures/BMPs prior to land disturbing activity.		
	2	During construction of sediment basins or stormwater management structures.		
	3	During rough grading, including hauling of materials.		
	4	Prior to removal or modification of sediment control measure.		
	5	Notice of completion received from permittee.		
	6	At completion of final grading.		
	7	Final establishment of vegetation/re-vegetation.		
	8	Completion of final erosion control measures.		
	9	As-built grading plan required.		
	10	Soils grading report required.		
	11	Geologic grading report required.		

ENGINEER'S CONSTRUCTION INSPECTION REPORT
FOR
CLEARING, GRADING, FILLING, AND DRAINAGE

TO: CITY ENGINEER **DATE:**_____

Project Name:_____ Project Number:_____
Location (address, or other)_____
_____

POND INFORMATION:

1. Type:_____
_____
2. Adequately protected from silting and compaction of infiltration surfaces during construction:_____
3. Outlet Type:_____
4. Outlet works at correct elevation(s), filter fabric installed properly (if needed), etc.:_____
_____
5. Spillway at correct elevation, slope, adequately armored, etc.:_____

CONVEYANCES:

1. Channels properly graded, sloped, planted, etc.:_____
_____
2. Storm drains at proper grade, inlets as designed, trenches as designed, pipe bedding properly prepared, backfilling procedures correct, materials as specified, etc._____
_____
3. Roof leaders and footing drains: Do drains go to infiltration trenches as designed, pipe bedding properly prepared, backfilling procedures correct, materials as specified, etc.:_____
_____

EROSION CONTROL INFORMATION:

1. Erosion facilities in place at the time specified relative to other construction:_____
2. Construction entrance pad in place as specified._____
3. Did facilities keep sediment, mud etc, out of water bodies, wetlands, and from crowding the property boundary?:_____
4. Are permanent erosion control measures in place and as designed:_____

AS-BUILT DRAWINGS ATTACHED:

As a professional engineer licensed by the State of Washington, I have personal knowledge of the construction inspection of the above named project, and I do hereby report that the project was built according to the approved plans and specifications, except as noted above or on the "as-built construction drawings".

_____
Signature, seal and date:_____

Seal

Construction Stormwater Pollution Prevention Plan Checklist

Project Name: _____
City 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, including off-site borrow and fill areas.
___ d. Total volumes of proposed cut and fill.

3. Existing Site Conditions

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

Construction Stormwater Pollution Prevention Plan Checklist

Project Name: _____
City 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)

Construction Stormwater Pollution Prevention Plan Checklist

Project Name: _____
City 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

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 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 surface waters, 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.

Construction Stormwater Pollution Prevention Plan Checklist

Project Name: _____
City 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, if applicable.

Appendix E – Requirements for Each SWPPP Element

1. Preserve Vegetation/Mark Clearing Limits:

    a. 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.

    b. The duff layer, native top soil, and natural vegetation shall be retained in an undisturbed state to the maximum degree practicable.

2. Establish Construction Access:

    a. Construction vehicle access and exit shall be limited to one route, if possible.

    b. Access points shall be stabilized with quarry spalls, crushed rock or other equivalent BMP to minimize the tracking of sediment onto public roads.

    c. Wheel wash or tire baths shall be located on site, if the stabilized constructions entrance is not effective in preventing sediment from being tracked onto public roads.

    d. If sediment is tracked off site, roads shall be cleaned thoroughly at the end of each day, or more frequently during wet weather. Sediment shall be removed from roads by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area.

    e. Street washing is allowed only after sediment is removed in accordance with 2.d, above. Street wash wastewater shall be controlled by pumping back on site or otherwise be prevented from discharging into systems tributary to waters of the state.

3. Control Flow Rates:

    a. Properties and waterways downstream from development sites shall be protected from erosion due to increases in the velocity and peak volumetric flow rate of stormwater runoff from the project site.

    b. Where necessary to comply with 3.a, above, stormwater retention or detention facilities shall be constructed as one of the first steps in grading. Detention facilities shall be functional prior to construction of site improvements (e.g., impervious surfaces).

c. If permanent infiltration ponds are used for flow control during construction, these facilities should be protected from siltation during the construction phase.

4. Install Sediment Controls:

a. Stormwater runoff from disturbed areas shall pass through a sediment pond, or other appropriate sediment removal BMP, prior to leaving a construction site or prior to discharge to an infiltratibn facility. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but shall meet the flow control performance standard of 3.a, above.

b. Sediment control BMPs (sediment ponds, traps, filters, etc.) shall be constructed as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.

c. 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.

5. Stabilize Soils:

a. Exposed and unworked soils shall be stabilized by application of effective BMPs that prevent erosion.

b. No soils should remain exposed and unworked for more than the time periods set forth below to prevent erosion:

c. During the dry season (May 1 — September 30): 7 days

d. During the wet season (October 1 — April 30): 2 days

e. The time period may be adjusted by the Permittee, if the Permittee can show that local precipitation data justify a different standard.

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

g. Soil stockpiles must be stabilized from erosion, protected with sediment trapping measures, and where possible, be located away from storm drain inlets, waterways and drainage channels.

6. Protect Slopes:

a. Design and construct cut and fill slopes in a manner that will minimize erosion.

b. Off-site stormwater (run-on) or groundwater shall be diverted away from slopes and undisturbed areas with interceptor dikes, pipes and/or swales. Off-site stormwater should be managed separately from stormwater generated on the site.

c. At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion. Temporary pipe slope drains shall handle the expected peak 10-minute flow velocity from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate predicted by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis shall use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis shall use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model to predict flows, bare soil areas should be modeled as "landscaped area."

d. Excavated material shall be placed on the uphill side of trenches, consistent with safety and space considerations.

e. Check dams shall be placed at regular intervals within constructed channels that are cut down a slope.

7. Protect Drain Inlets:

a. Storm drain inlets made 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.

b. Inlet protection devices shall be cleaned or removed and replaced when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

8. Stabilize Channels and Outlets:

a. All temporary on-site conveyance channels shall be designed, constructed, and stabilized to prevent erosion from the following expected peak flows. Channels shall handle the expected peak 10-minute flow velocity from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate predicted by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis shall use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis shall use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western

Washington Hydrology Model to predict flows, bare soil areas should be modeled as "landscaped area."

b. Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches shall be provided at the outlets of all conveyance systems.

9. Control Pollutants:

a. All pollutants, including waste materials and demolition debris, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of stormwater.

b. Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. On-site fueling tanks shall include secondary containment.

c. Maintenance, fueling and repair of heavy equipment and vehicles shall be conducted using spill prevention and control measures. Contaminated surfaces shall be cleaned immediately following any spill incident.

d. Wheel wash or tire bath wastewater shall be discharged to a separate on-site treatment system or to the sanitary sewer with local sewer district approval.

e. Application of 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' label requirements for application rates and procedures shall be followed.

f. BMPs shall be used to prevent or treat contamination of stormwater runoff by pH modifying sources. These sources include, but are not limited to: bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters. Permittees shall require construction site operators to adjust the pH of stormwater if necessary to prevent violations of water quality standards.

g. Construction site operators must obtain written approval from the Department of Ecology prior to using chemical treatment other than CO2 or dry ice to adjust pH.

10. Control De-Watering:

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

b. Clean, non-turbid de-watering water, such as well-point ground water, can be discharged to systems tributary to, or directly into surface waters of the state, as specified in 8, above, provided the de-watering flow does not cause erosion or flooding of receiving waters. Clean de-watering water should not be routed through stormwater sediment ponds.

c. Other de-watering disposal options may include: (i) infiltration; (ii) transport offsite in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters; (iii) on-site chemical treatment or other suitable treatment technologies approved by the City; (iv) sanitary sewer discharge with local sewer district approval, if there is no other option; or (v) use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized de-watering.

d. Highly turbid or contaminated dewatering water shall be handled separately from stormwater.

