

Chapter 4

Storm Drainage

City of Kelso
Engineering Design Manual
June 2008
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CHAPTER 4 - STORM DRAINAGE

4.00 General

- A. The City of Kelso has established the requirements for the design of facilities intended to protect the public health, safety, and welfare from damage due to flooding. Beyond that level of protection, additional measures are specified in this chapter that are intended to minimize any potential flooding damage and allow for efficient operation, repair, and maintenance of the storm drainage system.
- B. All plans, studies, and reports shall be stamped, signed, and dated by a professional civil engineer(s), registered in the state of Washington, and registered soil scientist, if appropriate, responsible for their preparation, and by the project engineer responsible for preparation of the stormwater management plans.
- C. If site conditions are appropriate and groundwater quality will not be impaired, infiltration is the preferred BMP. Direct discharge of untreated stormwater to groundwater is prohibited. All discharges to groundwater shall comply with the following state laws: the Water Pollution Control Act (90.48 RCW), the Water Resources Act (90.54 RCW), and Water Quality Standards for Ground Waters of the State of Washington (WAC 173-200). Infiltration may be limited near public water supply wells.
- D. These requirements shall apply to all storm drainage facilities in existing and proposed public rights-of-way, public drainage easements, and tracts of common ownership in the City. Storm drainage systems include, but are not limited to: inlets, pipes, ditches, creeks, rivers, wetlands, and storm water quality and quantity facilities.
- E. Design and construction of drainage facilities, including but not limited to: open channels, conveyance pipe, and inlets shall be in compliance with the latest edition of the City's ordinances, these Standards, the Standard Details, the latest edition of the WSDOT Standards for Road, Bridge and Municipal Construction, and the "Stormwater Management Manual for the Puget Sound Basin" prepared by the Washington State Department of Ecology, 1992. The City has adopted the Puget Sound Manual with the following notations:
 - 1. Stormwater quality requirements are amended by Section 4.06 of these Standards.
 - 2. Stormwater quantity management requirements are amended by Section 4.07 of these Standards.
 - 3. All steps within structures must comply with OSHA standards. There shall be no more than 24-inches between the top of the casting and the rung of the top step.
 - 4. Inside drops are not permitted unless specifically approved by the City Engineer.

If inside drops are allowed, they must be constructed with pipe and be installed in a sixty (60) inch or larger diameter manhole.

5. All pipes shall be installed with prefabricated watertight joints and fittings.
 6. All backfill material shall be referenced per the City of Kelso/Longview Standard Plans and Specifications.
 7. No private storm sewer shall be located within any lot other than the lot which is the site of the building or structure served by such sewer. The exception to this will be common areas in planned unit developments, and/or City rights-of-way, or as otherwise approved by the City Engineer.
 8. Where provisions of this chapter conflict with the Puget Sound Manual or other cited design guidance, this chapter shall take precedence.
 9. Curb inlets shall be used with curb and gutter road sections up to eight percent (8%) in tangential grade. Where the tangential grade exceeds eight percent (8%), combination curb inlets shall be used.
- F. Storm drainage systems within street right-of-way shall include underground storm sewers.
- G. Low lying areas may require the use of ditches, pumps, and water retention basins in uphill areas and other devices necessary to ensure adequate drainage of off-site property as well as the site. Off-site improvements may be required.
- H. Any substitution of material or method not explicitly provided for within these standards or the WSDOT Standard Specifications will only be considered if the result meets or exceeds the provisions of these Standards. The application for deviation must include the manufacturer's specifications, testing results, design drawings, calculations, and other pertinent information.
- I. Applications not covered within these Standards require review and approval by the City. Additional review may be required by others.

4.01 Testing and Inspections

- A. Unless approved otherwise by the City Engineer, all new storm drains shall be TV'd at no cost to the City. The Developer's contractor shall pay all costs associated with TV'ing new public storm pipe along with existing sections of pipe, which are disturbed or affected by new construction. Prior to conducting the television inspection, the Contractor shall clean, by use of a sewer-cleaner, all sediment and debris from the system. One (1) copy of the television inspection shall be provided to the City public works department for inspection and approval prior to placing the final lift of

pavement.

