CHAPTER 5
DRAINAGE

5-01 INTRODUCTION

Chapter 5 of the Snohomish County Engineering Design and Development Standards contains standards and specifications for drainage facilities located in County road rights-of-way, in private tracts and easements, or that implement approved best management practices for which the County has some responsibility to operate or maintain. This chapter is intended to be used in coordination with the Snohomish County Drainage Manual and Snohomish County Code (SCC or County Code), primarily chapters 7.53 (Water Pollution Control), 30.63A (Drainage), 30.63B (Land Disturbing Activity), and 30.63C (Low Impact Development). The drainage facilities described above shall be designed and constructed in accordance with the requirements of County Code, the Drainage Manual and these Standards. The County Engineer (the Engineer) or the Director of Planning and Development Services, as authorized by code, may impose additional or more stringent requirements than those specified in this chapter to mitigate drainage impacts; to protect public health, safety and welfare; or to comply with adopted codes and regulations.

This chapter is organized into two parts. Part I - General Standards, contains standards and specifications for drainage system components such as catch basins, pipes, and drains. Part II - Stormwater Flow Control and Treatment, contains standards and specifications for stormwater flow control and treatment facilities, which are typically composed of multiple drainage system components.

PART I – GENERAL STANDARDS

5-02 FACILITY LOCATION

Stormwater flow control and treatment facilities required for private land development shall not be located in the public right-of-way. Pursuant to SCC 30.63A.605, these facilities shall be located in separate lots or tracts. The County Engineer may approve, pursuant to SCC 30.63A.605 and SCC 30.63A.830, these facilities to be located in an easement, including an easement for a private road, if such placement is reasonably necessary to address special circumstances pertaining to a subdivision layout.

Detention, retention or infiltration facilities described in this chapter shall not be located within 200 feet of the top of an erosion hazard area or landslide hazard area, as defined by Subtitle 30.6 SCC, unless a geotechnical analysis shows that no slope instability will result. Under no circumstances shall these facilities be located within 50 feet of the top of an erosion hazard area or landslide hazard area.

5-03 CONVEYANCE SYSTEMS

A. Natural and Artificial Systems

Conveyance systems are drainage facilities, both natural and artificial, that collect, contain, and convey stormwater runoff. Natural conveyance systems include, but are not limited to, swales, wetlands, drainage courses, streams, and rivers. Artificial conveyance systems include, but are not limited to, gutters, ditches, pipes, catchbasins, manholes, constructed wetlands, open channels and swales.

Any requirement for artificial conveyance systems, where natural systems already exist, shall not eliminate or supersede any code requirements for protection of the natural systems.

B. Design

1. Hydraulic flow capacity for conveyance systems shall be calculated using the Manning Formula. Coefficients for specific conditions are provided in Table 5-1 below.
2. A single-event hydrologic model such as the Santa Barbara Urban Hydrograph model shall be used to predict flows for design purposes.

5-04 CONVEYANCE SYSTEMS - OPEN CHANNELS

(Standard Drawing: 5-010)

A. Design

1. Drainage conveyance systems in rural areas shall be:
   a. open, vegetation-lined channels for channel gradients up to 8%, or

b. open, rock-lined channels for gradients of 8% through 15%, or

c. enclosed pipe systems for gradients exceeding 15%.

2. Alternatives to the open, vegetation-lined channel standard for grades up to 8% may be approved if:

   a. construction of the vegetation-lined channel will require an EDDS deviation for some other reason; or

   b. the director determines that an open channel presents an unacceptable public health or safety risk; or

   c. a low impact development (LID) feature, with other specific design requirements, is approved as part of the conveyance system.

3. Open channel, vegetation-lined systems may also be approved for conveyance in certain urban areas, such as the Maltby UGA.

4. All ditches and channels shall be designed to provide a minimum freeboard of 6 inches when the design storm maximum flow is 10 cubic feet per second (cfs) or less. A minimum freeboard of 1.0 foot is required when the maximum design flow is greater than 10 cfs.

5. Ditch check dams may be installed across a ditch or swale to reduce flow velocity and dissipate energy. Ditch check dams shall be constructed in accordance with BMP C207 of the Drainage Manual.

6. Rock-lined channels with gradients exceeding 9% shall be designed by a professional civil engineer and approved by the Engineer. The design shall be based on soils and hydraulic analyses, and shall include rock sizing, filter blanket gradations and/or geotextile fabric.

7. Rock-lined open channels shall be lined with quarry spalls, or an acceptable alternative from the WSDOT Qualified Product List, that meet the requirements of Chapter 9-13 of the WSDOT Standard Specifications. The quarry spalls shall be placed to form a firm, dense protective mat consistent with Standard Drawing 5-010. They shall conform to the typical ditch section and profile. Individual rocks shall not protrude more than three inches from the ditch surface. Ditch dimensions shall be based on calculated stormwater flows.

8. The Engineer may require installation of a closed (pipe) drainage system under a paved shoulder with asphalt thickened edge under certain circumstances. See Standard Drawing 5-010.

9. Under exceptional conditions of erodibility or water velocity, the Engineer may require more stringent methods to control erosion and sediment transport.

B. Friction Coefficients

The Manning coefficient values shown in Table 5-1 shall be used for design of open channel conveyance systems. For other materials, designers shall use values contained in

the current WSDOT Hydraulics Manual or the "Normal" value shown in Open Channel Hydraulics, Ven Te Chow, 1959. Designers shall justify the source of the Manning coefficient value used if different from the values below**.**

Table 5-1 Open Channel Friction Coefficients

STANDARD OPEN CHANNEL FRICTION COEFFICIENTS	
GRASS	0.025
ROCK, 8 INCH AND LARGER	0.050
ROCK, SMALLER THAN 8 INCH	0.030
SMOOTH CONCRETE OR ASPHALT	0.015

5-05 CONVEYANCE SYSTEMS - PIPES

(Standard Drawings: 5-030, B-55.20-00, B-70.20-00 and 5-055A, B, C & D)

A. Slope

Pipes 18 inches and less in diameter shall be laid with a minimum slope of 0.5%. Pipes installed as water level equalizers, fish passages, and/or internal components of a detention/retention system may have a flatter slope.

B. Flow Velocity

The minimum flow velocity in a conveyance pipe shall be three (3) feet per second when flowing full.

C. Minimum Size

Conveyance pipes, including driveway culverts but not yard drain pipe systems described in subsection 5.05.G below, shall have a minimum diameter of 12 inches. In special cases, such as conflict with underground utilities where redesign would cause unusual hardship, the Engineer may approve the use of 8-inch pipe, provided its length does not exceed 60 feet. If 8-inch pipe is approved, the pipe shall be constructed of smooth-walled material (such as concrete, cast iron, double-walled polyethylene, or equivalent material). Installation shall meet or exceed the manufacturer's specification for cover requirements.

Replacement of any existing pipe shall be with an equivalent diameter or larger pipe. Single-walled plastic pipe must be upgraded to double-walled pipe.

D. Friction Coefficients

The Manning coefficient values shown in Table 5-2 shall be used for pipe system design. For other types of pipes and/or materials, designers shall use values contained in the current WSDOT Hydraulics Manual or the "Normal" value shown in Open Channel Hydraulics, Ven Te Chow, 1959. Designers shall justify the source of the Manning coefficient value used if different from the values below.

Table 5-2 Pipe Friction Coefficients

STANDARD PIPE FRICTION COEFFICIENTS	
PIPE	**COEFFICIENT,** n
Concrete, smooth wall	0.012
Corrugated steel or aluminum	0.024
Corrugated polyethylene (HDPE)	0.024
Corrugated polyethylene, smooth interior	0.012
Polyvinyl chloride (PVC)	0.012

E. Headwater Depth

For circular culverts, box culverts and pipe arches, the maximum headwater depth for the design storm shall not exceed 2.0 times the culvert height for culverts 18 inches and less, or 1.5 times the culvert height for culverts greater than 18 inches.

For bottomless culverts, the headwater depth of the 100-year storm shall not exceed the top of the culvert.

F. Wyes and Tees

Connections to a drainage pipe system in the public right-of-way shall be made only at catchbasins or manholes. Wyes or tees may be used for roof/footing/yard drain systems with pipes 8 inches or less in diameter. Cleanouts are required upstream of each wye or tee.

G. Yard Drain Systems

Yard drain system details are provided in Standard Drawing 5-030. Minimum pipe diameter for a single, residential roof/footing/yard drain system on private property is 4 inches. Systems serving multiple dwellings will require 6-inch or 8-inch pipe. Yard drain system pipes in the public right-of-way shall have a minimum diameter of 12 inches.

H. Drainage Stub-Outs

1. Drainage stub-outs shall be provided for each proposed lot to be served by a new drainage pipe system only if individual lot infiltration systems or dispersion systems are not provided per SCC 30.63A.525. Infiltration, dispersion or stub-out systems shall be designed and constructed in accordance with the Drainage Manual and the EDDS.
2. Each drainage stub-out, if installed, shall connect to the pipe conveyance system at the lowest elevation on the lot abutting the drainage system whenever possible, so that stormwater will be conveyed from all future roof downspouts, driveways, and yard drains. This requirement shall not preclude the connection of footing drains or

other subsurface drains. If a low area exists on the opposite side of a proposed driveway, an additional stub-out shall be installed to capture that drainage.

3. Each drainage stub-out shall have free-flowing drainage to an existing or proposed yard drain, dispersion trench or other structure on the pipe conveyance system or to an approved outfall location.
4. Drainage stub-outs shall be clearly marked at the time of drainage system construction.
5. Drainage stub-outs that are designed and/or installed at an elevation that may allow runoff from the main drainage system to backflow into the stub-out at design flow conditions shall be required to have a backwater flow prevention device installed at the upstream end of the stub-out.
6. For lots without individual roof downspout infiltration systems, downspout dispersion systems, or perforated stub-out connections, runoff from roof and footing drains shall be connected by non-perforated pipe to a standard catchbasin within the development's storm drainage system, using yard drains as shown on Standard Drawing 5-030.