11. Maintain BMPs:

a. All temporary and permanent erosion and sediment control BMPs shall be inspected, maintained and repaired as needed to assure continued performance of their intended function in accordance with BMP specifications.

b. All 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.

12. Manage the Project:

a. Development projects shall be phased to the maximum degree practicable and shall take into account seasonal work limitations.

b. The Permittee must require construction site operators to maintain, and repair as needed, all sediment and erosion control BMPs to assure continued performance of their intended function.

c. Construction site operators must periodically inspect their sites. Site inspections shall be conducted by a Certified Erosion and Sediment Control Lead who shall be identified in the SWPPP and shall be present on-site or on-call at all times.

d. Construction site operators must maintain, update and implement their SWPPP. SWPPPs must be modified whenever there is a change in design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.

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 Specifications

- See Figure 4.2 for details. Note: the 100' minimum length of the entrance shall be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length (100').
- 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)

- Consider early installation of the first lift of asphalt in areas that will paved; this can be used as a stabilized entrance. Also consider the installation of excess concrete as a stabilized entrance. During large concrete pours, excess concrete is often available for this purpose.
- Hog fuel (wood-based mulch) may be substituted for or combined with quarry spalls in areas that will not be used for permanent roads. Hog fuel is generally less effective at stabilizing construction entrances and should be used only at sites where the amount of traffic is very limited. Hog fuel is not recommended for entrance stabilization in urban areas. The effectiveness of hog fuel is highly variable and it generally requires more maintenance than quarry spalls. The inspector may at any time require the use of quarry spalls if the hog fuel is not preventing sediment from being tracked onto pavement or if the hog fuel is being carried onto pavement. Hog fuel is prohibited in permanent roadbeds because organics in the subgrade soils cause degradation of the subgrade support over time.
- Fencing (see BMPs C103 and C104) shall be installed as necessary to restrict traffic to the construction entrance.

- Whenever possible, the entrance shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.

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, 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.

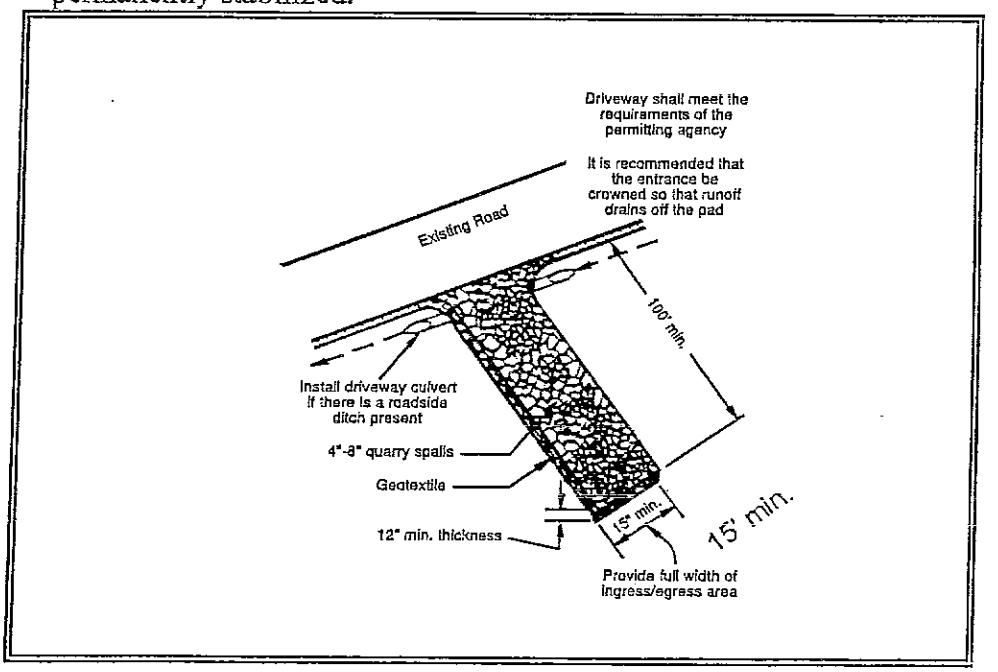


Figure 4.2 – Stabilized Construction Entrance

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.

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

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.

Table 4.7
Mulch Standards and Guidelines

Mulch Material	Quality Standards	Application Rates	Remarks
Straw	Air-dried; free from undesirable seed and coarse material.	2"-3" thick; 5 bales per 1000 sf or 2-3 tons per acre	Cost-effective protection when applied with adequate thickness. Hand-application generally requires greater thickness than blown straw. The thickness of straw may be reduced by half when used in conjunction with seeding. In windy areas straw must be held in place by crimping, using a tackifier, or covering with netting. Blown straw always has to be held in place with a tackifier as even light winds will blow it away. Straw, however, has several deficiencies that should be considered when selecting mulch materials. It often introduces and/or encourages the propagation of weed species and it has no significant long-term benefits. Straw should be used only if mulches with long-term benefits are unavailable locally. It should also not be used within the ordinary high-water elevation of surface waters (due to flotation).
Hydromulch	No growth inhibiting factors.	Approx. 25-30 lbs per 1000 sf or 1500 - 2000 lbs per acre	Shall be applied with hydromulcher. Shall not be used without seed and tackifier unless the application rate is at least doubled. Fibers longer than about ¾-1 inch clog hydromulch equipment. Fibers should be kept to less than ¾ inch.
Composted Mulch and Compost	No visible water or dust during handling. Must be purchased from supplier with Solid Waste Handling Permit (unless exempt).	2" thick min.; approx. 100 tons per acre (approx. 800 lbs per yard)	More effective control can be obtained by increasing thickness to 3". Excellent mulch for protecting final grades until landscaping because it can be directly seeded or tilled into soil as an amendment. Composted mulch has a coarser size gradation than compost. It is more stable and practical to use in wet areas and during rainy weather conditions.
Chipped Site Vegetation	Average size shall be several inches. Gradations from fines to 6 inches in length for texture, variation, and interlocking properties.	2" minimum thickness	This is a cost-effective way to dispose of debris from clearing and grubbing, and it eliminates the problems associated with burning. Generally, it should not be used on slopes above approx. 10% because of its tendency to be transported by runoff. It is not recommended within 200 feet of surface waters. If seeding is expected shortly after mulch, the decomposition of the chipped vegetation may tie up nutrients important to grass establishment.
Wood-based Mulch	No visible water or dust during handling. Must be purchased from a supplier with a Solid Waste Handling Permit or one exempt from solid waste regulations.	2" thick; approx. 100 tons per acre (approx. 800 lbs. per cubic yard)	This material is often called "hog or hogged fuel." It is usable as a material for Stabilized Construction Entrances (BMP C105) and as a mulch. The use of mulch ultimately improves the organic matter in the soil. Special caution is advised regarding the source and composition of wood-based mulches. Its preparation typically does not provide any weed seed control, so evidence of residual vegetation in its composition or known inclusion of weed plants or seeds should be monitored and prevented (or minimized).

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 4.6 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 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.