- B. All storm systems constructed of flexible pipe shall be deflection tested from manhole to manhole after the line is completely balled and flushed with water and after compaction tests for backfill are completed and accepted. The test shall be performed by pulling a solid pointed mandrel with a circular cross section with a diameter equal to ninety-five percent (95%) of the inside pipe diameter through the completed pipeline. The mandrel shall be a nonadjustable, odd-numbered-leg (nine (9) legs minimum) mandrel having an effective length of not less than its nominal diameter. Pull shall be manual without mechanical assistance and the mandrel shall negotiate the section freely. The contractor shall locate and repair any sections that fail the test and retest those sections. All repairs shall follow and be in compliance with the manufacturers recommendations.

4.02 Emerging Technologies and Experimental BMP's

- A. Emerging technologies and experimental best management practices are those which have not been fully tested and evaluated by the Department of Ecology and are not included as accepted practices in these standards or the Puget Sound Manual. Experimental BMP's that are adequately tested and proven effective shall be incorporated into this chapter as standard or accepted BMP's in the future.
- B. Subject to approval by the City Engineer, experimental BMP's may be allowed if all the following conditions are met:
 - 1. The experimental BMP usage is part of a Department of Ecology or City of Kelso research project.
 - 2. For water quality experimental BMP's: monitoring of the effluent quality produced by the BMP, as well as influent quality, will be conducted for at least two (2) years;
 - 3. For water quantity and conveyance experimental BMPs: a 5-year bond will be posted to cover any damages that are caused if failure of the BMP is to occur.
 - 4. Results of the research will be published; and
 - 5. Financing is available to construct the BMP, conduct the testing, and publish the results.
- C. The following emerging technologies water quality BMP's may be used with approval from the City Engineer:

1. Continuous Deflective Separation (CDS) stormwater treatment units as manufactured by CDS Technologies, Inc. or approved equal.
 - a. All CDS Technologies, Inc. products shall be designed and installed in accordance with the manufacturer's recommendations. A representative from the manufacturer shall witness the installation and submit a letter to the City certifying that the unit was installed according to the manufacturer's recommendations.
 - b. The inlet and outlet pipe from any CDS system must be a solid wall pipe and enter a manhole (sump, drywell, sedimentation, or standard manhole) prior to being discharged to any infiltration, detention, outfall, or other outlet or disposal system.
2. Stormwater Management Stormfilter as manufactured by Stormwater Management, Inc.:
 - a. All Stormwater Management, Inc. products shall be designed and installed in accordance with the manufacturer's recommendations. A representative from the manufacturer shall witness the installation and submit a letter to the City certifying that the unit was installed according to the manufacturer's recommendations.
 - b. If the peak conveyance flow through the stormfilter unit exceeds the treatment capacity of the unit, a stormgate manhole (as manufactured by Stormwater Management, Inc.) will be required in advance of the stormfilter unit.
 - c. If the treatment capacity of the stormfilter unit is less than the peak conveyance flow through the unit, then a pre-sedimentation manhole will be required in advance of the stormfilter unit.
 - d. The outlet from any stormfilter system must be a solid wall pipe and enter a manhole (sump, drywell, sedimentation, or standard manhole) prior to being discharged to any infiltration, detention, outfall or other outlet or disposal system.

4.03 Applicability

- A. The provisions of this chapter apply to all development activities or redevelopment that:
 1. Results in five thousand (5,000) square feet or more of new impervious area.
 2. Results in the platting of single-family residential subdivisions in an urban area.
- B. Provisions of this chapter shall apply to all land-disturbing activities except those exempted as follows:
 1. Commercial agricultural and forest practices regulated under WAC Title 222, except for Class IV General Forest Practices that are conversions from timber land to other uses, are exempt from the provisions of the minimum requirements. All other new development is subject to the minimum requirements.

2. Land-disturbing activities of less than five thousand (5,000) square feet.
3. Small residential projects that create less than five thousand (5,000) square feet of new impervious surface. Buildings that utilize roof downspout systems to infiltrate roof runoff may be deducted from area calculations.
4. The City Engineer may determine exemptions on a case-by-case basis provided adequate justification for deviation is given.