I. Pipe Placement and Materials

1. Construction of culverts and storm sewers shall comply with the WSDOT Standard Specifications Chapters 7-02 and 7-04, respectively, and AASHTO specifications. Pipe materials shall comply with Chapter 9-05 of the WSDOT Standard Specifications with the following additions and clarifications.
2. Corrugated polyethylene pipe is an acceptable alternative for Schedule A culvert pipe and for storm sewer pipe as specified in Chapters 7-02 and 9-05 of the WSDOT Standard Specifications. Corrugated polyethylene pipe shall be double-walled (smooth interior).
    a. Culvert pipe shall meet the requirements of AASHTO M 294 Type S or D for pipe 12 to 60 inches in diameter.
    b. Storm sewer pipe and fittings shall meet the requirements of AASHTO M 294 Type S or D.
3. Pipe shall be installed in a trench with bedding and backfill as shown in WSDOT Standard Plan B-55.20-00. For burial depths exceeding 15 feet, culvert and storm sewer pipe selection may vary in accordance with schedules in WSDOT Standard Specifications 7-02 and 7-04, respectively. Maximum and minimum depths of cover appropriate for various pipe materials and specifications are provided in the Fill Height Tables in Chapter 8 (Pipe Classifications and Materials) of the WSDOT Hydraulics Manual.
4. Galvanized steel pipe shall have asphalt coating Treatment 1 as specified in WSDOT Standard Specification 9-05.4. Aluminized steel pipe may be used without Treatment 1.
5. Where alternate materials are permissible (i.e. different types of storm sewer pipe, concrete, CMP, polyethylene, etc.), such alternate materials shall be clearly denoted

on the road construction plans. Alternate materials may be substituted in the field provided they are listed on the WSDOT Qualified Product List.

6. Corrugated metal pipe and treated corrugated steel pipe, except aluminized, shall not be used in streams, in or downstream of wetlands, in hydric soils, or as any part of a detention, retention, infiltration, or treatment system. Aluminized metal pipe may be used in streams, in or downstream of wetlands, in hydric soils, or in any part of a detention, retention, infiltration, or treatment system.
7. Pipe shall be laid on a straight line and grade between catchbasins.
8. Pipes laid close and parallel to each other (commonly called "twin pipes") shall not be allowed unless the site conditions warrant (typically a conflict with an existing utility) subject to prior approval of the Engineer.
9. All pipes shall have a minimum of 12 inches cover at the top of the bell, or cover per manufacturer's specifications, whichever is greater.
10. Where pipes of dissimilar material or size are joined, a catchbasin shall be installed.

J. Pipe Joints

All pipes shall be tightly joined except with the Engineer's approval, pipe systems that are designed to collect or disperse stormwater along the length of the pipe. Pipe joints shall meet the construction and testing requirements of Chapters 7-04, 9-04 and 9-05 of the WSDOT Standard Specifications.

K. Leak Testing

Leak testing, as set forth in WSDOT Standard Specification 7-04.3, shall be required as specified by the Engineer.

L. Pipe Ends

1. Driveway culverts and cross-culverts, 30 inches or less in diameter, projecting from driveways or roadway side slopes shall be beveled as shown on WSDOT Standard Plan B-70.20-00. Pipe ends stubbing out from the drainage system and located outside the road right-of-way, or in areas not accessible to errant vehicles, need not be beveled, but may require a headwall or other pipe end treatment in accordance with WSDOT Standard Plans and Standard Specifications.
2. Headwalls in any stormwater detention or water quality system shall be concrete or rock riprap with mortar. Refer to the WSDOT Hydraulics Manual or to FHWA Hydraulic Engineering Circular No. 11 (Design of Riprap Revetment) for riprap design.
3. Adequate energy dissipation shall be provided in accordance with the WSDOT Hydraulics Manual or FHWA Hydraulic Engineering Circular No. 14 (Hydraulic Design of Energy Dissipators for Culverts and Channels).
4. Level spreader trenches and swales shall conform to the following standards and specifications. Refer to Standard Drawings 5-055A, B, C and D.

a. Level spreader trenches and swales shall not be installed in critical areas, as defined by Snohomish County Code.

b. The maximum design inflow rate for a level spreader is 0.5 cubic feet per second.

c. The maximum allowable ground slope for surface flow into and out of a level spreader trench is 5%, unless an energy dissipater is provided. In any case, the maximum allowable ground slope for surface flow into or out of a level spreader trench is 20%.

d. An energy dissipation device may be required for freshwater outfalls with a design velocity greater than 10 feet per second. Further discussion is provided in Volume V of the Drainage Manual.

e. The trench and the dispersion device must be level. No wood structures are allowed due to breakdown and settlement over time. Preferred materials for the dispersion device are concrete, such as a concrete curb section or poured-in-place footing, or PVC lumber with anchor posts. Notches in the dispersion device shall be v-shaped as shown on Standard Drawings 5-055B and 5-055C. The dispersion device shall be placed and anchored so that the top of the dispersion device is 1 inch above ground level. Additional flow-spreading design options are discussed in Volume V of the Drainage Manual.

f. Level spreader trenches shall not result in a point source discharge onto an adjacent property.

g. Level spreader trenches shall not be located closer than 20 feet upstream from any adjoining downstream property.

h. For the grass swale dispersion system, the swale and drain rock dispersion berm shall extend a minimum of 10 feet downstream from the level spreader. Refer to Standard Drawing 5-055A.

i. Minimum separation between trenches shall be 50 feet laterally and 100 feet along the discharge flowpath.

j. Tightline systems may be required to prevent the creation or aggravation of downstream erosion conditions.

M. Pipe Trenches

1. The excavation, bedding, backfill, and compaction requirements for utility and storm drainage trenches are as set forth in Chapter 7-08 of the WSDOT Standard Specifications and as shown on WSDOT Standard Plan B-55.20-00. Backfill compaction shall be by mechanical means.
2. Trenches that cross streams or wetlands, are dug on slopes in excess of 8%, or that intercept perched water may transport water to unintended locations. Trench plugs or anti-seep collars shall be installed every 50 feet in the trench.
3. Trenches installed in the hyporheic zone of a stream require free-draining backfill and trench plugs or anti-seep collars. Trench plugs or anti-seep collars shall be installed as necessary to control flow through the trench.

4. The material for the trench plug shall be less permeable than the sides of the trench and shall support the roadway, and other loads, without differential settlement. When installed in a roadway prism, the top of the trench plug or anti-seep collar shall match the bottom of the roadway surfacing material (gravel base or crushed surfacing top course).

N. Debris Barriers

Debris barriers shall be designed and installed at entrances to and exits from enclosed drainage systems that are 18 inches or larger in diameter. Cross-culverts and driveway culverts shall be exempt from this requirement.

5-06 DRAINS

A. Specifications

Drains, including underdrains, shall conform to Chapter 7-01 of the WSDOT Standard Specifications. Authorized pipe materials shall be as specified in Section 7-01.2 of the Standard Specifications and the current revisions of the AASHTO M252 or M294 Specifications. An exception is galvanized or Treatment 1 corrugated metal pipe shall not be used in streams, in or downstream from wetlands, in acid-based soils, or for any part of a stormwater detention/retention system or drainage storage system.

B. Geotextile Fabric

Geotextile filter fabric shall be placed in underdrain trenches in accordance with the manufacturer's recommendations and these Standards. There shall be a one foot minimum overlap of the fabric when the geotextile fabric is wrapped around a trench section. Chapter 9-33 of the WSDOT Standard Specifications shall be used for determining the geotextile fabric properties required.

5-07 CATCHBASINS, MANHOLES AND INLETS

(Standard Drawings: B-05.20-00, B-05.40-00, B-05.60-00, B-10.20-00, B-25.60-00, 5-120, B-15.20-00, B-15.40-00, B-15.60-00 and 5-170)

A. Design

1. Chapter 7-05 of the WSDOT Standard Specifications applies to catchbasins, manholes and curb inlets unless otherwise specified.
2. Catchbasin and manhole design assumes soil load-bearing capacity of 3,300 pounds per square foot (psf). Where the soil capacity is less, the catchbasin or manhole bases shall be designed by a licensed engineer.
3. Manholes shall not be used except for special situations, such as angle points, difficult access or constricted areas, approved by the Engineer.
4. Maximum spacing on surface drainage courses between catchbasins, manholes or inlets shall be as shown in Table 5-3.

Table 5-3 Catchbasin, Manhole or Inlet Spacing

CATCHBASIN, MANHOLE OR INLET SPACING	
ROAD GRADE	**SPACING**
LESS THAN 1.0%	150 Feet
1.0% TO 3.0%	200 Feet
3.0% OR GREATER	300 Feet

5. Additional catchbasins shall be installed as needed to confine drainage to the gutter and prevent flow into traffic lanes or intersections. On cul-de-sacs and curves, inlet spacing shall be measured along the flow line of the roadway.
6. The maximum spacing between storm sewer access structures, whether catchbasins or manholes, or between a high point and an access structure, shall be 300 feet.

B. Types of Catchbasins

1. The following catchbasins may be used in storm sewers:

CB Type 1	WSDOT Std. Plan B-5.20-00
CB Type 1-L	WSDOT Std. Plan B-5.40-00
CB Type 1-P	WSDOT Std. Plan B-5.60-00
CB Type 2	WSDOT Std. Plan B-10.20-00

2. In special cases, such as conflict with existing underground utilities, the Engineer may approve the use of concrete inlets as shown on WSDOT Standard Plan B-25.60-00.
3. Concrete inlets and Type 1, Type 1-L, and Type 1-P catchbasins shall not be used in storm sewers where the depth from the finished grade to the invert of the lowest pipe exceeds 5 feet. Type 2 catchbasins shall be used instead.
4. Details for catchbasin circular frames and covers, including reinforcement of the flat slab tops, are shown on Standard Drawing 5-120.

C. Types of Manholes

1. Where the use of a manhole has been approved by the Engineer, the manhole shall be one of the following types:

MH Type 1	WSDOT Std. Plan B-15.20-00

MH Type 2	WSDOT Std. Plan B-15.40-00
MH Type 3	WSDOT Std. Plan B-15.60-00

2. Details for manhole circular frames and covers, including reinforcement of the flat slab tops, are shown on Standard Drawing 5-170.

D. Extension Risers

Extension sections or risers shall be installed as indicated on the above referenced standard drawings for catchbasins and manholes and shall be of the material indicated.

E. Ladders, Steps and Handholds

Catchbasin and manhole ladders, steps, and handholds shall conform to Standard Drawings 5-120 and 5-170. The step locations shall conform to the WSDOT Standard Plan for the applicable structure indicated in subsection B or C above.

F. Cover

All catchbasin and manhole structures shall be covered, as a minimum, up to the base of the frame for the grate or solid lid by compacted soil or appropriate paving material.