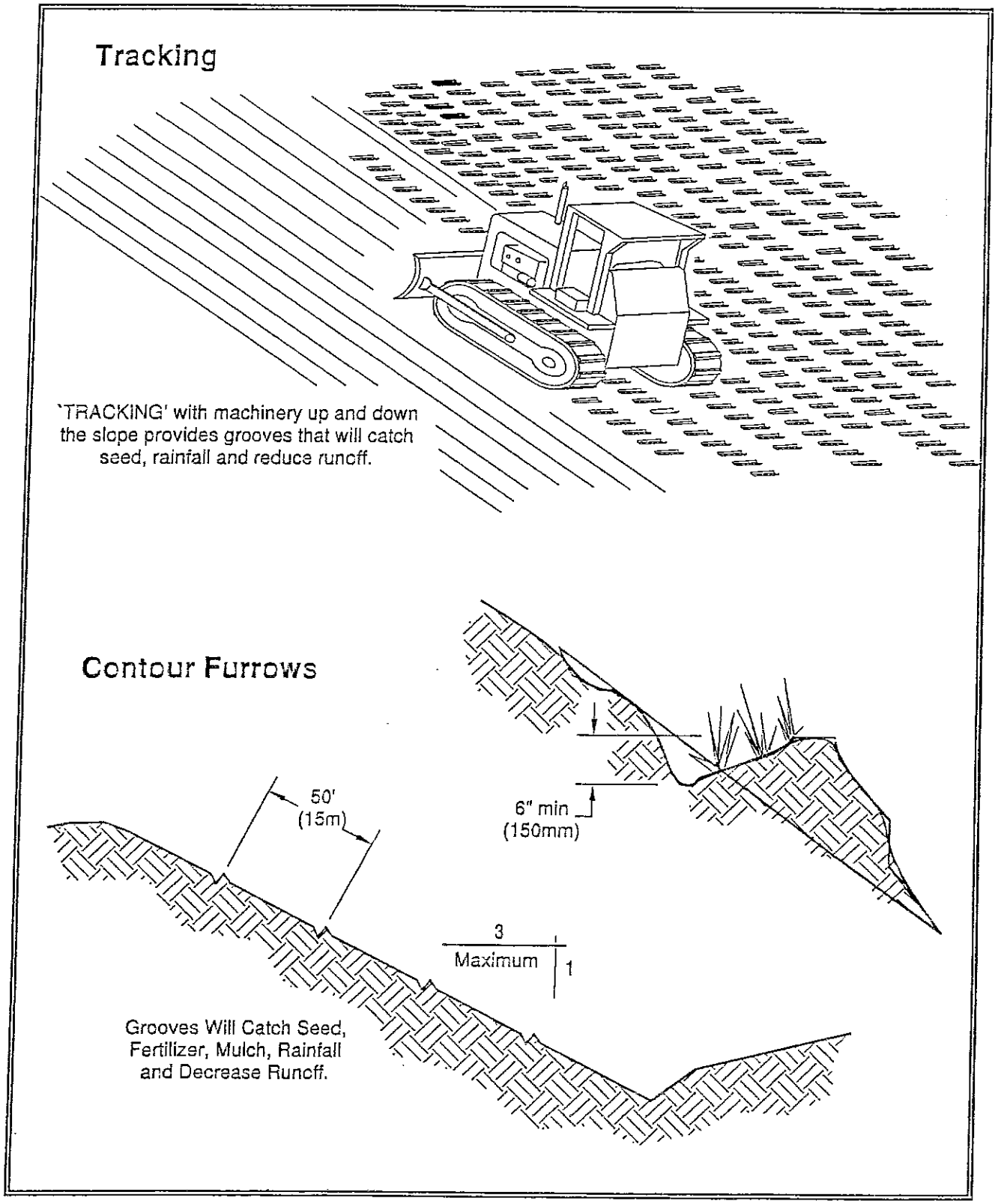


Figure 4.6 – Surface Roughening by Tracking and Contour Furrows

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 adequat 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.

- 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 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 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 4.13 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.

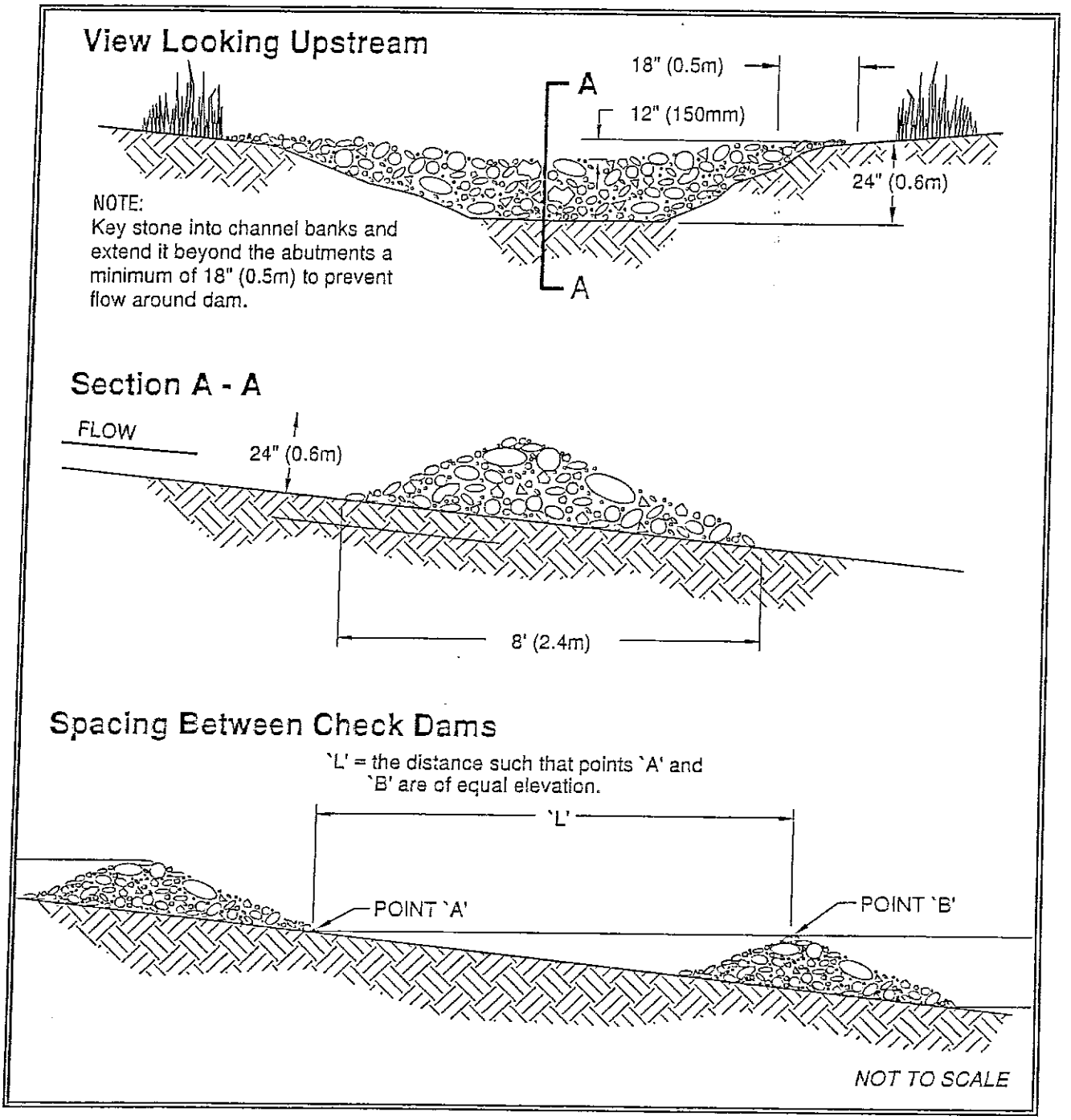


Figure 4.13 – Check Dams

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 4.9 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.

Table 4.9
Storm Drain Inlet Protetion

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.