4.04 General Standards

A. General

1. No more than seven thousand (7,000) square feet of impervious surfacing, including but not limited to roadway pavement, driveways, sidewalk, and parking lot shall drain to an inlet.
2. Storm drainage design within a development area must include provisions to adequately control run-off from all public and private streets and the roof, footing, and area drains of residential, multi-family, commercial, or industrial buildings. The design must ensure extension of the system in conformance with the Lower Cowlitz River Flood Control Master Plan.
3. Surface or subsurface drainage caused or affected by the changing of natural grade, existing ground, or removal of ground cover, or placement of impervious surfaces shall not cause flow to adjacent property in a volume, flowrate, or location different than existing conditions prior to development or the proposed storm drainage modification. Peak discharge may not be increased except where it can be demonstrated that there is no adverse impact.
4. Surface water entering the subject property shall be received at the naturally occurring locations and shall be discharged at the natural locations with adequate energy dissipaters within the subject property to minimize downstream damage, unless otherwise approved by the City Engineer.
5. The approved discharge point for storm water shall be a storm drain, existing open channel, creek, detention, or retention pond as approved by the City. Discharge to a Diking District facility requires their approval.
6. If crossing of private property is required to reach the approved point of discharge it is the responsibility of the applicant to secure a recorded drainage easement meeting the requirements of Section 4.04F.
7. All stormwater facilities shall be located within separate tracts denoted as a

stormwater facility on the face of the plat. Infiltration facilities may be located within right-of-way with the approval of the City Engineer.

B. Roof Drains

1. Provisions must be made for gravity drainage of roofs and foundation drains for all new buildings and structures.
2. In single-family residential developments where the measured infiltration rate is equal to or greater than eight (8) inches per hour, roof drains shall be discharged to an on-site infiltration system. The system shall include an approved emergency overflow to the public storm system or any approved outfall.
3. Roof downspout systems may be installed without observation wells as called for in the PSM.
4. The system shall be designed to discharge a minimum two (2) year, twenty-four (24) hour design storm into the ground. Runoff from roofs during the ten (10) and one-hundred (100) year storms shall be included in the post development design flow of the site facility(s) unless provided for in the roof system. Infiltration tests shall be provided for all proposed roof downspout systems prior to final stormwater report approval.
5. The City Engineer may waive this requirement upon written findings by a qualified geo-technical engineer demonstrating that such infiltration is unsuitable and roof runoff is conveyed to an approved water quantity control facility.
6. If drains are hard piped, all drains must drain to the street through weep holes in the curb unless otherwise approved by the City Engineer. Weep holes shall be installed at the lowest corner of the lot in conjunction with construction of the curb.

C. Fencing of Stormwater Facilities

1. Stormwater treatment and runoff control facilities located in or adjacent to residential areas shall be fenced unless these facilities are constructed as part of a development amenity such as a park or the City Engineer waives the fencing requirement due to special circumstances.
2. Stormwater treatment and runoff control facilities, other than those described in subsection one (1) of this section, shall be fenced if they pose safety risks to the public.
3. The size and type of fence shall be six (6) feet high green vinyl coated chain link fencing unless approved otherwise by the City Engineer.
4. Access to stormwater facilities for maintenance shall be provided and be

satisfactory to the City Engineer. A gate with a minimum width of 14 feet shall be provided for all facilities that require fencing.

D. Side slopes of Stormwater Facilities

1. For maintenance, safety, and stability reasons, side slopes of stormwater facilities normally shall be no steeper than four to one (4:1) within the area of submergence.
2. For facilities to be maintained by the City, vertical slopes (slopes greater than 4:1) are allowed if all the following conditions are met:
 - a. No more than twenty-five percent (25%) of the perimeter of the stormwater facility shall have vertical sides;
 - b. Vertical sides more than two (2) feet high shall have guardrail or be fenced;
 - c. Access for maintenance of facilities is provided; and
 - d. Side slopes in a biofiltration treatment area shall be no steeper than four to one (4:1).
3. For facilities that will not be maintained by the City, slopes steeper than three to one (3:1) are allowed if all the following conditions are met:
 - a. Side slopes in a biofiltration treatment area shall be no steeper than four to one (4:1);
 - b. Adequate long-term erosion control is provided;
 - c. No more than twenty-five percent (25%) of the perimeter of the stormwater facility shall have vertical sides;
 - d. Vertical sides (slopes greater than 3:1) more than thirty (30) inches high shall be fenced;
 - e. The maintenance and operations manual for the facility shall demonstrate that the facility can be maintained.
 - f. A note is recorded on the record drawings that the property owner(s) are responsible for ensuring the facility operates as designed and is properly maintained.
4. Side slopes steeper than four to one (4:1) may be allowed by the City Engineer for specialized development activity, such as stream bank reconstruction, where all the following conditions are met:
 - a. Side slopes do not need to be mowed, and
 - b. Adequate long-term erosion control and slope stability is provided.
 - c. The facility is designed by an engineer licensed in the State of Washington.
 - d. An approved geotechnical report for the site that has been prepared and stamped by a geotechnical engineer.
 - e. A letter stamped by a geotechnical engineer licensed in the State of Washington is submitted that states the design is in conformance with the sites geotechnical report.
 - f. No side slopes steeper than one and one-half to one (1.5:1) are allowed.