5-08 FRAMES, GRATES AND COVERS

(Standard Drawings: B-30.10-00, B-30.20-00, B-30.30-00, B-30.40-00, B-25.20-00, 5-220A, 5-220B, 5-225 and5-230)

A. Materials

Unless otherwise specified, materials and installation shall conform to the specifications of the WSDOT Standard Specifications. In particular, cast (gray) iron products shall conform to the requirements of AASHTO M306 and ductile iron to ASTM Designation A536, Grade 80-55-06. All metal castings shall meet the proof load testing requirements of AASHTO M306.

B. Types of Frames, Grates and Covers

1. Unless specified otherwise in these Standards, a 20-inch x 24-inch ductile iron frame and grate shall be used for drainage structures located within the road prism. See WSDOT Standard Plan B-30.10-00 for details.
2. When a structure does not function as an inlet to the drainage system, a solid locking cover shall be installed in accordance with WSDOT Standard Plan B-30.20-01.
3. Where the roadway grade is 4% or greater, a ductile iron vaned grate shall be installed in accordance with WSDOT Standard Plan B-30.30-00 or B-30.40-00.
4. A through-curb inlet frame shall be used on arterial roadways, where conditions limit the effectiveness of a flat surface inlet, in accordance with WSDOT Standard Plan B-25.20-00. Examples of such conditions include, but are not limited to, road grades exceeding 12%, locations where there is a high likelihood of clogging from

debris, such as sag vertical curves, and locations where surface flow is likely to flow over a curb. Grates used in through-curb inlets shall be ductile iron vaned grates.

5. All grates and associated products shall provide for the safe accommodation of non-motorized as well as motorized transportation.
6. Projects designed with rolled curbs shall use standard frames and grates instead of rolled curb frames and grates. Refer to WSDOT Standard Plans B-30.10-00, B-30.20-01, B-30.30-00 and B-30.40-00. EDDS Standard Drawings 5-220A, 5-220B and 5-225 for rolled curbs are provided for reference specifications and replacement purposes only.
7. Specifications for catchbasin or manhole rings and covers are provided in Standard Drawing 5-230.

C. Lettering

The top surfaces of grates and covers shall be embossed in block lettering as follows:

- "DRAIN": three-inch letters on all solid covers.
- "OUTFALL TO STREAM, DUMP NO POLLUTANTS": 1/2-inch letters on all grates.

D. Securing Grates and Covers

All solid covers and grates shall be secured with 5/8-inch stainless steel socket head cap screws as depicted on the Standard Drawings. A light coating of anti-seize thread compound shall be applied to the screws at the time of installation. The anti-seize compound used shall be Loctite 767 or approved equivalent, applied according to the manufacturer's recommendations.

5-09 OTHER MATERIALS

Subject to prior approval by the Engineer, other types and materials of pipe, geotextile fabric, and drainage hardware may be used provided that recognized specifications are available to control quality and acceptable user experience with the product can be shown. Drainage items on the WSDOT "Qualified Products List" will be accepted.

PART II – STORMWATER FLOW CONTROL AND TREATMENT

This section contains engineering standards for design and construction of stormwater flow control and treatment facilities. These systems are categorized herein as open systems (e.g., ponds and open filters), trenches, and closed systems (e.g., pipes and vaults). These categories are useful because many design features within each group, for example, earthen berms for open systems, are common to different systems in the group.

Many of these systems can provide both flow control and treatment, and the designer must also refer to Chapter 30.63A SCC (Drainage) and the Snohomish County Drainage Manual to for project-specific selection of appropriate stormwater facilities. The Snohomish County Drainage Manual also contains additional design information, including information about hydrologic analyses.

Standards and specifications for various drainage system components, such as catch basins, that may be part of flow control and treatment facilities are presented in other sections or chapters of EDDS or documents incorporated by reference. Unless otherwise noted in the Drainage Manual, those standards and specifications apply.

OPEN SYSTEMS

5-10 DETENTION PONDS

(Standard Drawings: 5-240A, 5-240B, 5-240C and 5-250)

A. General

1. Detention ponds shall be designed as flow-through systems, with the exception of parking lot detention, which may utilize a back-up system. Flow must enter through a conveyance system separate from the control structure and outflow conveyance system. The distance between the inlet and outlet should be maximized to promote sedimentation.
2. Detention pond bottoms shall not be wider than 30 feet at the bottom, unless an access/maintenance road is constructed into the bottom of the facility.
3. Detention pond bottoms shall be level.
4. The elevation of the detention pond bottom shall be a minimum of 0.5 feet below the invert inlet and invert outlet elevations.
5. State regulations require review and approval by the Washington State Department of Ecology Dam Safety Office of detention ponds that impound 10 acre-feet or more. Requirements imposed by the Dam Safety Office shall supersede any conflicting requirements contained in these Standards.
6. Detention ponds shall not be located within 200 feet of the top of an erosion hazard or landslide hazard area as defined by Subtitle 30.6 SCC, unless a geotechnical analysis shows that no slope instability will result. Under no circumstances shall detention ponds be located within 50 feet of the top of an erosion hazard area or landslide hazard area.
7. Energy dissipaters and level spreader trenches for outflow dispersion, if required, shall conform to the requirements of Section 5-05.L of these Standards.

B. Berms

1. Earthen berms higher than 6 feet must be designed by a professional engineer with geotechnical expertise.
2. Earthen berms 6 feet or less in height shall have a minimum top width of 6 feet, unless otherwise specified by a professional engineer with geotechnical expertise.
3. Earthen berms greater than 4 feet in height must be constructed by excavating a key equal to 50 percent of the berm cross-sectional height and width, unless specified otherwise by a geotechnical engineer.
4. Interior (water-side) slopes of earthen berms shall have a maximum slope of 3 horizontal to 1 vertical. Exterior (non-water-side) slopes of earthen berms shall have a maximum slope of 2 horizontal to 1 vertical.

5. Earthen berms must be constructed on native consolidated soil (or adequately compacted and stable fill soils analyzed by a geotechnical engineer) free of loose surface soil materials, roots, and other organic debris.
6. Earthen berms shall be constructed of material with the following characteristics per the United States Department of Agriculture's Textural Triangle: a minimum of 20% silt and clay, a maximum of 60% sand, a maximum of 60% silt, with nominal gravel and cobble content. Alternatively, berms may be constructed of material meeting the specifications of Table 5-4. Alternative specifications prepared by a licensed engineer with geotechnical expertise may also be submitted for approval.

Table 5-4 Earthen Berm Material Specifications

BERM MATERIAL SPECIFICATIONS	
SIEVE SIZE	**% PASSING**
4 inches square	100
US No. 4	30 - 80
US No. 200	15 - 30

7. Compaction of earthen berms shall be accomplished in such a manner as to produce a dense, low permeability engineered fill that can tolerate post-construction settlements with a minimum of cracking. The fill shall be placed on a stable subgrade and compacted to a minimum of 95% of the maximum density, as determined by the requirements of the 2008 WSDOT Standard Specifications Section 2-03.3(14)C - Compacting Earth Embankments.
8. The top of an earthen berm shall be at least 1 foot above the emergency spillway, subgrade, or hardened overflow surface elevation of the water surface occurring at the 100-year, 15-minute flow rate predicted by an approved continuous runoff model. The 100-year, 15-minute flow rate is estimated by multiplying the 100-year, 1-hour rate by a factor of 1.6.
9. Anti-seepage collars shall be used on outflow pipes in berms that impound more than 8 feet of water.

C. Concrete / Structural Elements

1. Detention ponds may have vertical concrete sidewalls, provided:
   a. The walls are designed by a licensed structural engineer.
   b. The walls are constructed with minimum 3000 psi structural reinforced concrete and are watertight. Porous materials, such as keystone, ecology blocks or rockeries shall not be used as an element of the wall below the waterline unless approved by the Engineer.
   c. A fence is installed along the top of all wall sections. Fence specifications are provided in EDDS Section 5-10.J.

d. A ladder is installed as a safety access measure.

D. Drains / Liners / Geotextile Materials

Liners are intended to reduce the likelihood that pollutants in stormwater will reach ground water when runoff treatment facilities are constructed. Information about selection of liners for different drainage facility components, and engineering standards and specifications for liners is set forth in Volume V, Chapter 4.4 of the Drainage Manual.

E. Presettling Basins / Inflow Control Structures

1. A presettling basin is a pretreatment system intended to remove debris, sediment and associated pollutants from stormwater before it enters treatment or flow control facilities. Additional pretreatment systems, such as oil control systems, may be required for some kinds of treatment or flow control systems or for some development or redevelopment projects for which the Stormwater Site Plan has determined the need for additional pretreatment.
2. Presettling basins shall be required to protect the following flow control and treatment systems:
    a. Granular medium filters (e.g., sand filters, zeolite filters, and compost filters).
    b. Stormwater treatment wetlands used either for flow control or treatment.
    c. Infiltration systems used either for flow control or treatment, except on-site infiltration and dispersion BMPs and perforated stub-out connections described in Volume III, Chapter 3 and Volume V, Chapter 5 of the Drainage Manual.
    d. Any flow control or treatment system for which the Stormwater Site Plan has determined that the post-development stormwater generated by the project will contribute a significant amount of sediment or debris to the flow control or treatment system.
3. Presettling basins shall have a wet pool with a dead storage volume of at least 30 percent of the total volume of runoff from the 6-month, 24-hour storm event.
4. Presettling basins may be constructed with earthen berms or vertical concrete walls, or may be contained in closed structures such as vaults or manholes. Earthen berms shall conform to the standards set forth in Section 5-10.B of this chapter. Other structures shall conform to the requirements of these Standards.
5. Presettling basins constructed of earthen material shall be lined in accordance with the requirements of Section 5-10.D of this chapter.
6. The flowpath length-to-width ratio shall be a minimum of 3:1. Interior berms or baffles may be used to achieve this ratio.
7. The depth of the dead storage volume shall be between 4 feet and 6 feet, unless otherwise specified for a particular flow control or treatment system in the Drainage Manual.
8. Inlets and outlets of presettling basins shall be designed to minimize flow velocity and turbulence.
9. The entire area of the presettling basin shall be accessible by maintenance equipment. If the width across the top of the presettling basin is greater than 30

feet, an access road to the bottom of the basin shall be constructed that meets the requirements of Section 5-10.I - Access Roads.