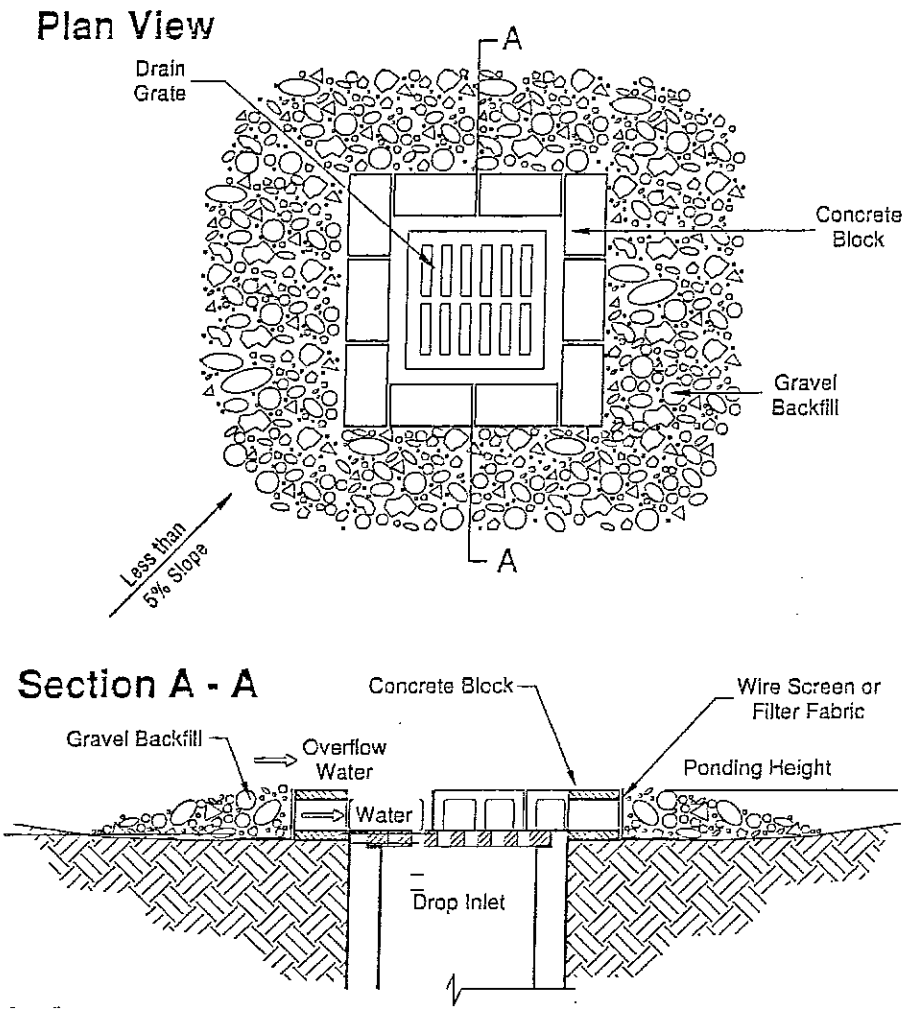
Design and Installation Specifications

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 4.14.

- 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.
- 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.



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 dowslope side of the structure.

Figure 4.14 – 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 4.14.

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

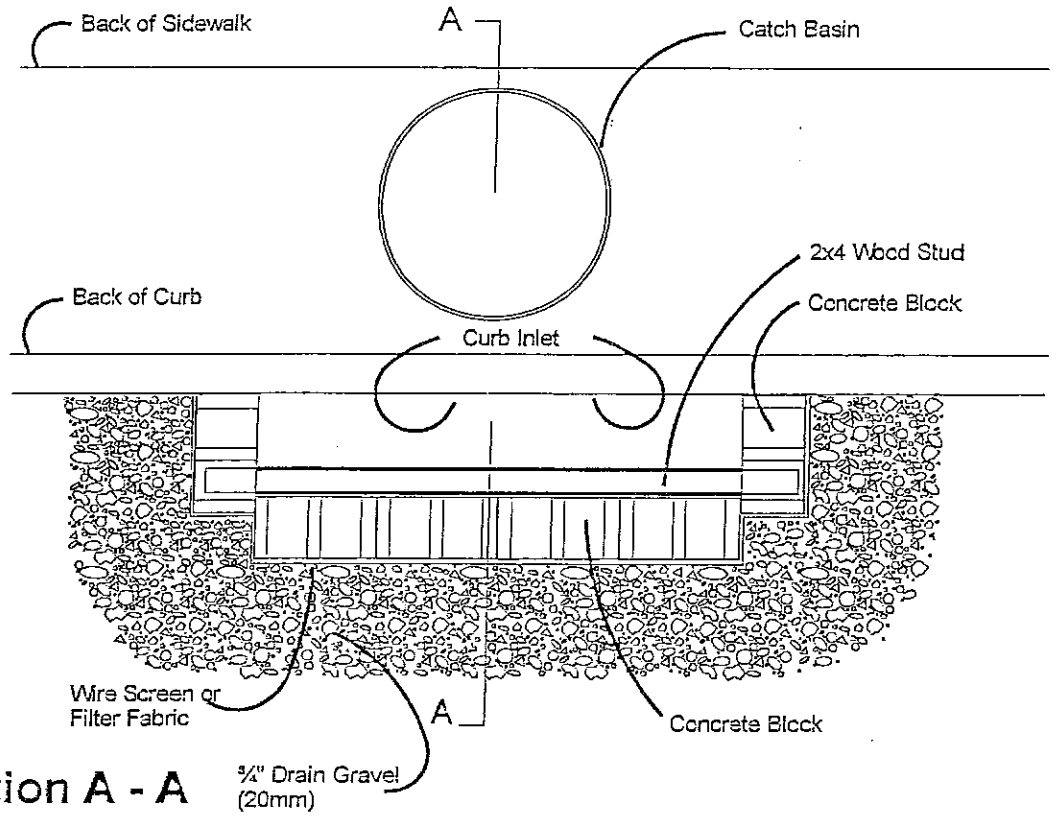
Curb and Gutter Sediment Barrier – Sandbag or rock berm (riprap and aggregate) 3 feet high and 3 feet wide in a horseshoe shape. See Figure 4.16.

- 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.