E. Drainage Structure Labeling and Signage

1. All inlets and manholes within paved areas shall be stenciled as follows:
 - a. Facilities draining to infiltration systems shall be stenciled to read:
"Please Protect – Drains to Drinking Water"
 - b. Facilities draining to surface waters shall be stenciled to read:
"Please Protect – Drains to Surface Water"
2. Signs shall be installed along water quality biofiltration systems that read:
"Water Quality Filter – Please Leave Vegetated"
3. Fenced detention and retention basins shall be marked with a sign that reads:
"[Public/Private] Stormwater Control Facility"

F. Stormwater Tracts and Easements

1. Tracts or easements shall be provided to the City for access and maintenance of all conveyance systems (including streams), or other facilities as deemed appropriate by the City Engineer, within the development site, which are to be maintained by the City. The minimum widths of tracts or easements shall be as follows, although the City Engineer may require increased widths when necessary to insure adequate area for equipment access and maintenance:
 - a. Pipes with an inside diameter less than or equal to thirty-six (36) inches: fifteen (15) feet;
 - b. Pipes with an inside diameter greater than thirty-six (36) inches: twenty (20) feet or larger as required by the City;
 - c. Pipes shall be centered within the tract or easement;
 - d. Storm pipes with more than a seven (7) foot depth to the invert shall require wider easements. A slope of one (1) horizontal to one (1) vertical from the storm drain invert to the ground surface shall be used in determining easement width.
 - e. Channels: sufficient width to cover the 100-year floodplain line or fifteen (15) feet from the waterway centerline, or ten (10) feet from the top of the recognized bank whichever is greater. A fifteen (15) foot wide access easement shall be provided on both sides of the channel for channel widths greater than fourteen (14) feet at the top of the recognized channel. Top width of channel plus fifteen (15) feet on one side.
2. No buildings or other structures that prevent access are permitted within tracts or easements. Fences crossing tracts shall provide gates of sufficient width to provide access by maintenance vehicles.
3. When possible easements for PUD, apartment complex, or commercial/industrial developments shall be in parking lots, private drives, or similar areas that allow unobstructed vehicle access for maintenance.

4. In all subdivisions bordering upon publicly owned or controlled bodies of water, there shall be provided one or more rights-of-way to the low water mark dedicated to the public, such rights-of-way having a minimum width of sixty feet and being capable of improvement for public access.

G. Detention Requirements

1. All proposed developments shall use adequate drainage management practices. Developments located within a master planned drainage basin will follow the recommendations adopted within the plan. Developments not located within the planned drainage basin shall use on-site detention facilities such that the peak release rate for the two (2) year, twenty-four (24) hour design storm after development shall not exceed one-half (1/2) of the pre-developed two (2) year, twenty-four (24) hour design storms. The peak release for the twenty-five (25) and one-hundred (100) year, twenty-four (24) hour design storms after development shall not exceed the respective pre-development design storm peak runoff rate.
2. Detention facilities shall be designed in accordance with Section 4.07 of these Standards.

H. Subsurface Drainage

1. Underdrains shall be provided for all existing springs and tile intercepted during construction.
2. Where high ground water exists or when it is necessary to reduce the piezometric surface to an acceptable level to prevent land slippage or underfloor flooding of buildings.
3. The drainage line installed shall begin at a cleanout and terminate at an approved point of disposal. Open jointed storm drain lines will not be accepted.

I. Maintenance

1. Ditches, including driveway culverts, within right-of-way shall be maintained by the adjacent property owner.
2. Ditches outside of right-of-way shall be maintained by the property owner.
3. Culverts not associated with a diking district ditch, pipes, catch basins, curb inlets and other related conveyance items will be maintained by the City.
4. Culverts and ditches located adjacent to a dike or within a diking district easement, tract or right-of-way shall be maintained by the associated diking district.