10. Other inflow control structures include flow splitters, which are used for "off-line" systems. Standards and specifications for flow splitters are contained in Volume V, Chapter 4 of the Drainage Manual.

F. Flow Restriction and Oil Pollution Control Structures

1. Flow Restriction / Oil Pollution Control (FROP) Structures

   a. A FROP structure shall be installed in a separate Type 2 catchbasin or vault outside the impoundment portion of a detention pond. It shall be located where it can function properly and be maintained effectively by a vactor truck.

   b. No part of a FROP structure shall restrict access into the catchbasin.

   c. A FROP structure shall be constructed and installed in accordance with Standard Drawings 5-240A and B, or as specified by the Engineer. The FROP-T shear gate shall be as specified on Standard Drawing 5-250.

   d. A riser pipe to serve as a primary overflow shall be provided as shown in Standard Drawing 5-240B. The riser pipe shall be able to bypass the 100-year developed peak flow over or around the restrictor system.

   e. A FROP structure shall be provided with a solid, round, locking lid. It shall be so located and installed such that no storm drainage will enter the structure through the access hole or the top slab or risers.

2. Oil Pollution Control Structures

   a. An oil pollution control unit shall be installed in a separate Type 2 catchbasin located where it can function properly and be maintained effectively by a vactor truck.

   b. The oil pollution control unit shall be constructed and installed in accordance with Standard Drawing 5-240C, or as specified by the Engineer, so that access into the catchbasin is not restricted.

   c. The shear gate shall be as specified on Standard Drawing 5-250.

   d. The oil pollution control unit shall be provided with a solid, round, locking lid. It shall be located and installed such that no storm drainage will enter the structure through the access hole or the top slab or risers.

G. Emergency Overflow Structures

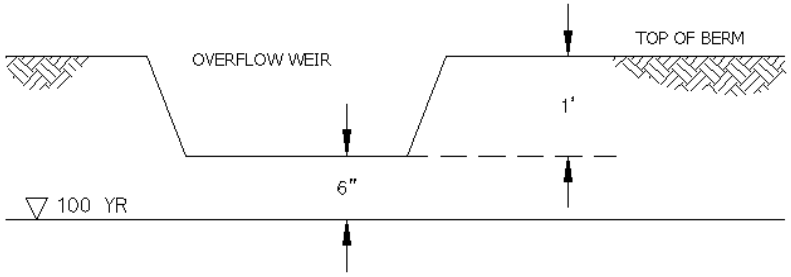
An emergency overflow structure allows water to exit a drainage facility by a selected path other than the standard outlet structure without causing damage to the drainage facility, such as erosion of an earthen berm.

1. An emergency overflow structure shall be provided that conveys the developed site's maximum developed flow from the facility into the downstream drainage system without damage to any drainage facility or system. Overflow structures may be open channel spillways, weirs or closed conduit systems, but shall not be connected to or through the flow control structure. The preferred method to establish the overflow

invert elevation in an open channel is a concrete curb or sill. The emergency overflow system for a flow control system shall bypass any water quality treatment system.

2. If the emergency overflow structure is an open channel, it shall be designed as a broad-crested weir, to pass the 100-year, 15-minute flow rate calculated using a continuous simulation runoff model approved by Snohomish County. The 100-year, 15-minute flow rate is estimated by multiplying the 100-year, 1-hour rate by a factor of 1.6. The channel shall be armored with quarry spalls or riprap that conform to WSDOT specifications, provided that larger material shall be used if necessary to prevent erosion from the maximum design flow. The quarry spalls or riprap layer shall be at least one foot thick. Individual rocks or riprap pieces shall not protrude more than three inches from the one foot thick layer.
3. The emergency overflow elevation shall be 0.5 feet above the 100-year, 15-minute flow rate calculated using a continuous simulation runoff model approved by Snohomish County. The 100-year, 15-minute flow rate is estimated by multiplying the 100-year, 1-hour rate by a factor of 1.6. The top of the pond berm shall be at least 1 foot above the elevation of the emergency overflow.
4. Emergency spillway systems for detention ponds that may impound 10 acre-feet or more are governed by the Dam Safety Guidelines of the Dam Safety Office of the Department of Ecology. These requirements shall supersede any requirements of this subsection that may conflict.

Emergency Overflow



H. Weirs Used For Flow Control

1. Weirs shall be designed to control flows in accordance with the calculation methods set forth in the Drainage Manual.
2. Weirs shall have a debris barrier installed directly upstream of the weir.
3. Weir wall structures shall be reinforced concrete on a reinforced concrete pad poured in place for five (5) feet upstream and downstream of the weir wall. The concrete pad shall extend one (1) foot in width to each side of the outside edge of the weir.
4. If a chain link fence is constructed directly over or adjacent to the weir structure, the chain link shall extend to within two (2) inches of the top of the weir, to prevent unauthorized access to the facility. A bottom rail meeting WSDOT Standard

Specifications shall be installed, extending a minimum of five (5) feet horizontally from each edge of the weir.

5. Weirs shall be designed as sharp-crested weirs using end contraction correction factors or other formulas approved by the Engineer.
6. Metal weir plates shall be designed to be field adjusted, bolted, or otherwise fastened to the foundation, not embedded in concrete. Weir plate fasteners that allow field adjustment shall be used.

I. Access Roads

1. Access to detention ponds shall be provided in accordance with Chapter 30.63A SCC.
2. Safe and adequate access shall be provided to operate and/or maintain the detention pond and its controls, to provide for repair and improvement, and to perform maintenance during all times of the year. Detention ponds shall be designed and constructed in a manner that provides safe access and working conditions for personnel, such as placing control structures in accessible locations and not elevating access frames and grates more than four (4) inches above the surrounding terrain. Any appropriate safety measures for personnel access, such as handholds, railings, etc. shall be installed. The Engineer shall determine whether a proposed access and its associated drainage facilities are adequate and safe.
3. Access shall be provided to:
    a. All control structures, including weirs and emergency overflow structures.
    b. All catchbasins and water quality treatment systems associated with the detention pond.
    c. All inlets and outlets of the pond, including level spreader trenches, energy dissipaters, and other pipe ends and pipe end structures.
    d. All catchbasins within the pond.
    e. The bottom of the ponds, except those ponds designed to be maintained from the perimeter.
4. Vehicular access shall meet the following criteria:
    a. The access road shall have a minimum width of 15 feet if a turnaround is provided; a 20-foot minimum width is required if a turnaround is not provided.
    b. The access road shall meet the HL-93 (Load Resistance Factor Design method) loading requirements of AASHTO. At a minimum, the road shall have 6 inches of compacted depth gravel borrow or pit run gravel over a stable subgrade. The gravel shall be well-graded, well-compacted and contain sufficient fines to bind the gravel for traction.
    c. The maximum allowable grade is 15%. If a grade greater than 15% is approved by the Engineer, the road must be paved with a minimum of 2 inches of hot mix asphalt (HMA) over the gravel layer.
    d. Materials shall meet WSDOT Standard Specifications 4-02 (Gravel Base) and 5-04 (Hot Mix Asphalt).

e. A hammerhead turnaround shall be provided if the access road:

- is 75 feet or longer, or
- connects to an arterial road right-of-way, or
- has a grade of 5% or greater, or
- has a horizontal curve radius of 100 feet or less.

f. Hammerhead turnarounds shall have dimensions of 40 feet by 40 feet with a 20-foot inside radius.

J. Fencing

1. The fencing requirements of this subsection are intended to provide permanent safety and security around detention ponds. Temporary fencing for the purpose of identifying boundaries for clearing, sensitive areas and buffers, or construction access, is described in BMPs C103 and C104 of the Drainage Manual.
2. Fencing is required for safety and security purposes around all detention ponds for which the maximum design water depth is greater than 3 feet or the inside slopes are steeper than 3 horizontal to 1 vertical.
3. Fencing is not required if one interior horizontal safety bench with a width of at least 10 feet is provided around the entire perimeter for each three feet of water depth, and the interior sideslopes are no steeper than 3 horizontal to 1 vertical. No benching or fencing is required where side slopes are 4 horizontal to 1 vertical or flatter.
4. Detention ponds that do not require fencing must still be graded to blend with the topography of the site.
5. Fencing and gates shall be Type 1 or Type 3 chain link fence in accordance with WSDOT Standard Specifications and Standard Plans L-10.10 or L-20.10. Line posts for all fences shall be galvanized and set in concrete. Fences shall be no less than six (6) feet in height, from the ground to the top of the chain link. Wooden fences are not allowed as the security fence.
6. The gap between the bottom of the chain link fence and the ground surface shall not exceed two inches.
7. An access opening with a minimum width of 16 feet shall be located at the access route entrance. Two gates of equal length shall be provided for the access opening. Gates shall be designed and constructed in accordance with WSDOT Standard Specifications and Standard Plans L-10.10 or L-30.10. Gates shall include a combination lock.

K. Vegetation

1. Permanent vegetation shall be established on earthen components of drainage facilities using seed mixes recommended in BMP C120, "Temporary and Permanent Seeding," in the Drainage Manual, unless the Drainage Manual specifies different vegetation for a particular drainage facility type.
2. Trees shall not be planted on constructed perimeter berms designed for runoff impoundment. Trees may be planted at the top of open detention ponds that are created solely by excavation (no fill or berms).

3. Within tracts or easements containing detention ponds, landscaping of areas other than those described above shall conform to requirements set forth in SCC 30.25.023. An approved planting list for vegetative screening of stormwater flow control or treatment facilities is provided in Appendix B.

5-11 INFILTRATION PONDS

A. General

1. Infiltration pond bottoms shall not be wider than 30 feet at the bottom, unless an access/maintenance road is constructed into the bottom of the facility.
2. Infiltration pond bottoms shall have a slope of less than 3 percent.
3. Initial basin excavation shall be conducted to within 1 foot of the final elevation of the basin floor. Excavate infiltration trenches and basins to final grade only after all disturbed areas in the upgradient project drainage area have been permanently stabilized. The final phase of excavation shall remove all accumulated sediment in the infiltration facility before putting it in service.
4. Relatively light-tracked equipment shall be used for excavation of the infiltration pond to avoid compaction of the floor. The use of draglines and trackhoes shall be considered. The area to be used for an infiltration pond shall be flagged or otherwise marked to keep heavy equipment from driving on it.
5. Infiltration ponds shall not be located within 200 feet of the top of an erosion hazard area or landslide hazard area as defined by Subtitle 30.6 SCC, unless a geotechnical analysis shows that no slope instability will result. Under no circumstances shall infiltration ponds be located within 50 feet of the top of an erosion hazard area or landslide hazard area.