Plan View



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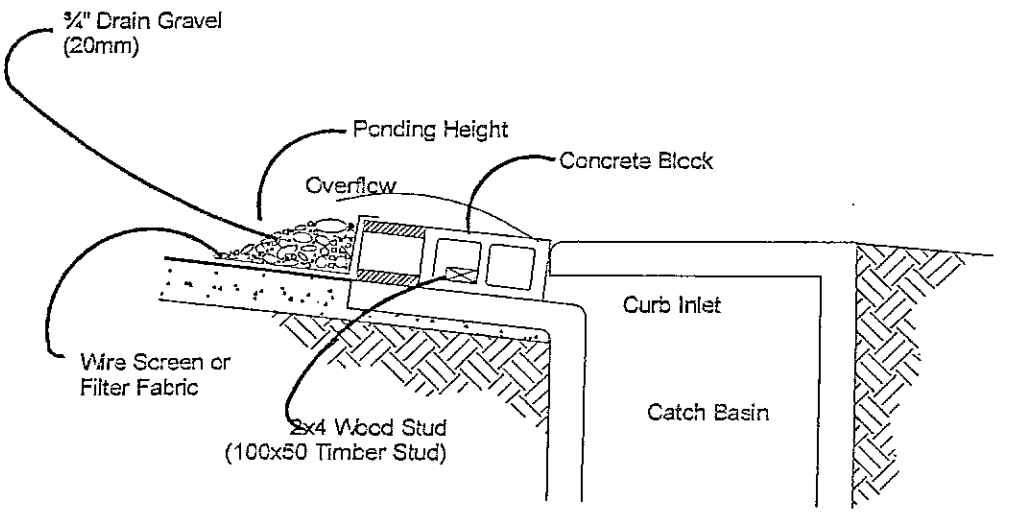
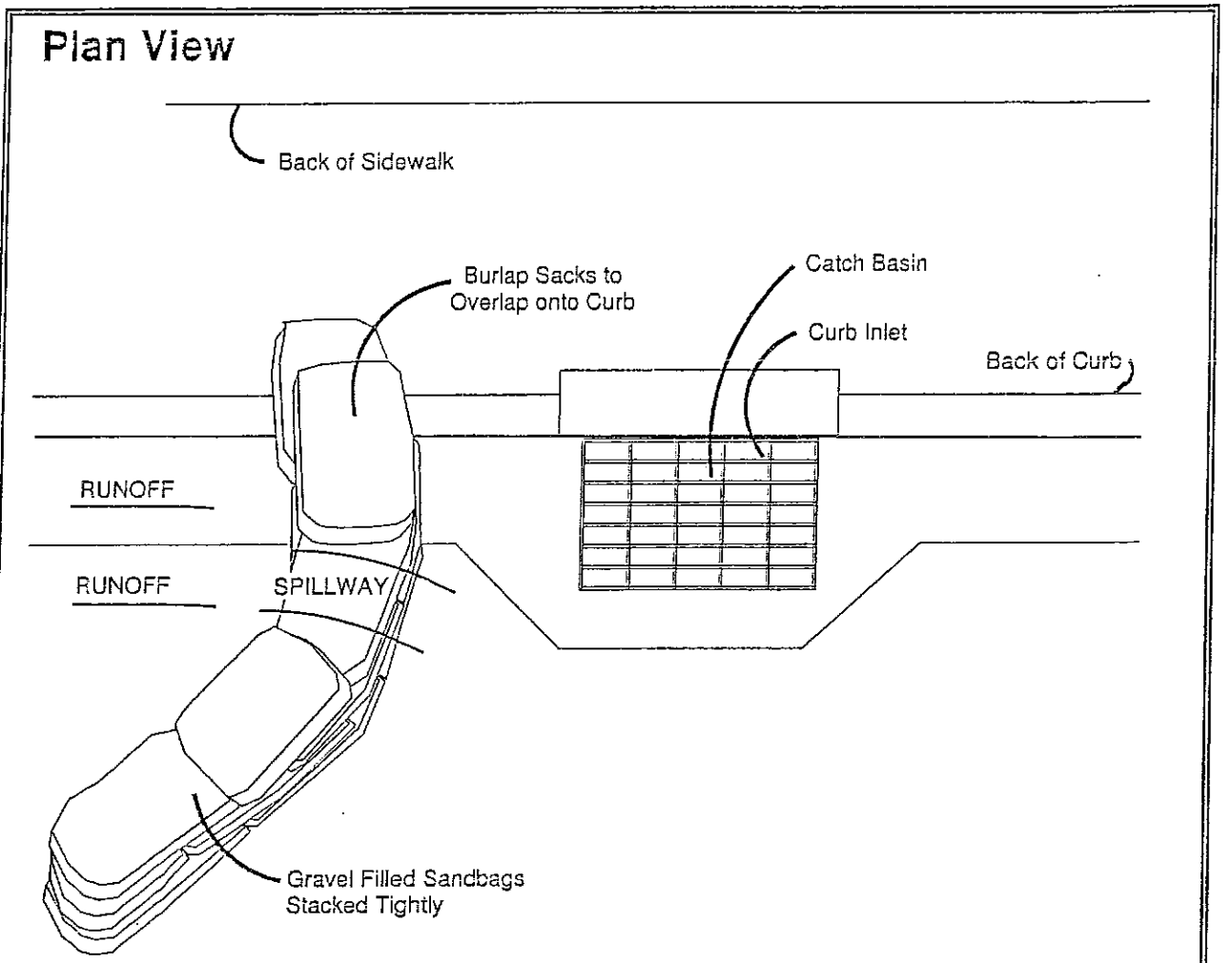


NOTES:
1. Use block and gravel type sediment barrier when curb inlet is located in gently sloping street segment, where water can pond and allow sediment to separate from runoff.
2. Barrier shall allow for overflow from severe storm event.
3. Inspect barriers and remove sediment after each storm event.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

Figure 4.15 – Block and Gravel Curb Inlet Protection



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.

Figure 4.16 – Curb and Gutter Barrier

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 4.17 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 1/4 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-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.

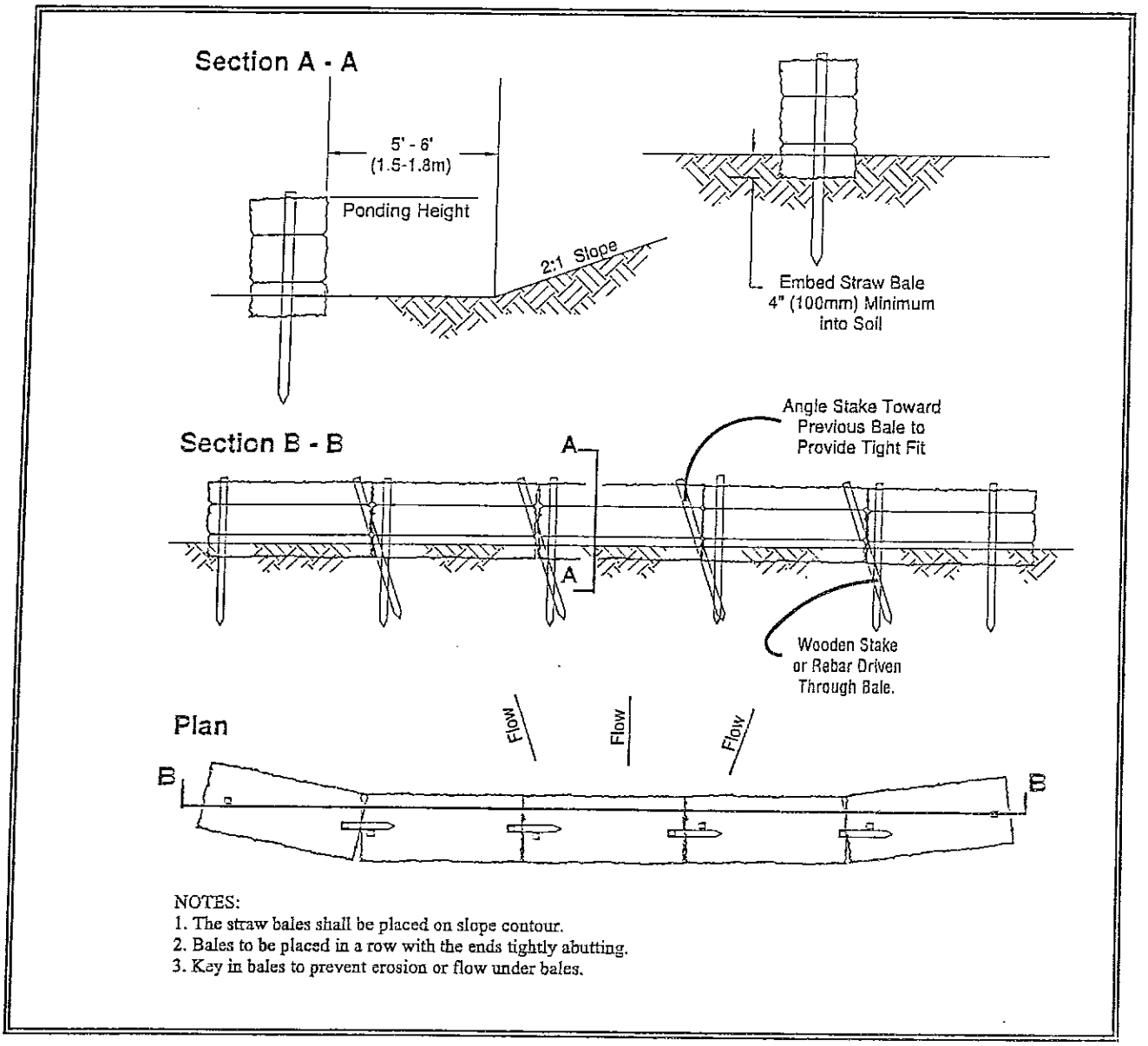


Figure 4.17 Straw Bale Barrier

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 4.19 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.