5. Any storm facility or conveyance system located within an easement or tract for that facility or system shall be maintained by the owner of the easement or tract.

4.05 Conveyance System Standards

- A. Storm drain conveyance systems shall be designed in accordance with the requirements of Chapter 6 of these Standards with the following notations:
 1. Stormwater conveyance elements to transport water within and from a development activity site shall be sized to carry flows from the "design storm" from the contributing drainage area based upon the projected full build-out of that contributing drainage area, and be fully compatible with existing downstream conveyance elements and flow conditions.
 2. Drainage facilities shall be a closed conduit system. Temporary drainage ditches, when approved, must be engineered to contain the stormwater without causing erosion or adverse effects.
 3. For stormwater conveyance design, the "design storms" shall be as follows:
 - a. 25-year storm shall show free-flowing conditions thru the proposed and/or existing conveyance system. The 50 year storm will be allowed to show surcharged conditions for pipe systems and culverts and bank full conditions for open channels are acceptable only for demonstrating adequacy of the conveyance system to convey the peak run-off provided that run-off is contained within the conveyance system element or the hydraulic grade line does not exceed the elevation of the roadway subgrade, and no portions of a building will be flooded.
 - b. Conveyance system adequacy shall be demonstrated by performing a backwater analysis.
 - c. Closed conveyance system elements shall be designed to operate in an open flow, not pressure flow regime except during the 100-year storm.
 - d. Runoff from the one-hundred (100) year storm may leave pipes and channels but shall not rise to elevations more than two (2) feet below that of the lowest finished floor of buildings.
 - e. For the ten (10) year storm, street ponding shall be limited to one-half (1/2) of the roadway area and shall not exceed the capacity of the inlet or produce a flow depth of greater than 0.12 feet at the edge of the travel lane.
 - f. For roadway flooding conditions during the one-hundred (100) year storm, one travel lane in either direction shall remain open to emergency vehicles at all times. A travel lane will be considered to be open to emergency vehicles if the maximum depth of flow in the travel lane does not exceed one half (1/2) foot. At a minimum travel lanes are assumed to be eleven (11) feet wide.
 - g. Design of conveyance systems shall be in accordance with Chapter III-2 of the Puget Sound Manual.

- h. Velocity flow in natural and man-made channels shall be such that the ten (10) year event remains below the erosive velocity of the channel.
 4. All storm pipes shall be constructed of HDPE smooth interior corrugated pipe. Where required for strength, Class 52 ductile iron pipe will be used.
 5. The minimum pipe size shall be twelve (12) inches within public right of way unless otherwise approved by the City Engineer. Storm drain lines from building roof drains, and footings shall transition to twelve (12) inches at a cleanout installed at the right of way line.
 6. Storm manholes with a mainline pipe that is entering or exiting at a slope of fifteen percent (15%) or greater shall be pre-channeled.
 7. Storm drain lines shall enter existing creek or drainage channel at ninety (90°) degrees or less to the direction of flow and have a head wall and scour pad, or rip rap to prevent erosion of the existing bank or channel bottom.
 8. All pipes, over eight (8) inches in diameter, which daylight shall have a protective grate installed that prohibits wildlife and children from entering the pipe.
 9. All storm pipes, including but not limited to roof laterals, mainlines, and culverts, that cross under a curb shall have a 'D' stamped into the curb directly above the pipe.
- B. Design of stormwater collection systems shall be in accordance with Urban Drainage Design Manual, Second Edition Circular No. 22, 2001 Edition published by the United States Department of Transportation, Federal Highway Administration (FHWA).
- C. Culverts at road crossings in natural perennial channels shall be designed to pass the peak discharge for the twenty-five (25) year storm such that the headwater does not exceed one and one-half (1.5) times the culvert diameter, or remains at least one (1) foot below subgrade whichever is less. The 100-year storm event shall be used for culverts determined by the City Engineer which may be subject to High Flow Damage, or are designed without a bottom.