B. Berms

- Standards and specifications for berms in Section 5-10.B - Detention Ponds shall apply to infiltration ponds.

C. Concrete / Structural Elements

- RESERVED

D. Drains / Liners / Geotextile Materials

1. If the infiltration pond is intended to provide treatment, all areas of the pond that are not constructed of native soil and that are below the design water level in emergency overflow conditions shall be lined with a minimum of 18 inches of treatment soil. See Section 4.4.2, Design Criteria for Treatment Liners, of Volume V of the Drainage Manual for treatment soil.
2. Unless otherwise specified, materials and methods shall conform to the 2008 WSDOT Standard Specifications.
3. Infiltration basins may be covered with a 6-inch to 12-inch layer of filter material such as coarse sand, or a suitable filter fabric to help prevent the buildup of impervious deposits on the soil surface.

E. Presettling Basins / Inflow Control Structures

- Standards and specifications for presettling basins and inflow control structures in Section 5-10.E - Detention Ponds shall apply to infiltration ponds.

F. Flow Restriction and Oil Pollution Control Structures

- RESERVED

G. Emergency Overflow Structures

- Standards and specifications for emergency overflow structures in Section 5-10.G - Detention Ponds shall apply to infiltration ponds.

H. Weirs Used For Flow Control

- RESERVED

I. Access Roads

1. Standards and specifications for access roads in Section 5-10.I - Detention Ponds shall apply to infiltration ponds.
2. Access to infiltration ponds shall be provided in accordance with Chapter 30.63A SCC.

J. Fencing

- Standards and specifications for fencing in Section 5-10.J - Detention Ponds shall apply to infiltration ponds.

K. Vegetation

1. Standards and specifications for vegetation in Section 5-10.K - Detention Ponds shall apply to infiltration ponds.
2. Infiltration basins designed to provide treatment must have sufficient vegetation established on the basin floor and side slopes to prevent erosion and sloughing and to provide additional pollutant removal.

5-12 BIORETENTION FACILITIES

Bioretention facilities are essentially infiltration basins with two special features: First, the infiltration basin is overexcavated and partially refilled with a special bioretention soil mix that functions as a granular filtration medium to provide stormwater treatment. Second, specific vegetation is planted to maintain the soil's ability to adsorb pollutants and infiltrate water, and to absorb and degrade pollutants captured by the soil. A bioretention facility can be used as a combination flow control / treatment system, or can be designed with an underdrain, which reduces or eliminates the flow control function. There are several configurations of bioretention facilities, the most common of which is an enclosed basin. The standards and specifications in this section apply to all configurations.

A. General

1. Minimize compaction of the base and sidewalls of the bioretention area. Excavation shall not be allowed during wet or saturated conditions. Excavation shall be

performed by machinery operating adjacent to the bioretention facility and no heavy equipment with narrow tracks, narrow tires or large lugged, high pressure tires should be allowed on the bottom of the bioretention facility.

2. On-site soil mixing or placement shall not be performed if the soil is saturated. The bioretention soil mixture should be placed and graded by excavators and/or backhoes operating adjacent to the bioretention facility.
3. Bioretention facilities shall not be located within 200 feet of the top of an erosion hazard area or landslide hazard area, as defined by Subtitle 30.6 SCC, unless a geotechnical analysis shows that no slope instability will result. Under no circumstances shall bioretention facilities be located within 50 feet of the top of an erosion hazard area or landslide hazard area.
4. Energy dissipaters and level spreader trenches for outflow dispersion, if required, shall conform to the requirements of Section 5-05.L of these Standards.

B. Berms

- Standards and specifications for berms in Section 5-10.B - Detention Ponds shall apply to bioretention ponds.

C. Concrete / Structural Elements

- Bioretention facilities that are not intended to provide flow control by means of infiltration may be contained in precast concrete vaults or cast-in-place concrete structures. These structures shall conform to all relevant requirements set forth in these Standards.

D. Drains / Liners / Geotextile Materials

1. Standards and specifications for drains, liners, and geotextile standards set forth in Chapter in Section 5-10.D - Detention Ponds shall apply to bioretention ponds. Additional drainage design information is set forth in Volume III, Chapter 3.3.12 of the Drainage Manual.
2. Aggregate for underdrain systems shall be clean washed rock of 0.75 inch to 1.5 inch diameter.
3. Underdrain systems, if included in the design, shall be designed in accordance with the requirements for sand filtration treatment facilities described in Volume V, Chapter 8 of the Drainage Manual.

E. Presettling Basins / Inflow Control Structures

- Inlets for bioretention facilities shall be designed to spread influent flow uniformly across the filter bed and to prevent erosion or channeling of the filter bed. The preferred inlet design for a bioretention system is dispersed flow across a vegetated strip, which provides pretreatment and dissipates energy of the influent. If such flow dispersion is not provided, a flow spreader in accordance with Volume 5, Chapter 4 shall be installed.

F. Flow Restriction and Oil Pollution Control Structures

- RESERVED

G. Emergency Overflow Structures

- An overflow structure shall be provided in accordance with the requirements for infiltration facility design set forth in Chapter 3.3.9 of this volume. See surface pool depth criteria below. For bioretention facilities with contributing drainage areas of less than 1000 square feet, a minimum of 2 inches of freeboard shall be provided, measured from the overflow invert to the lowest point of the top of the slope defining the bioretention facility. For contributing drainage areas of 1,000 square feet or greater, a minimum of 6 inches of freeboard shall be provided.

H. Weirs Used For Flow Control

- RESERVED

I. Access Roads

- Standards and specifications for access roads in Section 5-10.I - Detention Ponds shall apply to bioretention ponds.

J. Fencing

- Fencing, if required, shall conform to fencing standards and specifications in Section 5-10.J - Detention Ponds.

K. Vegetation

- Vegetation for bioretention facilities shall conform to the requirements set forth in Volume III, Chapter 3.3.12 of the Drainage Manual.

5-13 GRANULAR MEDIA FILTERS

Granular media filters include sand filters, amended sand filters, and other filters containing granular filtration media such as zeolites, compost, activated carbon, and other such materials intended to remove pollutants from stormwater.

A typical granular media filtration system consists of a pretreatment system, flow spreader(s), a horizontal media filtration bed, a geotextile fabric underneath the media bed, and an underdrain system. Some manufactured filters use media-filled canisters instead of a horizontal filter bed. The standards and specifications in this section were developed for horizontal bed sand filters, but should be applicable to other filtration media. Some of the standards and specifications may not be directly applicable to filter configurations other than a horizontal bed filter.

Typically, granular media filters are not designed to provide flow control, but there is no reason they cannot do so. For example, bioretention systems (see Section 5-12) can be designed as combination treatment / infiltration systems.

A. General

1. Sand filtration can be used in most residential, commercial, and industrial developments where debris, heavy sediment loads, and oils and greases will not clog

or prematurely overload the sand, or where adequate pretreatment is provided for these pollutants. Specific applications include residential subdivisions, parking lots for commercial and industrial establishments, gas stations, high-use sites, high-density multi-family housing, roadways, and bridge decks.

2. Sand filters should be located off-line before or after detention.
3. See Volume V, Chapter 8 of the Drainage Manual for hydraulic design requirements.
4. See Volume V, Chapter 8 of the Drainage Manual for filter sand specifications, as applicable.
5. An underground filter should be considered in areas subject to freezing conditions.
6. Sand shall be placed in the filter using a low ground pressure bulldozer or similar equipment (4 psig or less). The sand shall be settled by flooding the filter with a minimum of 10 gallons of water per cubic foot of sand.
7. Granular media filters that are also used for flow control shall not be located within 200 feet of the top of an erosion hazard area or landslide hazard area, as defined by Subtitle 30.6 SCC, unless a geotechnical analysis shows that no slope instability will result. Under no circumstances shall granular media filters be located within 50 feet of the top of an erosion hazard area or landslide hazard area.
8. Energy dissipaters and level spreader trenches for outflow dispersion, if required, shall conform to the requirements of Section 5-05.L of these Standards.

B. Berms

- Standards and specifications for berms set forth in Section 5-10.B - Detention Ponds shall apply to granular media filters.

C. Concrete / Structural Elements

- Granular media filters that are not intended to provide flow control by means of infiltration may be contained in precast concrete structures or cast-in-place concrete structures. These structures shall conform to all relevant requirements set forth in these Standards.

D. Drains / Liners / Geotextile Materials

1. Standards and specifications for drains, liners, and geotextile standards set forth in Chapter in Section 5-10.D - Detention Ponds shall apply to granular media filters. Additional drainage design information is set forth in Volume V, Chapter 8 of the Drainage Manual.
2. Aggregate for underdrain systems shall be clean washed rock of 0.75 inch to 1.5 inch diameter.
3. For granular media filters installed upstream of flow control systems, underdrain piping shall be sized to pass double the two-year return frequency flow indicated by the Western Washington Hydrology Model (WWHM), calculated with one foot of hydraulic head above the invert of the upstream end of the collector pipe.
4. For granular media filters installed downstream of flow control systems, underdrain piping shall be sized to pass the two-year return frequency flow indicated by WWHM,

calculated with one foot of hydraulic head above the invert of the upstream end of the collector pipe.