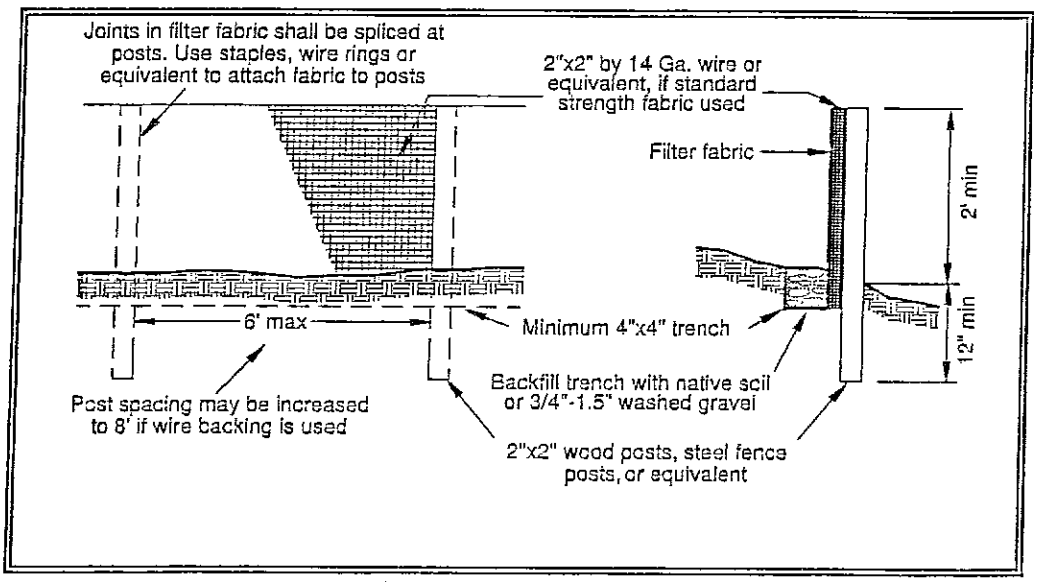


Figure 4.19 – Silt Fence

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 4.10):

Table 4.10 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

- 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.
- Standard Notes for construction plans and specifications follow. Refer to Figure 4.19 for standard silt fence details.

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, 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 4.20 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.

  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.

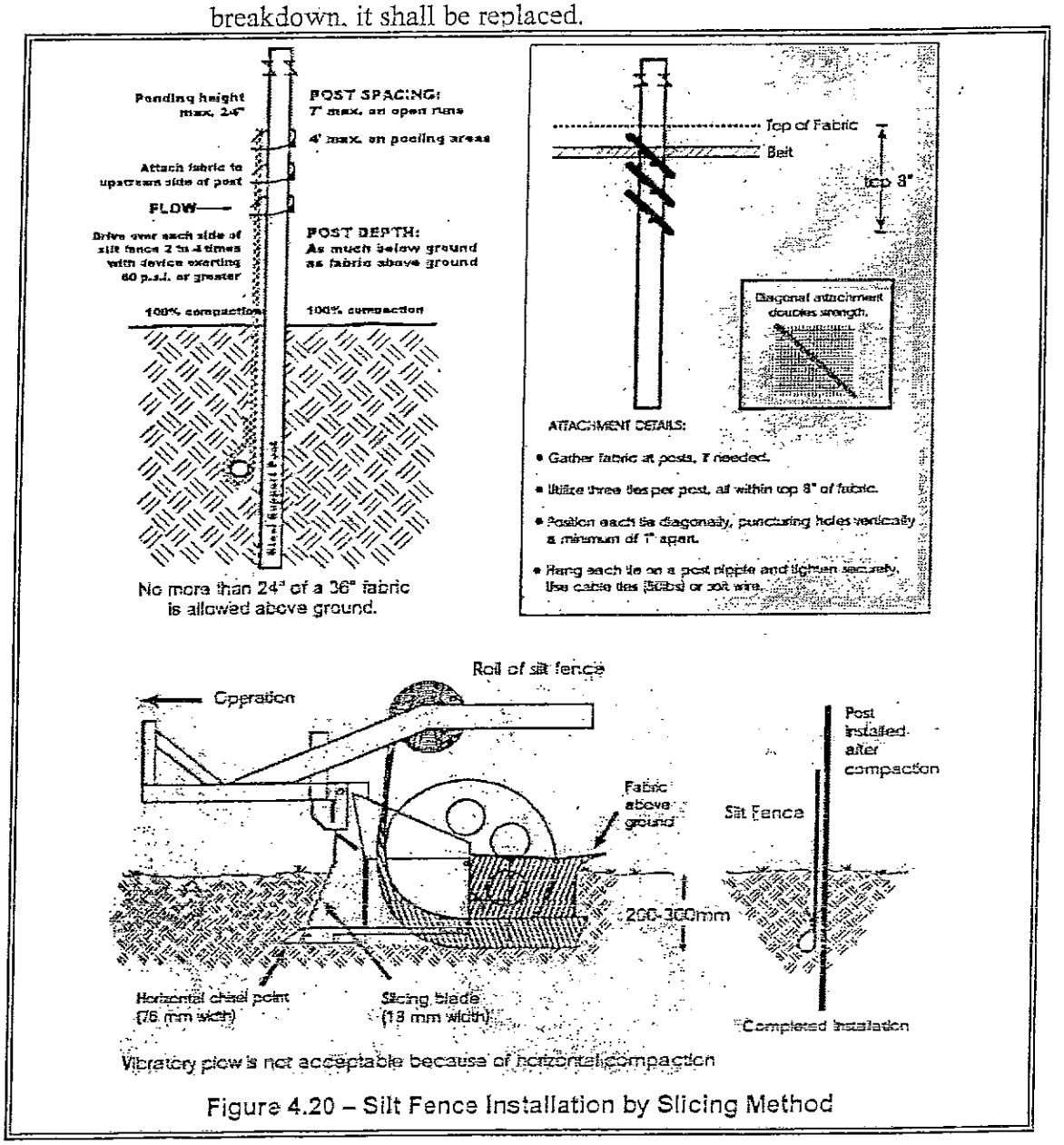


Figure 4.20 – Silt Fence Installation by Slicing Method

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 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 4.22 and 4.23 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:

  $SA = FS(Q_2/V_S)$

  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 (V_S) of 0.00096 ft/sec.

  FS = A safety factor of 2 to account for non-ideal settling.

  Therefore, the equation for computing surface area becomes:

  $SA = 2 \times Q_2/0.00096$ 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.