D. Alignment and Cover

1. Storm drain lines shall be located five (5) feet (south and east) from the right-of-way centerline. All changes in direction shall be made at a manhole.
2. Storm drain lines shall not be curved between structures. If unusual circumstances exist small diameter (12-inches) or less may be curved using a three and on-half (3.5) feet laying length.
3. A minimum cover of thirty-six (36) inches of cover is required above the top of the pipe to the top of the pavement surface. There shall be a minimum of one (1) foot separation from the top of pipe to the bottom of the roadway section.
4. In areas of relatively flat terrain the design engineer must show that sufficient depth is provided at the boundary of the development properly drain the upstream basin areas.
5. When necessary to locate drains in easements or tracts the storm drain shall be centered in the easement.

E. Manholes

1. Manholes shall be located at all changes in slope, alignment, pipe size, and at all pipe junctions with present or future storm drains.
2. Manholes shall be spaced no greater than every four-hundred (400) feet.
3. Standard manholes are required when rim to crown of pipe elevations exceed four (4) feet, otherwise flat-top manholes shall be used.
4. The crown of all upstream pipes shall not be lower than the crown of the downstream pipe.

F. Curb Inlets

1. Curb inlets shall be located in streets at the curblines to receive stormwater and convey it to the main storm drain.
2. Curb inlets shall be located in the tangent section immediately in advance of the curb returns on the upstream side of the intersection, at all street ends with a descending grade, at intermediate locations such that the width of flow does not exceed three (3) feet or three (3) inches in depth, whichever is less and in no circumstance at a spacing greater than four-hundred feet.

4.06 Water Quality Standards

A. General

1. The water quality BMP's shall be sited, designed, and constructed in accordance with the requirements detailed in the Puget Sound Manual for each BMP, with the following exceptions:
 - a. For biofiltration swales and vegetative filter strips, alternative design criteria from the publication Biofiltration Swale Performance, Recommendations, and Design Considerations--Appendix G by the Municipality of Metropolitan Seattle, water pollution control department, dated October 5, 1992 shall be used;
 - b. Underdrains are required if the swale slope is less than two percent (2%); and
 - c. When placed within a detention basin, calculations shall be provided that demonstrate that the peak stage during the water quality design storm is lower than the minimum swale elevation.
2. On-site water quality control measures shall be provided for new development or redevelopment with five-thousand (5,000) square feet of impervious surfaces.

B. Water Quality Treatment Storm

1. Treatment BMP's shall be sized to treat the water quality design storm, defined as sixty-four percent (64%) of the two (2) year recurrence interval, twenty-four (24) hour storm runoff event with a SCS 1A type rainfall distribution. The two (2) year, twenty-four (24) hour storm event is 2.54-inches.

C. Source Control BMP's

In addition to the other water quality treatment requirements in this section, commercial and industrial development activities and redevelopment shall, to the maximum extent practicable, be designed in accordance with Chapter IV of the Puget Sound Manual and utilize BMP's specified in Chapters IV-2, IV-3, and IV-4 of the Puget Sound Manual.

1. Oil/Water Separators.
 - a. Applicability: Development activities or redevelopment creating the following facilities require API or CPS-type oil/water separators:
 - Industrial machinery and equipment, trucks and trailers, aircraft, parts and aerospace, railroad equipment;
 - Log storage and sorting yards;
 - Airfields and aircraft maintenance;
 - Fleet vehicle yards;
 - Railroads;
 - Gas stations;

- Retail/wholesale vehicle and equipment dealers;
- Vehicle maintenance and repair;
- Construction businesses such as paving, heavy equipment storage and maintenance, storage of petroleum products. (This does not include construction sites);
- Other activities that exhibit a significant risk of high oil loading in runoff;
- Development activities and redevelopment creating the following facilities shall require spill control (SC) type oil/water separators:
 - (i) Restaurants;
 - (ii) Multi-family residential development activities creating parking spaces for twenty-five (25) or more vehicles;
 - (iii) Other activities where the risk of oil spills or illegal dumping of oil or grease is significant;
 - (iv) Where the risk of oil or grease spills or dumping is determined to be minimal by the City Engineer, oil/water separators shall not be required for those portions of a site; and
- b. Oil/water separators shall be designed in accordance with Chapter III, Section III-7 of the Puget Sound Manual.