5. The internal diameter of underdrain pipes shall be a minimum of 6 inches.
6. Underdrain pipes shall have two rows of ½-inch holes spaced 6 inches apart longitudinally (maximum), with rows 120 degrees apart (laid with holes downward).
7. The maximum perpendicular distance between two feeder pipes shall be 15 feet.
8. The main collector underdrain pipe shall have a minimum slope of 0.5 percent.
9. Geotextile fabric shall be installed between the granular filter medium and the aggregate for the underdrain system.
10. One inch of aggregate of the type used for the underdrain system shall be placed above the fabric.
11. Cleanout wyes with caps or junction boxes shall be provided at both ends of the collector pipes. Cleanouts shall extend to the surface of the filter. A valve box shall be provided for access to the cleanouts.
12. Access for cleaning all underdrain piping shall be provided. This may consist of installing cleanout ports, which tee into the underdrain system and surface above the top of the sand bed.
13. An inlet shutoff/bypass valve for the filter shall be installed.
14. Concrete liners may be used for sedimentation chambers and for sedimentation and sand filtration basins less than 1,000 square feet in area. Concrete shall be 5 inches thick Class A or better and shall be reinforced by steel wire mesh. The steel wire mesh shall be 6 gauge wire or larger and 6-inch by 6-inch mesh or smaller. An "Ordinary Surface Finish" is required. When the underlying soil is clay or has an unconfined compressive strength of 0.25 ton per square foot or less, the concrete shall have a minimum 6-inch compacted aggregate base. This base must consist of coarse sand and river stone, crushed stone or equivalent with diameter of 0.75- to 1-inch.
15. If an impermeable liner is not required and the basin has not been excavated to bedrock, a geotextile fabric liner shall be installed that retains the sand and meets the following requirements:
    a. For sand filter drain strip between the sand and the drain rock or gravel layers, the geotextile fabric shall meet specifications for moderate survivability set forth in the 2008 WSDOT Standard Specifications, Section 9-33.1, Geosynthetic Material Requirements, Table C.1.
    b. For sand filter matting located immediately above the impermeable liner and below the drains, a nonwoven geotextile fabric shall be used that meets specifications for moderate survivability set forth in the 2008 WSDOT Standard Specifications, Section 9-33.1, Geosynthetic Material Requirements in Table 1 and filtration properties for Class C in Table 2.

E. Presettling Basins / Inflow Control Structures

1. Standards and specifications for presettling basins and inlet control structures in Section 5-10.E - Detention Ponds shall apply to granular media filters.
2. Inlet bypass and flow spreading structures shall be designed to minimize turbulence and spread slow evenly across the surface of the filter bed. The maximum distance between the top of the spreader and the top of the sand bed shall be 8 inches. Flows may enter the sand bed by spilling over the top of the wall into a flow spreader pad or alternatively a pipe and manifold system may be used. A pipe and manifold system must retain the required dead storage volume in the first cell and be readily maintainable.
3. The minimum pipe diameter for an inlet pipe and manifold system shall be 8 inches. Multiple inlets are recommended to minimize turbulence and reduce local flow velocities.
4. Erosion protection must be provided along the first foot of the sand bed adjacent to the spreader. Geotextile fabric secured on the surface of the sand bed, or equivalent method, may be used.

F. Flow Restriction and Oil Pollution Control Structures

- As applicable, standards and specifications for flow restriction and oil pollution control structures in Section 5-10.F - Detention Ponds shall apply to granular media filters.

G. Emergency Overflow Structures

- As applicable, standards and specifications for emergency overflow structures in Section 5-10.G - Detention Ponds shall apply to granular media filters.

H. Weirs Used For Flow Control

- As applicable, standards and specifications for weirs used for flow control structures in Section 5-10.H - Detention Ponds shall apply to granular media filters.

I. Access Roads

- Standards and specifications for access roads in Section 5-10.I - Detention Ponds shall apply to granular media filters.

J. Fencing

- Standards and specifications for fencing in Section 5-10.J - Detention Ponds shall apply to granular media filters.

K. Vegetation

- RESERVED

TRENCH SYSTEMS

5-14 INFILTRATION TRENCHES

Infiltration trenches are trenches, typically at least 24 inches wide, that are backfilled with gravel, allowing for temporary storage of stormwater until it infiltrates into the adjacent soil. Infiltration trenches may contain a perforated pipe, may have a sand bed underneath the gravel, and the gravel may be covered with geotextile fabric or soil and vegetation.

NOTE: The standards and specifications in this section shall not apply to infiltration or dispersion systems constructed to comply with the on-site stormwater management requirements of SCC 30.63A.525. Standards and specifications for those systems are set forth in the Drainage Manual.

A. General

1. See Volume III, Chapter 3.3.11 of the Drainage Manual for detail drawings of infiltration trenches.
2. An observation well shall be installed at the lower end of the infiltration trench to check water levels, drawdown time, sediment accumulation, and conduct water quality monitoring. Figure 3.36 in Volume III of the Drainage Manual illustrates observation well details. It should consist of a perforated PVC pipe which is 4 to 6 inches in diameter and it should be constructed flush with the ground elevation. For larger trenches a 12-36 inch diameter well can be installed to facilitate maintenance operations such as pumping out the sediment. The top of the well shall be capped to discourage vandalism and tampering.
3. Infiltration trenches shall not be located within 200 feet of the top of an erosion hazard area or landslide hazard area as defined by Subtitle 30.6 SCC, unless a geotechnical analysis shows that no slope instability will result. Under no circumstances shall such infiltration trenches be located within 50 feet of the top of an erosion hazard area or landslide hazard area.

B. Berms

- RESERVED

C. Concrete / Structural Elements

- RESERVED

D. Drains / Liners / Geotextile Materials

1. Aggregate for an infiltration trench shall consist of clean aggregate with a maximum diameter of 3 inches and a minimum diameter of 1.5 inches. Void space for the aggregate shall be in the range of 30% to 40%.
2. The aggregate fill material shall be completely encased in an engineering geotextile material. Geotextile fabric shall surround all of the aggregate fill material except for the top one-foot, which is placed over the geotextile. The geotextile fabric shall meet

the requirements of the 2008 WSDOT Standard Specifications, Section 9-33.1, Geosynthetic Material Requirements for low survivability in Table 1 and filtration properties for Class C in Table 2.

3. The stone aggregate shall be placed in lifts and compacted using plate compactors. As a rule of thumb, a maximum loose lift thickness of 12 inches is recommended. The compaction process ensures geotextile conformity to the excavation sides, thereby reducing potential piping and geotextile clogging, and settlement problems.
4. Natural or fill soils shall not be intermixed with the stone aggregate. All contaminated stone aggregate must be removed and replaced with uncontaminated stone aggregate.
5. Following the stone aggregate placement, the geotextile fabric must be folded over the stone aggregate to form a 12-inch minimum longitudinal overlap. When overlaps are required between rolls, the upstream roll shall overlap a minimum of 2 feet over the downstream roll in order to provide a shingled effect.
6. Voids between the geotextile fabric and the excavation sides must be avoided. Natural soils shall be placed in these voids to ensure geotextile conformity to the excavation sides.

E. Presettling Basins / Inflow Control Structures

- Standards and specifications for presettling basins / inlet control structures in Section 5-10.E - Detention Ponds shall apply to infiltration trenches.

F. Flow Restriction and Oil Pollution Control Structures

- RESERVED

G. Emergency Overflow Structures

- RESERVED

H. Weirs Used For Flow Control

- RESERVED

I. Access Roads

- Standards and specifications for access roads in Section 5-10.I - Detention Ponds shall apply to infiltration trenches.

J. Fencing

- RESERVED

K. Vegetation

- RESERVED

CLOSED SYSTEMS

5-15 DETENTION VAULTS

(Standard Drawing: 5-230)

Detention vaults are structures that detain water in an enclosed concrete vault.

A. General

1. Detention vaults shall not be located within 200 feet of the top of an erosion hazard area or landslide hazard area as defined by Subtitle 30.6 SCC, unless a geotechnical analysis shows that no slope instability will result. Under no circumstances shall detention vaults be located within 50 feet of the top of an erosion hazard area or landslide hazard area.
2. Detention vaults shall be designed as flow-through systems.
3. Detention vaults for private land development projects shall not be located in the public right-of-way. Vaults may be located in private roads subject to a determination by the Engineer that the private road will not likely be converted to a public road in the future.
4. Energy dissipaters and level spreader trenches for outflow dispersion, if required, shall conform to the requirements of Section 5-05.L of these Standards.

B. Berms

- RESERVED

C. Concrete / Structural Elements

1. Detention vaults shall be designed with flat bottoms (longitudinally) or sloped toward the inlet to facilitate sediment removal. The distance between the inlet and the outlet should be maximized (as feasible). Flat-bottomed vaults are required to have removable panels over the entire vault for access, with additional features specified by the Drainage Manual.
2. Structural plans for all vaults shall be prepared and stamped by a professional engineer licensed in the State of Washington. The drawings shall include steel placement blockouts for inlet and outlet pipes, corner reinforcement, top attachment, water stops, construction joints, and design mix specifications for the concrete.
3. If the vault is to be covered with soil at project completion, the vault shall be designed for saturated soil loading with a minimum cover of two (2) feet. The design shall be adequate for live loads, dead loads, and seismic loads in accordance with the International Building Code, as amended and adopted as the Snohomish County Building Code. Vaults shall be watertight and constructed with 3000 psi minimum compressive strength reinforced concrete.
4. Closed vaults shall be designed to carry an AASHTO HL-93 (Load Resistance Factor Design method) live load or greater when located in the right-of-way or in areas

where the lids may be subject to vehicle loads. All design loads shall include an impact allowance in accordance with the AASHTO Standard Specifications for Highway Bridges.

5. The minimum internal height in a closed vault shall be seven (7) feet, the minimum internal width shall be four (4) feet, and the maximum depth from ground elevation to the vault bottom shall be twenty (20) feet.
6. The walls of all vaults shall have horizontal and vertical reinforcement on each face. Reinforcement shall be designed for both the hydrostatic pressure of a tank full of water and the earth pressure of the planned backfill plus any surcharge. The design of corners of vaults shall take into consideration the restraint provided by the adjoining walls and/or the lids.
7. Maintenance access and ventilation shall meet county, state and national standards. Closed vault ventilation shall be provided by a venting manhole cover or catchbasin grate.
8. Detention vaults shall have access openings positioned a maximum of 50 feet from any location within the vault, with a minimum of three access points. A ladder shall be provided to the bottom of each cell or compartment. Access points shall be located over the inlet/outlet and the sediment trap. Access shall consist of a round, locking ring and cover in accordance with Standard Drawing 5-230. The ladder shall be directly under the ring and cover. Access design shall provide sufficient clearance between walls and appurtenances to allow access for personnel and required safety and maintenance equipment.
9. The invert elevation of the outlet of the vault shall be elevated above the bottom of the vault to provide an average of 6 inches of sediment storage over the entire bottom of the vault.

D. Drains / Liners / Geotextile Materials

- RESERVED

E. Presettling Basins / Inflow Control Structures

1. Standards and specifications for presettling basins / inlet control structures in Section 5-10 - Detention Ponds shall apply to detention vaults. The presettling basin may be included as a chamber in the vault that provides flow control, or may be contained in a separate structure.
2. Vehicular access designed for AASHTO HL-93 (Load Resistance Factor Design method) loading or greater shall be provided for the sediment removal area. Access adequate for maintenance shall be provided directly over a closed sediment removal structure.