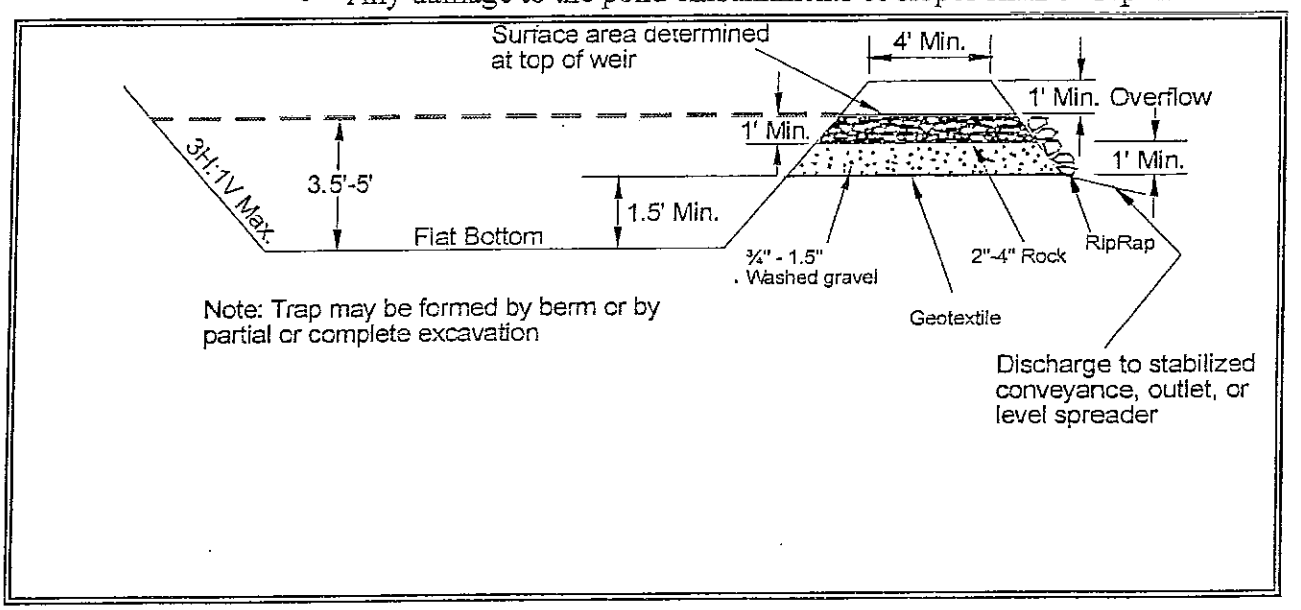


Figure 4.22 Cross Section of Sediment Trap

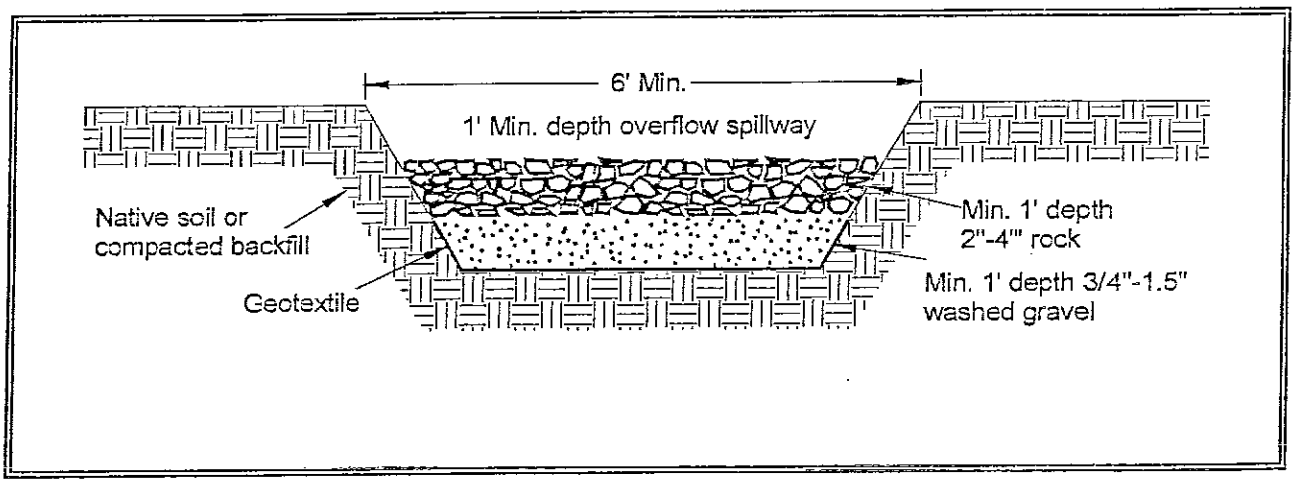


Figure 4.23 Sediment Trap Outlet

EMP 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

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 must 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 ft^3) or more are subject to the Washington Dam Safety Regulations (Chapter 173-175 WAC).
- See Figure 4.24, Figure 4.25, and Figure 4.26 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 must 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

  Obtain the discharge from the hydrologic calculations of the peak flow for the 2-year runoff event (Q_2). 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.

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.
- Length-to-width ratio between 3:1 and 6:1.
- 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 as stated in Minimum Requirement #7: Flow Control. 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 of additional discharge control. See Figure 4.28 for riser inflow curves.