D. Infiltration BMP's on Industrial and Commercial Sites

1. Infiltration of stormwater runoff shall not be allowed on commercial/industrial sites that, due to location or the proposed use, pose a significant threat of contamination to groundwater.
2. Approval for use of infiltration BMP's (RI.05-30 in the Puget Sound Manual) on industrial and commercial sites, including gas stations, shall be conditioned on all the following criteria, unless found inappropriate by the City Engineer:
 - a. Analysis of the potential for groundwater contamination from the site. This analysis shall include a soils and groundwater evaluation if deemed appropriate by the City Engineer;
 - b. Demonstration that no other feasible alternative exists for disposing of stormwater from the site; and
 - c. A "state waste discharge permit," as described in WAC 173-216, obtained from the state of Washington Department of Ecology, where required by the state, and other state permits and approvals as appropriate.
3. The requirements of this subsection shall not apply to runoff from portions of a site where the risk of groundwater contamination is no greater than single-family residential sites. Examples of these areas include rooftop drainage, runoff from undeveloped portions of a site, and drainage from portions of parking lots where the risk of illegal dumping is minimal.
4. In cases where infiltration is allowed on commercial and industrial sites and a

significant risk of groundwater contamination exists, the City Engineer may require groundwater monitoring to insure against groundwater contamination. The City Engineer may also require an agreement from the applicant for full mitigation in the event of groundwater contamination.

5. The provisions of this subsection do not apply to non-industrial and noncommercial sites that are defined under the NPDES permit system as industrial due to temporary construction activity.

4.07 Water Quantity Standards

A. General

1. All development activities and redevelopment, unless exempted in Section 4.04 of this chapter, shall provide quantity control of stormwater runoff in accordance with the requirements of this section.
2. Natural drainage flow routes to streams and wetlands shall be maintained, and discharges from the site shall occur at the natural location(s) and elevation(s), to the maximum extent practicable.
3. Transfer of runoff from one basin to another shall generally not be allowed.
4. No development within the city limits shall be allowed to increase the volume or rate of stormwater runoff onto an adjacent property or block existing drainage from adjacent lots.
5. All lots within the city limits must be designed to provide positive drainage from bottom of footings to an approved stormwater system. Positive drainage may be accomplished by swales, drywells, french drains, laterals to the storm system, laterals behind the curb or within a public utility easement, an approved backyard or side yard system, or some other method acceptable to the building official and/or City Engineer.
6. If surface detention is used an overflow shall be included to provide controlled discharge of the one-hundred (100) year, twenty-four (24) hour design storm event without overtopping any part of the pond embankment or exceeding the capacity of the emergency spillway. The spillway shall be able to safely pass all flows over the pond embankment without overtopping. Sufficient armoring will be required to prevent erosion.

B. Hydrologic and Hydraulic Analysis

1. Hydrologic and hydraulic analysis shall be in accordance with Chapters III-1 and III-2 of the Puget Sound Manual:
 2. Table III-1.3, SCS Western Washington Runoff Curve Numbers of the Puget Sound Manual shall be used to calculate pre-development and post-development runoff with the following constraints:
 - a. Existing conditions shall be established as the use over the last thirty (30) years, which results in the least amount of site runoff, as demonstrated by evidence acceptable to the City Engineer. Acceptable evidence may include, but not be limited to thirty (30) year old aerial photos, crop history, or tax assessor records; and
 - b. Redevelopment of existing sites less than ten thousand (10,000) square feet in area can assume predevelopment land use equivalent to the facility being redeveloped.
- C. Storm Retention/Infiltration Facilities:
1. Except as limited for commercial and industrial sites, infiltration of the 100-year storm is the preferred method for all stormwater disposals from development sites where local soil types and groundwater conditions are suitable, provided that water quality treatment is provided prior to infiltration. Soil suitability for infiltration shall be determined by a qualified geo-technical engineer through both approved field-testing and laboratory testing.
 2. The design infiltration rate for infiltration systems shall be limited to one-half (1/2) the measured infiltration rate. Infiltration rates shall be tested on-site for all soils.
- D. Storm Detention Facilities:
1. No flow control orifice smaller 2.5-inches shall be allowed. If the allowable release rate can not be met with all the site drainage controlled by a 2.5-inch orifice, the allowable release rate provided by a 2.5-inch orifice will be considered adequate at the discretion of the City Engineer.
 2. If a site is proposed to be constructed in phases, the first phase shall have a storm water quantity facility designed and built to accommodate the ultimate build out of the site.