F. Flow Restriction and Oil Pollution Control Structures

1. Standards and specifications for flow restriction and oil pollution control structures in Section 5-10.F - Detention Ponds shall apply to detention vaults.
2. Flow restriction and oil pollution control structures shall be located downstream from the vault in an appropriately sized manhole.

3. The outlet of the structure shall be a minimum of 2 feet above the highest elevation flow control orifice to retain oil within the structure.

G. Emergency Overflow Structures

- Standards and specifications for emergency overflow structures in Section 5-10.G - Detention Ponds shall apply to detention vaults.

H. Weirs Used For Flow Control

- RESERVED

I. Access Roads

1. Standards and specifications for access roads in Section 5-10.I - Detention Ponds shall apply to detention vaults.
2. Closed detention systems located where vehicle loads may be imposed shall be designed to carry an AASHTO HL-93 (Load Resistance Factor Design method) live load or greater.
3. Detention vaults for private land development projects shall not be located in the public right-of-way. However, detention vaults may be located in a private tract or easement, including those for a private road, subject to a determination by the County Engineer that the private road will not likely be converted to a public road in the future.

J. Fencing

- RESERVED

K. Vegetation

- RESERVED

5-16 DETENTION PIPES

(Standard Drawings: 5-230, 5-240)

Detention pipes, sometimes referred to as detention tanks, are detention facilities that detain the water in an underground pipe. The pipe may be metal, concrete, or plastic. Fundamentally, detention pipes function identically to detention vaults; the design and construction differences are related to the use of a pipe as opposed to a concrete vault.

A. General

1. Detention pipes shall not be located within 200 feet of the top of an erosion hazard area or landslide hazard area, as defined by Subtitle 30.6 SCC, unless a geotechnical analysis shows that no slope instability will result. Under no circumstances shall detention pipes be located within 50 feet of the top of an erosion hazard area or landslide hazard area.
2. Detention pipes shall be designed as flow-through systems.

3. Detention pipes for private land development projects shall not be located in the public right-of-way. Detention pipes may be located in private roads subject to a determination by the County Engineer that the private road will not likely be converted to a public road in the future.
4. Energy dissipaters and level spreader trenches for outflow dispersion, if required, shall conform to the requirements of Section 5-05.L of these Standards.

B. Berms

- RESERVED

C. Concrete / Structural Elements

1. Detention pipes shall conform to Chapter 9-05 of the 2008 WSDOT Standard Specifications and the requirements of this chapter. Corrugated metal pipe and treated corrugated metal pipe, except aluminized pipe, shall not be used for any part of a detention pipe.
2. Excavation, bedding, backfill, and compaction used for detention pipes shall conform to Chapter 7-08 of the WSDOT Standard Specifications and the requirements of this chapter.
3. Detention pipes shall have a minimum diameter of 36 inches. Pipes larger than 36 inches in diameter may be connected to adjoining structures with a section of pipe at least 36 inches diameter and no greater than 2 feet in length.
4. Parallel detention pipes shall meet the clearance specifications for multiple pipes shown on Standard Drawing 5-040, but in no case shall clearance be less than two (2) feet, with appropriate provisions for controlling the density of fill between the pipes.
5. Maintenance access and ventilation provisions shall meet county, state and national standards. Detention pipe ventilation shall be provided by an air vent connection that vents to an appropriate manhole cover or catchbasin grate.
6. Detention pipes shall have access openings positioned a maximum of 50 feet from any location within the vault, with a minimum of three access points. A ladder shall be provided to the bottom of each cell or compartment. Access points shall be located over the inlet/outlet and the sediment trap. Access shall consist of a round, locking ring and cover in accordance with Standard Drawing 5-230. The ladder shall be directly under the ring and cover. Access design shall provide sufficient clearance between walls and appurtenances to allow access for personnel and required safety and maintenance equipment.
7. The invert elevation of the outlet of the detention pipe shall be elevated above the bottom of the pipe to provide an average of 6 inches of sediment storage over the entire bottom of the pipe.

D. Drains / Liners / Geotextile Materials

- RESERVED

E. Presettling Basins / Inflow Control Structures

1. Standards and specifications for presettling basins / inlet control structures in Section 5-10.E - Detention Ponds shall apply to detention pipes. The presettling basin may be an open or closed structure.
2. Vehicular access designed for AASHTO HL-93 (Load Resistance Factor Design method) loading or greater shall be provided for the sediment removal area. Access adequate for maintenance shall be provided directly over a closed sediment removal structure.

F. Flow Restriction and Oil Pollution Control Structures

1. Standards and specifications for flow restriction and oil pollution control structures in Section 5-10.F - Detention Ponds shall apply to detention pipes.
2. Flow restriction and oil pollution control structures shall be located downstream from the detention pipe in an appropriately sized manhole.
3. The outlet of the structure shall be a minimum of 2 feet above the highest elevation flow control orifice to retain oil within the structure.

G. Emergency Overflow Structures

- Standards and specifications for emergency overflow structures in Section 5-10.G - Detention Ponds shall apply to detention pipes.

H. Weirs Used For Flow Control

- RESERVED

I. Access Roads

1. Standards and specifications for access roads in Section 5-10.I - Detention Ponds shall apply to detention pipes.
2. Closed detention systems located where vehicle loads may be imposed shall be designed to carry an AASHTO HL-93 (Load Resistance Factor Design method) live load or greater.
3. Detention pipes for private land development projects shall not be located in the public right-of-way. However, detention pipes may be located in a private tract or easement, including those for a private road, subject to a determination by the Engineer that the private road will not likely be converted to a public road in the future.

J. Fencing

- RESERVED

K. Vegetation

- RESERVED

5-17 GRANULAR MEDIA FILTER VAULTS

A granular media filter vault is identical in function of an open granular media filter vault; the differences in standards and specifications relate to the filter's placement in a vault as opposed to an open structure. As with closed systems used for flow control, filter vaults are suitable where space or land uses limit or preclude open facilities. Some additional standards and specifications are set forth in the Drainage Manual for specific types of systems, such as linear sand filters.

A. General

1. Vaults may be designed as off-line systems or on-line systems for small drainages.
2. In an off-line system, a diversion structure shall be installed to divert the design flow rate into the sediment chamber and bypass the remaining flow to a flow control system if one is required by SCC 30.63A.550 through 30.63A.555.
3. Granular medium filter vaults shall not be located within 200 feet of the top of an erosion hazard area or landslide hazard area, as defined by Subtitle 30.6 SCC, unless a geotechnical analysis shows that no slope instability will result. Under no circumstances shall such vaults be located within 50 feet of the top of an erosion hazard area or landslide hazard area.
4. Granular medium filter vaults for private land development projects shall not be located in the public right-of-way. Vaults may be located in private roads subject to a determination by the Engineer that the private road will not likely be converted to a public road in the future.
5. Energy dissipaters and level spreader trenches for outflow dispersion, if required, shall conform to the requirements of Section 5-05.L of these Standards.
6. General Notes 1 through 4 of Section 5-13.A - Granular Media Filters, General, apply to granular media filter vaults.

B. Berms

- RESERVED

C. Concrete / Structural Elements

1. General Notes 2 through 6 of Section 5-15.C - Detention Vaults, Concrete / Structural Elements, apply to granular media filter vaults.
2. To prevent anoxic conditions, a minimum of 24 square feet of ventilation grate shall be provided for each 250 square feet of sand bed surface area. For sufficient distribution of airflow across the sand bed, grates may be located in one area if the sand filter is small, but placement at each end is preferred. Small grates may also be dispersed over the entire sand bed area.
3. A shutoff / bypass valve shall be installed.

D. Drains / Liners / Geotextile Materials

1. Standards and specifications for drains, liners, and geotextile standards set forth in Chapter in Section 5-10.D - Detention Ponds shall apply to granular media filter vaults. Additional drainage design information is set forth in Volume V, Chapter 8 of the Drainage Manual.
2. Aggregate for underdrain systems shall be clean washed rock of 0.75 inch to 1.5 inch diameter.

E. Presettling Basins / Inflow Control Structures

1. Standards and specifications for presettling basins / inlet control structures in Section 5-10.E - Detention Ponds shall apply to granular media vaults. The presettling basin may be included as a chamber in the vault that provides flow control, or may be contained in a separate structure.
2. Inlet bypass and flow spreading structures shall be designed to minimize turbulence and spread slow evenly across the surface of the filter bed. The maximum distance between the top of the spreader and the top of the sand bed shall be 8 inches. Flows may enter the sand bed by spilling over the top of the wall into a flow spreader pad or alternatively a pipe and manifold system may be used. A pipe and manifold system must retain the required dead storage volume in the first cell and be readily maintainable.
3. The minimum pipe diameter for an inlet pipe and manifold system shall be 8 inches. Multiple inlets are recommended to minimize turbulence and reduce local flow velocities.
4. Erosion protection must be provided along the first foot of the sand bed adjacent to the spreader. Geotextile fabric secured on the surface of the sand bed, or equivalent method, may be used.
5. Vehicular access designed for AASHTO HL-93 (Load Resistance Factor Design method) loading or greater shall be provided for the sediment removal area. Access adequate for maintenance shall be provided directly over a closed sediment removal structure.
6. A v-shaped bottom, removable bottom panels, or equivalent sludge handling system shall be used. One foot of sediment storage in the presettling cell must be provided.
7. The pre-settling chamber must be sealed to trap oil and trash. This chamber is usually connected to the sand filtration chamber through an invert elbow to protect the filter surface from oil and trash.
8. If a retaining baffle is necessary for oil/floatables in the presettling cell, it must extend at least one foot above to one foot below the design flow water level. Provision for the passage of flows in the event of plugging must be provided. Access opening and ladder must be provided on both sides of the baffle.

F. Flow Restriction and Oil Pollution Control Structures

- As applicable, standards and specifications for flow restriction and oil pollution control structures in Section 5-10.F - Detention Ponds shall apply to granular media filters.

G. Emergency Overflow Structures

- Standards and specifications for emergency overflow structures in Section 5-10.G - Detention Ponds shall apply to granular media filters, as applicable.

H. Weirs Used For Flow Control

- As applicable, standards and specifications for weirs used for flow control structures in Section 5-10.H - Detention Ponds shall apply to granular media filters.