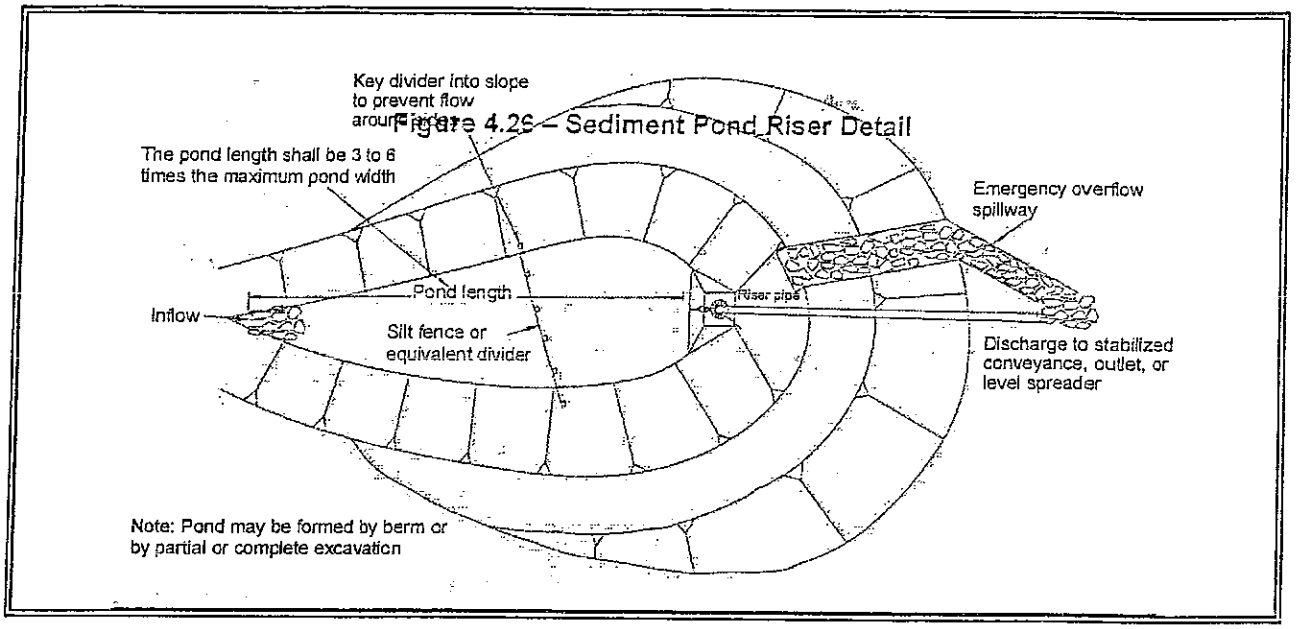


Figure 4.24 – Sediment Pond Plan View

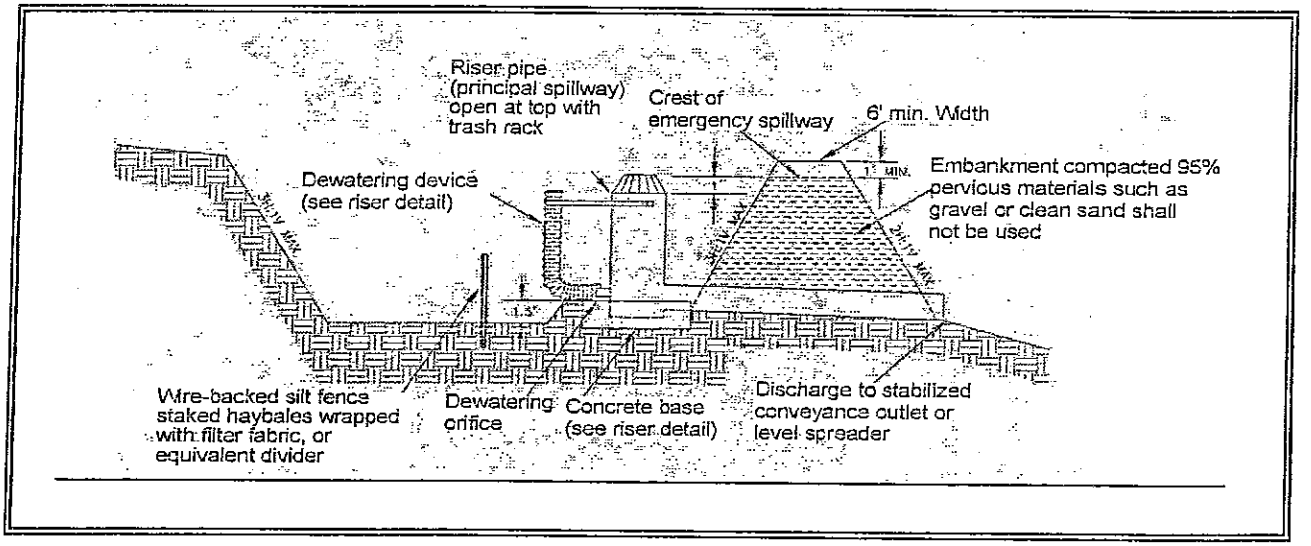


Figure 4.25 – Sediment Pond Cross Section

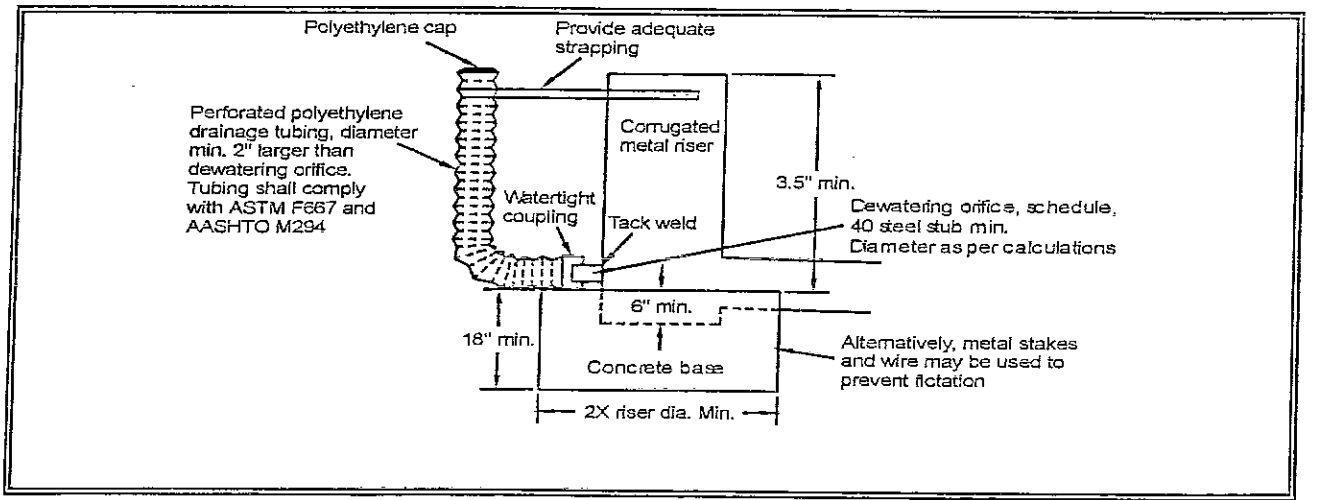


Figure 4.26 – Sediment Pond Riser Detail

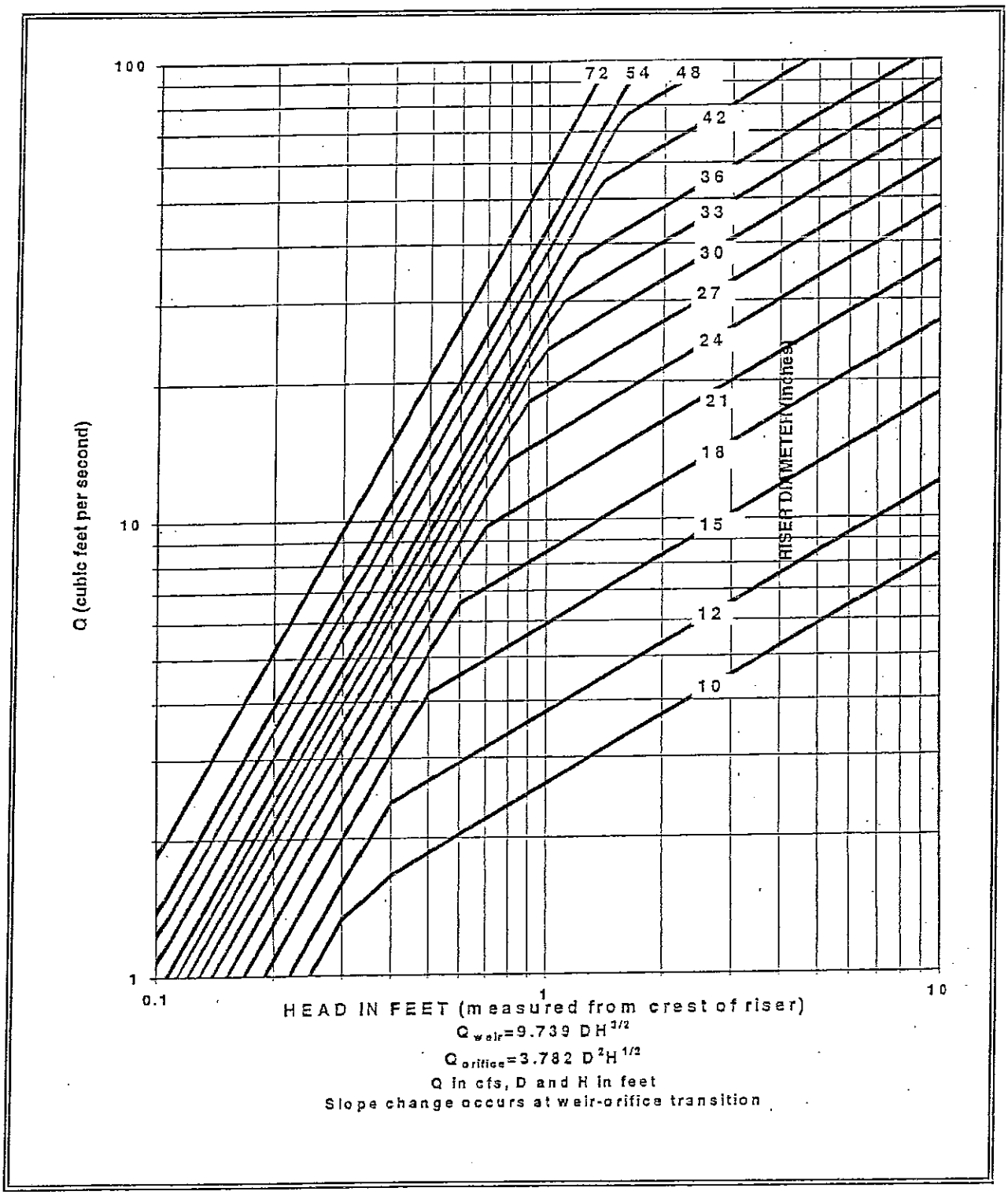


Figure 4.27 – Riser Inflow Curves

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 (Q_{10}). 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 Volume III.

Dewatering Orifice: Determine the size of the dewatering orifice(s) (minimum 1-inch diameter) using a modified version of the discharge equation for a vertical orifice and a basic equation for the area of a circular orifice. Determine the required area of the orifice with the following equation:

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

where A_O = orifice area (square feet)
A_S = pond surface area (square feet)
h = head of water above orifice (height of riser in feet)
T = dewatering time (24 hours)
g = acceleration of gravity (32.2 feet/second^2)

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

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

The vertical, perforated tubing connected to the dewatering orifice must be at least 2 inches larger in diameter than the orifice to improve flow characteristics. The size and number of perforations in the tubing should be large enough so that the tubing does not restrict flow. The orifice should control the flow rate.

- Additional Design Specifications

  The **pond shall be divided** into two roughly equal volume cells by a permeable divider that will reduce turbulence while allowing movement of water between cells. The divider shall be at least one-half the height of the riser and a minimum of 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** shall be prominently marked on the riser.

If an **embankment** of more than 6 feet is proposed, the pond must comply with the criteria contained in Volume III 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:

  1. Tight connections between riser and barrel and other pipe connections.
  2. Adequate anchoring of riser.
  3. Proper soil compaction of the embankment and riser footing.
  4. 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.