I. Access Roads

1. Standards and specifications for access roads in Section 5-10.I - Detention Ponds shall apply to granular media filter vaults.
2. Closed filter systems located where vehicle loads may be imposed shall be designed to carry an AASHTO HL-93 (Load Resistance Factor Design method) live load or greater.
3. Granular media filter vaults for private land development projects shall not be located in the public right-of-way. However, such vaults may be located in a private tract or easement, including those for a private road, subject to a determination by the County Engineer that the private road will not likely be converted to a public road in the future.

J. Fencing

- RESERVED

K. Vegetation

- RESERVED

5-18 UNDERGROUND INFILTRATION STRUCTURES

Underground infiltration structures are prefabricated underground structures used for infiltration, typically installed under pavement or other developed surfaces. They typically are so small as to not allow entry by people and so do not have human access specifications such as those for detention vaults.

A. General

1. Underground infiltration structures shall not be located within 200 feet of the top of an erosion hazard area or landslide hazard area, as defined by Subtitle 30.6 SCC, unless a geotechnical analysis shows that no slope instability will result. Under no circumstances shall underground infiltration structures be located within 50 feet of the top of an erosion hazard area or landslide hazard area.
2. Underground infiltration structures shall not be placed in fill.
3. Underground infiltration structures for private land development projects shall not be located in the public right-of-way. Such structures may be located in private roads subject to a determination by the Engineer that the private road will not likely be converted to a public road in the future.

4. Energy dissipaters and level spreader trenches for outflow dispersion, if required, shall conform to the requirements of Section 5-05.L of these Standards.

B. Berms

- RESERVED

C. Concrete / Structural Elements

- Underground infiltration structures shall be designed to carry an AASHTO HL-93 (Load Resistance Factor Design method) live load or greater when located in the right-of-way or in areas where the structures may be subject to vehicle loads. All design loads shall include an impact allowance in accordance with the AASHTO Standard Specifications for Highway Bridges.

D. Drains / Liners / Geotextile Materials

1. Unless otherwise specified, materials and methods shall conform to 2008 WSDOT Standard Specifications.
2. Aggregate surrounding and underlying the underground infiltration structure shall be washed crushed aggregate between 3/4 inch and 2 inches, unless otherwise specified by the vault manufacturer.

E. Presettling Basins / Inflow Control Structures

1. Standards and specifications for presettling basins / inlet control structures in Section 5-10.E - Detention Ponds shall apply to underground infiltration structures.
2. Vehicular access designed for AASHTO HL-93 (Load Resistance Factor Design method) loading or greater shall be provided for the sediment removal area. Access adequate for maintenance shall be provided directly over a closed sediment removal structure.

E. Flow Restriction and Oil Pollution Control Structures

- RESERVED

G. Emergency Overflow Structures

- Standards and specifications for emergency overflow structures in Section 5-10.G - Detention Ponds shall apply to underground infiltration structures.

H. Weirs Used For Flow Control

- RESERVED

I. Access Roads

1. Standards and specifications for access roads in Section 5-10.I - Detention Ponds shall apply to underground infiltration structures.
2. Underground infiltration structures for private land development projects shall not be located in the public right-of-way. However, such structures may be located in a private tract or easement, including those for a private road, subject to a

determination by the County Engineer that the private road will not likely be converted to a public road in the future.

J. Fencing

- RESERVED

K. Vegetation

- RESERVED

5-19 OIL / WATER SEPARATORS

(Standard Drawing: 5-230)

Oil / water separators are underground structures, usually housed in concrete vaults, intended to remove petroleum from water primarily by gravimetric separation. The two common configurations are the baffle type, often referred to as the API type after the American Petroleum Institute, and the coalescing plate (CP) type. Oil / water separators typically consist of three bays; forebay, separator section, and the afterbay. The CP separators need considerably less space for separation of the floating oil due to the shorter travel distances between parallel plates. Spill control separators, which consist of a simple catchbasin with a tee inlet, are not discussed in this section.

Information about appropriate applications of oil / water separators is found in Volume V, Chapter 11 of the Drainage Manual.

A. General

1. Oil / water separators shall not be located within 200 feet of the top of an erosion hazard area or landslide hazard area, as defined by Subtitle 30.6 SCC, unless a geotechnical analysis shows that no slope instability will result. Under no circumstances shall oil / water separators be located within 50 feet of the top of an erosion hazard area or landslide hazard area.
2. Oil / water separators for private land development projects shall not be located in the public right-of-way. Oil / water separators may be located in private roads subject to a determination by the Engineer that the private road will not likely be converted to a public road in the future.
3. Additional standards, specifications, and design criteria are set forth in Volume V, Chapter 11 of the Drainage Manual.

B. Berms

- RESERVED

C. Concrete / Structural Elements

1. Structural plans for all vaults shall be prepared and stamped by a professional engineer licensed in the State of Washington. The drawings shall include steel placement blockouts for inlet and outlet pipes, corner reinforcement, top attachment, water stops, construction joints, and design mix specifications for the concrete.

2. If the vault is to be covered with soil at project completion, the vault shall be designed for saturated soil loading with a minimum cover of two (2) feet. The design shall be adequate for live loads, dead loads, and seismic loads in accordance with the International Building Code, as amended and adopted as the Snohomish County Building Code. Vaults shall be watertight and constructed with 3000 psi minimum compressive strength reinforced concrete.
3. Closed vaults shall be designed to carry an AASHTO HL-93 (Load Resistance Factor Design method) live load or greater when located in the right-of-way or in areas where the lids may be subject to vehicle loads. All design loads shall include an impact allowance in accordance with the AASHTO Standard Specifications for Highway Bridges.
4. The minimum internal height in a closed vault shall be seven (7) feet, the minimum internal width shall be four (4) feet, and the maximum depth from ground elevation to the vault bottom shall be twenty (20) feet.
5. The walls of all vaults shall have horizontal and vertical reinforcement on each face. Reinforcement shall be designed for both the hydrostatic pressure of a tank full of water and the earth pressure of the planned backfill plus any surcharge. The design of corners of vaults shall take into consideration the restraint provided by the adjoining walls and/or the lids.
6. Maintenance access and ventilation shall meet county, state and national standards. Closed vault ventilation shall be provided by a venting manhole cover or catchbasin grate.
7. Vaults shall have access openings positioned a maximum of 50 feet from any location within the vault, with a minimum of three access points. A ladder shall be provided to the bottom of each cell or compartment. Access points shall be located over the inlet/outlet and the sediment trap. Access shall consist of a round, locking ring and cover in accordance with Standard Drawing 5-230. The ladder shall be directly under the ring and cover. Access design shall provide sufficient clearance between walls and appurtenances to allow access for personnel and required safety and maintenance equipment.

D. Drains / Liners / Geotextile Materials

- RESERVED

E. Presettling Basins / Inflow Control Structures

1. Standards and specifications for presettling basins / inlet control structures in Section 5-10.E - Detention Ponds shall apply to oil / water separators. The presettling basin may be included as a chamber in the vault that provides oil / water separation, or may be contained in a separate structure.
2. Vehicular access designed for AASHTO HL-93 (Load Resistance Factor Design method) loading or greater shall be provided for the sediment removal area. Access adequate for maintenance shall be provided directly over a closed sediment removal structure.

F. Flow Restriction and Oil Pollution Control Structures

- RESERVED

G. Emergency Overflow Structures

- Standards and specifications for emergency overflow structures in Section 5-10.G - Detention Ponds shall apply to oil / water separators, as applicable.

H. Weirs Used For Flow Control

- RESERVED

I. Access Roads

1. Standards and specifications for access roads in Section 5-10.I - Detention Ponds shall apply to oil / water separators.
2. Oil / water separators located where vehicle loads may be imposed shall be designed to carry an AASHTO HL-93 (Load Resistance Factor Design method) live load or greater.
3. Oil / water separators for private land development projects shall not be located in the public right-of-way. However, oil / water separators may be located in a private tract or easement, including those for a private road, subject to a determination by the County Engineer that the private road will not likely be converted to a public road in the future.

I. Fencing

- RESERVED

J. Vegetation

- RESERVED

CHAPTER 5 DRAWING INDEX

EDDS Standard Drawing No.	Title	REPLACED BY WSDOT Standard Plan No./Other Source
5-010	Shoulder Ditches	
5-020	Interceptor Ditch and Checkdam	BMP C207 1/
5-030	Yard Drain Connections	
5-040	Pipe Zone Bedding and Backfill	B-55.20-00
5-050	Beveled End Sections	B-70.20-00
5-055A	Level Spreader Swale	
5-055B	Level Spreader Trench – PVC	
5-055C	Level Spreader Trench – Concrete	
5-055D	Level Spreader Trench Notes	
5-060	Catchbasin Type I	B-05.20-00
5-070	Catchbasin Type 1-L	B-05.40-00
5-080	Catchbasin Type 1-P	B-05.60-00
5-090A & B	Catchbasin Type 2	B-10.20-00
5-100A & B	Catchbasin Type 2	B-10.20-00
5-110	Concrete Inlet	B-25.60-00
5-120	Catchbasin Details	
5-130A & B	Manhole Type 1	B-15.20-00
5-140A & B	Manhole Type 2	B-15.40-00
5-150A & B	Manhole Type 3	B-15.60-00
5-160	Manhole Type 4	DELETED
5-170	Manhole Details	
5-180	Rectangular Frame (Reversible)	B-30.10-00
5-190	Rectangular Solid Metal Cover	B-30.20-01
5-200	Rectangular Vaned Grate	B-30.30-00
	Rectangular Bi-Directional Vaned Grate	B-30.40-00
5-210	Combination Inlet	B-25.20-00
5-220A	Rolled Curb Frame & Grate 2/	
5-220B	Rolled Curb Frame & Grate Installation 2/	
5-225	Rolled Curb Vaned Grate 2/	
5-230	Manhole Ring and Cover	
5-240A	Flow Restrictor/Oil Pollution Control - T Restrictor	
5-240B	Flow Restrictor/Oil Pollution Control - T Restrictor	
5-240C	Oil Pollution Control Catchbasin	
5-250	Flow Restrictor/Oil Pollution Control - T Shear Gate Detail	
5-260A	Level Spreader Trench	DELETED
5-260B	Level Spreader Trench	DELETED
5-270	Bubble-Up Spreader	DELETED
5-280	Biofiltration Swale	DELETED

1/ Located in the Snohomish County Drainage Manual.

2/ For replacement of existing frames and grates only; not for new installation.